

Appendix 11.A NVC (National Vegetation Classification) Survey Report

E.ON Climate & Renewables UK Developments Ltd

Enoch Hill Wind Farm

National Vegetation Classification Survey Report (2014)



July 2015

Amec Foster Wheeler Environment
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Executive summary

Purpose of this report

This report has been produced to provide a baseline assessment of the plant communities at the proposed Enoch Hill Wind Farm, which is located approximately 6km south-west of New Cumnock in East Ayrshire Council area.

A National Vegetation Classification Survey was carried out in summer and autumn 2014 over an area covering approximately 7.72km² (772ha).

The site is dominated by mire plant communities which cover approximately 612ha (79%) of the total area surveyed, of which about 95% is blanket mire and the remainder being soligenous mire. Blanket mire of the site comprises three separate National Vegetation Classification mire communities (M17, M20 and M25) that have some correspondence with habitats listed on annex 1 of the Habitats Directive (Depressions on Peat Substrates, Northern Atlantic Wet Heaths with *Erica tetralix* and Blanket Bog). Soligenous mire of the site (M6 community) may overlap habitats listed on annex 1 of the Habitats Directive (Transition Bogs and Quaking Mires).

Grasslands cover approximately 154ha (20%) of the total area surveyed and mainly comprise rush-pasture community (M23), with subordinate cover of acid grassland plant communities (U4, U5 and U6) and sparse cover of neutral grassland plant communities (MG6 and MG9). Bracken-dominated vegetation is sparsely present, with a total coverage of approximately 5ha (1%) of the total area surveyed.





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1. Introduction

1.1 Project Background

Amec Foster Wheeler Environment & Infrastructure UK Limited (Amec Foster Wheeler) was commissioned by E.ON Climate & Renewables Ltd. (E.ON) to undertake vegetation studies consisting of a National Vegetation Classification (NVC) survey at the Site of a proposed wind farm (referred to as Enoch Hill Wind Farm) located in uplands, and the margins of uplands, situated to the south of Dalleagles, near New Cumnock, in East Ayrshire with a central grid reference of NS 582 089. The NVC survey area concentrated on the central, western and southern part of the Site, covering approximately 7.72km².

1.2 NVC Survey

The NVC allows for the detailed classification and survey of a wide range of plant communities that occur in Great Britain (Rodwell (ed.) 1991a to 2000^{1,2,3,4,5}). Averis *et al.* (2004⁶) is also referred to, as the authors provide a concise and up to date description of NVC communities and sub-communities of UK upland areas. NVC survey also allows the identification of certain plant communities that are categorised as potential groundwater dependent terrestrial ecosystems (GWDTE⁷) with reference to SNIFFER⁸ and SEPA guidance⁹.

1.3 Objectives

The objective of the NVC survey was to identify and map the constituent plant communities (and sub-communities, where possible) within the NVC survey area in accordance with NVC classification^{1,2,3,4,5,6}.

The results of the survey are intended to inform the design of the proposed Enoch Hill Wind Farm (by identifying any potential botanical constraints) and to provide the baseline for an Ecological Impact Assessment (EclA) of the proposed development. However, it should be noted that the baseline report does not contain any assessment of the potential impact of any proposed development upon habitats and/or plant communities.

Separate baseline reports have been prepared covering surveys carried out in 2012, 2013 and 2014 for bats, other legally protected fauna and birds.

¹ Rodwell (ed.) (1991a). Volume 1 - Woodlands and Scrub. Cambridge University Press.

² Rodwell (ed.) (1991b). Volume 2 – Mires and Heath. Cambridge University Press.

³ Rodwell (ed.) (1992). Volume 3 – Grassland and Montane Communities. Cambridge University Press.

⁴ Rodwell (ed.) (1995). Volume 4 – Aquatic Communities, Swamps and Tall-herb Fens. Cambridge University Press.

⁵ Rodwell (ed.) (2000). Volume 5 – Maritime Communities and Vegetation of Open Habitats. Cambridge University Press.

⁶ Averis, A.M., Averis, AB.G. Birks, H.J.B., Horsfield, D., Thompson, D.B.A. and Yeo, M.J.M. (2004). An Illustrated Guide to British Upland Vegetation. JNCC.

⁷ Groundwater Dependent Terrestrial Ecosystems (GWDTE) could potentially be affected by the development, which may change the quantity of groundwater supplying the GWDTEs. Such de-watering is controlled by the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR). SEPA requires sufficient information in relation to GWDTE to advise the determining authority of the likelihood of an authorisation being granted.

⁸ SNIFFER (2009). WFD95 'A Functional Wetland Typology in Scotland'.

⁹ SEPA (2014). Land Use Planning System SEPA Guidance Note 4. Planning Guidance on On-shore Windfarm Developments. LUPS-GU4, Version 7, 14 May 2014.





2. Methodology

2.1 Desk-based Study

Web-based resources were reviewed to gather any existing botanical and habitat data which may be of use with informing the survey work, including identification of any statutory designated sites present within 2km of the site boundary designated for botanical or habitat reasons¹⁰. A review of the following sources of information was therefore completed:

- ▶ The UK Biodiversity Action Plan (BAP)¹¹;
- ▶ The Ayrshire Local Biodiversity Action Plan (LBAP)¹²;
- ▶ Ayrshire Council websites¹³;
- ▶ Scottish Biodiversity List (SBL)¹⁴;
- ▶ The Scottish Government's Land Information Search¹⁵ (mainly for woodland of conservation value); and
- ▶ OS maps and web-based aerial photography.

Box 2.1 summarises the key features of interest noted within the desk study.

¹⁰ 2km is believed to be sufficient to capture the potential zone of influence

¹¹ The UK BAP describes the biological resources of the UK and provides detailed plans for the conservation of these resources at a national level. Action plans identify targets to aid recovery of the most threatened species and habitats. <http://jncc.defra.gov.uk/default.aspx?page=5155>. Accessed Aug 2014.

¹² The Ayrshire LBAP describes the biological resources of the region and strives to implement the UK BAP, as appropriate, using action plans. <http://www.east-ayrshire.gov.uk/Resources/PDF/A/AyrshireBiodiversityActionPlan.pdf>. Accessed Aug 2014.

¹³ Including Wind Farm Search Criteria Mapping at <http://maps.ayrshire.gov.uk/mapsAJP/mapWindfarmSearch.htm>. Accessed Jan 2015.

¹⁴ The SBL is a list of plants, animals and habitats that Scottish Ministers consider to be of principal importance to biological conservation. <http://www.biodiversityscotland.gov.uk/advice-and-resources/scottish-biodiversity-list> Accessed Aug 2014.

¹⁵ http://map.environment.scotland.gov.uk/landinformationsearch/lis_map.html. Accessed Aug 2014.

Box 2.1 Statutory and non-statutory sites of nature conservation value, protected and notable habitats and species.**Statutory Nature Conservation Sites¹⁶**

Scottish Natural Heritage (SNH) notifies specific sites that are of international or national importance for nature conservation as Sites of Special Scientific Interest (SSSI). International designations include Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites.

Non-Statutory Nature Conservation Sites¹⁷

This includes Areas of Local Environmental Importance, Local Wildlife Sites (LWS) and areas of woodland of conservation importance recorded by the Native Woodland Survey of Scotland (NWSS). These sites, which are designated due to the presence of notable species or important habitats, broadly constitute the most important wildlife and geological sites in the county that do not reach the criteria required for SSSI designation.

Protected Species¹⁸

Many species of animal and plant receive legal protection, which for the purposes of this study refer to:

- Species included on Schedule 1, 5 and 8 of the Wildlife and Countryside Act 1981 (WCA) (as amended), excluding species that are only protected in relation to their sale; and
- Species included on Schedule 2 and 4 The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland); and
- Protection of Badgers Act, 1992.

Notable Habitats and Species

These include habitats and species listed on Annex 1 and Annex 2 of the Habitats Directive, together with habitats and species which are listed on the Scottish Biodiversity List and/or the Ayrshire Biodiversity Action Plan and/or those which are of some other conservation interest based on their status nationally, regionally or locally.

2.2 NVC Survey

The NVC survey was carried out by Amec Foster Wheeler Consultant Ecologist David Knox, an experienced and professionally recognised ecologist (member of the Chartered Institute of Ecology and Environmental Management, CIEEM), between 14-18th July and 15-16th October 2014. The survey was undertaken within a survey area located primarily within the central, southern and eastern parts of the Site¹⁹, covering a total survey area of approximately 7.72km² (772ha).

Plant species were identified and recorded using the keys and nomenclature of Stace (2010²⁰) for higher plants and Atherton *et al.* (2010²¹) for bryophytes (mosses and liverworts).

Detailed NVC survey was undertaken by sampling representative areas of homogenous vegetation based upon visual inspection. These areas were mapped using detailed digital base maps using ArcPad (10.2) software running on a rugged, Windows 7, tablet PC, which has built-in GPS. NVC target notes (TN) were made where the vegetation was clearly homogenous, i.e. not gradational in character, and the survey avoided edges of plant communities. A hand-held GPS was used to ensure TNs were accurately located.

NVC communities are generally indicated by the presence of constant species, i.e. species that are almost always present and tend to be reasonably abundant (but not always the case). The presence of sub-communities is typically indicated by the presence of differential and/or preferential species (differential species are only found in particular sub-communities whilst preferential species are more prevalent in particular sub-communities).

The DAFOR²² scale was used to record the level of cover of plant species, although when possible the percentage cover of key plant species (e.g. ericaceous species in heath and *Sphagna* in mires) was also recorded.

¹⁶ http://gateway.snh.gov.uk/portal/page?_pageid=53,910284,53_920284&_dad=portal&_schema=PORTAL. Accessed Aug 2014.

¹⁷ <http://www.east-ayrshire.gov.uk/Resources/PDF/A/AyrshireBiodiversityActionPlan.pdf>. Accessed Aug 2014.

¹⁸ <http://data.nbn.org.uk/>. Accessed Aug 2014.

¹⁹ The survey area was informed by a range of engineering and other constraints which ruled out other areas within the Site due to unsuitability for wind farm construction.

²⁰ Stace, C.A. (2010). *New Flora of the British Isles*, 3rd Edition. Cambridge University Press.

²¹ Atherton, I., Bosanquet, S. & Lawley, M. (Eds.) (2010). *Mosses and Liverworts of Britain and Ireland – A Field Guide*. 1st Edition. British Bryological Society publication.

²² D – Dominant (>75% cover), A – Abundant (51-75% cover), F – Frequent (26-50% cover), O – Occasional (11-25% cover) and R – (locally) Rare (1-10% cover). The scale can be modified to indicate local abundance, e.g. Locally Frequent LF or Locally Abundant LA.

Mosaic vegetation is common in unenclosed upland areas and where possible the proportions of vegetation communities present and character of the mosaic were target noted.

The names of several plant species that are key to the NVC system have changed in recent years and this was taken into account during the survey, e.g. *Scirpus cespitosus* (deergrass) is most commonly *Trichophorum germanicum*²³ (Stace, 2010). Also, *Sphagnum recurvum* (recently divided into several species) is most commonly *Sphagnum fallax* and *Sphagnum auriculatum* is now called *Sphagnum denticulatum*²¹.

Data interpretation was undertaken with reference to the NVC volumes and Averis *et al.*⁶.

2.3 Non-native Species

The presence of invasive, non-native plant species²⁴ was noted during the NVC survey. There is no definitive list of such species, but as a general guide the surveyor considered species that are:

- ▶ Covered by national legislation relating to their spread in the wild²⁵; and/or
- ▶ Acknowledged to pose a significant threat to native species or habitats; and/or
- ▶ Particularly notable, extensive or numerous within the survey area.

2.4 Survey Constraints

The majority of NVC survey was carried out during mid-summer (July), which is an optimum period for such survey with a number of small areas covered during autumn. Hence, there is a possibility that early spring plant species may be missed or under recorded by the survey. Considering the experience of the surveyor, this is not considered to be a significant issue. Water flow levels in the survey area's watercourses were normal at the time of the survey visits and did not pose any issues.

²³ Stace (2010) divides deergrass into other species as well as *Trichoporum germanicum*, which are uncommon.

²⁴ A large number of non-native species have been recorded in the UK (the *Audit of Non-native Species in England* (Hill *et al.* 2005) counted a total of 2721 non-native species and hybrids present in England), although most are not currently thought to pose a particular risk to native species or habitats.

²⁵ Wildlife and Countryside Act 1981 (as amended in Scotland). Section 14.



3. Survey Results

3.1 Desk-based Study

No statutory designated or non-statutory sites are located within 2km of the survey area. However, several small areas of native woodland (each covering at most a few hectares in area) recorded by the Native Woodland Survey of Scotland (NWSS) are located close to the northern edge of the survey area (see Figure 3.1).

Desk study revealed that there are no records of higher conservation value plant species for the NVC survey area.

Reference to Wind Farm Search Criteria Mapping on the South Ayrshire Council website¹² indicates that the NVC survey area is partially located within, and borders south of, an area of Annex 1 habitats (defined in the website as wet heath), which covers a total area of approximately 14km².

3.2 General Site Description

The total NVC survey area covers approximately 7.72km² (772ha), located within the uplands and upland margins located about 6km south-west of New Cumnock in East Ayrshire Council area. The B741 is situated between 1 and 2km north of the wind farm. The land is primarily used for sheep grazing. However, it is also possible that the area may be used for cattle grazing. Fencing to contain livestock is present along the B741 and in the north-west of the survey area but most land within the survey area is unenclosed. There are no roads or any other permanent man-made structures of note located within, and in close proximity to, the survey area and farmers use all-terrain vehicles (ATV) to access the area. Commercial forestry is located close to the western and southern margins of the survey area and is delineated by fencing.

Land rises steadily from the northern edge of the survey area in the form of a number of gently rounded ridges and summits (named on Figure 3.1), with several intervening small river valleys, to Enoch Hill (569m Above Mean Sea Level, AMSL) located at the south of the survey area. Several minor watercourses and their headwaters are located within the survey area and include; Polmath Burn and Knockburnie Burn in the north-west of the survey area; Littlechang and Catlock Burns located close to the centre of the survey area; and the Trough, Polga, and Blarene Burn located in the north-east of the survey area. There are also some minor watercourses which are located on southern and eastern slopes of Enoch Hill (e.g. Bitch Burn).

3.3 NVC Survey

An overall NVC survey map is presented in **Figure 3.1** while single NVC community maps are presented in **Figures 3.2 to 3.6**. **Figure 3.7** shows the location of all grassland communities. All maps show TNs which are described within **Appendix A**. A list of the recorded floral species present in the survey area is presented in **Appendix B** which includes scientific names that are not used in the body of this report except for species that do not have an English name.

The NVC communities and sub-communities (where discernible) are summarised in the following sections. Mire vegetation (including mosaics) is considered in Section 3.3.1 and grassland communities are considered in Section 3.3.2. For the sake of clarity the description of mosaic vegetation is presented summarily. Moreover, the presence of mosaics composed of mire and grassland means that vegetation coverage data is simplified for the sake of clarity.

A total of 11 NVC plant communities are present within the survey area (M6, M17, M20, M23, M25, MG6, MG9, U4, U5, U6 and U20).

Mire

Mire dominated vegetation covers 612.18ha, which is about 79% of the survey area. 94.8% of mire vegetation is blanket mire and the remainder is soligenous mire. Mosaics of mire vegetation composed of two or more mire communities, and mires forming mosaics with grassland communities (see Section 3.3.2), form 52.3% of the total mire coverage.

Blanket mire²⁶ vegetation is produced by water logging of soils by rainfall. Within the survey area such vegetation, including most mosaics of blanket mire and grassland, is judged to be strongly dependent on topography as blanket mire is mainly found as extensive areas on flat to gently sloping land. Mire vegetation develops on peat, which is generally over 0.5m deep, waterlogged and inherently prone to instability due to both gravity and surface water-flow driven erosion. Peat hags (essentially 'cliff' like exposures of bare peat) are uncommon (e.g. TN21).

Soligenous²⁷ mire has a very different character to blanket mire forming due to water logging of soils due to acid groundwater flow. Such flows originate from a variety of sources, such as the drainage of groundwater from blanket mire.

Areas of M20 blanket mire include Blood Moss in the north-west of the survey area and most of the gently rounded summit areas (plateau like), which include Barbeys Hill, Chang Hill, Benty Cowan Hill, High Chang Hill, Littlechang Hill and much of Enoch Hill. A gently rounded ridge at the north-east edge of the survey area (Connelburn Rig) supports M25 blanket mire and a broad ridge, which extends roughly east of High Chang Hill supports M17 blanket mire.

Soligenous M6 mire is mainly located by lower lying ground, typically bordering many of the minor watercourses which drain the survey area. These include Littlechang Burn and Catlock Burn located close to the centre of the survey area and Knockburnie Burn located at the north-west of the survey area. Occasionally small stands of soligenous mire are also located within runnels which situated on steeper ground, e.g. at the north-east side of Enoch Hill (e.g. TN10).

Mire vegetation within the survey area is generally grazed by sheep to some extent, although grasslands are preferred over mires for grazing. Networks of drainage ditches are prevalent across almost all of the survey area and are likely to have been present for several decades. These have probably contributed to degradation of blanket mire through drainage and attendant erosion of peat. There are no recently excavated drains present. In places drains are particularly prominent, e.g. on the ridge to the north-east of High Chang Hill. However, about 1km to the north-east, at Benty Cowan Hill, drainage ditches are uncommon.

Blanket mire and soligenous mire vegetation, including mosaic vegetation (some with grassland), is summarised in Table 3.1, below.

Table 3.1 Mire Communities / Sub-communities at the Proposed Enoch Hill Wind Farm (see Figures 3.1, 3.2, 3.3, 3.5 and 3.6)

NVC Community	NVC Sub-community (where identified)	Area Cover (ha)	TN
M17 <i>Trichophorum germanicum</i> – <i>Eriophorum vaginatum</i> blanket mire	M17a <i>Drosera rotundifolia</i> – <i>Sphagnum</i> species	131.00	2, 5, 6, 7, 8, 10, 11, 12, 14, 16, 17, 20, 21, 23, 25, 26, 27 and 28
M20 <i>Eriophorum vaginatum</i> blanket mire	M20a species-poor sub-community	380.40	1, 4, 6, 7, 8, 10, 11, 12, 14, 15, 19, 20, 21, 23, 25, 28, 29 and 35
M25 <i>Molinia caerulea</i> – <i>Potentilla erecta</i> blanket mire	Not determined	69.18	1, 16, 17, 18, 24, 32 and 33
M6 <i>Carex echinata</i> – <i>Sphagnum recurvum/auriculatum</i> soligenous mire	M6c <i>Juncus effusus</i> M6d <i>Juncus acutiflorus</i>	31.6	1, 7, 8, 10, 16, 17, 23, 26 and 34

²⁶ Also termed ombrogenous mire.

²⁷ Also termed acid flushes.

Mire vegetation is generally characterised by sedge species, e.g. deergrass and/or cottongrasses, and moderate to low cover of *Sphagna*, e.g. *Sphagnum capillifolium*. Ericoids, e.g. common heather, cross-leaved heath and crowberry, are only present with a low level of cover and only rarely form a significant component of mire vegetation.

M17 blanket mire (see **Figure 3.2**) forms 25% of the total coverage of blanket mire and is locally prevalent in sections of the higher ground of the survey area, albeit typically as a mosaic with M20 community, by High Chang Hill (TN23) dominating much of the gentle rounded ridge extending north-east (TN27). M17 mire is also commonplace by Benty Cowan Hill, where drainage ditches are uncommon, and also on the gently rounded summit and land to the east of Chang Hill. M17 mire is also locally common as relics within areas dominated by M20 mire in lower lying sections of the survey area, e.g. western edge of Blood Moss (TN2), Barbeys Hill (TN6) and land by the upper reach of Littlechang Burn (TN5). In general, M17 mire (e.g. TN2) is dominated by deergrass with an abundance of *Sphagnum capillifolium*, *S.papillosum*, frequent bog asphodel and common heather with occasional cross-leaved heath. The vegetation is typically wet but not particularly boggy underfoot. In contrast, there are two minor areas of wet and boggy M17 vegetation in flat lying areas (TN26 and TN28). These stands are marginally more species rich compared to typical M17 vegetation in the survey area and most notably contain some cover of round-leaved sundew. The presence of this species infers these stands are examples of M17a sub-community, which are the least modified areas of blanket mire of the survey area. Crowberry is a species specifically noted in the Ayrshire LBAP as a species characteristic of upland habitats. The species is locally rare in M17a sub-community being only recorded within one stand (TN26).

M20 mire is commonplace across the survey area (see **Figure 3.3**) (66% of blanket mire coverage), such as along the western edge from Blood Moss (TN1 and TN3) rising to Barbeys Hill (TN4) and dominating much of the land by Enoch Hill (e.g. TN11). The community also dominates most of the centre of the survey area (TN15) including Chang Hill (TN29) and lower slopes of High Chang Hill (TN19 and TN25). In general, M20 mire is indicative of well modified, albeit wet, blanket mire, often with networks of drainage ditches (e.g. TN19) and is likely to be of lower nature conservation value than M17 mire. Typically M20 mire is predominantly composed of hare's-tail cottongrass, and rarely contains common cottongrass, with good cover of *Sphagnum fallax*, *S.capillifolium*, *S.papillosum*, bog asphodel, common blaeberry, heath rush, wavy hair-grass, heath bedstraw, with lesser cover of heath wood-rush, cross-leaved heath, deergrass, tormentil, common sedge, common bent, *Rhynchospora squarrosus*, *Pleurozium schreberi*, common heather and viviparous fescue. Crowberry is a species specifically noted in the Ayrshire LBAP as a species characteristic of upland habitats. The species is locally rare in M20 community being only recorded within one stand (TN4).

M25 mire is the least common blanket mire vegetation present in the survey area (see **Figure 3.5**), forming 9% of blanket mire coverage. About 35% of M25 mire exists as mosaics with M17 mire (e.g. TN16) and less commonly M23 rush-pasture (e.g. TN33) and rarely U5 grassland. In terms of distribution M25 mire is characteristic of the lower lying areas of the survey area, forming a reasonable proportion of the access route corridor (albeit as a mosaic with M23 rush-pasture, e.g. TN33) and adjacent north-west of the survey area and is locally common by the ridge located at the north-east of the survey area (TN16 to 18). The vegetation is rather species poor (e.g. TN18) and consists predominantly of purple moor-grass, with moderate cover of tormentil, *Sphagnum capillifolium*, *Rhynchospora squarrosus*, sweet vernal-grass, deergrass and locally rare hare's-tail cottongrass.

Soligenous mire vegetation (M6) (see **Figure 3.6**) is characterised by a good cover of soft rush (M6c) (e.g. TN10) or sharp-flowered rush (M6d) (e.g. TN16). About 64% of M6 community comprises mosaics mainly with M23 rush-pasture (e.g. TN34) and to a lesser extent blanket mire communities (e.g. TN7). Typically, M6 mire is botanically unremarkable featuring either soft rush or sharp-flowered rush (sometimes with low cover of articulated rush) and an abundant mix of *Sphagnum fallax*, *S.capillifolium*, *S.papillosum* and *S.palustre*. Bottle sedge is specifically listed in the Ayrshire LBAP as a species characteristic of upland habitats. The species is rarely present in water saturated stands of soligenous mire (TN3, TN7, TN10 and TN26).

Grassland

Grassland vegetation covers approximately 154.4ha (about 20% of the survey area) (see **Figure 3.7**), about 66% of which is rush-pasture vegetation (see **Figure 3.4**). Approximately 65% of grassland vegetation exists as mosaics of two or more grassland communities or as mosaics containing small to moderate proportions of mire communities (see Section 3.3.1).

In terms of overall distribution, grassland vegetation is essentially the converse of that of mire (see Section 3.3.1) as grasslands often typify lower lying, steeper ground, such as along the steeper sections of the northern slopes of Chang Hill, Benty Cowan Hill and High Chang Hill (e.g. TN13). Moreover, grassland forms the main component of mosaic vegetation on a very steep slope at the south-east margin of the survey area (TN35). Overall, grassland vegetation is commonplace on slopes which are too steep to contain deep peaty soils (suited to the formation of blanket mire), although one notable exception is an area of acid grassland (U6 vegetation) by the summit of Enoch Hill (TN9).

Most grasslands within the survey area are indicative of acid conditions and have probably not been subject to large scale agricultural improvements, such as fertilisation, in recent times although this may have occurred historically. The prevalence of drainage ditches across the survey area has probably caused some increase in the cover of grasslands at the expense of mires. Grassland vegetation that is border-line between mesotrophic and acid in character is present at the north-west edge of the survey area (TN31).

Rush-pasture vegetation commonly borders many of the minor watercourses of the survey area, e.g. Littlechang Burn and Catlock Burn located close to the centre of the survey area and Knockburnie Burn located at the north-west of the survey area and is often found as a mosaic with soligenous mire (see Section 3.3.1). Rush-pasture vegetation is also commonly found on slopes which are flushed by groundwater draining off blanket mires located upslope. Such areas form the headwaters of minor watercourses, such as the Polmath Burn in the north-west of the survey area.

Grasslands vegetation, including rush-pasture and a wide variety of mosaics (often with mire), is summarised in Table 3.2, below.

Table 3.2 Grassland Communities / Sub-communities at the Proposed Enoch Hill Wind Farm (see Figures 3.1, 3.4 and 3.7)

NVC Community	NVC Sub-communities (where identified)	Area Cover (ha)	TN
MG6 <i>Lolium perenne</i> – <i>Cynosurus cristatus</i> grassland	Not determined	1.85 (as mosaic with MG9)	31
MG9 <i>Holcus lanatus</i> – <i>Deschampsia cespitosa</i> grassland	Not determined	1.85 (as mosaic with MG6)	31
U4 <i>Festuca ovina</i> – <i>Agrostis capillaris</i> – <i>Galium saxatile</i> grassland	U4b <i>Holcus lanatus</i> – <i>Trifolium repens</i>	22.33	7, 13, 16, 17, 18, 22, 31 and 32
U5 <i>Nardus stricta</i>-<i>Galium saxatile</i> grassland	U5a species poor sub-community	30.46	13, 19, 24 and 35
U6 <i>Juncus squarrosus</i> – <i>Festuca ovina</i> grassland	U6d <i>Agrostis capillaris</i> – <i>Luzula multiflora</i>	9.39	4, 6, 11, 17, 18, 19, 22, 23 and 35
M23 <i>Juncus effusus</i> / <i>acutiflorus</i> – <i>Galium palustre</i> rush-pasture	M23a <i>Juncus acutiflorus</i> M23b <i>Juncus effusus</i>	90.4	25, 29, 30, 33 and 34

MG6 and MG9 mesotrophic grassland communities are found as a mosaic, also with U4 acid grassland (see below), at the north-west margin of the survey area (TN31). The mesotrophic grassland communities of the mosaic comprise abundant Yorkshire fog and crested dog's-tail with moderate cover of perennial rye-grass, tufted hair-grass, sweet vernal-grass, white clover, creeping buttercup, daisy, sweet vernal-grass, self-heal, marsh thistle and annual meadow grass. Locally rare species are an eyebright species, ribwort plantain and common mouse-ear.

U4 acid grassland forms about 16% of the grassland communities of the survey area and excluding M23 rush-pasture, is present in 49% of the five 'dry' grasslands communities present. Only 7% of U4 grassland exists as discrete stands with the remainder forming mosaics with U5 and U6 acid grasslands and M23 rush-pasture.

The majority of U4 grassland corresponds to U4b, which is indicative of a notable level of nutrient enrichment (e.g. TN32), which results in the vegetation being borderline between acid and mesotrophic in character. Typically, U4 grassland comprises abundant mat grass and sheep's fescue, with moderate cover of Yorkshire fog, common bent, sweet vernal-grass, red fescue, heath rush, *Rhynchospora squarrosus* and white clover. Locally rare species are tormentil, green-ribbed sedge, creeping buttercup, autumn hawkbit, eyebright species and carnation sedge.

U5 acid grassland forms 22% of the grasslands of the survey area and is present in 67% of the 'dry' grassland communities present. Less than 1% of this exists as discrete stands with the remainder existing in mosaics with U4 and U6 grasslands, M23 rush-pasture, and M17, M20 and M25 blanket mires. U5 vegetation within the survey area is the unremarkable U5a sub-community, which has a sward almost totally dominated by mat grass.

U6 acid grassland forms 7% of the grassland of the survey area of which about 80% exists as discrete stands (e.g. TN9), with the remainder forming mosaics with U4 and U5 acid grasslands and less commonly M23 rush-pasture and M20 blanket mire. Typically, U6 community is composed of abundant heath rush, with moderate cover of; sweet vernal-grass, mat grass, common bent, viviparous fescue, heath wood-rush, heath bedstraw, wavy hair-grass, common blaeberry, *Rhynchospora squarrosus*, *Pleurozium schreberi* and *Polytrichum juniperinum*. A notable, locally rare species is *Sphagnum capillifolium*. Taken together data tend to infer that U6d *Agrostis capillaris* – *Luzula multiflora* sub-community is predominant. In general, U6 community is likely to be former blanket mire or wet heath (i.e. peatland vegetation) which has been lost due to agricultural management such as livestock grazing, drainage and/or burning. It is conceivable, that the stand of U6 community by the summit of Enoch Hill has replaced former stands of peatland vegetation.

M23 rush-pasture vegetation covers a total area of 90.4ha (12% of the survey area), which is 66% of the total coverage of grassland vegetation. Discrete stands of M23 vegetation form 23% of the total coverage of the community, whilst the remainder is commonly found in mosaics with M6 soligenous mire and less commonly with M17, M20 and M25 blanket mires. M23 vegetation less commonly forms mosaics with U4, U5 and U6 acid grasslands. There are two distinct sub-communities of M23 vegetation present, namely M23a *Juncus acutiflorus* and M23b *Juncus effusus*. Logically, these sub-communities are defined by the abundance of sharp-flowered rush and soft rush, respectively. M23a sub-community is estimated to be marginally more commonplace (57%) compared to M23b sub-community (43%). Much of the rush-pasture vegetation within the survey area is rather rank and species poor. In places, such as at the north-west of the survey area (TN30), livestock grazing has resulted in M23a sub-community which is less rank and moderately species rich, albeit with common species. In addition to sharp-flowered rush the stands contain articulated rush, marsh thistle, marsh bedstraw, carnation sedge, common sorrel, *Rhynchospora squarrosus*, tufted hair-grass, Yorkshire fog, marsh willowherb, creeping buttercup, meadow vetchling, tufted forget-me-not, spear thistle and heath wood-rush.

3.4 Bracken

A stand of bracken was recorded on the very steep, south-east facing slope at the south-east margin of the survey area (TN35). This is botanically unremarkable and classified as U20 *Pteridium aquilinum* - *Galium saxatile* community. Bracken coverage is estimated to be about 5ha of the slope (about 1% of the total survey area), which also contains U5 and U6 grassland and M20 blanket mire communities.

3.5 Woodland and Scrub

Woodland habitats within the main NVC survey area are absent, apart from a few young broad-leaved trees and shrubs (mainly willow species) by steeper ground by watercourses, which is less prone to grazing and browsing animals. Consequently, woodland and scrub vegetation is not considered to merit any further consideration in this report.



4. Conclusions and Recommendations

4.1 Nature Conservation Designations

The survey area contains no land designated as statutory ecological sites. Although a few small areas of native woodland (Native Woodland Survey of Scotland (NWSS)) are located close to the northern margin of the survey area, there is minimal woodland within the survey area.

4.2 Vegetation

With a total of 11 NVC communities present, the survey area contains a fairly low variety of terrestrial vegetation communities, in the form of mires and grasslands, although these often form complex mosaics (see **Figure 3.1**).

Two species, crowberry and bottle sedge, were recorded which are considered to be of nature conservation value. This is because they are listed in the Ayrshire LBAP as characteristic of upland habitats. They were recorded at TN4 and TN26 (crowberry) and TN3, TN7, TN10 and TN26 (bottle sedge).

NVC communities present within the survey area are listed in **Table 4.1**, which includes a summary of their nature conservation and potential GWDTE status. For nature conservation purposes, any proposed development should seek to avoid or minimise potential effects upon M17 plant communities as these are listed on Annex 1 of Conservation (Natural Habitats, &c) Regulations 1994 (as amended in Scotland) (the Habitats Directive) and are considered to be the most sensitive blanket mire communities identified within the survey.

The wind farm infrastructure should ideally minimise effects on other Annex 1 habitats where possible. However, it is worth noting the following:

- ▶ The largest blanket mire plant communities (M20) are considered to be somewhat degraded, probably due to historical agricultural management (in a Phase 1 habitat survey they would be mapped as Wet Modified Bog);
- ▶ M25 blanket mire is rather species poor and not considered to be a good representative of the Annex 1 habitat; and
- ▶ M6 Mire is noted to be botanically unremarkable and, on this site, it is considered that it does not overlap with the Annex 1 habitat transition bogs and quaking mires.

Table 4.1 Conservation Status of the NVC Communities of the Proposed Development Area and Potential GWDTE Status

NVC Community	Annex 1 Habitat	Scottish Biodiversity List	Ayrshire LBAP	Potential GWDTE Status
M6 <i>Carex echinata</i> – <i>Sphagnum recurvum/auriculatum</i> mire	Not specified, but may overlap with Transition Bogs and Quaking Mires	Upland flushes, fens and swamps	Blanket bog	High
M17 <i>Trichophum germanicum</i> – <i>Eriophorum vaginatum</i> blanket mire	Overlaps with Blanket Bog (Active)	Blanket Bog	Blanket bog	No
M20 <i>Eriophorum vaginatum</i> blanket mire	Overlaps with Blanket Bog (Active)	Blanket Bog	Blanket bog	No
M23 <i>Juncus/effusus/acutiflorus</i> - <i>Galium Palustre</i> rush-pasture	No	Upland flushes, fens and swamps	Purple moor grass and rush pasture	High
M25 <i>Molinia caerulea</i> – <i>Potentilla erecta</i> blanket mire	Overlaps with Blanket Bog (Active)	Blanket Bog	Purple moor grass and rush pasture	Moderate
MG6 <i>Lolium perenne</i> – <i>Cynosurus cristatus</i> grassland	No	No	No	No
MG9 <i>Deschampsia cespitosa</i> grassland	No	No	No	Moderate
U4 <i>Festuca ovina</i> – <i>Agrostis capillaris</i> – <i>Galium saxatile</i> grassland	No	No	Acid grassland	No
U5 <i>Nardus stricta</i> – <i>Galium saxatile</i> grassland	No	<i>Nardus stricta-Galium saxatile</i> grassland	Acid grassland	No
U6 <i>Juncus squarrosus</i> – <i>Festuca ovina</i> grassland	No	<i>Juncus squarrosus</i> – <i>Festuca ovina</i> grassland	Acid grassland	Moderate
U20 <i>Pteridium aquilinum</i> – <i>Galium saxatile</i> community	No	No	No	No

4.3 GWDTE

NVC communities that potentially have reliance upon groundwater (either to a moderate or high degree) are set out in **Table 4.1**. NVC survey identifies “potential” GWDTEs based on communities recorded. To determine actual dependency of the potential GWDTEs recorded on groundwater, interpretation is required from hydrologists, which is not included as part of this report.

The development should incorporate appropriate stand-off distances where possible (250m for turbine bases, crane pads, borrow pits and other permanent infrastructure and 100m for access tracks) in order to avoid potential effects upon these areas. Where this is not possible, the professional opinion of a hydrologist and, potentially, the findings of a detailed hydrological study of the survey area will be required to accurately assess potential effects on GWDTEs.

4.4 Non-Native Species

No issues were found to be present in regard to non-native plant species.





Appendix A

NVC Target Notes

TN#	OS GR	NVC Type(s)	Target Note
1	NS.55142.08683	M20; minor M25 and M6	Western section of Blood Moss. Flat area dominated by tussocky blanket mire on boggy, wet ground. Comprises; hare's-tail cottongrass (D), <i>Sphagnum fallax</i> (A), <i>S. capillifolium</i> (F), <i>S. papillosum</i> (F), bog asphodel (F), common blaeberry (F), heath rush (F), wavy hair-grass (F), heath bedstraw (F), heath wood-rush (O), cross-leaved heath (O), deergrass (O), tormentil (O), common sedge (O), common bent (O), <i>Rhytidiadelphus squarrosus</i> (O), <i>Pleurozium schreberi</i> (O), common heather (R) and viviparous fescue (R). Occasional, small stands of purple moor-grass (M25 like) at margins of M20 blanket mire. Small stands of compact rush with good cover of <i>Sphagna</i> (M6 soligenous mire) in area.
2	NS.55012.08572	M17	Minor stand of M17 blanket mire community on flat plateau area at western edge of Blood Moss surrounded by M20 (on lower lying peat) to east (see TN1). Deergrass (D), <i>Sphagnum capillifolium</i> (A), <i>S. papillosum</i> (A), bog asphodel (F), common heather (F) and cross-leaved heath (O). Wet underfoot but not particularly boggy.
3	NS.55290.09585	M20	Blood Moss area is located on flat to gently sloping ground (a coll) with M20 blanket mire comparable to TN1. Very minor stands of bottle sedge in small runnels of soligenous mire draining from blanket mire. The area is generally <i>Sphagna</i> rich being composed of; <i>Sphagnum fallax</i> (A), <i>S. capillifolium</i> (F), <i>S. papillosum</i> (F), also with common sedge (O) and <i>Aulacomnium palustre</i> (R).
4	NS.55856.07682	M20 - U6	Small stand of M20 blanket mire and U6 acid grassland mosaic, with estimated proportions of 70:30, on gentle northern slope of Barbeys Hill. Composed of; heath rush (F), hare's-tail cottongrass (A), common heather (O), <i>Sphagnum capillifolium</i> (F), common blaeberry (F), wavy hair-grass (F), common cottongrass (O), tormentil (O), heath bedstraw (O), <i>Polytrichum commune</i> (O), crowberry (R) and cross-leaved heath (R). Monotonous M20 blanket mire surrounds the mosaic vegetation with common heather (F) with old ditches containing minor stands of rush-dominated soligenous mire vegetation (M6).
5	NS.56141.07442	M17	Small stand of M17 blanket mire generally comparable to TN2. Characteristic species are; deergrass (D), <i>Sphagnum capillifolium</i> (F), <i>S. papillosum</i> (F), common heather (F) and cross-leaved heath (O).
6	NS.55825.07403	M17 and M20	Gently rounded summit of Barbeys Hill mainly M20 blanket mire surrounding small stand of M17 with good cover of Cladonia lichen species along with species comparable to TN5. Mounds of <i>Sphagnum capillifolium</i> present.
7	NS.55811.07013	M20 - M17; minor M6c and U4b	Small valley between Logan Hill to west (afforested) and Enoch Hill to east. Area features mosaic of M20 - M17, with estimated proportion of 70:30. Network of small ditches present often with soligenous mire with soft rush (i.e. M6c) and also small stands of bottle sedge. Frequent small stands of semi-improved acid grassland on lower lying section of small valley, well grazed by sheep. Estimated to be U4b community.
8	NS.55904.06565	M20 - M17, minor M6c	Blanket mire mosaic comparable to TN7 with network of ditches with M6c community.
9	NS.56214.06740	U6d	Enoch Hill summit is gently rounded and features heath rush dominated acid grassland (U6, well grazed) with minor cover of U4b acid grassland and M23b rush-pasture vegetation. Vegetation typified by; heath rush (A), sweet vernal-grass (F), mat grass (F), common bent (F), viviparous fescue (O), heath wood-rush (O), heath bedstraw (O), wavy hair-grass (O), common blaeberry (O), <i>Rhytidiadelphus squarrosus</i> (O), <i>Pleurozium schreberi</i> (O), <i>Polytrichum juniperinum</i> (O) and <i>Sphagnum capillifolium</i> (R).



TN#	OS GR	NVC Type(s)	Target Note
10	NS.56520.06874	M6c with M20 and M17	Band of soligenous mire (a flush) contained within an approximately 30m wide gully eroded into M20 blanket mire on moderately sloping north-east side of Enoch Hill. Flush vegetation mainly composed of; soft rush, <i>Sphagnum fallax</i> , <i>S.capillifolium</i> , <i>S.papillosum</i> and rarely, bottle sedge. Small 'islands' of M20 and M17 blanket mire present. Edges of gully are eroded with some bare peat.
11	NS.56544.06813	M20; minor U6, M23b and M17	Most of the eastern and south-east side of Enoch Hill is dominated by M20 blanket mire (forming 80% of area) with remainder comprising minor stands of U6 acid grassland, M23b rush-pasture and M17 blanket mire.
12	NS.56881.07235	M17 - M20	High Chang Hill is a gently rounded ridge to the north-east of Enoch Hill, which contains a mosaic of M17 and M20 blanket mires, with proportion estimated to be 70:30.
13	NS.56464.07410	U4 - U5	Moderate sized area of mosaic vegetation of U4 and U5 acid grasslands on moderately steep slope. It is an evenly balanced mosaic, albeit with minor stands of M23b rush-pasture and U6 acid grassland.
14	NS.56240.07644	M17-M20	Gently sloping to flat ground, contained between two tributaries of Littlechang Burn, composed of M20 and M17 blanket mire communities (estimated proportion of 60:40, respectively). Minor stands of M6d soligenous mire present by ditches.
15	NS.56256.08085	M20	Upper section of spur of land extending north-west from Littlechang Hill summit. Area characterised by M20 blanket mire mainly composed of; hare's-tail cottongrass with moderate cover of <i>Sphagna</i> and cross-leaved heath and minor cover of common heather. Minor, scattered stands of U6 acid grassland present.
16	NS.58480.08240	M25 – M17; minor U4b and M6d	Ridge extending north-east from eastern side of Benty Cowan Hill. Locality mainly characterised by mosaic of M25 and M17 blanket mires, in proportion of 70:30, respectively. Minor stands of M20 blanket mire present and also U4b acid grassland on better drained (and grazed) land. Also, small stands of M6d sub-community (with abundant sharp-flowered rush) in lower lying, poorly drained areas.
17	NS.58940.08674	M25; minor M17, U4b, U6 and M6	Lower section of ridge as summarised in TN16. Locality dominated by M25 blanket mire of purple moor-grass with lesser cover of <i>Sphagna</i> and tormentil. Minor scattered stands of M17 blanket mire and U4b acid grassland also present. Well used ATV route present. Features characterised by a mixture of heath rush (U6) and soligenous mire (M6).
18	NS.59051.08750	M25; minor U4b and U6	Summit of ridge (see TN16 and TN17) dominated by M25 blanket mire of; purple moor-grass (D), tormentil (F), <i>Sphagnum capillifolium</i> (O), <i>Rhynchodeschisma squarrosum</i> (O), sweet vernal-grass (O), deergrass (O) and hare's-tail cottongrass (R). Minor scattered stands of U6 and U4b acid grassland vegetation present.
19	NS.57222.07840	M20 – M17; minor M23b, U5 and U6	Ridge rising south-westwards to High Chang Hill, mainly comprising a mosaic of M20 and M17 blanket mires with subordinate cover of M23b (by network of ditches) and some U5 and U6 acid grasslands by better draining areas. Ridge has locally very undulating topography probably due to a combination of drainage and attendant peat erosion.
20	NS.57045.07307	M17 – M20	Gently rounded area to north-east of High Chang Hill. Dominated by a mosaic of M17 and M20 blanket mire vegetation, with estimated proportion of 70:30, respectively. Frequent stands of <i>Sphagnum capillifolium</i> and <i>S.papillosum</i> . Purple moor-grass is locally frequent, suggesting there is some M25 blanket mire influence.
21	NS.57014.07169	M20 - M17	Peat hag edge about 1m high in blanket mire. Minor scattered stands of M23b rush pasture and U6 acid grassland present nearby (downslope of locality).

TN#	OS GR	NVC Type(s)	Target Note
22	NS.57106.07067	U4 - U6	Minor rounded knoll on ridge located to south-east of High Chang Hill. Knoll with mosaic of U4 and U6 acid grasslands, with estimated proportion of 70:30, respectively. Sparse <i>Sphagnum capillifolium</i> mounds present.
23	NS.57200.07010	M20. Minor M17, U6 and M6	Lower section of ridge to south-east of TN22, comprises mainly M20 blanket mire. Minor stand of soligenous mire also present containing <i>Sphagnum palustre</i> , <i>S.fallax</i> , <i>S.capillifolium</i> and <i>S.papillosum</i> .
24	NS.57344.06964	U5 - M25	Minor area of mosaic of U5 acid grassland and M25 blanket mire on steep slope at south-east edge of survey area. Estimated proportion of 70:30, respectively.
25	NS.57605.07116	M20 - M17 - M23b	Steep slope to east side of ridge at south-east edge of survey area. Mosaic dominated by M20 blanket mire with lesser cover of M17 blanket mire and M23b rush pasture.
26	NS.57436.07252	M17a and minor M6c	Small stand of blanket mire community in good condition in flat lying, poorly drained area, on ridge. Wet and boggy underfoot. Stand extends about 100m NE-SW and 30m NW-SE. Comprises; deergrass (A), <i>Sphagnum capillifolium</i> (A), <i>S.papillosum</i> (F), hare's-tail cottongrass (F), round-leaved sundew (O), common blaeberry (O), tormentil (O), wavy hair-grass (O), common sedge (O), common heather (R) and crowberry (R). Reasonable cover of round-leaved sundew infers presence of M17a sub-community. Common and hare's-tail cottongrasses with <i>S. cuspidatum</i> and bottle sedge are present by an old ditch, which also contains a small stand of M6c soligenous mire.
27	NS.57767.07497	M17	Gently sloping lower section of ridge to north-east of TN26. Dominated by M17 blanket mire community with small stands of M23b rush-pasture (possibly fed by the blanket mire) and U4 and U5 acid grasslands (in better drained areas).
28	NS.56840.07958	M17a stand in area of M20 - M17	Southern section of gently-rounded ridge which extends north to Chang Hill. Minor stand of M17a blanket mire in poorly drained area, similar to TN26. Surrounding area is largely composed of a mosaic of M20 and M17 blanket mire, with estimated proportion of 70:30, respectively. Minor, scattered stands of U6 and U5 acid grasslands are also present, located to west of locality, i.e. west of ridge.
29	NS.56940.08343	M17. Minor M20 and M23b	East side of Chang Hill is dominated by M17 blanket mire, with M20 blanket mire and minor stands of M17 blanket mire downslope (to east) with several ditches containing M23b.
30	NS.54684.09904	M23a	Rush-pasture vegetation of sharp-flowered rush (D), articulated rush (O), marsh thistle (F), marsh bedstraw (F), carnation sedge (O), common sorrel (F), <i>Rhynchospora squarrosus</i> (O), tufted hair-grass (O), Yorkshire fog (O), marsh willowherb (O), creeping buttercup (O), meadow vetchling (R), tufted forget-me-not (R), spear thistle (R) and heath wood-rush (R). Subject to sheep grazing, although nearby grassland provides better pasture (see below).
31	NS.54680.09983	MG6 - MG9 -U4b	Poor semi-improved grassland pasture comprises a mosaic of MG6, MG9 and U4b in estimated proportion of 40, 50 and 10%, respectively. Sward typically comprises; Yorkshire fog (A), tufted hair-grass (O), crested dog's-tail (A), perennial rye-grass (F), wavy hair-grass (R), white clover (F), creeping buttercup (F), daisy (F), sweet vernal-grass (F), self-heal (O), marsh thistle (O), annual meadow-grass (O), with locally rare; sheep's fescue, mat grass, eyebright species, ribwort plantain and common mouse-ear. Vegetation provides good pasture for sheep.
32	NS.54755.09984	U4b and M25	Mosaic of U4b - M25 grasslands of; mat grass (A), purple moor-grass (LF), common bent (O), sweet vernal-grass (O), red fescue (O), heath rush (O), <i>Rhynchospora squarrosus</i> (F) and white clover (O), with locally rare; tormentil, green-ribbed sedge, creeping buttercup, autumn hawkbit, eyebright species and carnation sedge.
33	NS.54799.09952	M23 - M25	Extensive area of mosaic of M23 rush-pasture and M25 blanket mire with proportion of 60:40, respectively. Vegetation has minor M17 influence.



TN#	OS GR	NVC Type(s)	Target Note
34	NS.54690.10086	M23b and minor M6c	Marsh violet occasionally present in M23b rush-pasture vegetation by low lying area, which is largely rank in character. Minor stands of M6c vegetation with <i>Sphagnum palustre</i> , <i>Polytrichum commune</i> and tormentil.
35	NS.57431.06853	U5 – M20 – U20 – U6	Very steep slope at south-east of survey area is characterised by a mosaic of U5 – M20 – U20 – U6, with proportions estimated to be 40:30:20:10, respectively. M20 blanket mire, which is mostly well grazed, is located on a gently-rounded ridge (Craig of Bahoun) located at the top of the slope.



Appendix B

Botanical Species List

Common Name	Scientific Name
TREES and SHRUBS	
Common heather	<i>Calluna vulgaris</i>
Crowberry	<i>Empetrum nigrum</i>
Cross-leaved heath	<i>Erica tetralix</i>
Willow	<i>Salix</i> spp.
Common blaeberry	<i>Vaccinium myrtillus</i>
GRASSES	
Common bent	<i>Agrostis capillaris</i>
Sweet vernal-grass	<i>Anthoxanthum odoratum</i>
Crested dog's-tail	<i>Cynosurus cristatus</i>
Tufted hair-grass	<i>Deschampsia cespitosa</i>
Wavy hair-grass	<i>Deschampsia flexuosa</i>
Sheep's fescue	<i>Festuca ovina</i>
Viviparous fescue	<i>Festuca vivipara</i>
Yorkshire fog	<i>Holcus lanatus</i>
Perennial rye-grass	<i>Lolium perenne</i>
Purple moor-grass	<i>Molinia caerulea</i>
Mat grass	<i>Nardus stricta</i>
Annual meadow-grass	<i>Poa annua</i>
SEDGES	
Green-ribbed sedge	<i>Carex binervis</i>
Common sedge	<i>Carex nigra</i>
Carnation sedge	<i>Carex panicea</i>
Bottle sedge	<i>Carex rostrata</i>
Common cottongrass	<i>Eriophorum angustifolium</i>



Common Name	Scientific Name
Hare's-tail cottongrass	<i>Eriophorum vaginatum</i>
Deergrass	<i>Trichophorum germanicum</i>
RUSHES	
Sharp-flowered rush	<i>Juncus acutiflorus</i>
Articulated rush	<i>Juncus articulatus</i>
Soft rush	<i>Juncus effusus</i>
Heath rush	<i>Juncus squarrosus</i>
Heath wood-rush	<i>Luzula multiflora</i>
HERBS	
Daisy	<i>Bellis perennis</i>
Common mouse-ear	<i>Cerastium fontanum</i>
Marsh thistle	<i>Cirsium palustre</i>
Spear thistle	<i>Cirsium vulgare</i>
Round-leaved sundew	<i>Drosera rotundifolia</i>
Marsh willowherb	<i>Epilobium palustris</i>
Eyebright species	<i>Euphrasia</i> sp.
Heath bedstraw	<i>Galium saxatile</i>
Meadow vetchling	<i>Lathyrus pratensis</i>
Tufted forget-me-not	<i>Myosotis laxa</i>
Bog asphodel	<i>Narthecium ossifragum</i>
Ribwort plantain	<i>Plantago lanceolata</i>
Tormentil	<i>Potentilla erecta</i>
Self-heal	<i>Prunella vulgaris</i>
Creeping buttercup	<i>Ranunculus repens</i>
Common sorrel	<i>Rumex acetosa</i>
Autumn hawkbit	<i>Scorzoneroides autumnalis</i>
White clover	<i>Trifolium repens</i>



Common Name	Scientific Name
Marsh violet	<i>Viola palustris</i>
FERNS AND ALLIES	
Broad buckler-fern	<i>Dryopteris dilatata</i>
Bracken	<i>Pteridium aquilinum</i>
BRYOPHYTES	
	<i>Aulacomnium palustre</i> moss
	<i>Hypnum jutlandicum</i> moss
	<i>Plagiothecium undulatum</i> moss
	<i>Pleurozium schreberi</i> moss
	<i>Polytrichum commune</i> moss
	<i>Polytrichum juniperinum</i> moss
	<i>Rhytidiadelphus squarrosus</i> moss
	<i>Sphagnum capillifolium</i> moss
	<i>Sphagnum cuspidatum</i> moss
	<i>Sphagnum fallax</i> moss
	<i>Sphagnum palustre</i> moss
	<i>Sphagnum papillosum</i> moss



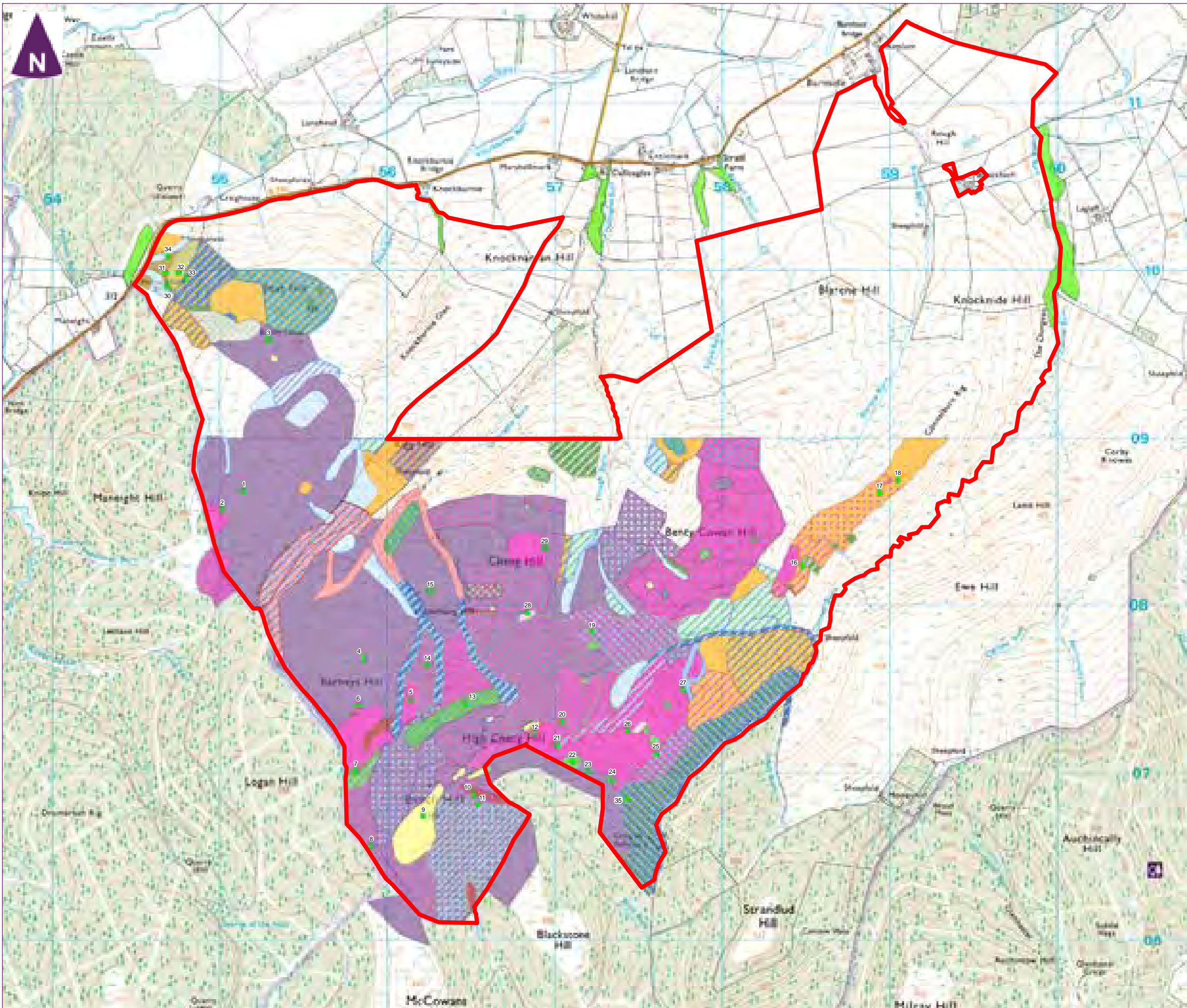


Appendix C

Figures

- Figure 3.1 NVC Survey Map – Overview
- Figure 3.2 NVC Survey Map – M17 (including mosaics where M17 dominates)
- Figure 3.3 NVC Survey Map – M20 (including mosaics where M20 dominates)
- Figure 3.4 NVC Survey Map – M23 (including mosaics where M23 dominates)
- Figure 3.5 NVC Survey Map – M25 (including mosaics where M25 dominates)
- Figure 3.6 NVC Survey Map – M6 (including mosaics where M6 dominates)
- Figure 3.7 NVC Survey Map – Grasslands (including mosaics where grassland communities dominate)





Key

- Site boundary
- NWSS site
- Enoch Hill NVC 2014 Target Note Location

NVC Communities

 M17	 M23b
 M17 - M20	 M25
 M17 - M23b	 M25 - M17
 M17 - M25	 M25 - M23
 M17 - U5	 M25 - minor M17
 M17 - minor M20	 M6
 M17a	 M6 - M23
 M20	 M6c
 M20 - M17	 M6d
 M20 - M17 - M23b	 MG6 - MG9
 M20 - M25	 U4 - M23 - U6
 M20 - M6c - U6	 U4 - M23b
 M20 - U6	 U4 - U5
 M20 - minor M17	 U4 - U5 - M23
 M20 - minor M23a	 U4 - U6
 M20 - minor M23b	 U4 - minor U6
 M20 - minor M23b and U6	 U4b
 M23	 U4b - M23a
 M23 - M25	 U4b - M25
 M23 - M6	 U5
 M23a	 U5 - M20 - U20 - U6
 M23a - U4	 U5 - M25
 M23a - U5	 U5 - U4
 M23a - minor M6	 U5 - U4b
 M23a - minor M6 and M20	 U6
 M23a - minor M6 and M25	 U6 - U4
	 U6 - U5

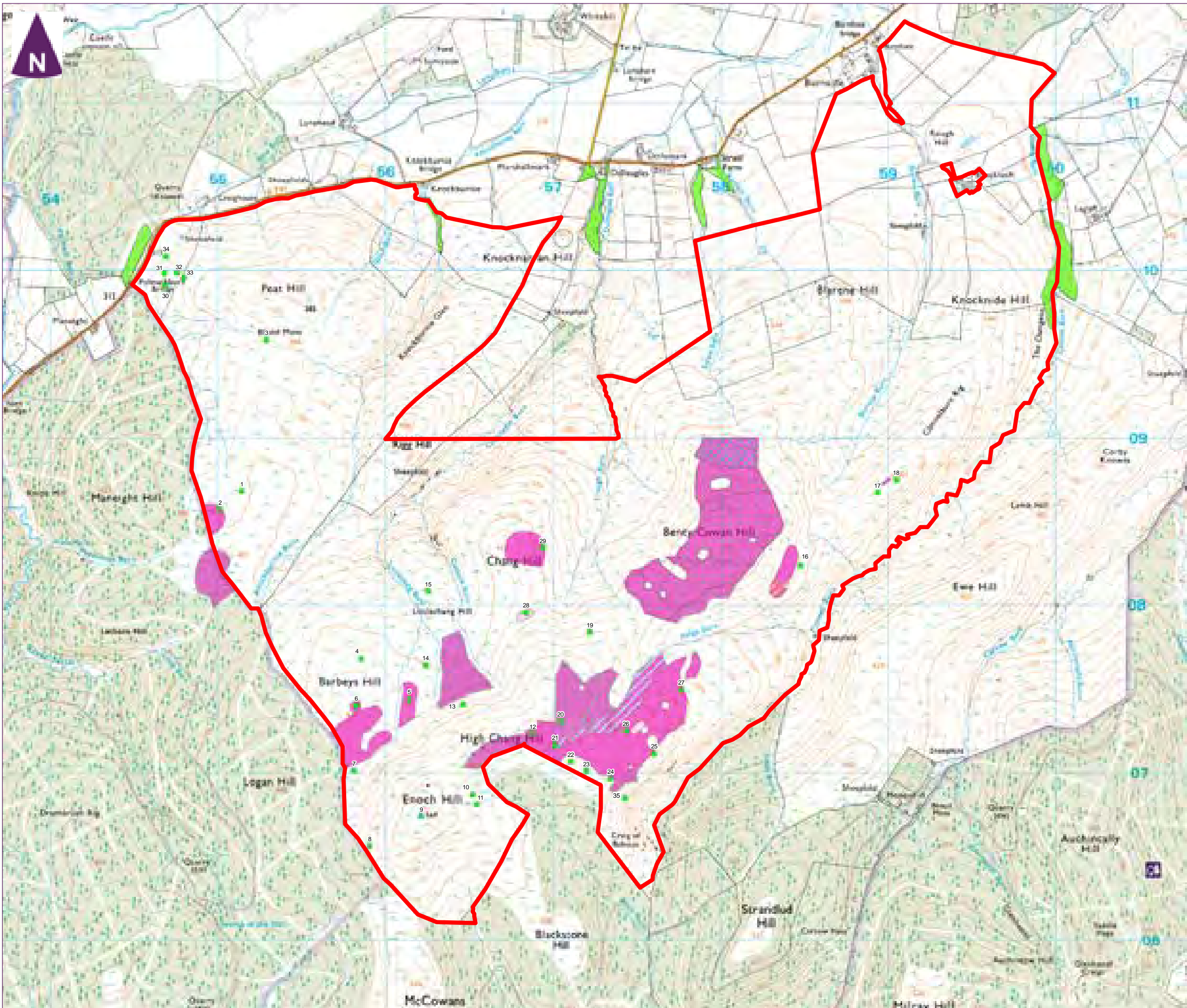
0 250 500 750 1,000 1,250 Metres
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Client

Enoch Hill Wind Farm
National Vegetation
Classification Report
(2014)



Figure 3.1
NVC Survey Map - Overview

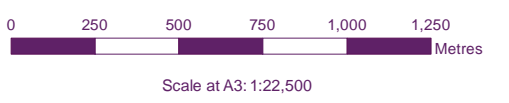


Key

- Site boundary
- NWSS site
- Enoch Hill NVC 2014 Target Note Locations

NVC Communities

- M17
- M17 - M20
- M17 - M23b
- M17 - M25
- M17 - U5
- M17 - minor M20
- M17a



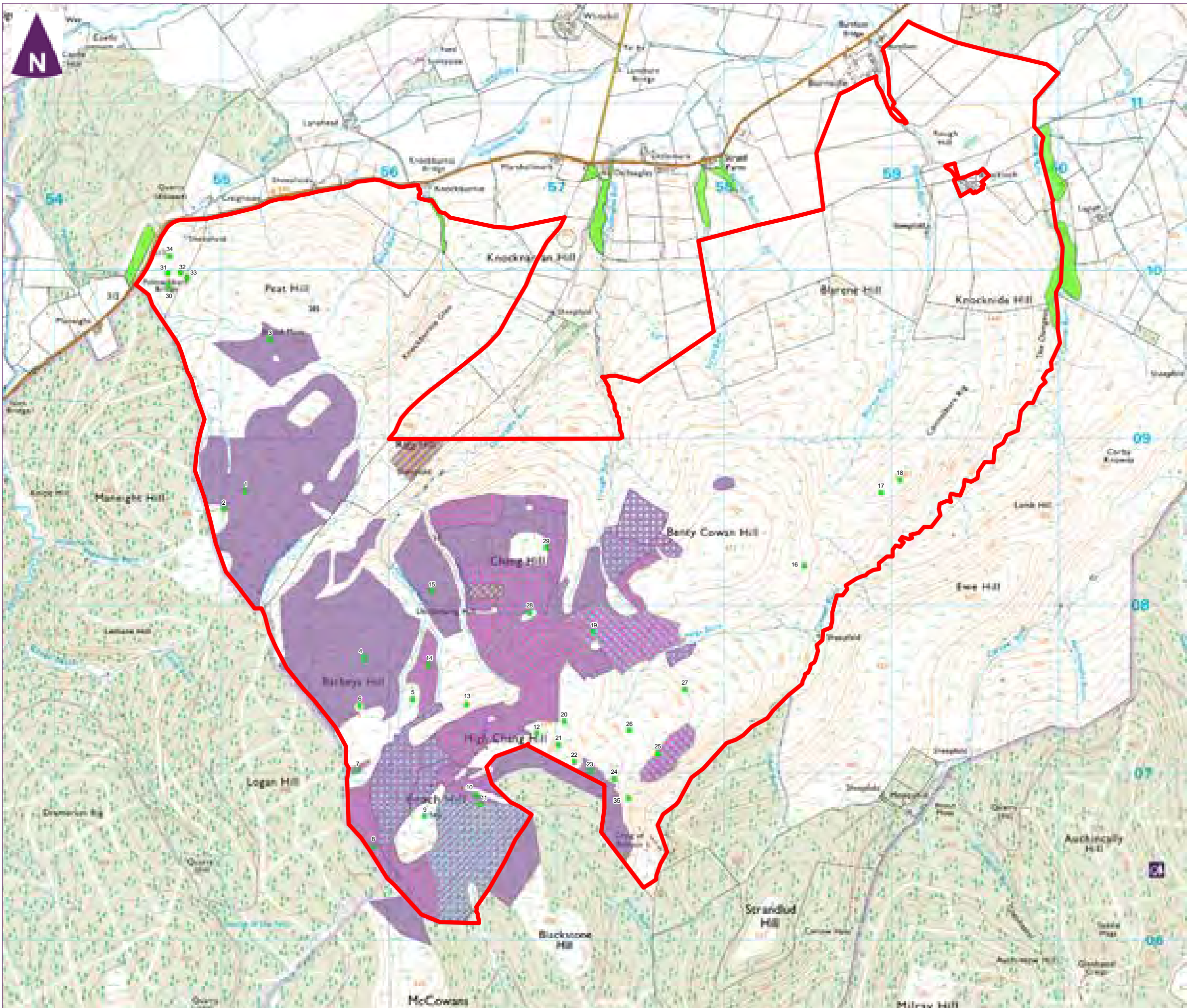
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Figure 3.2
NVC Survey Map - M17 (Including
Mosaics Where M17 Dominates)

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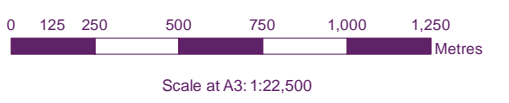


Key

- Site boundary
- NWSS site
- Enoch Hill NVC 2014 Target Note Locations

NVC Communities

- M20
- M20 - M17
- M20 - M17 - M23b
- M20 - M25
- M20 - M6c - U6
- M20 - U6
- M20 - minor M17
- M20 - minor M23a
- M20 - minor M23b
- M20 - minor M23b and U6



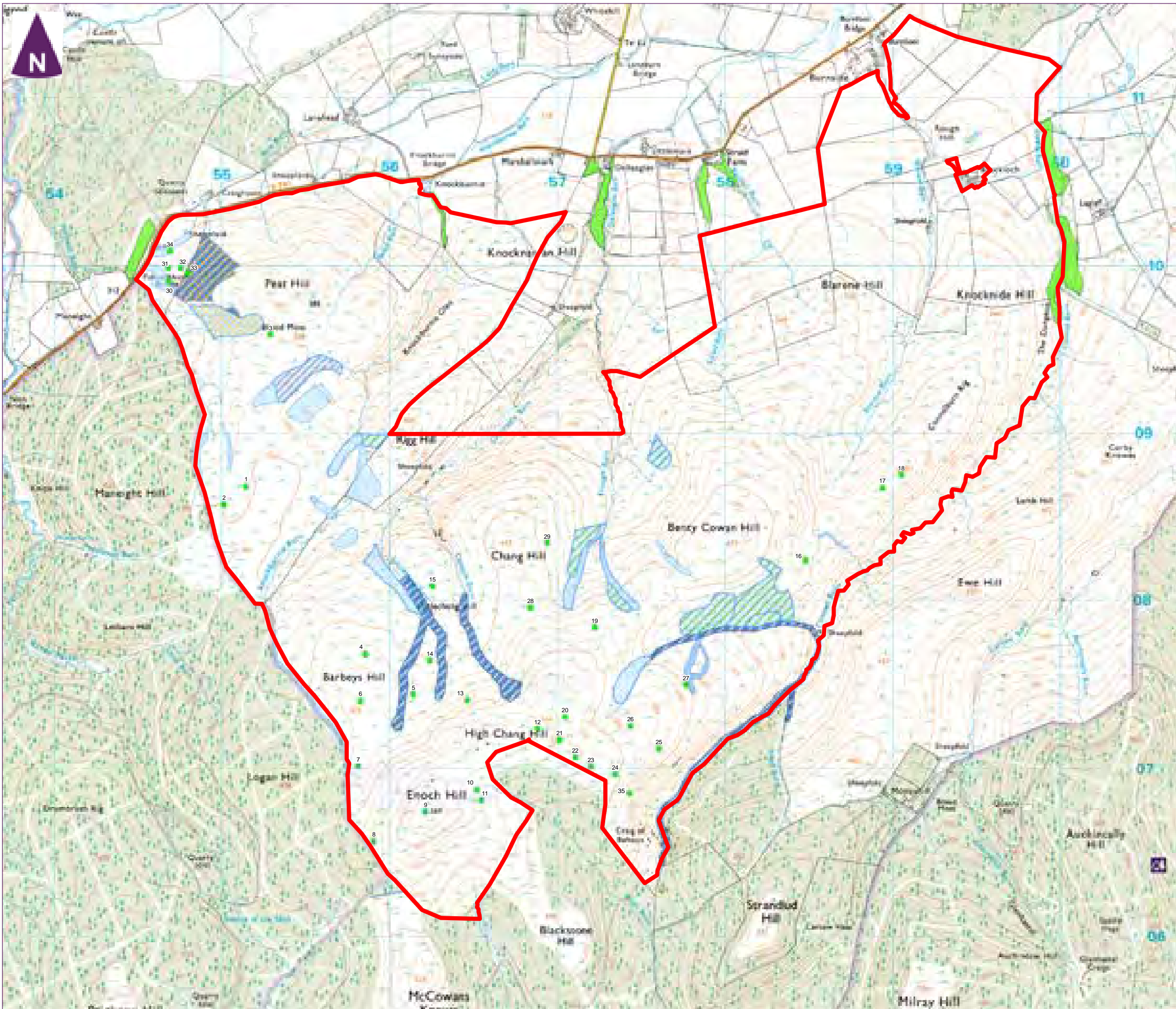
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Figure 3.3
NVC Survey Map - M20 (Including
Mosaics Where M20 Dominates)

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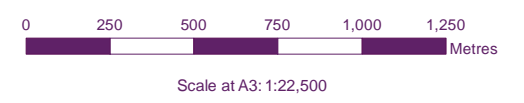


Key

- Site boundary
- NWSS site
- Enoch Hill NVC 2014 Target Note Locations

NVC Communities

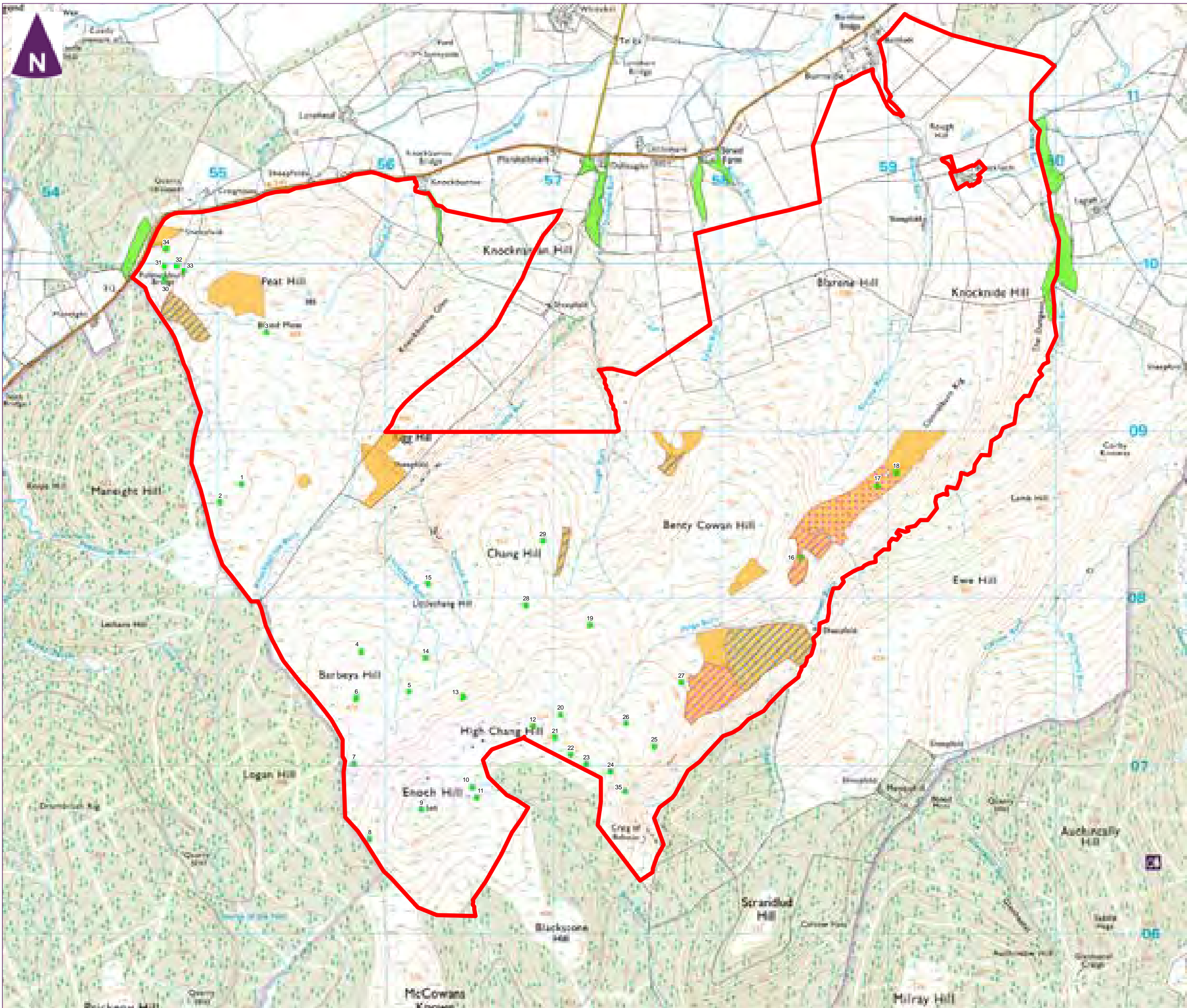
- M23
- M23 - M25
- M23 - M6
- M23a
- M23a - U4
- M23a - U5
- M23a - minor M6
- M23a - minor M6 and M20
- M23a - minor M6 and M25
- M23b
- M23b - M20






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Figure 3.4
NVC Survey Map - M23 (Including
Mosaics Where M23 Dominates)

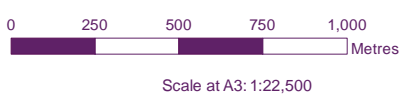


Key

-  Site boundary
-  NWSS site
-  Enoch Hill NVC 2014 Target Note Locations

NVC Communities

-  M25
-  M25 - M17
-  M25 - M23
-  M25 - minor M17



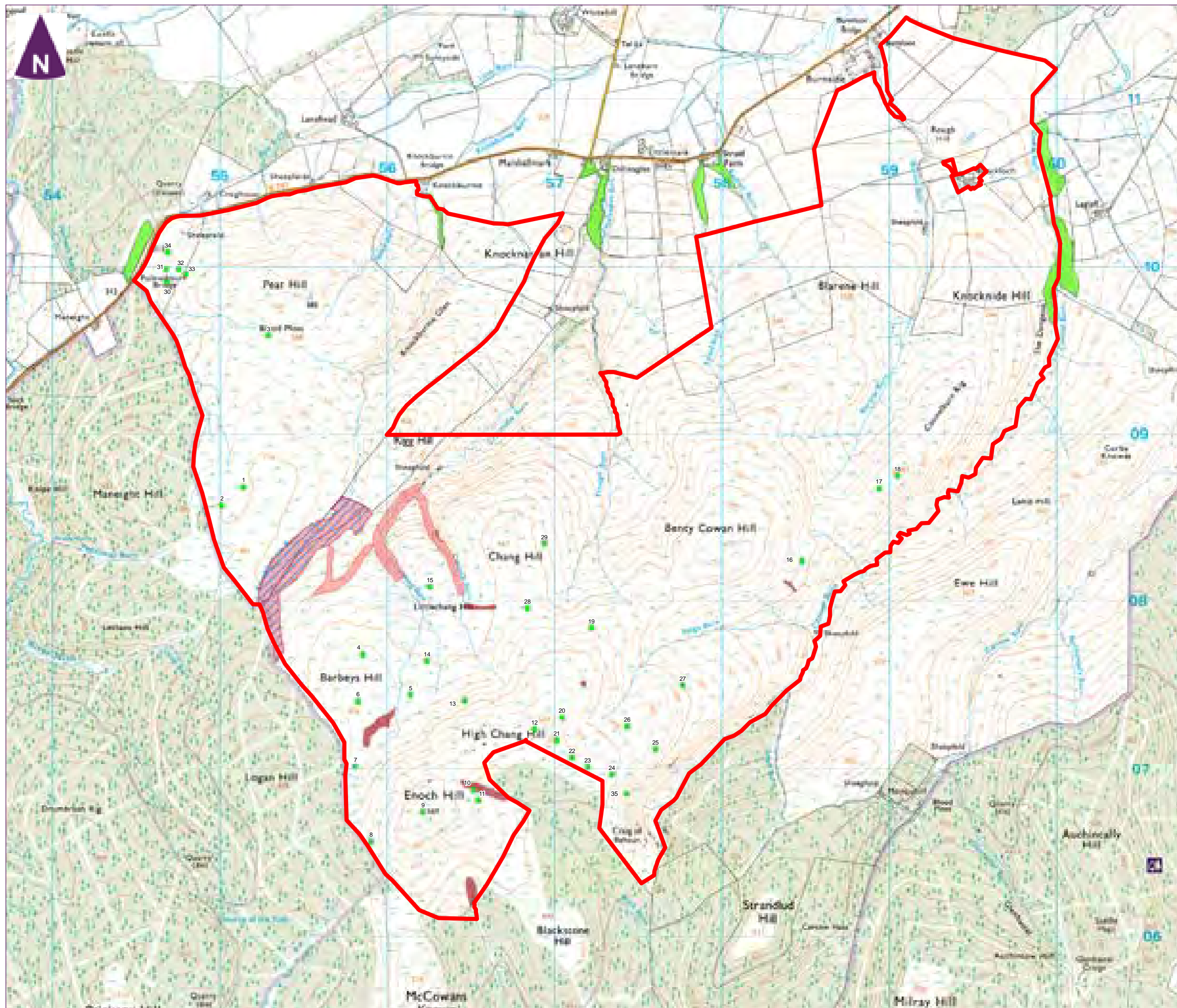
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Figure 3.5
NVC Survey Map - M25 (Including
Mosaics Where M25 Dominates)

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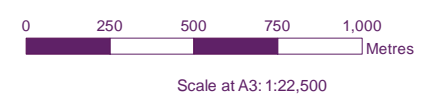


Key

- Site boundary
- NWSS site
- Enoch Hill NVC 2014 Target Note Locations

NVC Communities

- M6
- M6 - M23
- M6c
- M6d

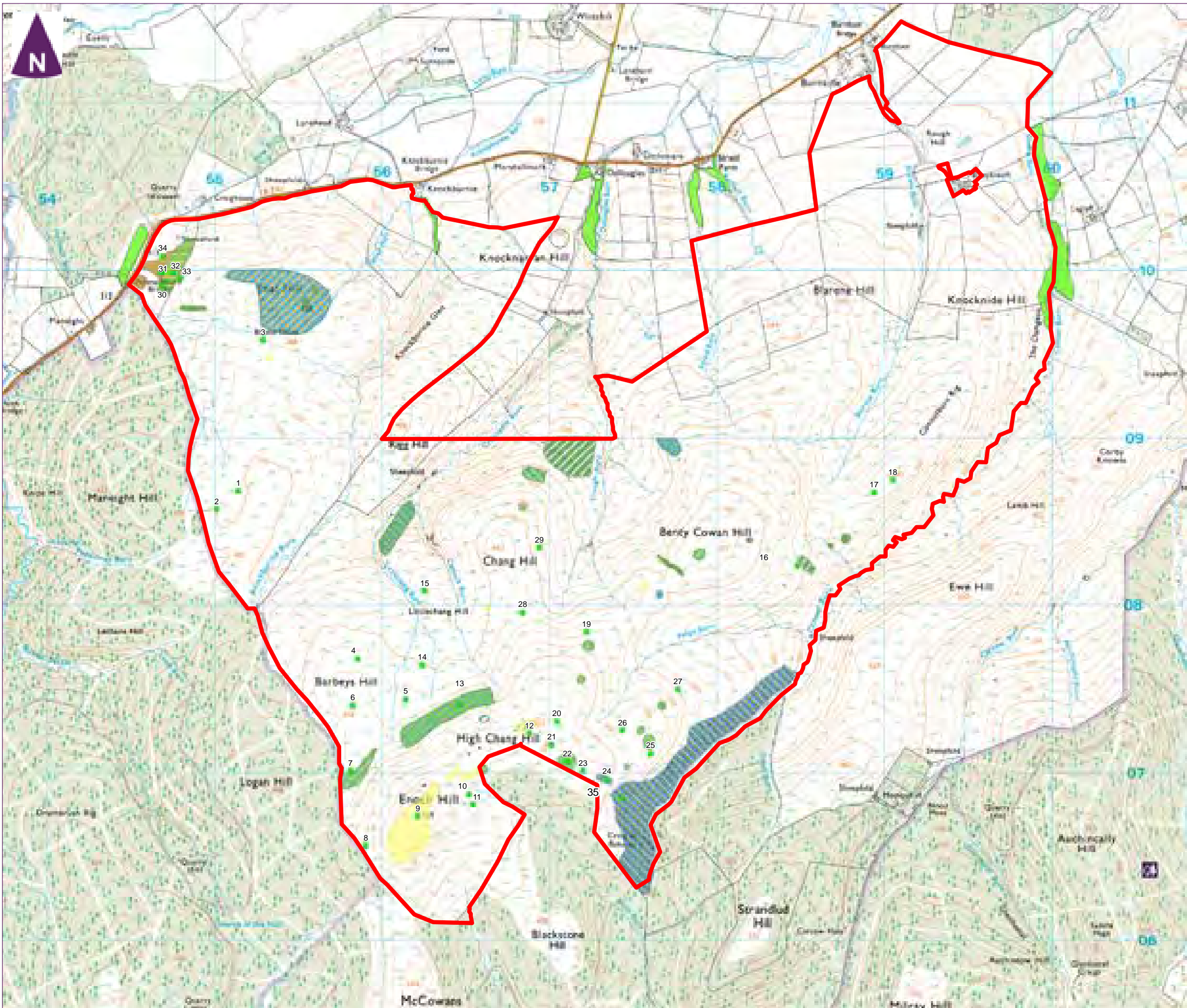


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(2014)

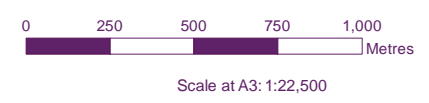


Figure 3.6
NVC Survey Map - M6 (Including
Mosaics Where M6 Dominates)



- Key**
- Site boundary
 - NWSS site
 - Enoch Hill NVC 2014 Target Note Locations

- NVC Communities**
- MG6 - MG9
 - U4 - M23 - U6
 - U4 - M23b
 - U4 - U5
 - U4 - U5 - M23
 - U4 - U6
 - U4 - minor U6
 - U4b
 - U4b - M23a
 - U4b - M25
 - U5
 - U5 - M20 - U20 - U6
 - U5 - M25
 - U5 - U4
 - U5 - U4b
 - U6
 - U6 - U4
 - U6 - U5



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National Vegetation
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Figure 3.7
NVC Survey Map - Grassland
Communities (including Mosaics Where
Grassland Communities Dominate)



Appendix 11.B
Protected Species Baseline Report

E.ON Climate & Renewables UK Developments Ltd

Enoch Hill Wind Farm

Protected Species (2013-2014) Baseline Report



Amec Foster Wheeler Environment & Infrastructure UK Limited

January 2015

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Project: E.ON Energy
Report: E.ON Energy
Report: E.ON Energy

E.ON**Enoch Hill Wind Farm****Protected Species (2013-2014)
Baseline Report**

Amec Foster Wheeler Environment &
Infrastructure
UK Limited

January 2015



ISO 9001:2008
ISO 14001:2004

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Executive Summary

This report has been produced in order to describe the baseline status of protected species within the Enoch Hill site boundary (the Site) and to identify any protected species constraints to a wind farm development at the Site. The Site is located immediately south of Dalleagles, New Cumnock, East Ayrshire. Specifically this report provides the methods and results of protected species surveys focussing on otter, water vole and badger undertaken in 2013 and 2014. These were the species considered most likely to be present on Site, with incidental sightings recorded for other species.

The Site encompasses a large area of upland marshy/pasture grassland with occasional mixed woodland belts along sections of watercourses. In 2013, all watercourses on Site and along the perimeter of the Site boundary were assessed for their potential to support otter and water vole, whilst the whole Site was assessed for the potential to support other protected species, primarily badger but also including red squirrel, reptiles and amphibians as well as UK BAP priority species. In 2014, all watercourses and areas within a smaller survey area were re-assessed for otter and water vole.

No confirmed otter holts were recorded during surveys, although signs of use by otter including spraints, slides and nine potential resting sites (one in 2013 and eight in 2014) were found along a number of burns; agreeing with a prior AECOM report (from 2012) that the Site is regularly used by otter. Some (limited) field signs indicating water vole presence were also identified in 2013, outside of the survey area surveyed in 2014, however no other evidence of water vole was recorded throughout the Site and they were not recorded in the 2014 surveys or by AECOM in 2012. No evidence of badger presence was found on Site. Small numbers of juvenile brown trout were incidentally recorded in the lower extent of Dalleagles Burn, however no other notable fish species were identified. A separate Aquatic Ecology Report provides more information. No reptiles or signs of their presence, field signs indicating the presence of red squirrel, or signs of any other notable species were found. Furthermore, no amphibians or signs of their presence were identified during protected species survey and only a single pond was found in the northern section of the Site, along the Redhall Burn to the south of Straid, i.e. “online”, which is highly likely to support fish and is considered largely unsuitable for great crested newts. In summary, on Site there is considered to be:

- Negligible potential for great crested newt;
- Low potential for other amphibians e.g. common frog;
- Moderate to high potential of commuting otter; low to high potential of foraging otter and negligible to low/moderate potential of resting up (potential is higher within lower elevation watercourses; proven use by otter along Dalleagles, Redhall, Knockburnie, Blarene, Connel and Polmath Burns);
- Low to moderate potential of foraging, commuting or burrowing water vole (potential is higher within lower elevation watercourses; proven use by water vole along Dalleagles Burn); and



- Low potential for badger (with negligible potential for sett creation) overall however this rises to moderate within woodland areas (with moderate potential for sett creation in these areas).

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1. Introduction

Amec Foster Wheeler Environment & Infrastructure UK Ltd (Amec Foster Wheeler) was commissioned by E.ON Climate & Renewables Ltd. (E.ON) to undertake baseline ecology surveying within the Enoch Hill site boundary (the Site). The Site is located to the south of Dalleagles, near New Cumnock, in East Ayrshire with a central grid reference of NS 582 089.

This report describes protected species surveys for otter (*Lutra lutra*), water vole (*Arvicola amphibius*) and badger (*Meles meles*) and include assessment of habitats on Site for other protected species such as red squirrel (*Sciurus vulgaris*), reptiles and amphibians, including great crested newt (*Triturus cristatus*). In addition, the Site was also assessed for its suitability to support other legally protected¹ or notable species such as those listed on the UK Biodiversity Action Plan (UKBAP)², Scottish Biodiversity List (SBL³) and Ayrshire Local Biodiversity Action Plan (LBAP).

This report is also complemented by separate bat, freshwater pearl mussel, habitat, aquatic ecology and ornithological reports. Accordingly, this report does not provide detailed information with regard to bats, aquatic ecology or birds apart from passing reference where relevant.

This report provides information (gathered in 2013 and 2014) regarding protected species, building on previous survey work undertaken by AECOM in 2012⁴. In their report, AECOM found that the Site provided good commuting habitat for otter although with limited foraging and resting site habitat; a single holt along Knockburnie Burn was identified. They assessed the southern sections of the Site as being suitable for water vole, however no field signs were recorded. Signs of badger were also absent from the AECOM survey.

The objective of this report is to identify the presence or otherwise of protected species constraints to development at the Site. The aims of the surveys and assessment were as follows:

- To assess the presence or potential presence of protected species within the Site;
- To assess these species' use of features within the Site; and
- To identify potential conflicts between these species and a proposed wind farm development.

¹ The Conservation (Natural Habitats & c.) Regulations 1994 (as amended); The Wildlife and Countryside Act 1981 (as amended); Nature Conservation (Scotland) Act 2004; Wildlife and Natural Environment (Scotland) Act 2011; and Protection of Badgers Act 1992 (as amended).

² The UK BAP was replaced by the 'UK Post-2010 Biodiversity Framework' (July 2012) which covers the period 2011-2020. This framework is implemented individually by each of the four UK countries. Following the publication of the new framework the UK BAP partnership no longer operates but many of the tools and resources originally developed under the UK BAP still remain in use and reference to UKBAP is still valid in terms of identifying notable species throughout the UK including Scotland.

³ The SBL is a list of flora, fauna and habitats considered by the Scottish Ministers to be of principal importance for biodiversity conservation and its publication was a requirement of Section 2(4) of The Nature Conservation (Scotland) Act 2004.

⁴ AECOM (Nov 2012). Enoch Hill Protected Species Report.



2. Methods

2.1 Survey Areas

The Site (as shown by the red-line boundaries in Figure 3.1 and Figure 3.2) encompasses a large area of upland marshy/pasture grassland with occasional mixed woodland belts along sections of watercourses. In September 2013, all watercourses on Site and along the red line boundary were assessed for their potential to support otter and water vole, along with incidental signs of habitat supporting salmonids, whilst the whole Site was assessed for the potential to support other protected species, primarily badger but also including red squirrel, reptiles and amphibians as well as BAP species.

In September 2014 follow-up surveys for otter and water vole were undertaken on all watercourses focussing on a smaller “survey area⁵” which excluded areas which were well-outside of the proposed development area, i.e. the northern part of the Site, illustrated on Figure 3.2.

The report makes reference to a number of watercourses. These watercourses are described in detail in the results section (Table 3.1) and their locations are illustrated on Figures 3.1 and 3.2.

2.2 Surveyors and Survey Conditions

Otter, water vole and badger surveys were undertaken between 16th and 20th September 2013 by Amec Foster Wheeler Consultant Ecologists Sian Jones MCIEEM, Kirsten Bywater ACIEEM and Rachael Greaves MSc whilst surveys from 15th – 18th and 23rd September 2014 were undertaken by Amec Foster Wheeler Senior Ecologist Claire Hopkins MCIEEM, Consultant Ecologist Jenny Sneddon MCIEEM and Consultant Ecologist Rachel Finan MCIEEM. All surveyors met the CIEEM Competency for Species Survey (CSS) requirements for these species⁶. Survey conditions were suitable and no survey constraints were recorded that would influence the validity of the results.

2.3 Otter Survey

An otter survey was conducted of all watercourses and water bodies within the Site in September 2013 (see Figure 3.1) and a smaller survey area in September 2014 (see Figure 3.2). Standard survey methods for otter were followed whereby the banks of watercourses were inspected for signs of otter⁷ and for potential resting sites. Evidence for otter presence includes: spraints (faeces) – which are often located on prominent features within the channel or on the bank (including weirs, bridges, rocks, tree roots, confluences of burns and other riverside features); boneless spraints; slides; and footprints – located in soft mud, silt or sand banks. This methodology

⁵ The “smaller survey area” was informed by a range of engineering and other constraints which ruled out other areas within the Site due to unsuitability for wind farm construction.

⁶ CIEEM Competencies for Species Survey (CSS) guidance: <http://www.cieem.net/competencies-for-species-survey-css>: accessed January 2014.

⁷ Chanin, P. (2003). Monitoring the otter *Lutra*. Conserving Natura 2000 Rivers Monitoring Series No. 10. English Nature, Peterborough.

conforms to SNH guidance⁸. Any field sign locations identified in 2012 by AECOM (such as the holt along Knockburnie Burn) were reassessed as part of the 2013 and 2014 survey work, with presence/absence of these signs noted. Terminology was as follows:

- **Resting Site** – collective term for holts and couches used in the Habitats Regulations;
- **Potential resting site** – a site considered to provide suitable resting habitat together with inconclusive signs of use or potential use;
- **Holt** – an underground, resting site, often underneath heather root matrices or within tree roots;
- **Couch** – an above ground resting site that can be used for sleeping or grooming;
- **Breeding site** – a term used to identify an area of land in which otters breed, within which a natal holt is located;
- **Natal holt** - a discrete holt that is used by the female to birth the cubs and where they can remain for up to three months; and
- **Nursery area** - an area within a breeding site with high levels of activity associated with cubs. Holts within these areas are considered unlikely to be the primary natal holts where cubs are born.

Notes on general site habitat suitability for otter were also recorded. Suitable otter habitat provides access to freshwater, sufficient prey, resting and breeding sites that are secure from direct disturbance. In terms of resting sites, otters can utilise a range of above and below-ground structures in their home range and in freshwater habitat can often sleep above ground and in open areas⁹. In terms of a potential breeding sites (within which a natal holt is located), data tend to be sparse and in some instances contradictory, which may reflect the fact that females tend to choose remote and secretive locations, often some distance away from the watercourse, upstream along small tributaries, within reedbeds, scrub/woodland and sometimes in open ground (e.g. on peatland sites in Shetland and other upland areas in Scotland)¹⁰. It is considered likely that a breeding site would be adjacent to a good supply of food, be free from significant disturbance and be at low potential of flooding. As much of the Site is extensively farmed (sheep grazing) the surveys were restricted to watercourses except where adjacent (within ~10m of bank tops) suitable habitats for resting sites were present such as woodland, scrub or coarse grassland.

2.3.1 Water Vole Survey

A water vole survey was conducted of all watercourses and water bodies within the Site in September 2013 (see Figure 3.1) and a smaller survey area in September 2014 (see Figure 3.2). Standard survey methods for water voles were followed whereby watercourses were inspected for signs of water vole, i.e. droppings – including those

⁸ SNH (2008) Otters and Development. Scottish Wildlife Series. <http://www.snh.org.uk/publications/online/wildlife/otters/default.asp>; accessed January 2015.

⁹ Kruuk, H., Carss, D.N. Conroy, J.W.H. & Gaywood, M.J.. 1998. Habitat use and conservation of otters *Lutra* in Britain: a review. *Symposia of the Zoological Society of London*, 71, 119-134. In: Kruuk, H. 2006. *Otters: ecology, behaviour and conservation*. Oxford University Press.

¹⁰ Liles, G. 2003. *Otter Breeding Sites: Conservation and Management*. *Conserving Natura 2000 Rivers Conservation Techniques Series* No. 5, English Nature Peterborough.

deposited in well-used territorial latrines – footprints; feeding stations with characteristic cut vegetation close to the water’s edge; runways in vegetation; and burrows. Notes were taken on the general suitability of watercourses to support water vole, including details of burn geomorphology and riparian and emergent vegetation.

Habitats were classed as being unsuitable if they were heavily modified either by bankside engineering works or grazing; if they lacked suitable food plants such as a range of grasses, rushes and herbs; or if the banks were overly rocky or otherwise unsuitable for burrowing (including in heavily shaded forestry plantations). This methodology has been adapted from the Water Vole Conservation Handbook¹¹ which states that:

- *“A field survey...should include all areas of habitat suitable for water voles which could be directly affected by the proposals, and should extend some distance from the site boundaries to inform impact assessment and mitigation...the distance from the site which will need to be surveyed in detail will be dependent on the nature and magnitude of potential impacts...”*

In addition, watercourses were searched for signs of the presence of American mink (*Neovison vison*) which is a non-native species and a predator of water vole.

2.3.2 Badger Survey

In September 2013 the entirety of this Site was systematically surveyed for badger setts and signs indicating the presence of badgers (see Figure 3.1). Within this area of search all suitable fence lines, woodland and scrub habitats were systematically surveyed for evidence of badgers in the form of:

- Faeces: badgers usually deposit faeces in characteristic excavated pits, concentrations of which (latrine sites) are typically found at home range boundaries;
- Setts, comprising either single isolated holes or a series of holes, likely to be interconnected underground;
- Paths between setts, under fence lines or leading to feeding areas;
- Scratching posts at the base of tree trunks;
- Snuffle holes (small scrapes in the ground where badgers have searched for insects, earthworms and plant tubers);
- Day nests (bundles of grass and other vegetation where badgers may sleep above ground);
- Hair traces; and
- Footprints.

If found, activity levels at setts were scored using the following criteria:

¹¹ Strachan, R., Moorhouse, T. and Gelling, M. (2011). The water vole conservation handbook. 3rd Edition. WildCRU, Oxford.

- Number of well used holes (with one or more of the following features: Well-worn entrance; freshly excavated soil; bedding material);
- Number of partially used holes (leaves or twigs in entrance, presence of bedding materials and/or mosses and other plants growing in or around entrance); and
- Number of disused holes (partially or completely blocked, with considerable amount of excavation required for reoccupation).

If a badger sett was identified it was further classified according to the following criteria according to survey guidance¹² and according to advice presented in CIEEM's In Practice¹³:

- **Main setts:** These are in continuous use; they are large, well-established, often extensive and may have large spoil heaps outside the entrances. There are likely to be well-worn paths leading to the sett. The main sett is where the cubs are most likely to be born. There is generally only one main sett per social group of badgers. Main setts are usually built in very specific positions, where there is the right combination of soil (to facilitate drainage and ease of digging), aspect, slope and cover. Since suitable sett sites are at a premium, main setts are usually long-established, and may have been in use for decades or even centuries. The average number of holes in a main sett is 15;
- **Annexe setts:** These occur in close association with the main sett (usually within 150m), and are linked to the main sett by clear, well-used paths. Annexe setts consist of six holes on average, but they are not necessarily in use all the time, even if the main sett is very active. If a second litter of cubs is born, this may be where they are reared;
- **Subsidiary setts:** These comprise five holes on average, but are not in continuous use and are usually some distance from the main sett (50m or more). There is no obvious path connecting them to the main sett and their 'ownership' can often only be determined by bait marking;
- **Outlying setts:** These consist of only one or two holes. They can be found anywhere within the territory and usually have small spoil heaps, indicating that they are not very extensive underground. There are no obvious paths connecting them to other setts, they are only used sporadically and often used by foxes or rabbits when not occupied by badgers.

2.3.3 Other Species

Habitats on Site were assessed in September 2013 for the potential to support other protected and notable species and information gathered comprised the following:

- **Invertebrates:** The general suitability of terrestrial habitats for invertebrates such as butterflies, bees and moths, e.g. botanical diversity, larval food plants of notable butterfly species. The general suitability of watercourses to support aquatic invertebrates was also assessed, e.g. overhanging vegetation, channel width, depths, flow, bank and substrate material;

¹² Harris S, Cresswell P and Jefferies D (1989). Surveying Badgers. Mammal Society and Scottish Natural Heritage (2003). Best Practice Guidance - Badger Surveys. Inverness Badger Survey 2003. Commissioned Report No. 096.

¹³ Andrews, R. (2013). The classification of badger (*Meles meles*) setts in the UK: a review and guidance for surveyors. CIEEM In Practice Issue 82 December 2013.

- **Fish:** The general suitability of watercourses and water bodies to support a range of fish species, including channel width, depths, flow, bank and substrate material, obstacles to upstream migration of, for example, sea trout (*Salmo trutta*), Atlantic salmon (*Salmo salar*), lamprey species and eels (*Anguilla anguilla*). The potential for breeding sites such as redds was also assessed dependent on in water conditions. Visual inspection of waterbodies was undertaken to detect the level of suspended solids. Incidental notes were taken on all of these features by surveyors whilst undertaking other surveys e.g. otter and water vole surveys (more information is provided in a separate Aquatic Ecology Report);
- **Amphibians:** The suitability of habitats (including ponds and water bodies) was assessed for amphibians such as the European protected species great crested newt and the UK BAP species common toad (*Bufo bufo*) along with the quality and accessibility of surrounding terrestrial habitats;
- **Reptiles:** The general suitability of terrestrial habitats to support reptiles, e.g. embankments, slopes, potential natural and artificial refugia, interface or edge habitats, and shade free areas near dense vegetation. In addition, linkages to off-site habitats were assessed in respect of these species such as adder (*Vipera berus*) and common lizard (*Zootoca vivipara*);
- **Red Squirrel:** The general suitability of woodlands and shelterbelts to support red squirrel; field signs for this species include dreys (distinctive bundles of twigs in trees) and chewed pine cones, which are often discarded on prominent features at feeding stations; and
- **Other UKBAP species** such as west European hedgehog (*Erinaceus europaeus*), brown hare (*Lepus europeaus*), mountain hare (*Lepus timidus*), polecat (*Mustela putorius*), pine marten (*Martes martes*) and wild cat (*Felis silvestris*).

2.4 Survey Limitations

Weather conditions experienced during field surveys for otter and water vole were satisfactory; in general water levels were low and suitable for survey. Evidence of both otter and water vole was found during survey work, therefore the water level was considered sufficient to allow for otter and water vole evidence to remain in situ without washing away. No survey limitations were therefore recorded that could affect the validity of the results.



3. Results

3.1 Otter and Water Vole

3.1.1 2013 Surveys

A summary of the watercourses surveyed and their suitability for supporting otter and water vole is described in Table 3.1, all evidence of otter and water vole and their locations are shown in Table 3.2 and Figure 3.1.

All watercourses on Site flow south to north, with small watercourses being present within the southern section of the Site, widening into larger watercourses to the north. Habitats on Site are generally dominated by marshy grassland, with areas of acid grassland and flushes, all of which are lightly grazed by sheep. Further north, habitats become more dominated by pasture, grazed by cows, with watercourses widening and meandering through areas of semi natural woodland and scrub.

Table 3.1 Watercourse Habitat Descriptions and Overview of Results (Figure 3.1, September 2013)

Name	Description
Dalleagles Burn	<p>Dalleagles Burn (Plate 1, Appendix B) forms at the convergence of Crocradie Burn and Trough Burn, the latter rising between Chang and Benty Cowan Hills. Crocradie Burn itself forms at the confluence of Catlock Burn and Littlechang Burn, rising on High Chang and Enoch Hills. The burn passes through marshy and grazed upland grassland habitats in the south, passing into mixed woodland along the northern boundary of the Site. This burn is sinuous and up to ~0.5m deep with a number of small waterfalls set into the hillsides. The channel bed is largely bedrock to the south becoming more dominated by a mixed rock substrate to the north (cobble/pebble with some boulders). The burn is broad in places (3-5m) and becomes shallower with a substrate of largely smaller rocks and pebbles to the north. Large trees overhang along the site boundary location, with tree roots buttressing the steep banks however the majority of bank top vegetation across the Site is dominated by rough pasture with low intensity sheep grazing.</p> <p>Otter spraint was recorded along this watercourse; it is probably regularly used as a commuting route given its links through woodland and to other watercourses in the area. The northern extent of the watercourse has potential to be used as a good foraging resource with small numbers of brown trout (<i>Salmo trutta</i>) recorded. The southern tributaries (Crocradie Burn, Trough Burn, Catlock Burn and Littlechang Burn) are much smaller and the presence of small waterfalls is likely to restrict fish movement upstream, therefore reducing prey availability. At its northern extent within the Site, there are plenty of opportunities for resting sites, primarily alongside tree roots or underneath overhanging banks. However, no evidence was found of current resting sites along this watercourse (Dalleagles Burn or associated tributaries) and the majority of the habitats along its length are considered unsuitable for resting sites being exposed due to bank top vegetation dominated by sheep grazed grassland.</p> <p>Two water vole burrows and the remains of lawns associated with these burrows were identified along the lower courses of this burn (northern section of the site, Plate 2, Appendix B) although the burrows may have been disused. There is considered to be a low potential for water vole in the upper courses, a moderate potential in lower courses, where banks tend to have more extensive vegetation including potential food plants and banks of suitable substrate for burrow creation.</p>
Straid Burn	<p>A minor watercourse of very narrow width (<50cm) for much of its extent, winding through grazed pasture (Plate 3, Appendix B). Towards its northern extent in the Site it widens out to ~1m, through primarily wooded/scrub areas, and drops substantially through the landscape, with a steep decline through the woodland via waterfalls. Substrate of pebbles and cobbles along lower course with bedrock in the steeper upper courses.</p> <p>No field signs were found indicating the presence of otter or water vole however it is considered likely that otter may use it for foraging/commuting similarly to other watercourses on Site, particularly to the north of the Site where the watercourse is larger and holds potential to support small numbers of fish.</p> <p>Overall moderate to high potential for commuting/foraging otter and negligible to low potential for couch/holt creation (decreasing in potential from north to south along the watercourse). Overall low potential for water vole along the watercourse although areas of marshy grassland and flushes in the wider area also provide low potential for water vole.</p>

Name	Description
Redhall Burn	<p>Largely the same as Straid Burn although up to ~2m at its widest (to the north). Also present is an online pond (Plate 4, Appendix B; appears to have been created for game given the adjacent hide) of ~1,400m², ~1m depth at most and little emergent vegetation visible at the time. Grassy, rush dominated, shallow banks.</p> <p>A number of otter spraints were identified associated with the pond along this watercourse. Up to five spraint were recorded atop boulders where water exits the pond into the watercourse (Plate 4, Appendix B). This online pond is an important foraging resource for otter present in the local area as it likely supports good numbers of fish and the abundance of spraint shows it is regularly used. It is likely that this watercourse is primarily used as a foraging resource (mainly the online pond). It is considered unlikely that otter will shelter or rest up along this watercourse given the relative lack of suitable features.</p> <p>No evidence of water vole was identified during survey however areas of marshy grassland and vegetation surrounding the pond are considered provide suitable habitat for this species, with a low potential considered elsewhere.</p>
Knockburnie Burn	<p>As per Dalleagles Burn but ~half the size and few waterfall areas. Slower flowing with areas of pooling water where the land becomes flatter (in between hills). It passes through marshy and grazed upland grassland habitats in the south, however with a much smaller extent of woodland habitat towards the northern boundary. It appears on average ~30cm deep with occasional, small, rocky waterfalls. The channel bed is more peat-based than previous watercourses (primarily in marshy, flat areas where water tends to pool up to ~5m width) however includes mixed rock substrate (cobble/pebble with some boulders) in places. The majority of bank top vegetation is dominated by rough pasture with low intensity sheep grazing (Plate 5, Appendix B).</p> <p>Otter spraint identified in places along its length, indicating the presence of foraging/commuting otter. Given the presence of other spraint sites in the locality and the freshness of the spraint, it is considered that otter are likely to commute regularly along this burn. A single potential resting up site was identified in this habitat (Plate 5, Appendix B), with flattened vegetation noted that was not attributed to water flow. The holt identified along this burn by AECOM in 2012 no longer appears to be present; although a spraint was recorded in the location of this prior holt.</p> <p>Water vole field signs were not identified along this watercourse, however, potential is considered low for supporting this species, with this increasing to moderate in marshy areas or grassy areas within woodland, as per the other watercourses.</p>
Spout Burn	<p>Very minor burn of <0.5m width – channel not visible in places due to it mainly running through marshy ground. Primarily earth/peat substrate and where watercourse is visible the flow is smooth. Banks are similarly earthen/peat, with bank top vegetation of marshy and grazed grassland.</p> <p>The burn offers few opportunities for foraging otter. If otter do use this watercourse it is likely only to be for commuting given its size. No field signs indicating the presence of this species were identified along this watercourse and there is considered to be a negligible potential of otter resting up or sheltering in holts.</p> <p>Low potential of supporting water vole; no field signs identified and banks of the watercourse are shallow and mostly unsuitable for burrow creation.</p>
Blarene Burn	<p>Moderate sized watercourse, ~1-2m wide, ~30cm deep (Plate 6, Appendix B). Substrate cobble/pebble with some siltation in places. No boulders. It meanders through a number of fields all of which are grazed by either sheep or cows. Banks are mostly shallow and earthen however further south banks become steeper. Within the fields, banks are poached in places. Bank top vegetation all pasture. It runs beneath post and barb wire fences that have hanging timber boards beneath them over the watercourse.</p> <p>Otter spraint and a single otter slide were observed along this watercourse indicating that is used as a commuting route or foraging resource on at least a frequent basis by otter; it may support small numbers of fish although none were observed. The potential of otter using the watercourse for resting up/sheltering within holts is considered low given the general lack of features suitable for such use.</p> <p>Low potential of water vole in upper courses due to unsuitability of banks for burrow creation; being too shallow and generally extremely exposed, moderate potential in lower courses where banks are more extensive and bankside vegetation is less well-grazed.</p>
Unnamed tributary of Knockburnie Burn (draining from Blood Moss)	<p>As per Spout Burn, no field signs indicating the presence of otter or water vole were observed.</p>

Name	Description
Connel Burn (including Polga and Purreoch Burns)	<p>Forms the eastern boundary of the Site, it flows north from within plantation woodland offsite to the south towards New Cumnock to the north. It varies between 2-4m wide and is ~50cm deep with a smooth/rippled/unbroken standing wave flow. The substrate is cobble/pebble with a number of boulders also present within the watercourse. It is clad with broadleaf woodland within the north east of the Site with steep earthen banks. South of this, the banks of the watercourse are shallow however the watercourse is located within a gorge with steep banks with exposed rock in places. The bank top vegetation here is dominated by rough pasture with low intensity sheep grazing.</p> <p>Otter spraint was recorded along this watercourse, probably regularly used as a commuting route given its links to plantation woodland to the south. It may also be used for foraging as the burn holds potential to support good numbers of fish. No potential resting sites or holts were identified, however the potential of such features being created at times is considered to be low (primarily in the woodland areas).</p> <p>Low potential of water vole in upper courses, due to unsuitability of banks for burrow creation; being too shallow and generally extremely exposed, moderate potential in lower courses where banks are more extensive and sheltered.</p>
Polmath Burn	<p>Watercourse is located along the western site boundary, adjacent to plantation woodland. Small watercourse, ~1m wide, ~30cm deep. Substrate pebble and silt in lower courses. In the upper course it splits into many tributaries that cut through marshy grassland and rush pasture. The origin of much of the water in the burn is from flushes on Site. Banks are still grazed by sheep. It is culverted under the B741 to the north.</p> <p>Otter may use it for foraging/commuting; in a similar way to other watercourses on Site, the higher up the watercourse the less likely the use due to the likely higher probability of finding fish at the lower elevations and the distinct lack of shelter in the exposed higher climbs. Low potential for water vole in upper courses, due to unsuitability of banks for burrow creation; being too shallow and generally extremely exposed, moderate potential in lower courses where banks are more extensive and sheltered. Areas of marshy grassland around this watercourse are considered to pose moderate potential for supporting water vole, being suitable to support burrows and with sufficient foraging material present.</p>

Table 3.2 Summary of Otter and Water Vole Field Signs (Figure 3.1, September 2013)

Watercourse	Target Note Number	Grid Reference	Feature Description
Dalleagles Burn	1	NS 57301 10367	1x small spraint, fresh
	2	NS 57303 10119	3x spraint, fresh
	3	NS 57283 10092	2x spraint, 1 old, 1 fresh
	4	NS 57307 09970	2x water vole burrows, plus lawns
	5	NS 57321 10356	1x old spraint
Redhall Burn	6	NS 58244 10132	5x spraint, various ages, a lot of fish bones
	7	NS 58224 10271	1x large spraint, fresh
Knockburnie Burn	8	NS 56251 10410	1x spraint, fish bones
	9	NS 56307 10345	Potential resting site, flattened vegetation
	10	NS 56319 09898	1x large spraint, fresh
	11	NS 55867 09358	1x small, old spraint
Blarene Burn	12	NS 59195 10538	1x slide (over vegetation between backwater and stream)
	13	NS 59141 09695	1x old spraint
Connel Burn	14	NS 59286 08577	3x spraint, 2 old, 1 fresh plus boneless spraint
Polmath Burn	15	NS 54662 09705	1x old spraint
	16	NS 54830 09369	2x spraint, 1 old, 1 fresh

In summary, otter activity was focussed within the northern areas of the Site, generally along the lower, downstream sections of the larger watercourses. A single potential resting site was identified within woodland west of Dalleagles and spraint was found on most watercourses within the Site; however sprainting sites were at higher density along the Dalleagles Burn and Knockburnie Burn. An online pond (likely shooting pond) associated with Redhall burn was used as an important foraging resource for otter, with five spraints (varying ages) recorded on a large boulder adjacent to the pond, spraint were dominated by fish bones (located over 2km from the area under consideration for development). The Connel Burn forms the eastern site boundary, this watercourse is large and provides a good commuting route for otter between good offsite habitat to the north and plantation woodland to the south. Otter spraint and boneless spraint was recorded along this stretch. The northern stretches of the Connel Burn and Dalleagles Burn provide good habitat for couches and holts, with numerous gaps beneath tree roots and under rocks, however no conclusive evidence confirming their presence was recorded. Generally, evidence of otter decreased further up the watercourses.

The southern sections of the Site (upper courses of the streams) are generally exposed and do not provide suitable habitat for holts, however there remains a low potential that otter may rest along these upper courses infrequently for short periods of time during the night as these areas are relatively undisturbed. The upper courses also do not appear to provide the foraging opportunities that are present along the lower stretches of the watercourses.

Two water vole burrows were recorded along Dalleagles Burn within a smooth flowing section of the river; these were surrounded by distinct “lawn” areas. No other evidence of water vole was recorded throughout the Site and they were not recorded by AECOM in 2012. Along some of the flatter watercourses with a slower flow, banks provide good potential for water vole and although no evidence of water vole was recorded along the upper stretches of the watercourses this should not be concluded as absence. There remains a potential that water vole may be present within this Site however only in small numbers in distinct isolated populations.

3.1.2 2014 Surveys

The 2014 surveys were undertaken on a smaller survey area, for reasons previously explained⁵, as illustrated on Figure 3.2 and included the Connel Burn, Polga Burn, Bitch Burn, Trough Burn, Knockburnie Burn, Littlechang Burn, Polmath Burn, Catlock Burn, Crocradie Burn and minor tributaries of the watercourses.

The focus of otter activity recorded in September 2014 was along the Connel Burn which forms the eastern boundary of the Site where five potential resting sites (couches/holts) were recording along with 19 sprainting locations and one potential otter slide (i.e. where the otter regularly enters the watercourse). Activity was also recorded along the Polga Burn, Knockburnie Burn, Bitch Burn, Littlechang Burn, Catlock Burn, Polmath Burn and Crocradie Burn. No confirmed otter holts or couches were recorded.

No signs of water vole were recorded. An incidental sighting of a stoat (*Mustela erminea*) was made along the Knockburnie Burn.

Table 3.3 Otter Field Signs (Figure 3.2, September 2014)

Watercourse	Target Note Number	Grid Reference	Feature	Description
Connel Burn	1	NS 57645 06495	Otter spraint (s)	Spraint on rock adjacent to Connel Burn. Heavily sprainted rock.
	2	NS 57606 06669	Otter spraint (s)	Remnants of a spraint and some small bones on top of a rock within the Connel Burn.
	3	NS 57607 06692	Otter spraint (s)	A fresh spraint (quite liquid - jelly?) and some small bones/old spraint on a rock within the channel.
	4	NS 58018 07183	Otter spraint (s)	Two spraints on a small rock within the channel and one remnant spraint.
	5	NS 58050 07189	Otter spraint (s)	Large boulder in the channel which is regularly used rock for sprainting. All ages.
	6	NS 58223 07319	Otter spraint (s)	Rock ~3m from the channel which is regularly used for sprainting. Mainly old spraints.
	7	NS 58392 07470	Otter spraint (s)	Two otter spraints (one old and fragmented and the other one was intact) on a rock close to a large pool along the watercourse. Suitable for fish. Overhanging banks and vegetation.
	8	NS 58538 07625	Potential otter slide	Potential otter slide along the bank.
	9	NS 58646 07865	Potential otter resting site	Potential otter resting place along the eastern bank of Connel Burn between two large boulders.
	10	NS 58657 07918	Otter spraint (s)	Two otter spraints on top of a large boulder (old).
	11	NS 58732 08123	Potential otter resting site	Potential otter resting place ~ 2m from the Burn in a hole along the bank. Two entrances present. Does not extend but may provide suitable shelter.
	12	NS 58891 08209	Otter spraint (s)	A single spraint on top of a rock along the bank
	13	NS 59057 08348	Otter spraint (s)	Three old and remnant spraints and one reasonably fresh spraint on top of a large rock within the channel.
	14	NS 59239 08464	Otter spraint (s)	A single intact spraint on top of a boulder in the middle of the channel.
	15	NS 59302 08530	Potential otter resting site	Potential otter resting place ~1m above the water. Two holes present in the bank.
	16	NS 59281 08575	Otter spraint (s)	Large boulder at the edge of the watercourse which is regularly used for sprainting.
	17	NS 59413 08655	Otter spraint (s)	Old/remnant spraint on top of a stone in the watercourse.
	18	NS 59444 08750	Otter spraint (s)	Rock on western bank of watercourse which is regularly used for sprainting. Lots of small mammal bones present.
	19	NS 59506 08752	Otter spraint (s)	A single spraint on a small rock.
	20	NS 59531 08808	Otter spraint (s)	One old and one very recent spraint on top of a rock.

Watercourse	Target Note Number	Grid Reference	Feature	Description
	21	NS 59632 08980	Otter spraint and Potential otter resting site	Old alder tree ~15m from the burn up the slope of the hill. Fragments of spraints identified on the lower branches. High potential as an otter resting place.
	22	NS 59743 09031	Otter spraint (s)	A single remnant spraint.
	23	NS 59753 09035	Otter spraint and Potential otter resting site	Small copse of broadleaved trees along the edge of the watercourse. Fresh spraint on a rock towards the edge of the burn adjacent to the trees. Numerous remnant spraints also present. Likely that the woodland offers suitable habitat for shelter for otter.
Polga Burn	24	NS 58550 07774	Otter spraint (s)	Spraint on rock near the confluence of Connel Burn and Polga Burn.
	25	NS 58420 07862	Otter spraint (s)	Two spraints on top of a large boulder in the channel (one remnant and one whole).
	26	NS 57422 07418	Otter spraint (s)	Old, grey otter spraint.
Trough Burn	27	NS 57298 08826	Otter spraint (s)	A single spraint on top of a rock at the top of the chute/waterfall in the middle of the Burn.
Knockburnie Burn	28	NS 55325 07818	Stoat observed	Stoat seen along the watercourse. Took refuge under the eastern bank.
	29	NS 55321 07817	Otter spraint (s)	A single otter spraint on a rock.
	30	NS 55312 07911	Otter spraint (s)	Spraint on boulder in watercourse.
	31	NS 55277 07959	Otter spraint (s)	Remnant otter spraint.
	32	NS 55781 08595	Otter spraint (s)	Spraint on boulder in watercourse.
	33	NS 55819 08723	Otter spraint (s)	Spraint on boulder in watercourse.
	34	NS 55823 08774	Otter spraint (s)	A single otter spraint on a rock.
	35	NS 55835 08826	Otter spraint (s)	A single otter spraint on a rock.
	36	NS 55844 08853	Otter spraint (s)	Spraint on boulder in watercourse.
37	NS 55816 08984	Otter spraint (s)	Spraint on boulder in watercourse.	
Polmath Burn	38	NS 54855 08813	Otter spraint (s)	Four otter spraints on boulder in minor watercourse. The spraints are dry and parts of the spraints have been washed away. There is a jelly like substance which is thought to be from otter, which is fresher.
	39	NS 54901 09172	Otter spraint (s)	Two dry spraints on boulder in middle of minor watercourse.
	40	NS 54872 09246	Otter spraint (s)	Spraint on boulder in minor watercourse, only as a fragment of original spraint however it is reasonably fresh.
	41	NS 54804 09407	Otter spraint (s)	Old otter spraint on boulder in watercourse - it is dry and white. There is another spraint adjacent to this one.
	42	NS 54735 09487	Otter spraint (s)	Six spraints on boulder. One is quite fresh however the others are drier.

Watercourse	Target Note Number	Grid Reference	Feature	Description
	43	NS 54665 09743	Otter spraint (s)	A single dry otter spraint on boulder.
	44	NS 54667 09743	Otter spraint (s)	Otter spraint - mostly washed away.
Unnamed w/c south of Enoch Hill	45	NS 56527 06233	Otter spraint (s)	Spraint x2 on mossy rock on unnamed watercourse draining south of Enoch Hill.
Bitch Burn	46	NS 56620 06893	Otter spraint (s)	Spraint (dry, fragmented) on peat tussock by Bitch Burn.
Catlock Burn	47	NS 56702 07482	Otter spraint (s)	Spraint (recent/fresh) on tussock by Littlechang Burn.
	48	NS 56229 08537	Otter spraint (s)	Spraint (various ages) x several on rock by deep pool. Small fish seen in water nearby.
	49	NS 56182 08616	Potential otter resting site	Tunnel like structure along watercourse. There are no otter signs here but could be potential resting place.
	50	NS 56165 08617	Potential otter resting site	Cave like hole in side of bank. Potential resting place.
Crocradie Burn	51	NS 56240 08706	Otter spraint (s)	Spraint (dry, intact) on rock by burn.
	52	NS 56376 08805	Otter spraint (s)	Spraint (recent) x2 and older x1 on large rock.
	53	NS 56408 08958	Otter spraint (s)	Spraints (dry, intact) x2 on rock by cliff.
Littlechang Burn	54	NS 56067 07315	Otter footprint	Otter print along water channel. Narrow channel with very little flowing water, is approximately 0.3m wide.
	55	NS 56213 07961	Potential otter resting site	Potential couch behind crumbling bank. No signs indicating use.
	56	NS 56192 07994	Otter spraint (s)	Spraint on boulder in watercourse.
	57	NS 56149 08052	Otter spraint (s)	Spraint on boulder in watercourse – dry.
	58	NS 56005 08222	Large waterfall / chute system	Obstruction along watercourse for fish migration upstream. Large chute/waterfall system which is complex and fallen trees. Upstream of this, the watercourse changes and flattens out.

3.2 Badger

No badger field signs were identified during survey in September 2013. The Site is largely considered unsuitable for sett creation being primarily large swathes of grazed pasture, marshy grassland, acid grassland and flushes. Where banked fencelines, woodland and scrub are present, particularly close to or adjacent to watercourses, the potential for sett creation is considered to be low (increasing potential closer to the site boundaries where connectivity to suitable habitat in the wider area is better). Overall, the Site provides a relatively small amount of habitat suitable to support badger sett creation. Areas suitable for sett creation are limited largely to the lower courses of burns associated with woodland, scrub and field boundaries along steep inclines. Such habitats are generally poorly connected to areas of suitable habitat outwith the Site unless along site boundaries. Foraging potential on Site is also considered fairly poor given the waterlogged and open, unconnected nature of much of the grassland. Badger activity is likely to be largely restricted to areas close to the site boundary due to connectivity

across the main body of the Site being poor (particularly in the south where watercourses are not associated with adjacent woodland/scrub features).

3.3 Invertebrates

No evidence of any notable invertebrates was identified during protected species surveys, however conditions and the time of year was sub-optimal for these species groups, particularly butterflies. The nature of habitats on Site, largely grazed rough pasture, common in the wider area is considered unlikely to support rare invertebrate species given the often specific habitat requirements of these animals.

3.4 Fish

Small numbers of juvenile brown trout were recorded in the lower extent of Dalleagles Burn, however no other notable fish species were identified during protected species survey. It is considered likely that the majority of larger watercourses on site are suitable to support such species, however this is much less likely in upstream areas where steep waterfalls are likely to restrict fish movement. Further detail is provided in a separate Aquatic Ecology report, which includes information on consultation exercises undertaken.

3.5 Amphibians

No amphibians or signs of their presence were identified during protected species survey, however given that they generally require specific survey techniques in order to identify their presence on Site; this does not necessarily mean amphibians are absent. A single online pond (~1,000m²) which is highly likely to support good numbers of fish and is considered largely unsuitable for great crested newts was identified south of Straid along the route of the Redhall Burn. Table 3.4 provides the results of a Habitat Suitability Index¹⁴ (HSI) assessment for great crested newts. The HSI was calculated according to standard methods based on the following ten features collected from maps and in the field: (i) location, (ii) pond area, (iii) likelihood of pond drying, (iv) water quality, (v) level of shade, (vi) presence of waterfowl, (vii) presence of fish, (viii) other ponds within 1km², (ix) terrestrial habitat and (x) macrophyte cover.

The HSI score, which ranges from 0.1-1.0, was calculated with reference to the standard Natural England spreadsheet (<http://www.naturalengland.org.uk/conservation/wildlife-management-licensing/docs/WML-A14-2.xls>), which is also accepted and used by SNH. The HSI scores are interpreted as follows¹⁵ in relation to their suitability for GCN:

- <0.5 = poor;
- 0.5-0.59 = below average;

¹⁴ Oldham R.S., Keeble J., Swan M.J.S. & Jeffcote M. (2000) Evaluating the suitability of habitat for the great crested newt (*Triturus cristatus*). *Herpetological Journal*, Vol. 10 pp.143-155.

¹⁵ In accordance with http://www.narrs.org.uk/Documents/nasdocuments/HSI_guidance.pdf: accessed January 2014.

- 0.6-0.69 = average;
- 0.7-0.79 = good; and
- >0.8 = excellent.

The results presented in Table 3.4 indicate that with a score of 0.39, the pond has Poor suitability for great crested newts. In general, the Site is largely unsuitable for amphibians, with little shelter/hibernation opportunities within open pasture land, although species such as common frog (*Rana temporaria*) may be present within more heterogeneous habitats to the north.

Table 3.4 Results of Habitat Suitability Index Assessment

Pond Reference	Pond 1 (Online pond)
Location	0.5
Pond Area	0.95
Pond Drying	0.9
Water Quality ¹⁶	1
Shade	1
Fowl	0.67
Fish	0.01
Ponds	0.1
Terrestrial Habitats	0.67
Macrophytes	0.4
Total (HSI Score)	0.39

3.6 Reptiles

No reptiles or signs of their presence were identified during protected species survey. Shelter for reptiles is limited to the dense tussocks of vegetation present across the Site (considered to be of poor value due to the lack of connectivity to better quality features, along with their waterlogged and exposed nature), with hibernation and summer sheltering sites largely limited to areas close to site boundaries where woodland and scrub (and therefore tree roots) exist. Although some boulders and other rocky formations exist in the more upland locations on Site, these are not well connected to other such sites and are fairly exposed, providing little shelter.

Overall, a lack of connectivity to suitable habitats in the surrounding area, lack of areas suitable for sheltering on Site and grazing pressure across much of the Site is likely to limit the presence of reptiles in the general area, making the Site of low potential of supporting these species.

¹⁶ Water quality assessed based on a visual assessment of water clarity, likely or known aquatic invertebrates and the presence or otherwise of polluting factors.

3.7 Red Squirrel

No field signs indicating the use of the Site by red squirrel were noted during protected species survey. Woodland areas were limited on Site and comprised broadleaved-dominated mixed woodland which is of lower suitability for this species than the large coniferous woodland areas along much of the site boundary (outwith the Site).

4. Summary & Conclusions

4.1 Protected and/or Notable Fauna

Table 4.1 provides a summary of notable and/or protected species that were recorded on Site and/or where suitable habitat was recorded. It also provides a summary of further survey requirements (mainly pre-construction) as well as general recommendation, e.g. implications for site design and construction.

Table 4.1 Considerations in Respect of Protected Faunal Species

Receptor	Legal Context	Suitability of Site for this species	Recommendations (e.g. Survey requirements / Timing, extent of survey required)
Terrestrial invertebrates	The terrestrial invertebrates considered to be present at the Site receive minimal legal protection, e.g. against sale. Some of the terrestrial invertebrates considered potentially present on Site (e.g. small heath, <i>Coenonympha pamphilus</i>) are listed on the UKBAP, SBL and Local BAP as priority species.	The habitats on Site are considered to provide a range of larval and nectar food source for a range of common and widespread invertebrate species.	No specific surveys are recommended for terrestrial invertebrates.
Amphibians	Great crested newt are classed as European protected species and are fully protected under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Common amphibian species including common frog and smooth newt (<i>Lissotriton vulgaris</i>) are protected against sale and trade only in the Wildlife and Countryside Act 1981 (as amended).	A single online pond has been identified on site which is considered to be unsuitable for GCN. Much of the survey area is waterlogged with the site and surrounding area crisscrossed by small watercourses. Shelter for amphibians is limited, with hibernation and summer sheltering sites largely limited to areas close to site boundaries where woodland and scrub (and therefore tree roots) exist. Although some boulders and other rocky formations exist in the more upland locations on site, these are not well connected to other such sites and are fairly exposed, providing little shelter Negligible potential: great crested newt. Low potential: other amphibians e.g. common frog (however primarily in lower elevation habitats closer to site boundaries).	No specific surveys are recommended for amphibians.
Reptiles	Common reptile species, which include common lizard, adder and slow worm (<i>Anguis fragilis</i>), are afforded protection under the Wildlife and Countryside Act 1981 against being killed or injured.	Low to Negligible (negligible in higher elevations with marshy, waterlogged grassland).	No specific surveys are recommended for reptiles.

Receptor	Legal Context	Suitability of Site for this species	Recommendations (e.g. Survey requirements / Timing, extent of survey required)
Otter	<p>Otters are classed as European protected species and are fully protected under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). This lists a number of offences in relation to otters and the places in which they live.</p> <p>It is an offence to deliberately or recklessly:</p> <ul style="list-style-type: none"> • capture, injure or kill an otter; • harass an otter or group of otters; • disturb an otter in a holt or any other structure or place it uses for shelter or protection; • disturb an otter while it is rearing or otherwise caring for its young; • obstruct access to a holt or other structure or place otters use for shelter or protection or to otherwise deny the animal use of that place; • disturb an otter in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species; and • disturb an otter in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young. <p>It is also an offence to:</p> <ul style="list-style-type: none"> • damage or destroy a breeding site or resting place of such an animal (note that this does not need to be deliberate or reckless to constitute an offence); • keep, transport, sell or exchange or offer for sale or exchange any wild otter or any part or derivative of one (if obtained after 10 June 1994). 	<p>Generally, watercourses on Site provide good commuting routes for any otter resident in the local area; with spraints noted in a number of locations around Site, although these were mostly recorded in the lower courses where watercourses were generally larger.</p> <p>Foraging opportunities appear to be more prevalent within the northern and eastern areas of the Site (outside of the areas being considered for potential development).</p> <p>Potential resting sites are similarly restricted primarily to the lower areas, largely associated with woodland banks. However, no evidence of current use in this manner was identified aside from potential resting sites along Knockburnie Burn, Connel Burn, Littlechang Burn and Catlock Burn.</p> <p>Higher courses: Moderate potential of commuting otter; Low potential of foraging otter; Negligible potential of resting up.</p> <p>Lower courses: High potential of commuting otter; High potential of foraging otter; Low to moderate potential of resting up.</p>	<p>It is considered that the surveys undertaken to-date are sufficient to inform the ES.</p> <p>Since otter signs were recorded across the Site, at least a 50m buffer should be assigned to all watercourses, apart from watercrossings. Watercrossings should avoid potential or confirmed resting sites and should be constructed in a manner so as to allow through passage of otter. Pre-construction surveys should be undertaken. Construction mitigation will need to be included, such as water quality protection and protection of otters from accidental injury (i.e. by covering exposed pipes etc).</p>

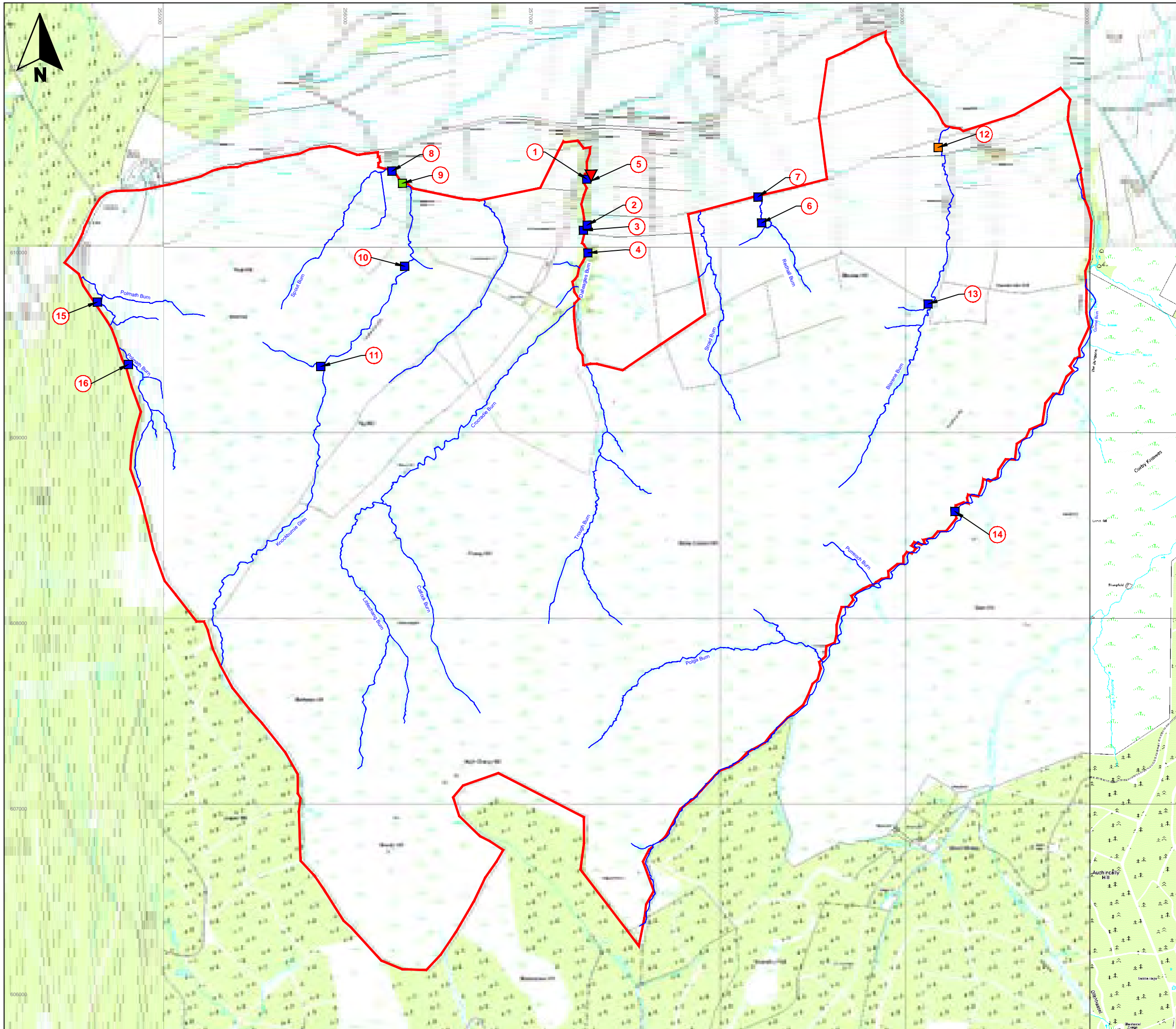
Receptor	Legal Context	Suitability of Site for this species	Recommendations (e.g. Survey requirements / Timing, extent of survey required)
Water vole	Under the Wildlife and Countryside Act 1981 (as amended) it is an offence to intentionally or recklessly damage, destroy or obstruct access to a water vole burrow or to disturb a water vole whilst it's occupying its burrow. The animal itself is not covered by the legislation.	<p>A number of watercourses have grazed or very rocky, steep banks, particularly in the higher courses. However, where grazing is not intensive (where habitats tend towards marshy grassland and within shallow basins in watercourses lined with trees), the soil and moderately steep banks are suitable for burrowing. Potential water vole burrows were identified just outside the site boundary in such an area (2013). Signs were not recorded in 2014.</p> <p>Excluding burrowing, watercourses are generally suitable for water vole, with an abundance of vegetation for foraging such as grasses and rushes, and mostly shallow slow flowing burns. Flood events are however likely in some areas, reducing the suitability for this species.</p> <p>Higher courses: Residual low potential of foraging, commuting or burrowing water vole.</p> <p>Lower courses: Low to moderate potential of foraging, commuting or burrowing water vole with a higher potential along the northern extent of Dalleagles Burn, where water vole burrows were identified.</p>	<p>It is considered that the surveys undertaken to-date are sufficient to inform the ES, as long as the ES is submitted no later than August 2015 after which time the surveys should be repeated and updated.</p> <p>Since water vole have the potential to be present on Site, at least a 50m buffer should be assigned to all watercourses, apart from watercrossings. Watercrossings should avoid potential or confirmed burrows (recorded in 2013 only). Pre-construction surveys should be undertaken. Construction mitigation will need to be included, such as water quality protection.</p>
Badger	Offences under the Protection of Badgers Act 1992 (as amended) include: wilfully taking, injuring or killing badgers; cruelty; intentionally or recklessly interfering with a badger sett; selling and possession, marking and ringing.	<p>Overall, the Site provides a relatively small amount of habitat suitable to support badger. Areas suitable for sett creation are limited largely to the lower courses of burns associated with woodland, scrub and field boundaries along steep inclines. Such habitats are generally poorly connected to areas of suitable habitat outwith the Site unless along site boundaries.</p> <p>Foraging potential on site is also considered fairly poor given the waterlogged and open, unconnected nature of much of the grassland.</p> <p>No field signs indicating the presence of badger were identified during survey.</p> <p>Low potential of foraging/commuting badger presence, moderate potential within woodland areas.</p> <p>Negligible potential of sett creation within areas of grassland and pasture (largely waterlogged) and moderate potential within woodland areas.</p>	No specific surveys are recommended for badgers to support the ES, since the surveys undertaken to-date have recorded no sign of the species, and the Site provides generally sub-optimal habitats. Pre-construction surveys should be undertaken to ensure badgers have not moved into the Site from surrounding areas.

Receptor	Legal Context	Suitability of Site for this species	Recommendations (e.g. Survey requirements / Timing, extent of survey required)
Red squirrel	<p>The following provides a summary of the offences in the Wildlife and Countryside Act 1981 (as amended) in relation to red squirrels. It is an offence to intentionally or recklessly:</p> <ul style="list-style-type: none"> • kill, injure or take a red squirrel; • damage, destroy or obstruct access to any structure or place which a red squirrel uses for shelter or protection (a drey); • disturb a red squirrel when it is occupying a structure or place for that purpose; • possess or control, sell, offer for sale or possess or transport for the purpose of sale any live or dead red squirrel or any derivative of such an animal; and • Knowingly causing or permitting any of the above acts to be carried out is also an offence. 	<p>Low potential within mixed woodland on Site only (higher potential outwith site boundary within coniferous woodland).</p> <p>Negligible potential across the rest of the habitats on Site.</p>	<p>Sightings and signs have confirmed that the Site is adjacent to areas which contain red squirrel territories, but habitat on Site is unsuitable.</p> <p>No specific surveys are recommended for red squirrels.</p>



Appendix A Figures





Key

- Site boundary (Sept. 2013) and survey area
- Otter spraint(s)
- Otter slide
- Potential otter resting site
- ▼ Water vole burrow
- 16 Target note

0 m 1000 m
Scale 1:20,000 @ A3

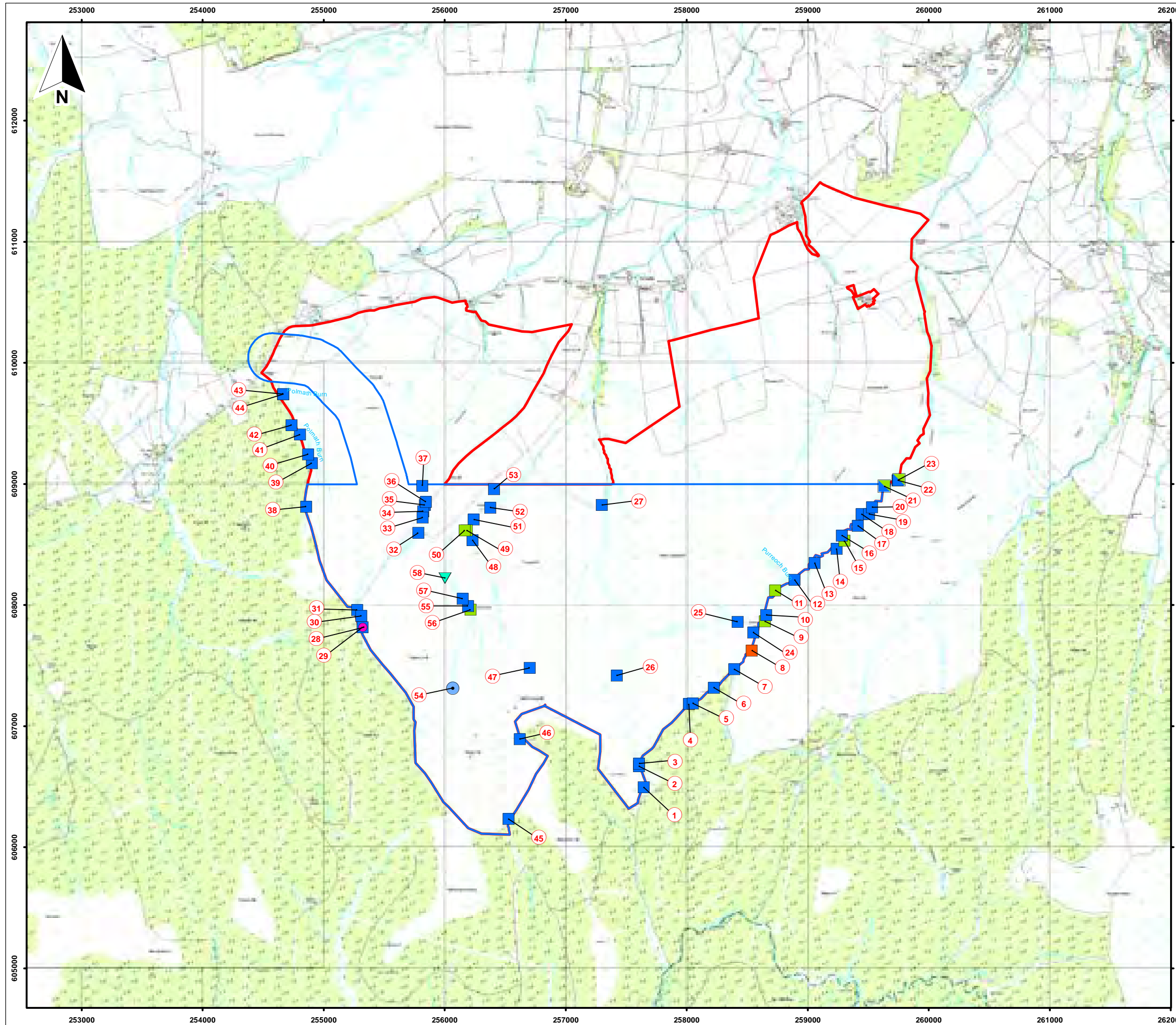
Enoch Hill Wind Farm
Protected Species (2013-2014) Baseline Report

Figure 3.1
Protected Species Survey
(September 2013)

October 2014
32965-Gla39.dwg barkr



Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright. 100027856



- Key:**
- Site boundary (Sept. 2014)
 - Survey area
- Protected Species Signs**
- ▼ Large waterfall / chute system
 - Otter spraint(s)
 - Otter footprint
 - Potential otter slide
 - Potential otter resting site
 - Otter spraint and potential otter resting site
 - Stoat
 - 57 Target note

0 1,250 Metres
Scale: 1:22,500 @ A3

N:\Projects\32965 - Enoch Hill Wind Farm EIA\040\ArcGIS\MXDs

Enoch Hill Wind Farm
Protected Species (2013-2014) Baseline Report

Figure 3.2
Otter and Water Vole Survey
(September 2014)

October 2014
32965-Gla163.mxd barkr



Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright. 100027856

Appendix B Photographs

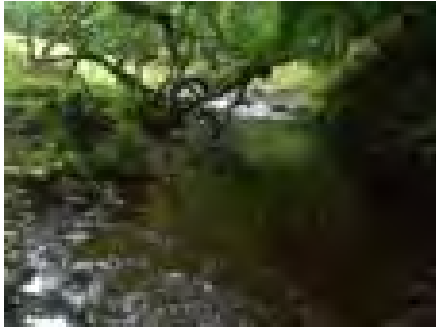


Plate 1: Dalleagles Burn

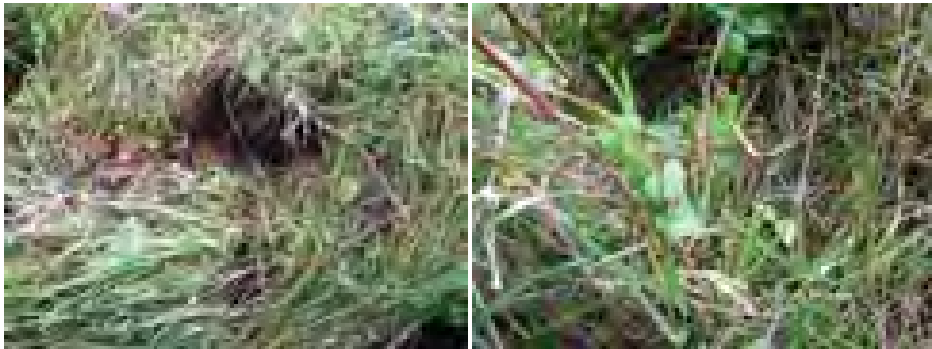


Plate 2: Dalleagles Burn water vole signs

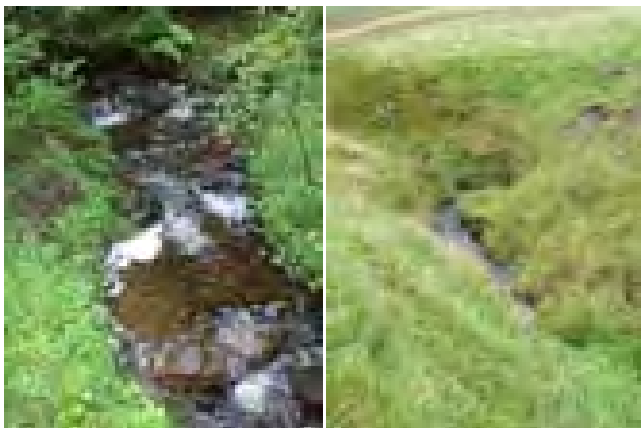


Plate 3: Straid Burn



Plate 4: Online pond and spraint, Redhall Burn

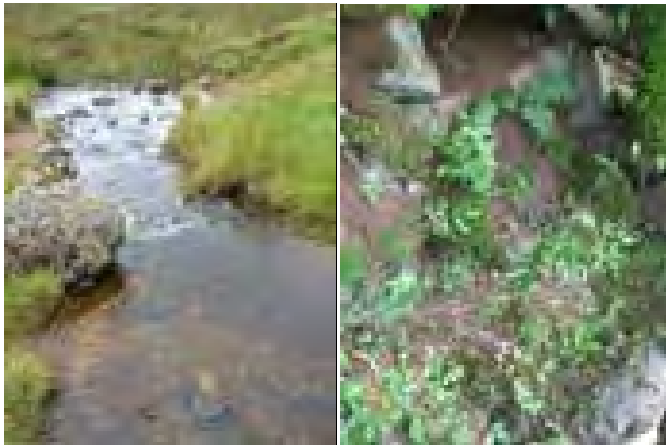


Plate 5: Knockburnie Burn and potential otter resting site

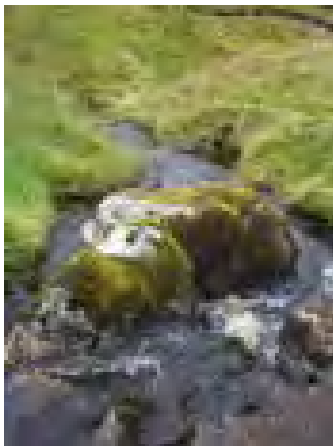


Plate 6: Blarene Burn

Appendix 11.C

Autumn Bat Survey Report



Enoch Hill Wind Farm Autumn Bat Surveys

1. Introduction

AMEC Environment & Infrastructure UK Ltd (AMEC) was commissioned by E.ON Climate and Renewables (ECR) to undertake autumn bat surveys at the proposed Enoch Hill Wind Farm near Dallegles in East Ayrshire.

Bat surveys including walked transects and static bat activity surveys were undertaken by AECOM during 2012.

Scottish Natural Heritage (SNH) requested static monitoring surveys to be extended into October and November due to the presence of a hibernaculum¹ at the Craigdullyear limestone mine east of New Cumnock (approximately 10km linear distance east north east of the site).

AMEC continued the static monitoring surveys employed by AECOM into October and November and undertook simultaneous investigations at the Craigdullyear Mine. The purpose of these surveys was to investigate the importance of the Enoch Hill site (the site) to bats, and in particular to those species which may pass through the site during autumn migration.

This Technical Note details the methods used and the results obtained from static monitoring surveys and autumn surveys at Craigdullyear Mine.

This report complements a report authored by AECOM².

2. Methods

2.1 Consultation

A search on the National Biodiversity Network (NBN) Gateway³ reveals that there are records of at least four species of bats using the mine: Daubenton's bat (*Myotis daubentonii*), Natterer's bat (*M. nattereri*), whiskered bat (*M. mystacinus*) and brown long-eared bat (*Plecotus auritus*).

¹ A hibernaculum is a roost used by bats for prolonged periods of torpor or for hibernation during the winter months (typically between November and March). Certain species of bats (namely, *Myotis* species and brown long-eared bats [*Plecotus auritus*]) tend to select roosts which have stable low temperatures (typically 3-5°C) and high humidity and the best sites – often in underground situations such as mines, tunnels and caves – are often used by many individuals.

² AECOM (2012). Enoch Hill Wind Farm. Protected Species Report. Prepared on behalf of ECR.

³ <http://data.nbn.org.uk/imt/> accessed 03/04/2013



The Ayrshire Bat Group was contacted via email on 03 April 2013 for details of swarming and hibernation survey results for the past five years.

2.2 Static monitoring surveys

Static monitoring surveys were undertaken at ten locations across the site in accordance with the locations used by AECOM². AnaBat SD2 detectors (Titley Electronics) were deployed at each location between 10-16 October (six nights) and between 14-20 November 2012 (six nights) which exceeds the minimum survey standards guidance from the Bat Conservation Trust⁴.

Detector placement was carried out by AMEC surveyors including bat specialists Claire Hopkins MCIEEM and Rachel Finan MCIEEM.

Bat echolocation calls were recorded onto Compact Flash (CF) memory cards and downloaded onto a computer for out-of-field analysis. Calls were identified and assigned to species or species group using AnaLook software.

The locations of bat detectors are detailed in the AECOM report² and summarised in Table 2.1.

Table 2.1 Locations of Static Bat Detectors

Static monitor location	Location	Grid Reference
1	Woodland edge at Knockburnie Burn on western boundary of the site	NS 55244 07981
2	Adjacent to Knockburnie Burn	NS 55399 08289
3	Between Littlechang and Catlock Burns on Littlechang Hill	NS 56125 08309
4	Catlock Burn between Littlechang Hill and Chang Hill	NS 56379 08184
5	On southern flank of Barbeys Hill	NS 55873 07452
6	On western boundary of the site adjacent to woodland edge	NS 55157 07009
7	Within area of peat to east of Enoch Hill	NS 56853 06751
8	On woodland edge to east of Enoch Hill	NS 56698 06856
9	North of Polga Burn on southern flank of Benty Cowan Hill	NS 57863 07789
10	Adjacent to Polga Burn	NS 57797 07761

⁴ Hundt, L. (2012). Bat surveys: Good practice guidelines, 2nd Edition, Bat Conservation Trust. These guidelines recommend a minimum of five nights' consecutive survey effort.



2.3 Autumn survey at Craigdullyart Mine

AMEC carried out a limited scoping survey at the Craigdullyart limestone mine involving the deployment of four AnaBat detectors over a two week period between 23 October and 09 November. Each detector was installed inside each of four mine entrances in such a way that they were concealed from casual onlookers but with the microphones directed across the entrance. The detectors were set up to record from 30 minutes prior to sunset to 30 minutes after sunrise.

The locations of the detectors are described in Appendix A and are summarised here:

- A – NS 66394 15433 – Furthest from road.
- B – NS 66361 15383 – Inside mine approx. 25m in from entrance.
- C – NS 66350 15336 – on ledge at mine entrance.
- D – NS 66335 15300 – closest the road.

In addition a probe was deployed adjacent to one of the detectors (Location C) for the whole of the monitoring period. The probe (EL-USB-1 from Lascar Electronics) was programmed to take temperature and relative humidity readings every five minutes for the whole of the monitoring period.

No disturbance of bats was possible as surveyors did not make any attempt to search for roosting/hibernating bats and because the surveys took place outwith the hibernating period. In addition, Claire Hopkins MCIEEM) holds a valid SNH Bat Roost Science, Research and Education Licence - licence number 12767 (which includes access to hibernacula).

2.4 Limitations

The current static monitoring surveys used AnaBat detectors with 12V power supplies (compared with the SongMeter SM2 detector system used by AECOM). Although bat activity data recorded with AnaBats are not directly comparable with data recorded with SM2 detectors, only one detector type was used per survey period (i.e. AnaBat detectors were not deployed at the same time as SM2 detectors) so data between detector locations are comparable within a given monitoring period. Given the very low levels of bat activity recorded this difference is not considered to be a significant constraint.

Two AnaBat detectors failed during the surveys such that no results were obtained from Location 5 in October and Location 6 in November, most likely as a result of damage caused by damp. The minimum 5 nights' survey period was reached for all of the other detectors and the absence of data from two locations is not considered to significantly affect the outcome of the surveys.

Weather conditions during October were generally mild and clear at the beginning of the monitoring period but the weather became much colder and wind, rain and snow on the upper parts of the site around Enoch Hill were encountered when surveyors returned to collect detectors. Weather conditions during the November surveys were generally poor with cool temperatures of below 5°C and drizzle and occasional rain. These conditions are normal for upland sites at this time of year and coincide with normal reductions in bat activity typically observed at this time of year.



Analysis of bat call data was undertaken using available reference documents⁵ however as a product of the similarities between species' call parameters (e.g. frequency bandwidth and call shape) and the differences between the call parameters of individuals of the same species and even individual bats flying in different situations it was not always possible to identify the species from the resulting AnaLook files.

Calls were attributed to *Myotis* species where this is the case, and no attempt was made to assess the relative activity of different species of bats at the Craigdullyear Mine. Bat calls have only been attributed to species level where there is a high degree of certainty of a correct identification.

Remote monitors such as AnaBats are good at detecting passing bats but it is not possible to use these systems to identify the number of bats or the direction of travel. Instead the method described above enables the relative levels of activity between different locations to be determined. As the 10 detectors were programmed in the same way and were set up with suitable sensitivity settings it follows that different levels of bat activity (i.e. numbers of bat passes) are a true reflection of differences in levels of utilisation of different parts of the site by bats.

3. Results

3.1 Consultation

The Ayrshire Bat Group responded to an email request on 03 April 2013 with the following comments and advice in relation to the Craigdullyear Mine:

“The site at Craigdullyear has reasonable numbers of Brown Long Eared, Natterer's Daubenton's every year for about the past twenty. There is only one record of a Whiskered and that is from some time ago. We have harp trapped around the mine entrance in the past and found significant numbers of swarming bats although records of these were not kept. We have not applied for a ringing licence because we did not think that it was necessary. Unfortunately we cannot provide you with specific records as there have not been committed to paper.

Please also be aware that research over the past two years has confirmed the presence of Leisler's bat and Nathusius' pipistrelle in Ayrshire. Though we have, as yet no current records for the New Cumnock area, these are both species considered to be at risk from turbines according to Natural England.”⁶

Although detailed results of swarming or hibernation roost counts are not available the conservation importance of the mine to bats is recognised.

⁵ E.g. Russ, J. (2012). British Bat Calls. A Guide to Species Identification. Pelagic Publishing, Exeter.

⁶ Email received from Tom Hastings of Ayrshire Bat Group on 03 April 2013.



3.2 Static monitoring surveys

The results of the static (AnaBat) monitoring surveys are summarised in Table 3.1 below.

Table 3.1 Static detector survey results

Static monitor location	October 2013 results	November 2013 results
1	No bat passes detected	No bat passes detected
2	No bat passes detected	No bat passes detected
3	No bat passes detected	No bat passes detected
4	1x common pipistrelle <i>Pipistrellus pipistrellus</i> (14/10/12 at 18.55. 40 minutes after sunset) 1x <i>Myotis</i> species (14/10/12 at 22.34. 4h19 after sunset)	No bat passes detected
5	No data obtained – detector failure	No bat passes detected
6	No bat passes detected	No data obtained – detector failure
7	No bat passes detected	No bat passes detected
8	1x <i>Myotis</i> species (11/10/12 at 21.42. 3h24 after sunset)	No bat passes detected
9	1x <i>Myotis</i> species (13/10/12 at 20.47. 2h29 after sunset)	No bat passes detected
10	No bat passes detected	No bat passes detected

All four bat passes⁷ were detected during the October surveys. The timing of the common pipistrelle pass is consistent with a bat emerging from a roost relatively close to the site and using the edge of the site for passing through or foraging. The three *Myotis* passes were all in isolation – on different nights, at different times of night and in different locations. Their detection in the 2.5-4.5 hours after sunset may be indicative of bats travelling toward a swarming site (peaks in swarming activity tend to be around four hours after sunset [pers.obs.]) however the number of bats involved does not tend to indicate that the Enoch Hill site is an important strategic location for bats travelling to hibernation/swarming sites⁸.

⁷ A pass is defined as a single burst of bat echolocation call, and is quantified by a single AnaLook call file

⁸ The autumn surveys at Craigdullyeart were undertaken at the end of October/beginning of November which is reasonably late for swarming which tends to be between August – October with peaks between mid-August and mid-September (based on studies at caves in the Yorkshire Dales; studies at other sites in the north of England have found swarming to be up to a month later) therefore observed activity is likely to represent the late stages of swarming.



That no bats were recorded at all in November may be explained by the poor weather conditions experienced during the surveys as well as by the natural reduction in bat activity which would be expected in winter.

3.3 Autumn survey at Craigdullyeart Mine

Craigdullyeart Mine is situated between Corsencan Hill and Craigdullyeart Hill at 350m altitude approximately 4km ENE of New Cumnock and approximately 10km east north east of the Enoch Hill site. The former limestone mine is located in a clearing in conifer plantation forestry 200m north of Garclaugh Burn – a minor tributary of the River Nith. The mine has a number of entrances surrounded by spoil which has become largely overgrown with grass and tall ruderal species. There is evidence for extensive underground workings at the mine which is also approximately 500m south of the Guelt Limekiln and flooded quarries⁹. There is evidence of occasional visitors to the mines – the area has been spoiled by fly tipping, graffiti and fires.

The temperature values recorded during the monitoring period were relatively low and fluctuated around an average of 6°C and humidity values were consistently high (around 100%) which indicate ideal conditions for hibernating. Fluctuations in temperatures can be explained by the fact that the probe was close to the entrance of the mine and therefore subject to external (daily) variations in temperature. The environmental data are shown in Figure 1.

Figure 1 Temperature and humidity during autumn monitoring period



⁹ <http://canmore.rcahms.gov.uk/en/site/76899/details/craigdullyeart+hill+quarries+and+kiln/>



All four of the bat detectors deployed in the mine entrances were fully operational for the period of monitoring and all provided data on the presence of bats during this period.

A total of 316 bat passes¹⁰ were recorded over the 17 night monitoring period at the mines, although the number of passes varied between entrances with the lowest number at Location C. Interestingly Location B which was deep inside the mine recorded the second highest total number of bat passes suggesting that the bats were passing through the mine and not simply swarming around the entrances. At least 5 species were recorded during this period including typical “swarming” species Daubenton’s bat, Natterer’s bat and brown long-eared bat¹¹, although common and soprano pipistrelle (*P. pygmaeus*) bats were also recorded as shown in Table 3.2. *Myotis* species made up the largest volume of bat activity at the mines with 161 passes in total.

Table 3.2 Results of autumn bat activity (AnaBat) survey at Craigdullyart Mine

Sum of Number	Label							
Location	Possible Natterer’s	Daubenton’s	<i>Myotis</i> sp.	Common pipistrelle	Soprano pipistrelle	Brown long-eared	Query	Grand Total
A		7	39	12	108	2	15	183
B	11	5	83	2				101
C			10		4			14
D	2		4				12	18
Grand Total	13	12	136	14	112	2	27	316

Bat activity typically commenced between 30 minutes and 1 hour after sunset, but there was a marked peak in activity at around 3h 30 after sunset (see Figures 2), with bat passes from the 4 different entrances grouped together for analysis purposes. Cumulative percentage curves are smoother reflecting a more gradual drop-off in activity towards dawn (see Figure 2b) with the last bat activity being up to 30minutes before sunrise. Three passes were also obtained from *Myotis* species after sunrise. This may indicate that some bats were choosing to roost inside the mine although it is unclear what proportion of the recorded activity related to bats returning to roost or carrying out social activity.

¹⁰ Where a pass is defined as a single, discrete burst of echolocation, as distinguished by a single AnaBat call file.

¹¹ Although it should be noted again that these identifications are based on interpretation of calls against a small reference library of calls.

Figure 2a Time after sunset/before sunrise for bat calls inside Craigdullyear Mine (frequency)

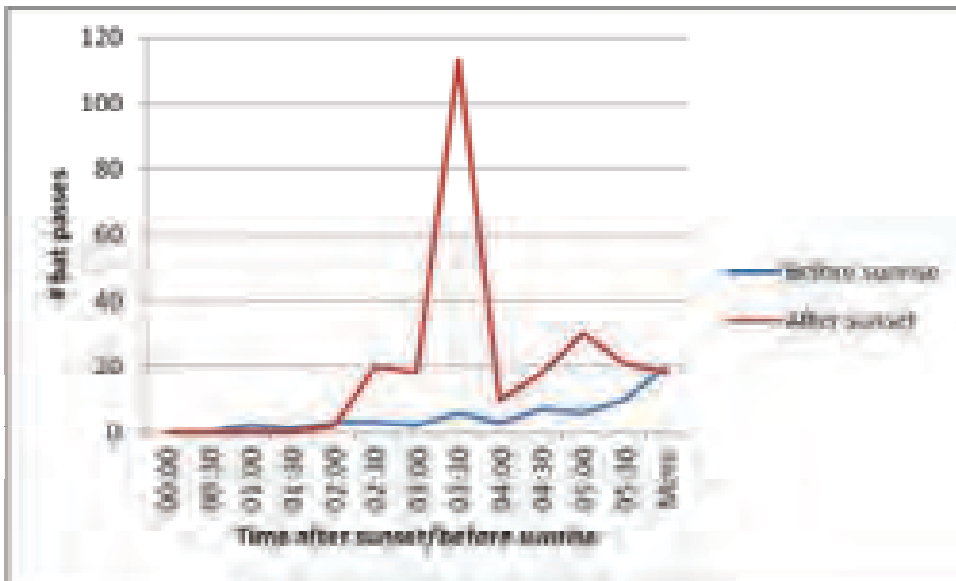
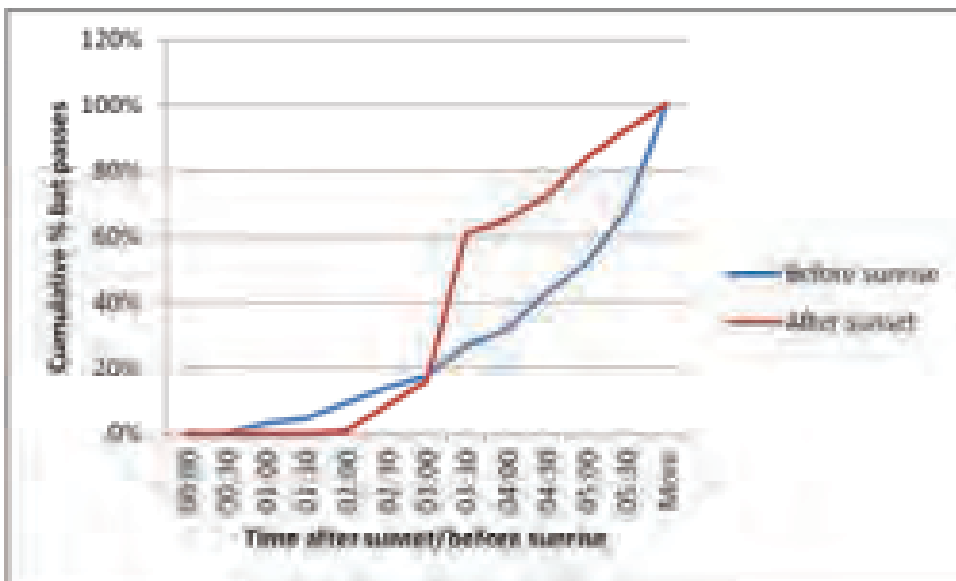


Figure 2b Time after sunset/before sunrise for bat calls inside Craigdullyear Mine (cumulative %)



4. Conclusions and recommendations

Very low numbers of bats were recorded during static monitoring surveys at the Enoch Hill site and no high risk species¹² were recorded during the surveys. Taken together with AECOM's summer 2012 data the Enoch Hill site is not seen to be important for bats, with very limited activity recorded at woodland edges and watercourses in October.

No bat activity surveys at height have been undertaken at Enoch Hill; however there are proposals to install bat detection equipment onto met masts at the site in 2014. Although such surveys are not mandatory⁴ they are generally recommended in order that activity of high-flying species at risk of turbine collisions may be detected. The consultation response from the Ayrshire Bat Group has indicated that Leisler's bat (*Nyctalus leisleri*) and Nathusius' pipistrelle bats (*Pipistrellus nathusii*) are present in the wider area and may therefore be at risk of turbine collisions however through experience of undertaking bat activity surveys at height at nearby sites (e.g. proposed Quantans Hill Wind Farm [ECR], approx. 11km south of the Enoch Hill site) to result in a very small subset of (generally low) activity recorded at ground level, this is not considered to be a high risk at Enoch Hill.

During the autumn survey at Craigdullyear Mine the site's importance to *Myotis* species, which are also known to use the mine as a hibernation roost, was confirmed and the use of the mines as a swarming site has also been confirmed. From studies undertaken elsewhere selection of underground sites by bats for swarming and hibernation takes into account several factors including the characteristics of the underground site itself¹³, and the number of bats visiting such sites varies according to local differences in weather in the surrounding catchment area¹⁴ and on the time of year, as species compositions of swarming bats change as autumn progresses¹⁵.

In conclusion the results of bat detection surveys undertaken to date at the Enoch Hill site do not indicate any significant and consistent peak in the activity of individual bats of swarming/mine-hibernating species (i.e. *Myotis* and brown long-eared bats) across the site; the presence of the mine (or other similar features which are not currently known in the Nith valley) is not considered to be a constraint on the development of a wind farm at the Enoch Hill site.

¹² Bat populations likely to be threatened due to impacts from wind turbines are considered to be noctule (*Nyctalus noctula*), Leisler's (*N. leisleri*) and Nathusius' pipistrelle (*P. nathusii*).

¹³ E.g. Glover, A.M. and Altringham, J.D. (2008). Cave selection and use by swarming bat species

¹⁴ E.g. Grubb, E. (University of Leeds) - Proceedings of the North of England Bat Conference, Leeds Metropolitan University, 16th March 2013.

¹⁵ E.g. Parsons, K.N, Jones, G, Davidson-Watts, I. & Greenaway, F. (2003). Swarming of bats at underground sites in Britain - implications for conservation. *Biological Conservation* 111: 63-70.



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Appendix A

Mine Photos

Appendix A – Photographs of Craigdullyeart Mine

Mine entrance A: NS 66394 15433.
Furthest entrances from the road. There are 2 mine entrances approx. 5m apart. Detector located outside the entrance on a grassy ledge to the right hand side of the right hand (northernmost) entrance.



Mine entrance B: NS 66361 15383
Southern entrance to the workings identified above. Detector inside the mine approximately 25m from the entrance. As the tunnel opens out into large chamber the detector was placed on a low wall at ground level.





Mine entrance C: NS 66350
15336
Steep entrance with large quantities of fly tipped rubbish strewn across the ground. Detector placed on a bird dropping-stained ledge on the wall at the right hand side.



Mine entrance D: NS 66335
15300.
Closest entrance to the road
(i.e. southernmost). Detector
placed inside the entrance on
the far left hand side.



Appendix 11.D

Bat Survey Report 2013

Enoch Hill Wind Farm

Bat Survey Report 2013



AMEC Environment & Infrastructure UK Limited

April 2014

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Document Revisions

No.	Details	Date
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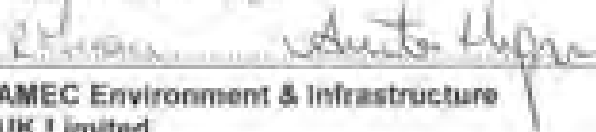
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Enoch Hill Wind Farm

Bat Survey Report 2013

AMEC Environment & Infrastructure
UK Limited

April 2014

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1. Introduction

1.1 Background

This Technical Report has been prepared by AMEC E&I UK Ltd (AMEC) on behalf of E.ON Climate and Renewables UK Developments Ltd (EC&R) to provide the details of bat surveys undertaken in 2013 at the proposed Enoch Hill Wind Farm site (the Site) near Dalleagles in East Ayrshire.

This report supplements bat survey data comprising bat activity transects and static bat activity surveys which were collected in 2012 and reported previously¹.

SNH provided a response to a scoping report on 18 December 2012 in which they confirmed that they were satisfied that survey effort undertaken to date was appropriate. In order that data pertaining to bats at the Site would remain up-to-date at the time of an assessment of potential effects of a wind farm development, EC&R commissioned AMEC to carry out a subsequent year of data collection in 2013.

This Technical Report identifies the scope of the 2013 surveys undertaken, details the methods used and results of the surveys.

¹ AMEC (2013) Enoch Hill Wind Farm Autumn Bat surveys. Prepared on behalf of ECR; and AECOM (2012). Enoch Hill Wind Farm. Protected Species Report. Prepared on behalf of ECR.

2. Methods

2.1 Scope of Surveys

The scope of bat surveys undertaken in 2013 was designed by AMEC bat specialists Claire Hopkins MCIEEM (SNH licensed bat worker) and Rachel Finan MCIEEM and was based on interpretation of the 2012 Bat Conservation Trust (BCT) Guidelines² with cognisance of the 2012 survey results detailed in AMEC and AECOM reports identified above.

Table 2.1 summarises the factors taken into account to determine the Site risk to bats (i.e. **LOW RISK**) and the level of survey effort required at Enoch Hill in 2013.

Table 2.1 Assessment of Site Risk and Survey Effort

Potential Risk Factor	Potential Risk Level	Comment
Geographical location	Medium	Site located in upland East Ayrshire within range of high risk species including Leisler's (<i>Nyctalus leisler</i>), noctule (<i>N. noctula</i>) and Nathusius' pipistrelles (<i>Pipistrellus nathusii</i>).
Site		
Potential roost features	Low	No roost opportunities present within the site boundary.
Foraging habitat suitability	Low	The Site is dominated by open upland acid grassland and modified bog habitats which are managed for grazing (predominantly sheep) with several minor watercourse valleys including Connel, Catlock and Knockburnie Burns. The Site is bordered to south and west by mature conifer plantation forestry which provides edge habitat foraging opportunities. Foraging opportunities are therefore unremarkable in the local context.
Commuting route suitability	Low-Medium	Conifer plantation woodland and minor watercourses provide local commuting routes.
Species – Bandit pipistrelle ³ (<i>P. pipistrellus</i>) and soprano pipistrelle (<i>P. pygmaeus</i>)	Low	Bandit and soprano pipistrelles are common and widespread in Scotland ⁴ . Ecology of these species is that they are habitat generalists and forage in open, edge and closed (e.g. woodland) habitats. Whilst individuals of these species are at risk of turbine collisions, the risks to population is low.

² Hundt, L. (2012). Bat Surveys – Good Practice Guidelines. 2nd Edition, Bat Conservation Trust.

³ Also referred to as “common” pipistrelle.

⁴ Taken from the note by Haddow, J. (2011). The status of Scottish bats; <http://www.snh.gov.uk/docs/B953637.pdf> and Battersby, J. (Ed) (2005). UK Mammals: Species Status and Population Trends. Reported by the Tracking Mammals Partnership. JNCC / Tracking Mammals Partnership, Peterborough.

Potential Risk Factor	Potential Risk Level	Comment
Species - <i>Myotis</i> species. May include Daubenton's bat (<i>M. daubentonii</i>), Natterer's bat (<i>M. nattereri</i>) or whiskered bat (<i>M. mystacinus</i>).	Low	<p>Daubenton's bat, a riparian specialist, is fairly common and widespread in Scotland.</p> <p>Natterer's bat, a woodland specialist, is widely distributed but uncommon in Scotland.</p> <p>Whiskered bat, a woodland/riparian feeder, is uncommon and rare in Scotland.</p> <p>These three <i>Myotis</i> species are present in the vicinity of the Site (i.e. hibernating at Craigdullyear Mine – see AMEC 2013 report).</p> <p>These species are at low risk of turbine collisions due to their flight behaviour.</p>
Species– Brown Long-eared bat (<i>Plecotus auritus</i>)	Low	<p>Brown long-eared bat is a woodland specialist and is common in the UK .</p> <p>Brown long-eared bat is known to be present in the vicinity of the Site (i.e. hibernating at Craigdullyear Mine – see AMEC 2013 report).</p> <p>This species is at low risk of turbine collisions due to its flight behaviour.</p>
Species – Noctule, Leisler's and Nathusius' pipistrelle	Medium	<p>The noctule bat's range is restricted to the south of Scotland and this species is thought to be rare.</p> <p>Leisler's bat's range is restricted to the south of Scotland with isolated records in the north east, although it is considered to be the most frequently encountered of the two <i>Nyctalus</i> species (sp.) in south west Scotland.</p> <p>Nathusius' pipistrelle is thought to be rare although this species is elusive and insufficient data are present to determine its status in Scotland⁵.</p> <p>All three species have been recorded in Ayrshire (refer to consultation results, reported in AMEC 2013).</p> <p>These species are those most frequently recorded as dying at turbines and are at high risk at individual and population level from turbine collisions.</p> <p>The Site does not represent optimal habitat for any of the three high risk species.</p>
Level of bat activity recorded	Low	<p>Only common and widespread species/low risk species were recorded during static recorder(AnaBat) surveys in autumn 2012 (see AMEC 2013 report).</p>
Adjacent to Site and wider area		
Potential roost features	Low -Medium	<p>The Site is located in a sparsely populated and open part of East Ayrshire with few suitable tree roosting opportunities. Farm buildings and cottages to the north of the Site boundary e.g. Knockburnie, Dalleagles and Burnside may support bat roosts.</p>
Foraging habitat suitability	Low -Medium	<p>The River Nith and former gravel pits and reclaimed land to the west of New Cumnock (including Knockshinnoch Lagoons Nature Reserve) provide excellent foraging habitat adjacent to the north of the Site.</p> <p>The extensive areas of commercial conifer plantations are of lower value to foraging bats.</p>

⁵ E.g. <http://www.nathusius.org.uk/Distribution.htm> (accessed 22/01/2014).

Potential Risk Factor	Potential Risk Level	Comment
Commuting route suitability	Medium	Site represents open upland hilltops situated between the Afton, Nith and Doon valleys and, as such, bat activity is likely to be concentrated in lower altitude areas where shelter and insect populations are higher.

2.2 Desk Study

Reference is made to ongoing research by the Scottish Leisler's Bat Project⁶ which in 2013 was extended to include the Isle of Arran as well as monitoring of previously identified populations in Dumfries and Galloway and South Ayrshire.

No additional consultation has been undertaken since the 2013 report (AMEC).

2.3 Bat Activity Transects

In accordance with the 2012 BCT guidelines and in line with the assessment of Site risk as being low, a series of bat activity transect surveys were undertaken on foot three times in 2013: once in spring (30 May⁷), summer (08 July) and autumn (09 September).

Surveys were led by AMEC Senior Consultant Ecologist Claire Hopkins MCIEEM (SNH bat licence 20423) and by AMEC Consultant Ecologists Rachel Finan MCIEEM (Agent on the above bat licence) and Jenny Sneddon MCIEEM⁸ with assistance from health and safety companions.

Owing to the large size of the Site and the hilly terrain present, the bat activity transect surveys were undertaken within a reduced study area based on the indicative turbine layout. The study area was divided into three separate transect routes which followed the routes used by AECOM in 2012 (see report). Each transect route covered a separate section of the study area, such that:

- Transect A – Starting at Polmathburn Bridge on the B741, the transect route follows the edge of Carsphairn Forest on the flanks of Maneight Hill, crosses Knockburnie Burn and traverses the open and gently undulating open bog habitats of Blood Moss, returning through semi-improved grassland on the western slopes of Peat Hill.

⁶ E.g. http://www.bats.org.uk/data/files/Scottish_BW_Conference_2012/Leislars_poster_Nov_2012.pdf and updates reported in the Scottish Batworker's Conference, Battleby, November 2013.

⁷ Bats are typically active between April and October, but in 2013 a delayed onset of spring was recorded in early 2013 which resulted in bat activity remaining very low until May. As such, the weather conditions experienced in south west Scotland in late May were consistent with those normally associated with late April. See <http://www.metoffice.gov.uk/research/news/cold-spring-2013> and http://www.bats.org.uk/news.php/193/british_bats_face_challenges_after_second_cold_spring_in_a_row. Resources accessed 16/10/2013.

⁸ Using CIEEM's competency framework Claire and Rachel are "authoritative" and Jenny is "competent" at undertaking bat surveys: <http://www.cieem.net/competency-framework#themes>.

- Transect B – starting on Barbeys Hill and circumnavigating the grassy and marshy upland slopes of Enoch Hill, this transect also covers High Chang Hill and Chang Hill and crosses minor tributaries of Littlechang and Catlock Burns.
- Transect C – the easternmost transect follows the ridge surrounding the source of Polga Burn from the summit of Benty Cowan Hill to woodland edge at High Chang Hill and crosses the Polga Burn in its lower reach close to the confluence with Connel Burn.

Each transect route was marked out using canes during a daytime visit at the beginning of the survey season, and was walked clockwise or anti-clockwise by pairs of surveyors on the same night, and with the start/end locations varied on each survey visit. The routes/directions of travel taken on each survey are shown in **Figures 3.1 – 3.3**.

The route was walked at a consistent and relatively slow pace (around 2.5km/h) with no stopping points, but with a stop scheduled each time a bat was encountered to note species and behaviour. Hand-held Duet frequency division bat detectors were used to detect bat activity in the field, and the locations of bat activity were geo-referenced using Garmin e-Trex GPS. Bat activity call files were transferred to computer and were checked manually in the office to confirm species and behaviour.

Surveys were undertaken in suitable weather conditions (i.e. when air temperatures were above 7 degrees Centigrade, wind speeds were moderate or less [Beaufort], and conditions were clear/dry), and details of weather conditions were recorded before and after each survey (and during the survey where conditions changed).

Surveys were all undertaken at dusk, commencing at around sunset and continued for around 2.5 hours after sunset, in accordance with recommendations given in Chapter 7 of the 2012 BCT guidelines for bat activity away from roosts. Details of the actual times of survey and weather conditions encountered are provided in Tables A.1 – A.3 in **Appendix A**.

2.4 Static Bat Detector Surveys

Song Meter SM2+ bat detectors (Wildlife Acoustics) were selected to record bat activity. Detectors were set up with pre-programmed Secure Digital High Capacity (SDHC) memory cards (settings information is shown in Box 1) and microphones were checked (and, where necessary, replaced) periodically through the survey period to ensure high sensitivity.

Detector units were set out by the AMEC staff stated in **Section 2.3**, along with AMEC Consultant Ecologist David Knox MCIEEM⁹. Analysis and interpretation were undertaken by Claire Hopkins who is experienced at using static detector units to assess bat activity.

⁹ David is also deemed “competent” to undertake this type of work under CIEEM guidelines.

Box 1 SM2+ bat detector settings

Recording time	30 minutes before sunset until 30 minutes after sunrise on a daily basis (adjusted for Site location Enoch Hill Latitude: 55.34N Longitude 4.25W)
Advanced settings	Sample rate 192000, High pass filter 16kHz, trigger level; 12dB, 1s
Recording medium	32GB SDHC Class 10 memory cards pre-set using Song Meter Configuration Utility programme
Power	Internal D-Cell battery
Microphone	Single omnidirectional SMX-US microphone (with extension cable where required)
Recording dates	30 May – 04 June 11 – 16 July 04 – 09 September

Detectors were located in different environments across the study area to allow for comparisons between open/edge habitat and proximity to foraging resources. Bat detector locations are detailed in **Table 2.2** and shown in **Figure 2.1**.

Table 2.2 Static Detector Location Overview

Location Number	Location Name	Description
1	Blood Moss NS 55488 08861	Detector located within an extensive area of sheep-grazed upland grassland and bog habitat over 200m from the nearest field boundaries, watercourses (e.g. Knockburnie Burn) and woodland edges.
2	Woodland edge west of Knockburnie Burn NS 55202 07981	Attached to the fencepost which marks the western boundary of the Site the detector was located in edge habitat where extensive mature conifer plantation woodland of the forest meets the open grassland habitats of the Site.
3	Littlechang Hill NS 56144 08264	Located in open grassland habitat on southern side of a steep river valley (Crocradie Burn) between two burns (Littlechang/Catlock). Location was used in summer and autumn only.
3a	Barbeys Hill NS 55930 07318	In spring, instead of Location 3, the SM2 was placed at Location 3a. Whilst Barbeys Hill is closer to the edge of the forestry than the Littlechang Hill location the habitats immediately surrounding the detector locations (which are approximately 1km apart) are very similar (upland grassland habitats grazed by sheep) and the detectors are also at similar altitude (470m at Barbeys Hill compared with 435 at Littlechang Hill). As only a small number of bat calls were detected at Location 3a and given the similarities in the habitats monitored at each location the data obtained from the detectors have been combined for analysis purposes and are referred to hereafter as Location 3 (Littlechang Hill).
4	Woodland edge at Logan Hill NS 55759 07031	Detector was attached to fence at the edge of Carsphairn Forest and adjacent to the upper reaches of Knockburnie Burn.
5	Bitch Burn NS 56698 06847	Detector placed on post and wire fence on the site boundary where Bitch Burn flows out of the Site into a spur of conifer plantation woodland.
6	Polga Burn NS 57799 07785	The detector was located half way between the source of Polga Burn on High Chang Hill, and its confluence with Connel Burn at the eastern edge of the Site.

Each detector was set to record for a minimum of five consecutive nights per survey. Data were sampled for analysis, according to which of the sampled nights had coverage from all detector locations over five consecutive nights.

Bat activity data were sampled in WAC format (Wildlife Acoustics' custom format) and converted to AnaLook sound files using the Kaleidoscope conversion programme¹⁰. Whilst this format does not retain the full spectrum of call parameters (e.g. amplitude/loudness) the AnaLook programme enables analyses of data according to frequency, time and shape of the call.

Bat calls were analysed to species or genus level, where possible, according to comparison with known parameters of bat calls from published references and from experience of bat call analysis in similar habitats and geographic situations¹¹. Calls which could not be identified to species level because they did not conform to the library of known species calls¹¹ were assigned to another category according to their genus:

- *Nyctalus* - unclear noctule/Leisler's bat calls;
- *Pipistrellus* – unclear bandit pipistrelle/soprano pipistrelle calls¹²; and
- *Myotis* – unclear *Myotis* species calls.

The bat activity Index (BAI) is a means of identifying relative levels of bat activity, taking into account the number of passes per unit time. The BAI for all data across all detector locations has been calculated according to the fact that all detectors recorded for the requisite five consecutive nights per survey period.

2.5 Weather Conditions

Following the delayed onset of spring in 2013, summer weather conditions were seen to be warm and calm for an extended period¹³, and these were reflected in the warm temperatures experienced on bat activity transect surveys.

2.6 Limitations

No bat passes were recorded at Location 1 (Blood Moss) in May/June 2013 however there were a number of noise files on the dates the detectors were deployed which indicate that the lack of bat calls detected was not due to detector error.

¹⁰ Version 1.0: <http://www.wildlifeacoustics.com/products/kaleidoscope-software>.

¹¹ Species identification literature including Russ, J. (2012). *British Bat Calls – a guide to species identification*, Exeter; and AnaBat call analysis course notes/experience gained from Sandie Sowler (course attended by Claire Hopkins, 2012) and David Dodds (course attended by Claire Hopkins, October 2013), were used to identify bat calls to species or genus level through interpretation of frequency, call shape and slope parameters.

¹² Note that *Nathusius*' pipistrelle calls are quite distinct from the other two pipistrelle species so are not included in this category.

¹³ E.g. <http://www.metoffice.gov.uk/news/releases/archive/2013/hot-weather>.

As bat detection surveys at height were not undertaken and because the maximum range of SM2+ detectors is outwith the rotor swept path height of the proposed turbines, the level of bat activity at ground level and at height has not been determined at the same location and it is not possible to interpret using the described methods the likely at-height activity levels. Some general comments on bat activity are provided in **Section 4**.

Because static detector surveys rely on remote monitoring of bat activity, it is not possible to infer the number of individual bats passing the microphone, direction of travel or the behaviour of the bat (except where “feeding buzzes” or social calls were distinguishable during call analysis). Instead the relative levels of bat activity based on bat passes is discussed¹⁴.

¹⁴ Bat calls are flexible by nature, with individual bats adjusting their calls according to their behaviour, the prevailing weather conditions and the presence of other bats, thus the same bat may produce echolocation calls that look very different each time it passes a microphone; there is also a degree of overlap between individuals and even between species which means that calls may look similar in AnaLook even if they are produced by a different bat.

3. Results

3.1 Desk Study

The Scottish Leisler's Bat Project has been running since 2009 and the following summarises the findings of the project as reported⁶:

- Leisler's bat appears to be the dominant of the two *Nyctalus* species in the south and west of Scotland with the exception of Dumfries and Castle Douglas where noctule dominates. Records of noctule bats outwith these areas are rare.
- Leisler's bat appears to roost predominantly in trees and does not tend to use buildings in south west Scotland.
- Culzean Country Park (approx. 35km west of the Site) is currently the only known breeding site for Leisler's bat in Scotland.
- Records were obtained from sites on Arran in 2013 and indicate that the species may be more widespread in Scotland than previously thought.

3.2 Bat Activity Transects

The results of bat activity transect surveys are shown in detail in **Appendix A** (Tables A.1 – A.3) and **Figures 3.1 – 3.3**. **Table 3.1** shows a summary of the results including the weather conditions experienced, the bat species recorded and concentrations of bat activity along with any evidence of commuting.

Table 3.1 Transect Survey Results (Summary)

Month	Weather conditions	Bat species	Bat activity
30 May 2013 Figure 3.1	Optimal. Mild (14°C/11°C), calm, dry. Weather conditions over previous days also ideal.	Bandit pipistrelle	Transect A – No bat activity recorded. Transect B – No bat activity recorded. Transect C – Several bandit pipistrelle bats recorded foraging along farm track on return to Dalleagles (i.e. not recorded on transect route).
08 July 2013 Figure 3.2	Optimal: Warm (19 °C/ 17°C), calm, dry, low cloud cover. Weather conditions over previous days also ideal.	Bandit and soprano pipistrelle	Transect A – Late observation of soprano pipistrelle bat at Knockburnie Burn. Transect B – Single pipistrelle sp. recorded passing/commuting (direction not determined) on northern slopes of Barbey's Hill. Transect C – two bandit pipistrelles recorded near Connel Burn; two isolated observations on flanks of Benty Cowan Hill and a number of bandit and soprano pipistrelles foraging on a track near Dalleagles (i.e. not recorded on transect route).
9 September 2013 Figure 3.3	Favourable: Mild (10 °C/8 °C); calm, dry, 80% cloud cover.	Bandit and soprano pipistrelle	Transect A – soprano and bandit pipistrelle seen flying around opening in trees. No other bats detected on survey. Transect B – a single bandit pipistrelle and unidentified pipistrelle bat pass recorded along woodland edge on western boundary of Site. Transect C – Two isolated soprano pipistrelle passes and one bandit pipistrelle pass.

3.3 Static Bat Detector Surveys

The results of static bat activity surveys are shown in detail in **Appendix B** and bat detector locations are shown in **Figure 2.1**. Analysis and interpretation of the bat activity data shows the following:

- A total of 1,372 bat calls were detected between six bat detector locations and five consecutive nights across three survey periods (May/June, July and September) in 2013.
- As shown in **Appendix B**, Table B.1 the species with the highest proportion of passes was Leisler's bat (57.9% of calls, with an additional 4.2% of calls identified to the genus *Nyctalus* sp.¹⁵). 21.1% of calls were from soprano pipistrelle, 12.5% were bandit pipistrelle, 2.9% were *Myotis* species (with an additional 0.4% attributed to Daubenton's bat), 0.6% were unidentified *Pipistrellus* sp. and 0.4% could not be assigned to species level. No noctule, brown long-eared bat or Nathusius' pipistrelle species calls were recorded.
- As shown in **Appendix B**, Table B.2 bat activity was not evenly spread across the detector locations, with 56.7% of calls at the lowest altitude of Blood Moss (Location 1); 22.4% on woodland edge at Logan Hill (Location 4) and 11.4% at Polga Burn (Location 6) and with Bitch Burn (Location 5), woodland edge at Knockburnie Burn (Location 2) and Littlechang Hill (Location 3) collectively accounting for less than 10% of the recorded bat activity.

As shown in **Appendix B**, Table B.3, the levels of bat activity were not consistent across the three survey periods. Only 3.6% of bat activity was recorded in May/June and 5.2% in September, compared with 91.3% in July.

Bat Activity at Detector Locations

As shown in Tables B.1 and B.2 and in Graphs B1-B6 bat activity at different locations varied:

- Location 1 (Blood Moss) – the highest levels of activity overall (778 passes), this was dominated by high levels of Leisler's bat activity (584 passes and 15 *Nyctalus* passes which are likely to be Leisler's bat – combined this amounts to 77% of activity at this location) followed by bandit and soprano pipistrelle/unidentified pipistrelle bat (165 passes or 34.2% of activity). *Myotis* species (seven passes) including Daubenton's bat (four passes) accounted for 1.4% of activity at Blood Moss and unidentified bat calls made up 0.4% of activity.
- Location 2 (woodland edge at Knockburnie Burn) – as at Location 1 the full complement of species/species groups identified across the study area was present at this location, although the relative activity levels were much lower (62 passes overall) with 24 soprano pipistrelle passes, 11 from *Myotis* sp., 16 from bandit pipistrelle, nine from *Nyctalus* sp. (including three confirmed to be Leisler's bat) and single passes from unidentified *Pipistrellus* sp. and an unidentified bat.
- Location 3 (Littlechang Hill) had the lowest levels of bat activity with 18 bat passes across the three survey periods. The majority of calls were from soprano and bandit pipistrelle (11 passes collectively or 61.1% of the passes at this Location), 6 were from *Nyctalus* sp. (including 4 confirmed Leisler's passes) and a single *Myotis* sp. pass was also recorded.

¹⁵ No confirmed and definitive noctule bat calls were identified from analysis of the bat activity data, and it is considered likely that the *Nyctalus* sp. calls identified – which all had call frequency characteristics within the area of overlap between noctule and Leisler's bat (i.e. peak frequency of 20kHz – 23kHz) – are also Leisler's bat.

- Location 4 (Woodland edge at Logan Hill) had the second highest levels of bat activity with 308 passes, dominated by Leisler's bat (194 passes) and *Nyctalus* sp. (27 passes) and followed by soprano pipistrelle (38), bandit pipistrelle (36 passes) and *Myotis* sp. (13 passes).
- Fifty bat passes were recorded across the three survey periods at Location 5 (Bitch Burn) of which half were soprano pipistrelle (25 passes), 10 were *Nyctalus* sp. (including eight confirmed Leisler's passes), nine were bandit pipistrelle and six were from *Myotis* sp.
- Location 6 (Polga Burn) recorded the full complement of bat species/groups identified at the Site, with 156 passes recorded across the three survey periods. Over 92% of the bat activity at this location was from soprano (95 passes) or bandit pipistrelles (46 passes; three of which could not be classified to species level); *Nyctalus* sp. (seven passes including two Leisler's bat); *Myotis* sp. (three passes including one Daubenton's bat pass) and two passes could not be identified.

From interpretation of the above data, high levels of Leisler's bat activity – particularly in July – skewed the relative activity levels to the west (e.g. Location 1 [Blood Moss] and Location 4 [Logan Hill].) There were no apparent correlations between the altitude (high activity levels recorded at Location 1 – Blood Moss – were not matched at Location 2 – Woodland edge at Knockburnie Burn which are at the same altitude) or the level of shelter (bat activity levels were notably higher at woodland edge habitats at Logan Hill [Location 4] compared with woodland edge at Knockburnie Burn [Location 2] and Bitch Burn [Location 5]) although each of these locations reflects similar habitat compositions with open grassland and mire habitats juxtaposed with conifer plantation edge habitat.

It is evident from the above data that the three species groups (i.e. *Nyctalus* sp. [here assumed to be Leisler's bat]; *Pipistrellus* sp. [i.e. soprano and bandit pipistrelle] and *Myotis* sp. [including Daubenton's bat] are present across the Site and occasionally make use of both open, edge and sheltered (e.g. Location 6 – Polga Burn) habitats.

3.3.1 Bat Activity Index

The BAI varies according to which survey period is sampled but the mean BAI has been calculated for each species and indicates the highest BAI from Leisler's bat/*Nyctalus* (56.8 passes per night), followed by pipistrelle species (soprano pipistrelle 19.3 passes per night; bandit pipistrelle 11.5 passes per night and unidentified pipistrelle species 0.5 passes per night). *Myotis* sp. including Daubenton's had a BAI of three passes per night. The data on which these interpretations are based however indicate that in respect of Leisler's bat in particular the relative activity is higher in the summer, possibly reflecting the use of the Site as a summer foraging habitat resource. There is no evidence to suggest that there is any migratory activity of any species, as no uplift in bat activity was recorded in September.

Timing of Bat Activity

Different bat species have characteristic times of emergence from roosts (and, to a lesser extent, times of re-entry into roosts after foraging) with *Nyctalus* sp. typically emerging first (within 20 minutes of sunset), *Pipistrellus* species between 20 and 40 minutes after sunset; and *Myotis* species and brown long-eared bats tending to emerge late. **Appendix B** Table B.5 and Graph B.7 show the relationship between time of first/last bat activity and the time of sunrise/sunset across all detector locations and all survey periods.

The data from the Site in 2013 showed a delay between sunset and first bat activity in the evening; a corresponding delay at dawn such that no activity was recorded in the hour preceding sunrise indicates that the roosts are likely to be distant from the Site. There was a sharp increase in the level of bat activity over one hour after sunset and a “blip” with lower activity levels around three hours after sunset corresponding with documented variation in activity levels by foraging bats during the course of the night. There was a steep reduction in bat activity corresponding with around 4.5 hours after sunset. Finally, as evidenced by the shallower curve, bats took longer returning to roosts at dawn than arriving at the Site in the evening. More detailed interpretation, including species accounts, have not been undertaken.

Activity of High Risk Bat Species

The activity of Leisler’s bat (here combined with *Nyctalus* sp. activity for analysis purposes) across the Site was scrutinised in greater detail to understand more about the likely behaviour of this species.

In May/June only six Leisler’s/*Nyctalus* sp. bat passes were recorded overall in this time period however passes were recorded within three minutes of each other at Location 5 (Bitch Burn) and Location 2 (Knockburnie Burn) on 30 May. These passes could feasibly be from the same bat.

In July, periods of continuous Leisler’s/*Nyctalus* sp. bat activity were recorded over the five-night recording period in July as shown in **Table 3.2** below. There is evidence (see observations in **Table 3.2**) that a minimum of two bats were likely to be present within the study area where bat activity was recorded in two separate detector locations within the same minute but the distance between the detectors made it unlikely to be the same bat¹⁶ e.g. 11-12 July.

Bouts of continuous bat activity¹⁷ were recorded at Locations 1 (Blood Moss) and 4 (Woodland edge at Logan Hill) where the majority of Leisler’s bat calls were detected. There were also numerous examples of adjacent detector locations e.g. 1 and 4; 4 and 5; recording Leisler’s/*Nyctalus* sp. bat activity within 3-5 minutes of each other. As Leisler’s/*Nyctalus* sp. are fast fliers¹⁸ they are capable of covering the relatively short distances (maximum 2.5km) between detector locations within this time. Hence, it can be speculated that it is likely that the same bat was recorded on multiple occasions and by multiple detectors.

In September two independent observations were made (21.08 on 05 September and 00.11 on 06 September) at two locations (2 and 5). There is insufficient evidence for these passes being from the same bat or different bats.

Whilst the maximum number of high risk bats using the Site is not known, the above detail, including the skew of data towards the western side of the Site and the high levels of activity in the summer, as well as observations of feeding behaviour in individual call files, indicates that the Site is used for foraging, but it is not known if Leisler’s bats will forage communally or solitarily.

¹⁶ This takes into account the fact that detectors were synchronised prior to the surveys.

¹⁷ Continuous bat activity is indicative of foraging behaviour whereby bats pass repeatedly pass overhead chasing insect prey.

¹⁸ With a hunting speed of over 40km/h (Dietz, C., von Helversen, O. and Nill, D. (2007). *Bats of Britain, Europe and Northwest Africa*. London.)

The results do not indicate that the Site is located on a commuting route as commuting behaviour tends to be associated with single passes, which may be separated by several minutes or hours, and which may also be correlated with particular times of the night when (a) bat(s) is/are passing through the Site.

Table 3.2 Leisler's/Nyctalus sp. Static Survey Results (detail)

Evening	Continuous bat activity*	Detector locations	Observations
11 – 12 July	22.45 – 22.55	1, 4, 3	Min. two bats as two recorded within same minute on four separate occasions at Locations 1 and 4, 1 and 5, 1 and 6.
	23.04 – 23.19	1, 4	
	23.25 – 23.35	1, 4, 5, 6	
	23.44 – 23.56	1, 4	
	00.26 – 00.35	1	
	01.19 – 02.11	1, 4, 6	
	02.26 – 02.57	1	
12-13 July	22.36 – 22.47	1, 3, 4	Min. two bats as two recorded within same minute on 18 separate occasions at Location 1 and 4, and once at locations 1 and 2.
	22.53 – 23.33	1, 2, 4, 5	
	23.38 – 00.38	1, 4	
	00.52 – 01.43	1, 4	
	01.53 – 01.58	1	
13-14 July	03.55 – 03.57	1, 4	Min. two bats as two recorded within same minute on 10 occasions at Locations 1 and 4 and once at Locations 1 and 3.
	22.31 – 22.32	4	
	22.44 – 22.50	1	
	23.05 – 23.38	1, 3, 4	
	23.45 – 23.50	1	
	23.57 – 00.20	1	
	00.42 – 02.02	1, 3, 4	
	02.08 – 02.14	1	
14-15 July	02.23 – 02.29	1, 4	Min. two bats as two recorded within same minute on 14 occasions at Locations 1 and 4, and once at Locations 4 and 5.
	22.43 – 22.50	1, 6	
	22.57 – 00.28	1, 4, 5	
	00.38 – 01.01	1, 4, 5	
	01.06 – 01.33	1, 4	
15-16 July	01.38 – 01.48	1	Min. two bats as two recorded within same minute on 12 occasions at Locations 1 and 4
	01.53 – 02.27	1, 4	
	22.38 – 23.33	1, 4, 5	
	23.39 – 23.42	4	
	23.49 – 23.55	1, 4	
	<i>No bats recorded after midnight</i>		

*Activity is deemed to be continuous if multiple bat passes are recorded over a period of time. Bouts of activity are those separated by periods of greater than 5 minutes.

4. Conclusions

The weather conditions experienced during bat activity transect surveys were excellent (see summary in **Table 3.1**), coinciding with a period of high barometric pressure over the UK in this period. As such, conditions are considered to have been favourable for bats in terms of foraging and in terms of maternity roosting as this period also coincides with the birth of young bats. Bat activity levels recorded during surveys are therefore assumed to represent the upper level of activity that would be expected for the Site.

Collectively, bat activity transect surveys and static bat activity surveys which were undertaken in May/June, July and September 2013 returned data for at least four species (Leisler's bat, soprano pipistrelle, bandit pipistrelle and Daubenton's bat) although it cannot be ruled out that other *Myotis* species or noctule may also have been recorded.

Bat activity levels during the transect surveys were seen to be very low, with small numbers of pipistrelle species occasionally recorded foraging on the transect routes, and no *Myotis* or *Nyctalus* species were recorded.

Bat activity recorded remotely using static detectors provided a clearer view of the likely usage of the Site by foraging bats, and particularly noteworthy was the high level of Leisler's bat activity (including feeding behaviour), in particular at Location 1 (Blood Moss) in July. As such, whilst the mean BAI for *Myotis* species was very low and the mean BAI for pipistrelle species was also low; the mean BAI for Leisler's bat/*Nyctalus* sp. was high (around double the BAI for pipistrelle species), which is relatively high in AMEC's experience of carrying out bat surveys in Dumfries and Galloway and Ayrshire.

Interpretation of bat call data from static detectors indicates that small numbers of pipistrelle, *Myotis* and Leisler's bats visit the Site regularly to forage. Whilst the absence of roosting opportunities within the Site has already been reported (AMEC, 2013) in general the relationships between bat calls and sunrise/sunset times do not indicate the presence of significant bat roosts (i.e. maternity roosts) close to the detector locations as there are no consistent patterns of early/late records during any of the survey periods.

The 2013 static detector surveys revealed a high level of Leisler's/*Nyctalus* sp. activity, a species which specialises in foraging in open habitats and shows preference for cattle-grazed pasture farmland which is found in lower regions of the Site, was recorded at all detector locations. The pattern of activity indicates that a small number of individuals, which roost off-site, travel to the Site to forage, particularly in summer, and that the Site does not appear to be on a commuting route for this species (see **Section 3.3**).

The risk of collision to this species appears to be higher in the summer (when the majority of the bat passes were detected) and during favourable weather conditions (i.e. moderate or lower wind speed and little rainfall) when hunting. It should be noted that hunting grounds of this species are reported as covering 7.4-18.4 square km¹⁸. The six detectors deployed across the Site recorded over a collective area of approximately 3km² and, as such, it is possible that of the Leisler's bat activity recorded the detectors were recording not only multiple passes from the same bat (consistent with foraging behaviour) but also that the detectors at different locations were recording the same bat (see **Table 3.2**). As such, the apparent risk to populations of this species from collision with turbines may be lower than is implied by the 2013 data.

The bat calls were recorded at ground level (and up to the theoretical maximum range of SM2+ detectors, which is taken to be below turbine height) and no inferences can be made about the activity of high risk bat species at height.

5. Recommendations

The level of survey effort in 2013 reflected the initial assessment of Site risk to be low as shown in **Table 1.2** but the results from 2013 surveys indicate that the risk may actually be higher due to the presence of regularly-occurring Leisler's bat/*Nyctalus* sp. at certain times of the year. It is recommended that bat detection equipment including microphones 'at height' (i.e. within the height band of the rotor swept path) and at ground level (i.e. below 10m) is installed onto anemometry masts (met masts) scheduled for installation in 2014 and set to record continually throughout the 2014 active bat season. In addition to providing additional bat activity data this will also provide more information about the bat flight heights throughout the bat activity season of March/April – October. This would be particularly important for the high-risk Leisler's bat and noctule bat (if this species is present) and enable the bat activity to be linked to weather conditions.

As general good practice it is recommended that turbines should be located at least 50m (to blade tip) from the maximum theoretical height of trees and well-used field boundaries and river valleys to minimise the potential for impacts on foraging and commuting bats. Provided this recommendation is incorporated into the design of the wind farm, it is considered that adverse impacts on individuals or populations of low-risk bat species are unlikely. Should it not be possible to incorporate such stand-offs on all or part of the Site, it is possible that further bat survey pre- and/or post construction would be required, focussing on those turbines which do not allow the recommended stand-offs. Furthermore, in recognition of a growing body of evidence that suggests that bats may be attracted to turbines¹⁹ once wind farms are built, some further consideration will need to be given to this factor.

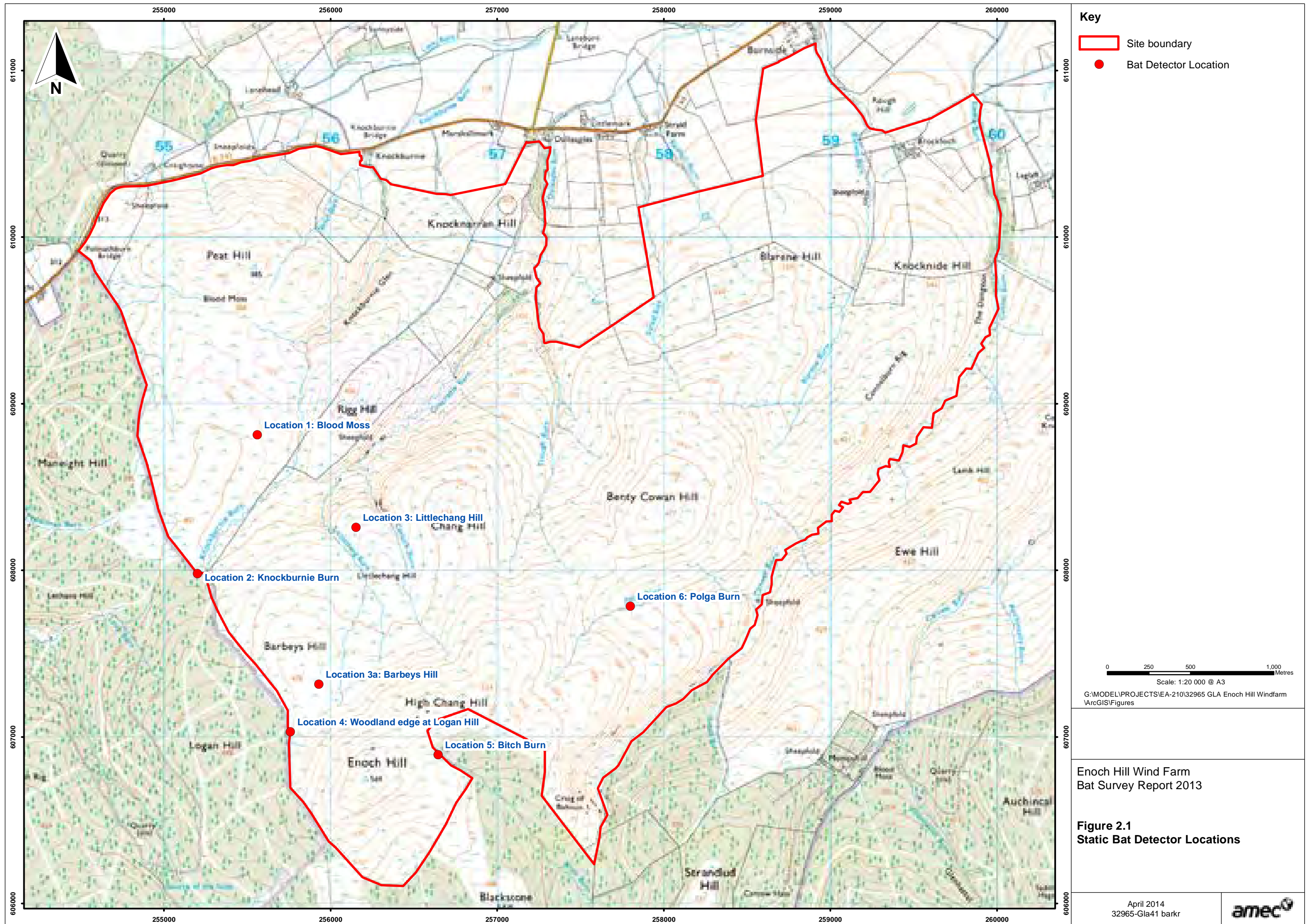
There are no proposals for construction of wind farm infrastructure within 200m of identified roosts in buildings and therefore there are no licensable activities proposed.

Interpretation of 2013 bat activity data indicates that the risks to pipistrelle species and *Myotis* species from development and operation of a wind farm at Enoch Hill is low, taking into account the observed activity. The risks to Leisler's bat/*Nyctalus* sp. appear to be higher than initially anticipated and further investigation targeting this species group is needed in 2014.

¹⁹ Cited in Walsh, K., Matthews, J. and Raynor, R. (2012). Bats and Wind Turbines. Version 2, June 2012. <http://www.snh.gov.uk/docs/B999258.pdf>

Figures

- 2.1 Static Bat Detector Locations
- 3.1 May Bat Activity Transect Survey
- 3.2 July Bat Activity Transect Survey
- 3.3 September Bat Activity Transect Survey



Key

- Site boundary
- Bat Detector Location

0 250 500 1,000 Metres
Scale: 1:20 000 @ A3

G:\MODEL\PROJECTS\EA-210\32965 GLA Enoch Hill Windfarm
ArcGIS\Figures

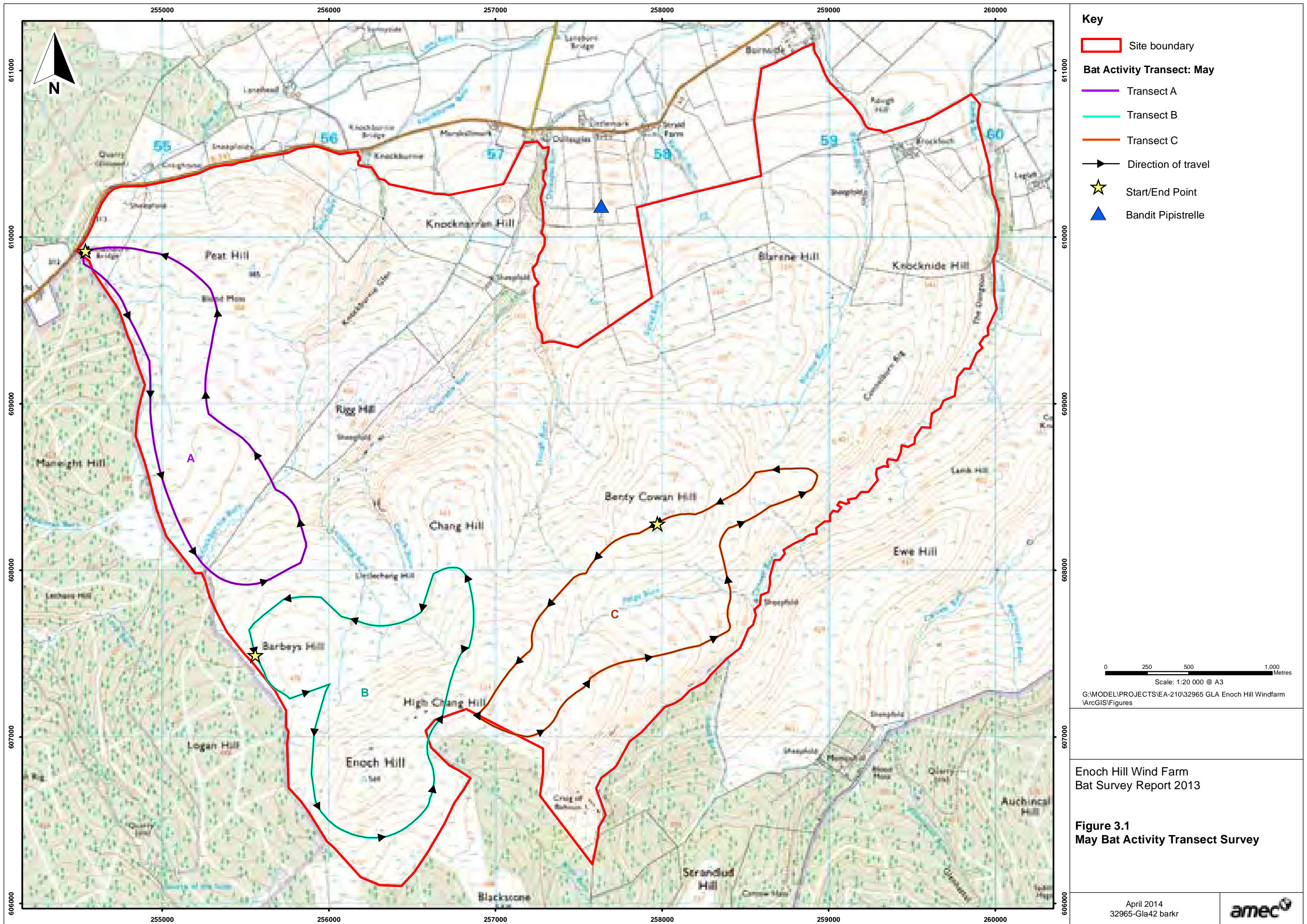
Enoch Hill Wind Farm
Bat Survey Report 2013

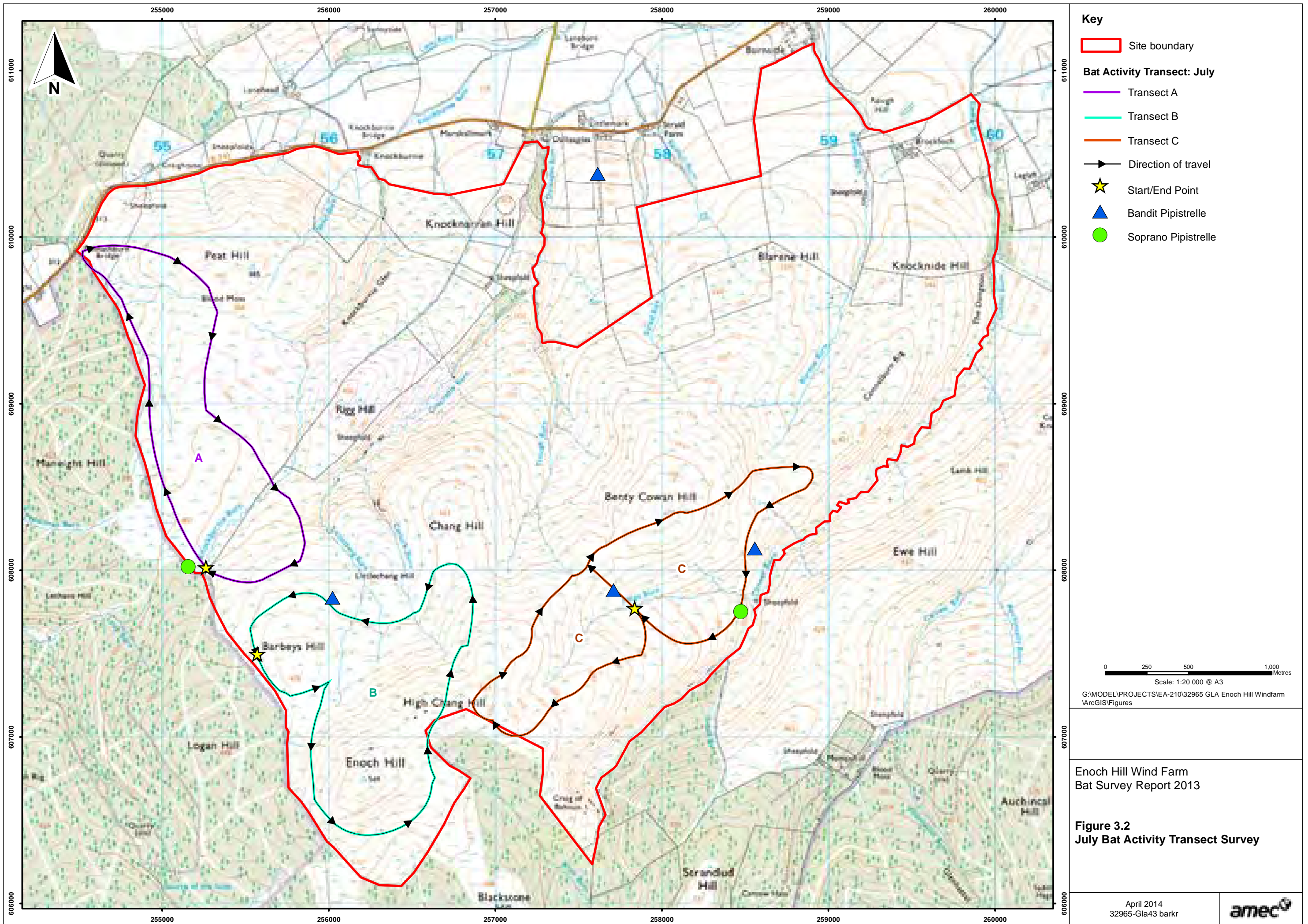
Figure 2.1
Static Bat Detector Locations

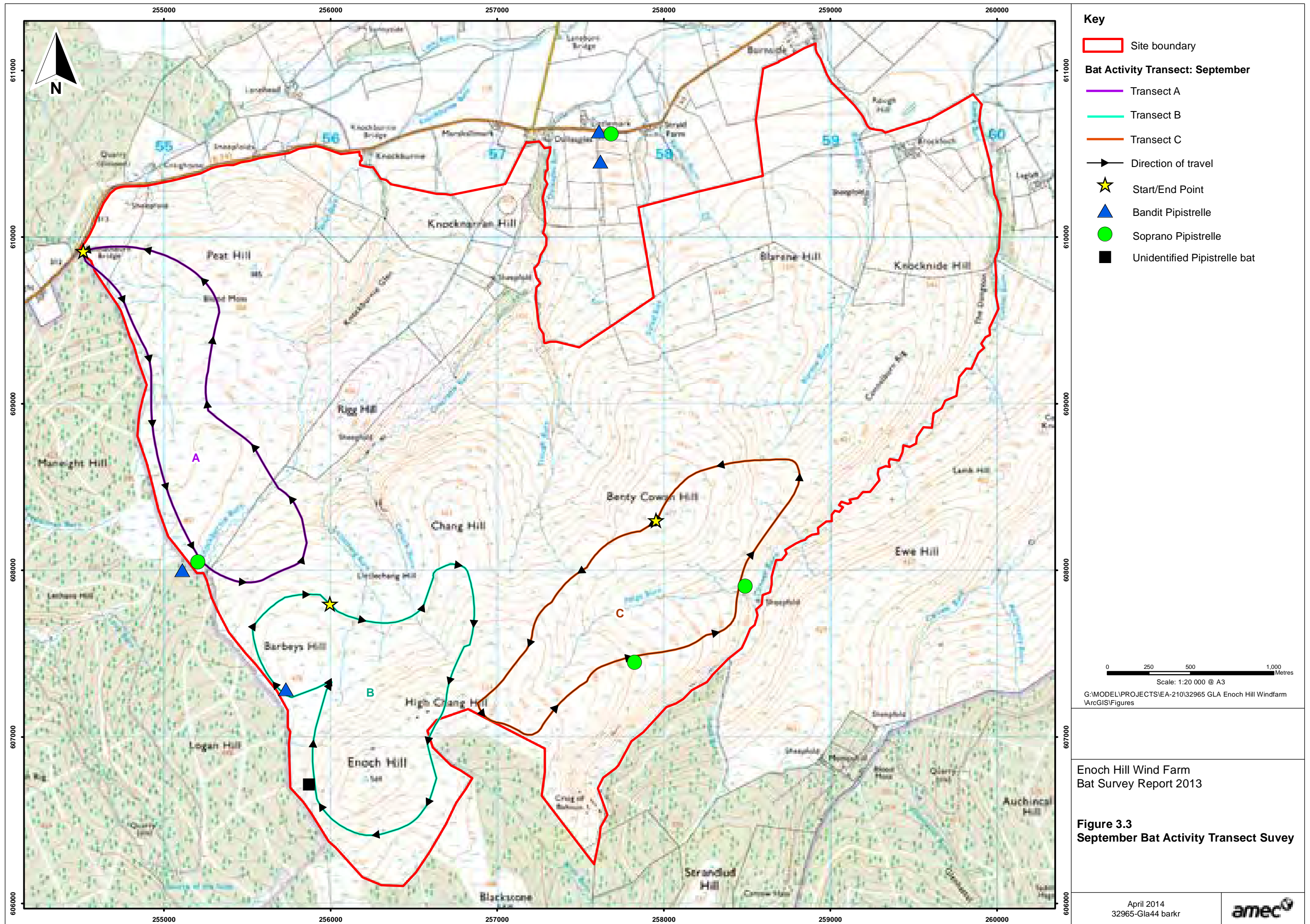
April 2014
32965-Gla41 barkr



Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright. 100027856









Appendix A

Bat Activity Transect Survey Results

Details of bat activity transect surveys are provided in Tables A.1 – A.3 inclusive and shown in **Figures 3.1 – 3.3**.

Table A.1 – May 2013 Bat Activity Transect (Dusk)

Site Name	Date	Survey Type	Sunset	Survey start	Survey end	Start/end location
Enoch Hill	30/05/2013	Dusk transect	21.44	Transect A – 21.43 Transect B – 21.45 Transect C – 21.44	Transect A – 00.11 Transect B – 23.59 Transect C – 00.48	Transect A – Road Transect B – Barbey's Hill Transect C – Benty Cowan Hill
Temperature	Precipitation	Cloud cover	Moon phase	Wind speed/direction	Surveyors	Direction of travel
14 at start, 11 at end	None	30%	Half moon	Calm	Rachel Finan (A) Jenny Sneddon (B) Claire Hopkins (C)	A – anti-clockwise B – anti-clockwise C – anti-clockwise
Real time (BST)	Location	Species	Max Number of Individual Bats Present	Bat Passes	Behaviour	Additional Notes
TRANSECT A						
No bats recorded						
TRANSECT B						
No bats recorded						
TRANSECT C						
00.48	NS 57642 10160	Bandit pipistrelle	Several	Continuous	Foraging	Foraging along farm track on return to Dalleagles. (Not recorded on transect route).

Table A.2 – July 2013 Bat Activity Transect (Dusk)

Site Name	Date	Survey Type	Sunset	Survey start	Survey end	Start/end location
Enoch Hill	08/07/2013	Dusk transect	21.58	Transect A – 21.58 Transect B – 22.00 Transect C – 22.00	Transect A – 00.35 Transect B – 01.00 Transect C – 00.53	Transect A – Knockburnie Burn Transect B – Barbey's Hill Transect C – Polga Burn
Temperature	Precipitation	Cloud cover	Moon phase	Wind speed/direction	Surveyors	Direction of travel
19 at start, 17 at end	None	5%	New moon	Calm	Rachel Finan (A) Jenny Sneddon (B) Claire Hopkins (C)	A – clockwise B – clockwise C – clockwise
Real time (BST)	Location	Species	Max Number of Individual Bats Present	Bat Passes	Behaviour	Additional Notes
TRANSECT A						
00.35	NS 55268 07955	Soprano pipistrelle	1	1	Pass	Single bat pass at Knockburnie Burn at end of survey.
TRANSECT B						
00.22	NS 55973 07849	Bandit pipistrelle.	1	1	Pass	Single bat flew overhead near Littlechang Hill/Barbey's Hill.
TRANSECT C						
23.42	NS 58570 08114	Bandit pipistrelle	2	Several	Foraging	At least 2 bats foraging along faint track near eastern edge of Site (Connel Burn).
23.51	NS 58403 07771	Soprano pipistrelle	1	1	Pass	Single pass (not seen) on ridge above Polga/Connel Burns.

Site Name	Date	Survey Type	Sunset	Survey start	Survey end	Start/end location
00.10	NS 57831 07913	Bandit pipistrelle	1	1	Pass	Single bat pass (not seen) on flanks of Benty Cowan Hill.
00.45	NS 57636 10283	Bandit pipistrelle	3+	Several	Foraging	Several bats recorded foraging along farm access track near Dalleagles (not recorded on transect route).

Table A.3 – September 2013 Bat Activity Transect (Dusk)

Site Name	Date	Survey Type	Sunset	Survey start	Survey end	Start/end location
Enoch Hill	09/09/2013	Dusk transect	19.51	Transect A – 19.45 Transect B – 19.45 Transect C – 19.51	Transect A – 22.14 Transect B – 22.00 Transect C – 22.12	Transect A – Road Transect B – northern flanks of Enoch Hill Transect C – Benty Cowan Hill
Temperature	Precipitation	Cloud cover	Moon phase	Wind speed/direction	Surveyors	Direction of travel
10 at start, 8 at end	None	20%	1 st quarter	Calm	Rachel Finan (A) Jenny Sneddon (B) Claire Hopkins (C)	A – anti-clockwise B – clockwise C – anti-clockwise
Real time (BST)	Location	Species	Max Number of Individual Bats Present	Bat Passes	Behaviour	Additional Notes
TRANSECT A						
20.36	NS 55201 07983	Soprano and bandit pipistrelle	2	several	Foraging	Seen flying from open area, circling into trees near Knockburnie Burn. Similar behaviour on second pass. Flying approx. 4m high.
TRANSECT B						
21.13	NS 56002 06401	Pipistrelle sp.	1	1	Pass	Single pass along conifer plantation edge.
21.34	NS 55783 07081	Bandit pipistrelle	1	1	Pass	Single pass overhead at conifer edge.
TRANSECT C						
20.49	NS 58403 07677	Soprano pipistrelle	1	1	Pass	Single pass on ridge between Polga Burn and Connel Burn.

Site Name	Date	Survey Type	Sunset	Survey start	Survey end	Start/end location
21.04	NS 58652 08369	Soprano pipistrelle	1	1	Pass	Single pass over minor watercourse to north of Connel Burn on Connelburn Rig.
22.05	NS 57610 10522	Bandit pipistrelle	1	Several	Foraging	Several passes along farm access track near road. (Not recorded on transect route).
22.10	NS 57663 10627	Bandit and soprano pipistrelle	Several	Continuous	Foraging	Foraging around street lights at Dalleagles Cottages. (Not recorded on transect route).



Appendix B

Static Detector Survey Results

Table B.1 – Bat activity by species according to survey period (according to total number of bat passes).

Species/species group	May-June	July	September	Total	%
Bandit pipistrelle	12	149	11	172	12.5
Soprano pipistrelle	19	224	46	289	21.1
<i>Pipistrellus</i> sp.	2	5	1	8	0.6
Daubenton's	1	4	0	5	0.4
<i>Myotis</i> sp.	9	20	11	40	2.9
Leisler's	1	792	2	795	57.9
<i>Nyctalus</i> sp.	5	52	0	57	4.2
Query	0	6	0	6	0.4
Total	49	1252	71	1372	100.0
%	3.6	91.3	5.2	100.0	

Table B.2 – Bat activity by species according to detector location (according to total number of bat passes).

Species/species group	Location 1 - Blood Moss	Location 2 – Woodland edge at Knockburnie Burn	Location 3 - Littlechang Hill	Location 4 – Woodland edge at Logan Hill	Location 5 - Bitch Burn	Location 6 - Polga Burn	Total	%
Bandit pipistrelle	60	16	5	36	9	46	172	12.5
Soprano pipistrelle	101	24	6	38	25	95	289	21.1
<i>Pipistrellus</i> sp.	4	1	0	0	0	3	8	0.6
Daubenton's	4	0	0	0	0	1	5	0.4
<i>Myotis</i> sp.	7	11	1	13	6	2	40	2.9
Leisler's	584	3	4	194	8	2	795	57.9
<i>Nyctalus</i> sp.	15	6	2	27	2	5	57	4.2
Query	3	1	0	0	0	2	6	0.4
Total	778	62	18	308	50	156	1372	100.0
%	56.7	4.5	1.3	22.4	3.6	11.4	100	

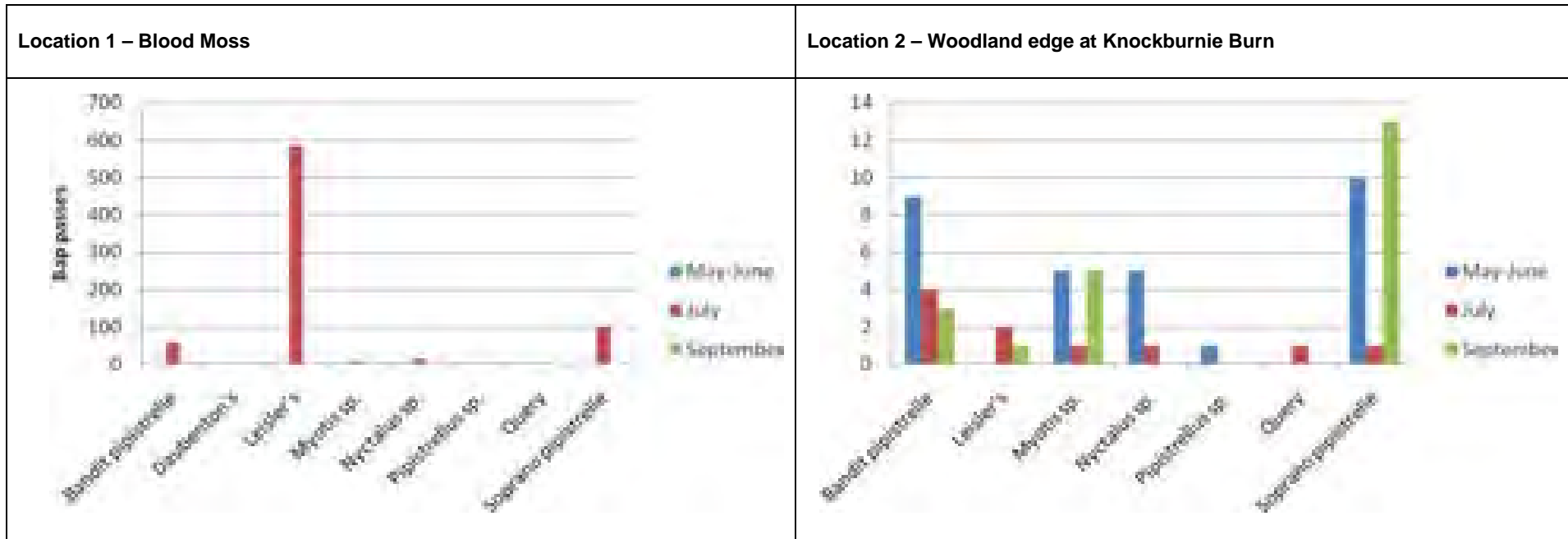
Table B.3 – Bat activity by location according to survey period (according to total number of bat passes).

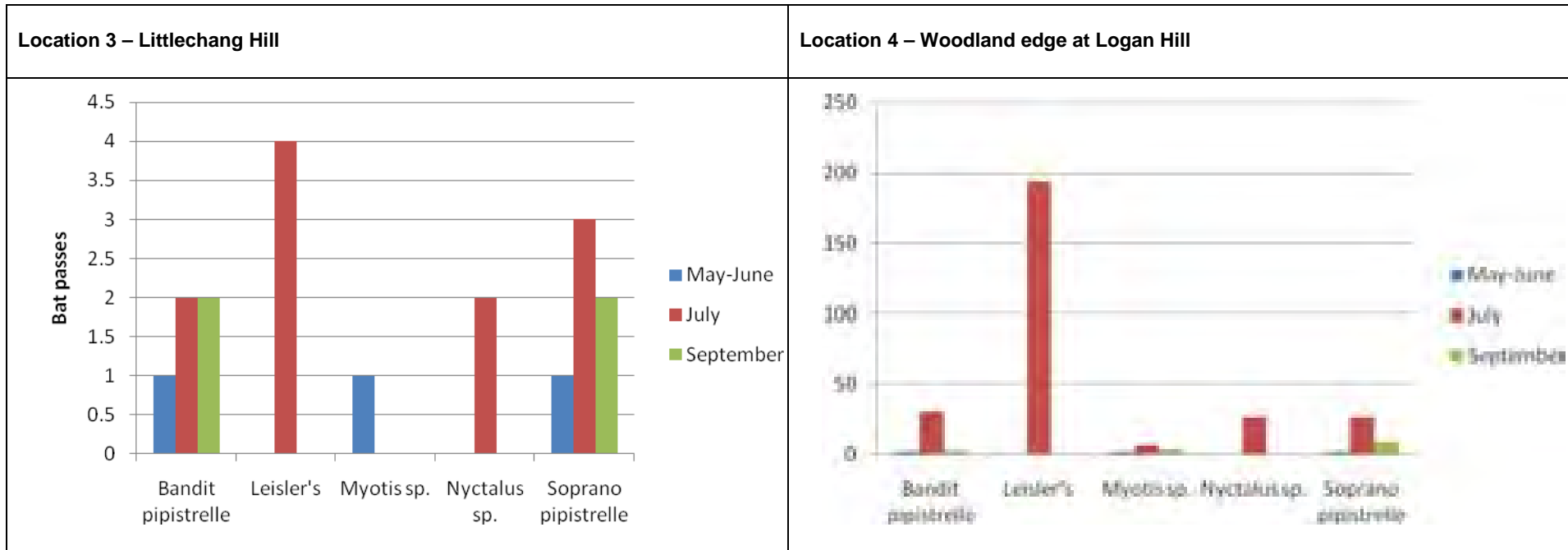
	May-June	July	September	Total	%
Location 1 - Blood Moss	0	773	5	778	56.7
Location 2 – Woodland edge at Knockburnie Burn	30	10	22	62	4.5
Location 3 - Littlechang Hill	3	11	4	18	1.3
Location 4 – Woodland edge at Logan Hill	6	286	16	308	22.4
Location 5 - Bitch Burn	2	37	11	50	3.6
Location 6 - Polga Burn	8	135	13	156	11.4
Total	49	1252	71	1372	100
%	3.6	91.3	5.2	100	

Table B.4 - Bat Activity Index (BAI) per night (based on five continuous nights of recording per survey period).

Species/species group	May-June	BAI May-June	July	BAI July	September	BAI September	Mean BAI per night
Bandit pipistrelle	12	2.4	149	29.8	11	2.2	11.5
Soprano pipistrelle	19	3.8	224	44.8	46	9.2	19.3
Pipistrellus sp.	2	0.4	5	1	1	0.2	0.5
Daubenton's	1	0.2	4	0.8	0	0	0.3
Myotis sp.	9	1.8	20	4	11	2.2	2.7
Leisler's	1	0.2	792	158.4	2	0.4	53.0
Nyctalus sp.	5	1	52	10.4	0	0	3.8
Query	0	0	6	1.2	0	0	0.4

Graphs B1 – B6 – detail of bat activity at each detector location (number of passes shown against species/species group).





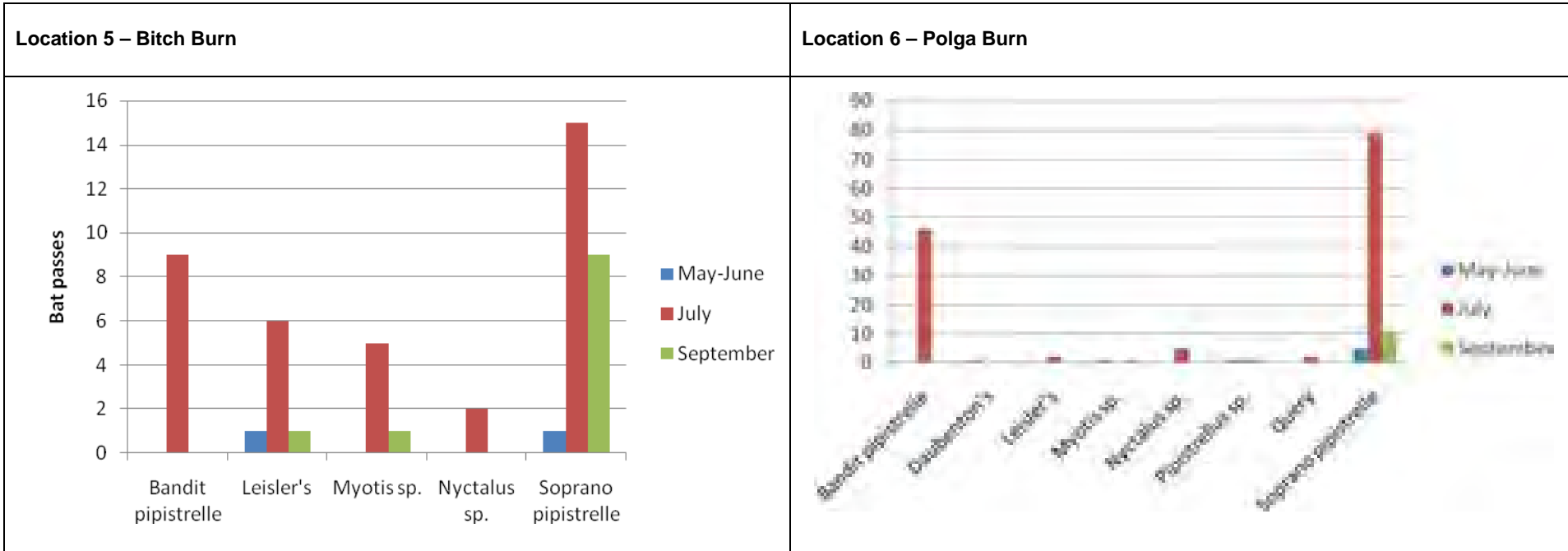
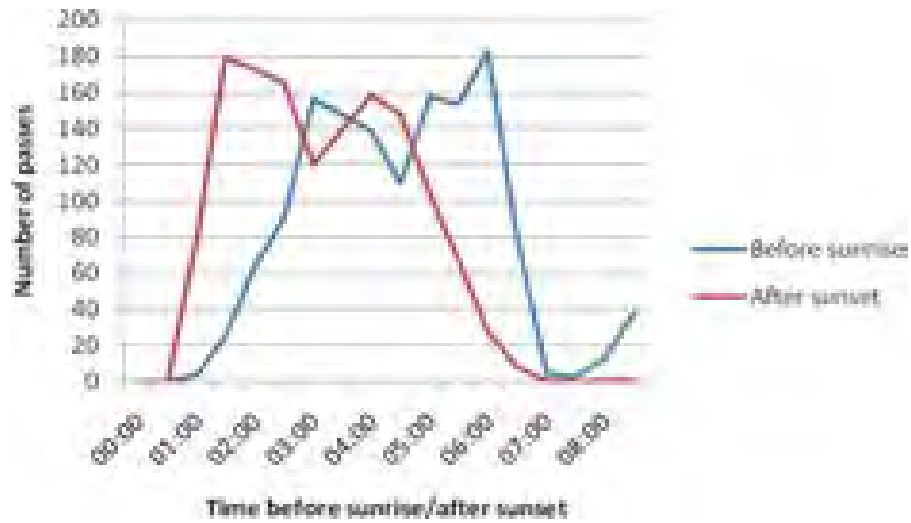


Table B.5 - Relationship between time of bat activity and time after sunset/before sunrise (bat passes for all species/species groups).

Time before sunrise	Number of bat passes	Time after sunset	Number of bat passes
00:00	0	00:00	0
00:30	0	00:30	0
01:00	4	01:00	79
01:30	25	01:30	179
02:00	64	02:00	173
02:30	91	02:30	165
03:00	157	03:00	120
03:30	148	03:30	139
04:00	139	04:00	158
04:30	110	04:30	148
05:00	158	05:00	104
05:30	154	05:30	68
06:00	183	06:00	28
06:30	80	06:30	8
07:00	5	07:00	1
07:30	3	07:30	0
08:00	13	08:00	1
More	38	More	1

Graph B7 – Relationship between bat activity and time after sunset/time before sunrise.



Appendix 11.E

Bat Survey Report 2014

E.ON Climate and Renewables

Enoch Hill Wind Farm

Bat Survey Report 2014



Amec Foster Wheeler Environment & Infrastructure UK Limited

February 2015

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E.ON Climate and Renewables

Enoch Hill Wind Farm

Bat Survey Report 2014

Amec Foster Wheeler Environment &
Infrastructure UK Limited

February 2015

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Executive Summary

Purpose of this Report

This report has been produced for the purpose of describing the methods used and results obtained in a series of bat surveys undertaken at Enoch Hill in 2014. This report complements previous reports relating to bat activity at Enoch Hill, providing information on the presence of roost and potential roost sites and on observed bat activity at control/reference locations in the Nith Glen as well as on-site at anemometer masts.

Bat activity monitoring on two anemometer masts on the site in summer-autumn 2014 demonstrated low levels of bat activity and a low proportion of activity “at height” compared with at ground level. Species present include common and soprano pipistrelle, Leisler’s and Daubenton’s bats.

Bat activity data returned from three detectors deployed for eight nights at relatively sheltered and wooded sites adjacent to the road in the Nith Glen (and ~ 1km from the site boundary) demonstrate that activity at glen level is significantly higher than on comparatively open and exposed upland areas on site. There is no physical barrier to movement from the glen to the hillside for foraging or commuting and it is considered likely that some of the bats recorded at the anemometer mast detectors are the same as those recorded on the glen detectors.

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1. Introduction

1.1 Background

E.ON Climate & Renewables UK Developments Ltd (E.ON) is developing plans for a wind farm development at Enoch Hill, located between Dalmellington and New Cumnock, East Ayrshire.

Bat surveys have been undertaken by Amec Foster Wheeler Environment and Infrastructure UK Ltd (Amec Foster Wheeler – formerly Amec Environment & Infrastructure [Amec]) in previous years at the Enoch Hill site (“the site”) to inform the baseline for an Environmental Impact Assessment (EIA) of the proposed development. Specifically the following have been undertaken:

- Autumn swarming and hibernation surveys¹; and
- Bat activity transect and static bat detector surveys, summer 2013².

Following the completion of bat surveys in 2013² - which had used a level of survey effort appropriate to a low risk site³ - higher than anticipated levels of Leisler’s bat (*Nyctalus leisleri*)/*Nyctalus* species activity were collected (see later sections). As such, the results from 2013 surveys indicated that the risk to populations of these species may actually be higher at certain times of the year. Amec Foster Wheeler was commissioned by E.ON to undertake further studies into the bat activity on site at Enoch Hill in order to inform the baseline bat activity on the site, and in particular to identify whether there is a risk to *Nyctalus* populations - and Leisler’s bat populations in particular - from wind farm development.

It is intended that the information provided in this report will be used to inform an EIA for a wind farm development at Enoch Hill.

¹ Amec E&I UK Ltd (2012). Rr016i1 – Enoch Hill Wind Farm autumn bat survey report. Technical Note prepared on behalf of E.ON.

² Amec E&I UK Ltd (2014). CGOS037 – Enoch Hill Wind Farm Bat Survey Report 2013. Report prepared on behalf of E.ON.

³ In accordance with “the BCT guidelines”: Hundt, L. (2012). Bat surveys: good practice guidelines. Bat Conservation Trust, London.

2. Methods

2.1 Aims

Although they are capable of flying long distances, *Nyctalus* species, and Leisler's bats in particular, tend not to stray a great distance from the roost⁴. The results of bat surveys undertaken in 2013 indicated that Leisler's bat occurs regularly on the site, with high levels of activity noted at an area known locally as Blood Moss (approximately 1.5km north of the proposed turbine envelope) and with lower levels of activity along woodland edges and watercourses (Polga Burn and Bitch Burn) at the Site boundaries, although low levels of activity were also recorded within the proposed turbine envelope (i.e. at Littlechang Hill). Although there are no opportunities for roosting on the site itself, the implication is that there may be a roost/roosts relatively close to the site which may be affected by the proposed wind farm development.

The 2014 surveys were designed to gather further data on the potential locations of bat roosts – in particular for those species whose populations are at high risk of collisions with wind turbines⁵ – and on the flight behaviour (in particular times of year, weather conditions and flight height) of bats at the site.

The aims of the 2014 surveys were therefore to:

- Identify potentially suitable bat roosting habitat within commuting distance of the site⁶; and
- Collect bat activity data simultaneously at ground level and at height from the two anemometer masts on the site; and
- Make comparisons between activity on the site and at glen level.

⁴ Pers. Comm. John Haddow (Auritus Wildlife Consultancy) – director of the Leisler's Bat Project in south west Scotland.

⁵ The species whose populations are considered to be at high risk of wind turbine collisions are noctule, Leisler's and Nathusius' pipistrelle (*P. nathusii*) in accordance with Natural England (2014). Technical Information Note TIN051, 3rd Edition (March 2014): <http://publications.naturalengland.org.uk/publication/35010>. Whilst common and soprano pipistrelles may be at medium risk of individual collisions their populations are not thought to be at high risk from such events.

⁶ Note that typical commuting distance varies according to species. The primary focus of this study was to identify potential roosts of *Nyctalus* species, i.e. noctule and Leisler's bats – because of the high risk to populations of these species caused by wind farm developments in some locations. Leisler's bats tend to commute up to 4km between roosts and foraging areas (pers. comm. John Haddow); common pipistrelle bats travel short distances (up to 1.5km on average) compared with soprano pipistrelles (around 1.75km) according to Davidson-Watts & Jones, 2006; and *Myotis* species up to 6km from the roost (e.g. http://www.bats.org.uk/pages/uk_bats.html#Resident).

2.2 Desk study

Reference is made to ongoing research by the Scottish Leisler's Bat Project⁷ which in 2013 was extended to include the Isle of Arran as well as monitoring of previously identified populations in Dumfries and Galloway and South Ayrshire.

No additional consultation has been undertaken since the 2014 report².

2.3 Surveyors

Surveys were designed and implemented by Claire Hopkins, BSc MSc MCIEEM (SNH bat roost visitor licence no. 20423). Claire has over 10 years' experience in undertaking bat surveys and bat call analysis. Claire meets the standards required in the CIEEM Competencies for Species Survey: Bats⁸.

2.4 Roost assessment surveys

A search of Ordnance Survey (OS) maps and publicly available internet aerial mapping resources was undertaken in June 2014 to identify features (trees, buildings and other man-made structures) within the wider area surrounding the site which may be used by bats for roosting. Bat roost assessment surveys, coupled with a static bat detector exercise (see Section 2.6), were undertaken in four areas adjacent to the site and the B741 Dalmellington-New Cumnock road. These were:

- Knockburnie – farm steading and narrow wooded river valley along Knockburnie Burn;
- Marshallmark – cottage and dog kennels adjacent to the road;
- Dalleagles – farm buildings, houses and larger area of broadleaved woodland alongside Dalleagles Burn; and
- Dalleagles Terrace – a row of semi-detached cottages adjacent to the road, with tree-lined track leading uphill towards Benty Cowan Hill.

An assessment of roost suitability or roost use by bats was undertaken whereby trees and buildings/groups of buildings were categorised in relation to the value their features may offer for roosting bats, as determined by professional judgement and set out in Table 2.1.

⁷ E.g. http://www.bats.org.uk/data/files/Scottish_BW_Conference_2012/Leislars_poster_Nov_2012.pdf and updates reported in the Scottish Bat worker's Conference, Battleby, November 2013.

⁸ http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/CSS/CSS_-_BATS_April_2013.pdf. Accessed 22/12/2014.

A systematic survey approach was taken, with buildings being surveyed one by one for signs of bat presence/activity or for features which may have the potential to be used by bats for roosting. Surveys were undertaken using close-focussing binoculars and a high powered torch, where appropriate, in accordance with BCT guidelines.

Table 2.1 Roost potential categories (adapted from BCT Guidelines)

Category	Roost Potential	Description
1a	n/a – roost confirmed	Known or confirmed bat roost within a structure or tree. Bats confirmed to be present through visual observation of live bats during survey work e.g. live bats seen/heard in the structure during daytime roost assessment surveys. Evidence present to indicate the presence of bats e.g. droppings, staining, scratch marks, grease marks.
1b	High	Unconfirmed (suspected) bat roost but there is some evidence present to indicate the likely presence of bats or the potential historic use of the structure by bats e.g. anecdotal evidence from reliable source such as a landowner.
2a	Medium-high potential to support roosting bats	Structures/trees that have a medium-high potential to support bat roosts but no roost or signs of bats have been confirmed. Structures offer suitable roosting habitat including the following: <ul style="list-style-type: none"> • Trees: tree crevices, flaking bark, dead wood, knot holes, snag ends; • Buildings/Structures: broken tiles, gaps under lead flashing, gaps under guttering, cracked chimney breasts, crevices between stone work, missing mortar, etc.
2b	Low potential to support roosting bats	Structures offering some overall potential to support roosting bats.
3	Little/no potential to support roosting bats	Structures with negligible potential to support roosting bats.

Signs indicative of the presence of a bat roost were searched for e.g. audible squeaking, staining, droppings, scratch marks, smoothing around access point, etc. Potential access points were noted, including aspect, height and characteristics (where possible), along with GPS location.


As development proposals do not seek to affect any of the buildings or trees referred to above, the assessment was restricted to a single ground-based survey, and it is not considered to be a limitation that detailed assessment (such as climb-and-inspect, emergence/re-entry surveys or detector surveys) have not been undertaken.

2.5 Bat activity surveys at met masts

Following the granting of planning consent for the installation of two anemometry masts (“met masts”) on the site bat detection equipment including two microphones ‘at height’ (at 50m, i.e. within the height band of the rotor swept path of proposed candidate wind turbines) and at ground level (i.e. below 10m) were installed onto the met masts in spring 2014 and set to record continually throughout the 2014 active bat season. A description of each met mast location is shown in Table 2.2 and their locations are shown in Figure 2.1.

Table 2.2 Met mast detector locations

Detector number/name	Habitat description	Photograph
High Chang Hill met mast 1 NS 564 071	Met mast on southern boundary of the site. Single microphone at height of 50m and single microphone at ground level.	

Detector number/name	Habitat description	Photograph
Littlechang Hill met mast 2 NS 563 080	High- and low-level microphones installed on met mast on Littlechang Hill between Littlechang and Catlock Burns.	

Song Meter SM2+ bat detectors (Wildlife Acoustics) were installed on each met mast to record bat activity. Detectors were set up with pre-programmed Secure Digital High Capacity (SDHC) memory cards (settings information is shown in Box 1) and the lower microphones were checked (and, where necessary, replaced) periodically through the survey period to ensure high sensitivity. It was not possible, following installation, to

check or replace the upper microphones although it was possible to switch between two at height microphones in case of failure.

Box 1 SM2+ bat detector settings	
Recording time	30 minutes before sunset until 30 minutes after sunrise on a daily basis (adjusted for Enoch Hill site location, Latitude: 55.35N Longitude 4.25W).
Advanced settings	Sample rate 192000, High pass filter 16kHz, trigger level; 12dB, 2s.
Recording medium	4x 32GB SDHC Class 10 memory cards pre-set using Song Meter Configuration Utility programme.
Power	Solar panel (external power source) .
Microphone	Single omnidirectional SMX-US microphone with 2m extension cable at ground level. Additional microphone with 50m extension cable was used at each of the met mast locations to achieve at height monitoring. Second microphone at height installed to enable microphone to be swapped if sensitivity lost.



Recording commenced in July 2014 and continued until December 2014. Bat activity data were recorded as AnaLook call files; each call file may include a sequence of individual bat calls, which were identified manually and categorised to species or genus level according to its call parameters⁹. Each call file is defined as a “pass”.


2.6 Bat activity surveys at control sites

In order to compare bat activity on site (i.e. at the Littlechang Hill [440m] and High Chang Hill [540m] met masts) with a control, static SM2+ detectors were deployed at three locations close to glen level (at approximately 270m altitude). These three automated detectors (labelled Glen 1 – Glen 3) were programmed in the same way as the met mast detectors and differed only in the temporary period of deployment and the absence of microphones at height. The detectors were deployed on 16 September and collected on 24 September 2014, thus recording for a total of eight nights within the bat activity period. The locations of the static detectors are described in Table 2.3 and shown in Figure 2.1.

⁹ Species identification literature including Russ, J. (2012). British Bat Calls – a guide to species identification, Exeter; and AnaBat call analysis course notes from Sandie Sowler (course attended by Claire Hopkins, 2012), were used to identify bat calls to species or genus level through interpretation of frequency, call shape and slope parameters.

Table 2.3 Glen detector locations

Detector number/name	Habitat description	Photograph
Glen 1 - Knockburnie Burn NS 56338 10095	Detector located on boundary at southernmost edge of Knockburnie Burn adjacent to the burn. Sheep-grazed pasture dominates the surrounding area and an area of broadleaved woodland borders the burn between the detector and the B741 Dalmellington-New Cumnock road.	
Glen 2 – Dalleagles Wood NS 57169 10224	Detector affixed to fencing stob adjacent to farm track on south western edge of broadleaved woodland along Dalleagles Burn. Sheep-grazed pasture borders the area to the west and south.	

Detector number/name	Habitat description	Photograph
Glen 3 – Dalleagles Terrace NS 57619 10313	Detector on mature ash tree adjacent to tree-lined track leading south from Dalleagles Terrace along a broad ridge between Dalleagles Glen and Straid Burn.	

2.6.1 Weather conditions

Weather conditions experienced during the bat roost surveys in 2014 were excellent, coinciding with a warm and dry summer¹⁰. Details of the weather conditions experienced during the met mast surveys are coupled with the bat activity data and are provided in Appendix B.

2.7 Limitations

Tree roost assessment surveys were undertaken from the ground and in the middle of summer when leaves and other vegetation can obscure some features.

Access was sought to Knockburnie Farm and Marshallmark (Afton Boarding Kennels) but was not attempted for buildings at Dalleagles or Dalleagles Terrace where some landowners had requested not to be involved. As such, the building roost assessment surveys (which were undertaken from ground level) are not comprehensive and the roost category for these features were assessed on the basis of criteria including the age and style of building, any obvious features where roost access could be gained. For the purpose of the exercise – i.e. to assess whether these features offer suitability for roosting – this level of assessment, in lieu of exhaustive ground-level or targeted night-time surveys, is considered to be robust. Furthermore development proposals do not seek to affect any of the buildings or trees named or referred to in this report; this was not compromised by limiting the surveys to ground level.

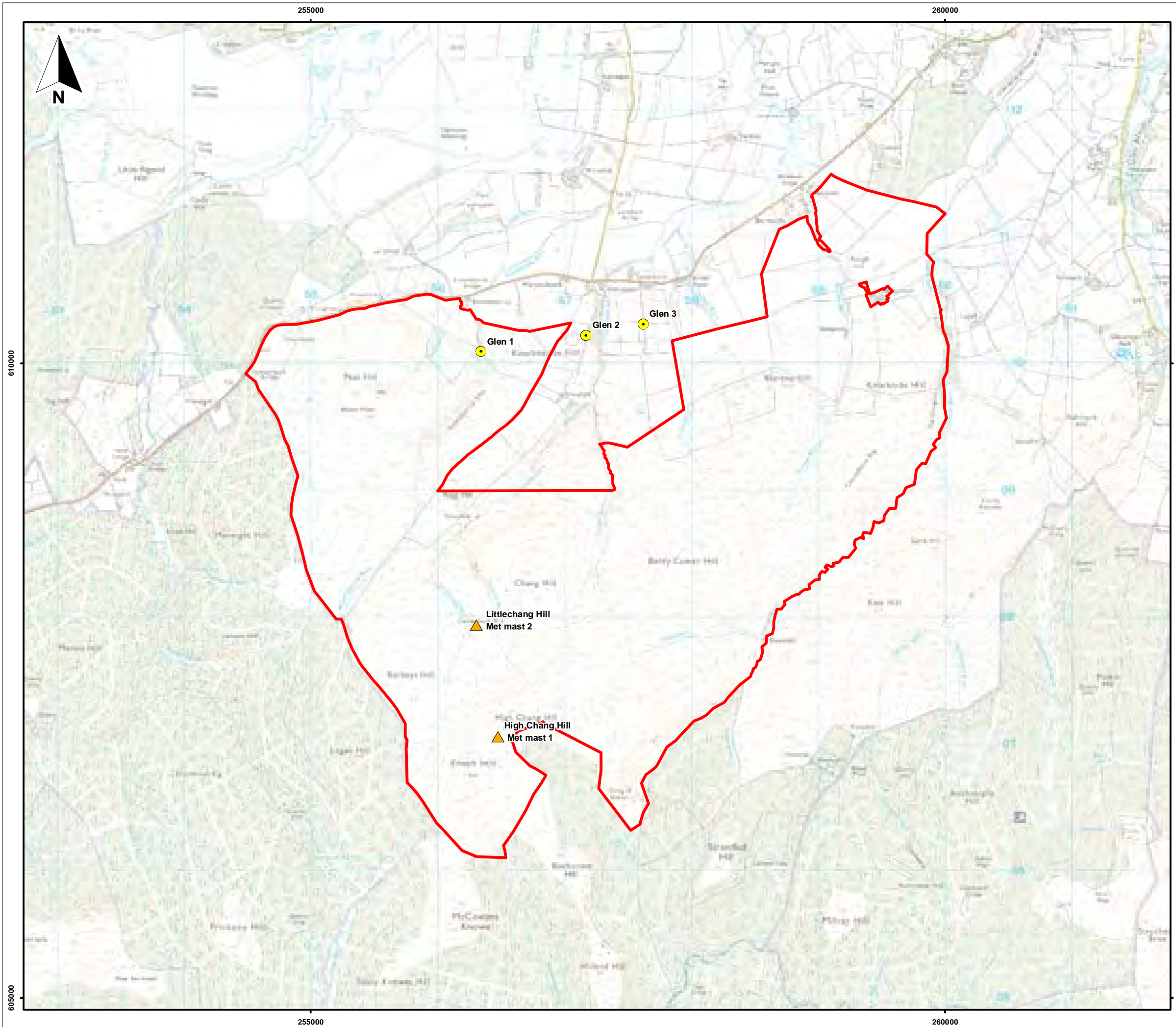
¹⁰ E.g. <http://www.metoffice.gov.uk/climate/uk/summaries/2014/summer>. Accessed 19/01/2015.

During the autumn when the sun is low on the horizon and day length is short the external batteries installed alongside the met mast detectors do not charge fully during the daytime and will either not record throughout the night or do not switch on at all. This typically coincides with the period when bat activity naturally tails off at the onset of hibernation.

Sonic interference with the upper microphone at the Littlechang Met Mast 2 assumed to be from the sonic anemometer or other met mast electrical recording devices resulted in memory cards being filled in a matter of a few days; compared with several weeks (at comparable sites with low observed bat activity) under typical conditions without sonic interference. As a result of this the top microphone was switched off on a site visit on 07 August 2014. As such, at height bat activity was recorded only at High Chang Hill Met Mast 1 for the entire survey period. This fact does not affect the low overall observed levels of bat activity on the Site during 2014 and bat activity at height would be anticipated to be lower than at ground level, in line with observed activity at the Enoch Hill mast.

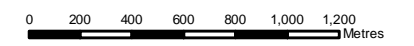
Although bat detectors were functioning in November no calls were returned for this month and as this month is typically associated with the onset of hibernation, bat activity - if recorded – would be likely to be representative of opportunistic foraging on mild weather nights, rather than regular activity. As such, the absence of data from this month is not seen to be problematic.

Only small numbers of bats were recorded at the met masts (at ground level and height) and the sample size for at-height bat data is therefore small. As such, it should be noted that there is a high deviation from the mean wind speeds quoted for each observed bat pass; for clarity, maximum wind speed and sample size have also been quoted in Table B.2.



Key

- Site boundary
- Detector Location
- ▲ Met Mast



1:25 000 @ A3
 Project Path: ShrewsburyG:\MODEL\PROJECTS\EA-210\32965
 GLA Enoch Hill Windfarm\ArcGIS\Figures

Enoch Hill Wind Farm
 Bat Survey Report 2014

Figure 2.1
Bat Detector Locations 2014

Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright. 100001776

3. Results

3.1 Roost assessment surveys

A review of OS maps and aerial photographs combined with knowledge of the site and surrounding area from previous surveys (Amec E&I UK Ltd 2012, 2014) confirmed that there is no roosting habitat on site and there are few features immediately to the west, east and south of the site (dominated by open upland habitats and conifer plantation forestry with low inherent suitability for roosting). The site is bounded to the north by the comparatively flat floodplain of the upper reaches of the River Nith, and in this area, notwithstanding large areas of former open cast coal workings, are found the most fertile areas of farmland, patches of broadleaved and semi-natural woodland, lagoons and other wetlands (e.g. Knockshinnoch Lagoons Nature Reserve), along with smallholdings, farm steadings and other buildings. These features provide roosting opportunities for bats of all species potentially found on the site; and high value foraging habitat. The wider countryside is known to include hibernation roosts for several species (reported previously¹).

Mature broadleaved woodlands adjacent to the B741 were found to contain numerous cracks, cavities, splits, snag ends and other features which offer shelter and protection for roosting bats. Many bat species have very specific roost requirements in terms of preferred size, aspect and level of clutter surrounding roost access points, and included trees which were considered to have features suitable for all of the bat species which had previously been recorded at Enoch Hill^{1, 2}.

The results of bat roost assessment surveys from these woodland areas (all of which are located over 1.5km north of the proposed turbine envelope) are shown in Appendix A, Table A.1 and Figure 3.1. Of the 22 trees with roost potential, one supports a bat roost (category 1a) on the basis of the presence of a bat dropping and possible signs of wear. In addition 19 trees with high potential to support roosts (category 2a) and two with low potential (category 2b) were also recorded. Trees with no potential were not mapped.

Building surveys revealed a roost, assumed to be from pipistrelle species (i.e. common pipistrelle *Pipistrellus pipistrellus* or soprano pipistrelle *P. pygmaeus*) on the basis of the small size, the texture and the location of droppings observed, at Marshallmark (Afton Boarding Kennels) and anecdotal reports from a tenant¹¹ of bats roosting in a house at Dalleagles Terrace. It was not possible to survey the remaining buildings along the roadside therefore the roost potential category is unknown.

3.2 Bat activity surveys at met masts

The results of bat activity surveys at height are shown in Table B.1 in Appendix B.

The following species were recorded at the met masts:

¹¹ Casual conversation between Claire Hopkins and tenant of Dalleagles Terrace during bat surveys in July 2013.

- Common pipistrelle;
- Soprano pipistrelle;
- Leisler's bat; and
- Daubenton's bat (*Myotis daubentonii*).

In addition, calls which could only be attributed to genus level were also recorded from Pipistrelle species¹², *Nyctalus* species¹³ and *Myotis* species¹⁴ and as such, more species may be present than those listed above.

In general very low levels of bat activity were recorded at the met masts; a total of 255 bat passes were recorded across the survey period, of which 149 (58.4%) were at Littlechang Met Mast and 106 (41.6%) were at High Chang Hill Met Mast. These can be further divided into ground level (71 passes at Littlechang; 88 at High Chang Hill) and at height (78 passes at Littlechang and 18 at High Chang Hill). All of the passes recorded at height at Littlechang were recorded in July.

Bat activity was dominated by pipistrelle species with soprano pipistrelle accounting for 67% of the recorded activity (171 passes) followed by common pipistrelle (12.5%), pipistrelle species (9.4%), Leisler's (3.1%), *Nyctalus* (2.7%), Daubenton's (6%) and *Myotis* sp. (1.6%) with three unidentified bats (1.1%).

Further analysis has been carried out on the wind speeds at which bat passes were recorded at the met masts. The details of these analyses are shown in Appendix B, Table B.2. In summary the bats recorded at height were recorded at higher wind speeds than those recorded at ground level and although the sample size is very small, it can be seen that activity was recorded at relatively high wind speeds with activity being recorded at a maximum of 12.69m/s (common pipistrelle). Mean wind speeds were typically lower than 6m/s although most species/species groups were shown to be tolerant of flying at much higher speeds of over 10m/s (common and soprano pipistrelle).

3.3 Bat activity surveys at control sites

All three of the glen detectors were fully operational for the eight nights of deployment. The results of surveys are summarised in Appendix B.3.

A total of 2,545 bat passes were recorded between the three glen level detectors. Activity was dominated by soprano pipistrelle activity (84.3% of all activity) with common pipistrelle accounting for 11.4% and pipistrelle species 1.1%. In addition to Daubenton's bat (1.4%) and Leisler's bat (0.3%) another species – brown long-eared

¹² Note that Nathusius' pipistrelle calls are quite distinct from the other two pipistrelle species so are not included in this category.

¹³ *Nyctalus* species present in south west Scotland are Leisler's and noctule bat. Leisler's is thought to be the dominant *Nyctalus* species in this geographical area; and noctule has not previously been recorded at the Enoch Hill site.

¹⁴ *Myotis* species known to be present in south west Scotland are: Daubenton's bat (*M. daubentonii*), Natterer's bat (*M. nattereri*) and whiskered bat (*M. mystacinus*) – see also Amec 2012 report.

bat – was also identified from the calls, accounting for 0.1% of passes. *Myotis* species (1.0%) and *Nyctalus* species (0.2%) were also present.

Of the passes recorded, the majority were at Glen 3 (60.7%), followed by Glen 2 (33.1%) and Glen 1 (6.2%) and there was a high proportion of social calls and feeding buzzes compared with the met mast detectors.

3.4 Comparison of bat activity at glen level and on the site

This report details the results of the first studies comparing bat activity at met masts and control or reference sites at glen level. Notwithstanding the limitations detailed in Section 2.7 above, the following observations are notable in the context of a proposed wind farm development at Enoch Hill.

3.4.1 Bat activity at glen level is higher than observed at on-site met masts

Within an eight night period in September 2014, totals of 158 (Glen 1); 842 (Glen 2) and 1,545 passes (Glen 3), compared with three soprano pipistrelle passes at High Chang Hill Met Mast 1 and four soprano pipistrelle and a single unidentified pipistrelle bat pass at Littlechang Hill Met Mast 2 (ground level only). A combination of factors contribute to this discrepancy. The habitats present at glen level include broadleaved woodland, running water, linear vegetation, grassland and built environment; compared with habitats which are dominated by mire (blanket bog and marshy grassland) and upland acid grassland (see NVC report 2014¹⁵). From published information pertaining to bat foraging habitat preferences¹⁶ it is apparent that the types of habitats present at glen level are better suited for the foraging preferences of the species observed. Indeed a number of “feeding buzzes” (i.e. indicating foraging behaviour) were recorded during surveys, both on met masts and at glen level, however the proportion of feeding buzzes was notably higher at the glen detectors. Whilst the number of passes does not provide a reliable indication of the number of bats present (and indeed pipistrelle bats will forage in upland areas where insect prey is abundant and will often forage along a beat which involves repeated passes along the same feature¹⁷) the proportion number of feeding buzzes recorded on the glen detectors indicates that there is better foraging success there than on the upland areas.

3.4.2 Bat species composition at glen level is different than observed at on-site met masts

The species recorded at glen level were similar to those recorded on site, with the addition of brown long-eared bat which is a species which is morphologically and behaviourally adapted to life within woodland habitats. This

¹⁵ AMEC (2014). NVC Survey Report 2014. Prepared on behalf of E.ON Climate and Renewables.

¹⁶ E.g. Walsh, A.L. and Harris, S. (1996). Foraging habitat preferences of vespertilionid bats in Britain. *Journal of Applied Ecology* Vol. 33, pp. 508-518; and Dietz, C., von Helversen, O. and Nill, D. (2007). *Bats of Britain, Europe and Northwest Africa*. A&C Black, London.

¹⁷ Racey, P.A. and Swift, S.M. (1985). Foraging ecology of *Pipistrellus pipistrellus* (Chiptera: Vespertilionidae) during pregnancy and lactation. 1. Foraging behaviour. *Journal of Animal Ecology* 54, pp. 205-215.

species has not been recorded previously during surveys at the Enoch Hill site¹⁸ although it is known to be present in the wider area (see Amec Foster Wheeler, 2012¹).

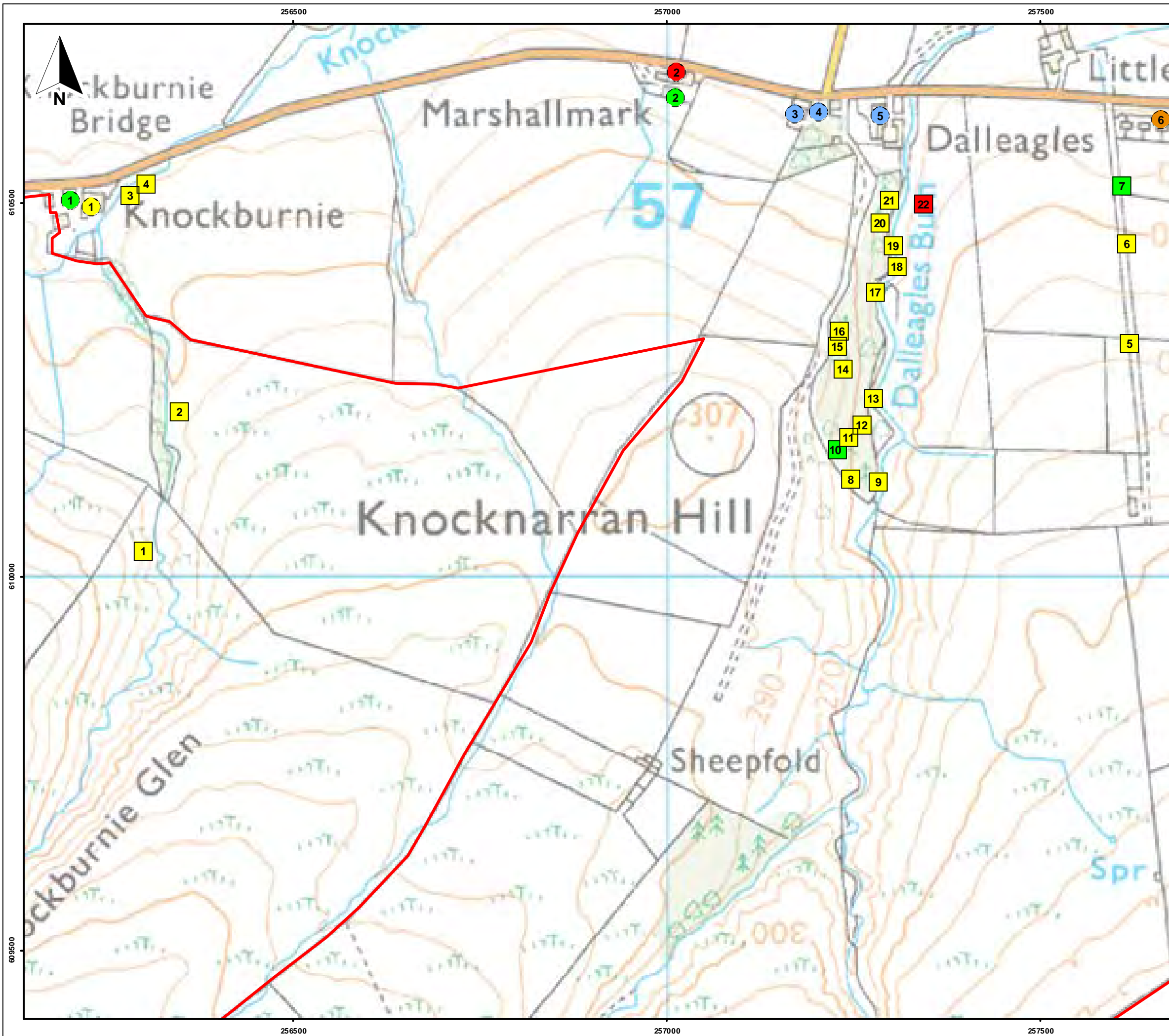
Bat activity at on-site met masts represents a sub-set of the activity recorded at glen level. Whilst the origin of individual bats recorded by detectors at on-site met masts cannot be definitively identified it is entirely possible, given the observed/documentated commuting distances of the species identified⁶, that the activity recorded at the two different locations may have been from the same individual bats.

3.4.3 There are roosts and potential roosts present within commuting distance of the site

The results reported in Section 3.1 above confirm the presence of roosts and potential roosts in trees and buildings within the survey area. Although the origin (in terms of day roosts and breeding sites) cannot be inferred from these surveys alone it cannot be refuted that there are no structures (i.e. buildings or trees) within the site which are suitable for supporting bat roosts, and the identified glen level survey area represents the closest such features to the site. There are no known barriers to bats commuting between glen level and upland habitats on the site (such as, for example, activity blackspots documented around radar installations¹⁹) and therefore it is considered likely that individuals seeking foraging areas may regularly fly up to the site to supplement their feeding resources.

¹⁸ It should be noted that brown long-eared bat has a very quiet call and can even navigate and forage without using echolocation calls, and is notorious for being under-recorded despite being common throughout the UK (see http://www.bats.org.uk/data/files/Species_Info_sheets/brownlongeared_11.02.13.pdf).

¹⁹ Nicholls, B. and Racey, P.A. (2007). Bats avoid radar installations: could electromagnetic fields deter bats from colliding with wind turbines? PLoS One 2(3): e297. Doi: 10.1371/journal.pone.0000297.



Key

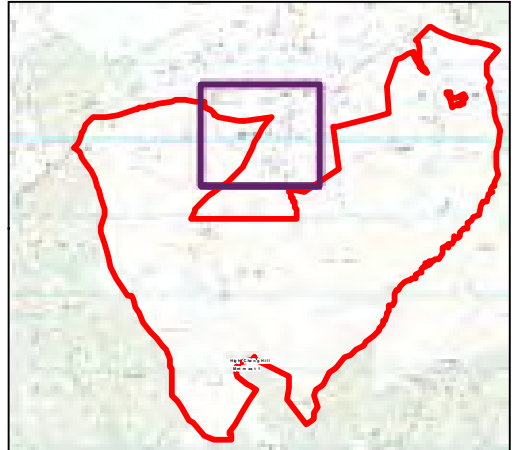
- Site boundary

Bat Roost Potential

- Confirmed Roost
- High
- Medium-High
- Low
- Unknown

Tree

- Confirmed Roost
- Medium-High
- Low



0 100 200 Metres
 1:25 000 @ A3
 Project Path: ShrewsburyG:\MODEL\PROJECTS\EA-210\32965
 GLA Enoch Hill Windfarm\ArcGIS\Figures

Enoch Hill Wind Farm
 Bat Survey Report 2014

Figure 3.1
 Bat Roost Assessment Survey Results

Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright. 100001776

4. Conclusions and Recommendations

Whilst not identifying the species or number of bats involved, the roost surveys served to indicate that potential does indeed exist in the Nith Glen within commuting distance of all bat species identified within the site. Also, whilst not representing the highest value of habitats used by foraging bats, the upland moorland, bog and wetland habitats present on the site along with sheltered riparian areas (e.g. tributaries of Dalleagles Burn, Straid Burn and Connel Burn) and woodland edges at the boundaries of the site, provide foraging areas which are evidently used regularly by a number of species, including high risk Leisler's bats.

Bat activity data observed and reported in 2013 (Amec E&I UK Ltd, 2014) demonstrated that the highest proportion of activity (in terms of the number of bat passes) was in mid-late summer, and this period was represented by on-site detector surveys at two met masts during the 2014 surveys. Although spring was not represented in 2014 the 2013 data suggest that the bat activity patterns on the Site are much lower at that time of year. Recorded bat activity for the July-December period in 2014 indicated higher numbers of bat passes during the summer period than the autumn period and this would fit with the activity patterns of the observed bat species documented in scientific literature quoted elsewhere in this report. As such it is considered that the highest risk of turbine collisions would be expected to take place in July-August.


Anecdotal evidence from a local bat expert (John Haddow) indicates that Leisler's bats tend to be tree-roosting and also tend to forage within 4km of the roost (based on radiotracking studies carried out in south west Scotland)



It is considered that a robust quantity of data have been collected on site at Enoch Hill since 2012 and the subsequent reports provide detailed interpretation of the observed bat activity and behaviour on and adjacent to the site. Whilst the bat activity levels at the met masts, and particularly at height - are relatively low, resulting in small sample sizes on which to base analyses of observed bat activity in relation to wind speed, the 2014 data indicate that most bat activity takes place at wind speeds of less than 6m/s.


Appendix A


Bat roost surveys 2014



Table A.1 Bat roost assessment - trees



Tree target note	Location	Grid reference	Description	Photograph
1	Knockburnie	NS 56299 10035	<p>Two mature ash trees on steep-sided Knockburnie Glen. Large hollow in trunks, and knot holes visible from ground but no signs of bats.</p> <p>Roost category: 2a (medium-high potential)</p>	


Tree target note	Location	Grid reference	Description	Photograph
2	Knockburnie	NS 566348 10221	<p>Large mature ash in a clearing adjacent to Knockburnie Burn and on west bank. Patches of damaged bark and wounds including one with hole all the way through.</p> <p>Roost category: 2a</p>	
3	Knockburnie	NS 56281 10511	<p>Huge mature ash adjacent to house and road. Large hole in trunk at 10m, cracked bark and knot holes (covered with cobwebs at time of survey) east-facing onto burn.</p> <p>Roost category: 2a</p>	
4	Knockburnie	NS 56303 10526	<p>Another large mature ash tree with knot holes and hollows under branches. High potential for roosting.</p> <p>Roost category: 2a</p>	No photograph.



Tree target note	Location	Grid reference	Description	Photograph
5	Track above Dalleagles Terrace	NS 57619 10313	Small ash tree with hole in branch at 2.5m. Roost category: 2a	



Tree target note	Location	Grid reference	Description	Photograph
6	Track above Dalleagles Terrace	NS 57616 10446	<p>Hawthorn tree with rotten section of main trunk.</p> <p>Roost category: 2a</p>	


Tree target note	Location	Grid reference	Description	Photograph
7	Track above Dalleagles Terrace	NS 57610 10524	<p>Large mature ash tree on track with rope hanging from low branch. Small knot holes and flaking bark with some potential.</p> <p>Roost category: 2b (low potential)</p>	
8	Dalleagles Wood	NS 57246 10131	<p>Large dead tree with stress fractures, hazard beams, flaking bark and rotting snag ends on woodland edge.</p> <p>Roost category: 2a</p>	


Tree target note	Location	Grid reference	Description	Photograph
9	Dalleagles Wood	NS 57283 10128	<p>Mature ash with lots of wounds and cavities on main trunk approx. 7-9m up. Located in middle of wood near old wall.</p> <p>Roost category: 2a</p>	
10	Dalleagles Wood	NS 57228 10171	<p>Large mature beech on steep bank. Broken limb has a split suitable for roosting although may close up if branch moves.</p> <p>Roost category: 2b</p>	


Tree target note	Location	Grid reference	Description	Photograph
11	Dalleagles Wood	NS 57244 10187	<p>Dying sycamore, simple trunk with knot hole approx.8m up. Adjacent to beech with two trunks entwined and cavity between them.</p> <p>Roost category: 2a</p>	


Tree target note	Location	Grid reference	Description	Photograph
12	Dalleagles Wood	NS 57261 10204	<p>Stress fractures in main trunk and large branch on part-fallen larch by Dalleagles Burn.</p> <p>Roost category: 2a</p>	
13	Dalleagles Wood	NS 57277 10239	<p>Two standing dead ash trees on river bank with ubiquitous peeling bark on main trunk and branches</p> <p>Roost category: 2a</p>	



Tree target note	Location	Grid reference	Description	Photograph
14	Dalleagles Wood	NS 57236 10279	Stress fracture in main branch of mature larch approx. 10m up. Roost category: 2a	
15	Dalleagles Wood	NS 57228 10309	Split and hole in small branch approx. 3.5m high on mature beech adjacent to western edge of wood near the track. Roost category: 2a	

Tree target note	Location	Grid reference	Description	Photograph
16	Dalleagles Wood	NS 57231 10329	<p>Small mature ash with wounds leading to small cavities in trunk</p> <p>Roost category: 2a</p>	

Tree target note	Location	Grid reference	Description	Photograph
17	Dalleagles Wood	NS 57279 10381	<p>Mature oak tree with exposed section of trunk revealing rotting heartwood. Twisted and folded branches and snag ends also present.</p> <p>Roost category: 2a</p>	

Tree target note	Location	Grid reference	Description	Photograph
18	Dalleagles Wood	NS 57308 10416	<p>Mature oak with branch sticking out to north with long split/crack offering roost potential.</p> <p>Roost category: 2a</p>	

Tree target note	Location	Grid reference	Description	Photograph
19	Dalleagles Wood	NS 57303 10443	<p>Mature larch with 5m vertical split in trunk.</p> <p>Roost category: 2a</p>	

Tree target note	Location	Grid reference	Description	Photograph
20	Dalleagles Wood	NS 57286 10474	Thin mature hazel with small hole at 2m. Roost category: 2a	
21	Dalleagles Wood	NS 57299 10505	Large woodpecker hole approx. 10m up in mature ash tree. Roost category: 2a	







Tree target note	Location	Grid reference	Description	Photograph
22	Dalleagles Wood	NS 57344 10500	<p>Large mature Scots pine on eastern bank of Dalleagles Burn. Large hollow branch at 1.5m and visible hazard beams and knot holes further up. Bat dropping visible beneath hazard beam on northern side and possible signs of wear.</p> <p>Roost category: 1a (current roost confirmed)</p>	

Table A.2 Bat roost assessment - buildings

Building/group target note	Location	Grid reference	Description	Photograph
1	Knockburnie Farm	NS 56229 10496	<p>Stone farm buildings with pitched slate roofs. Hanging tiles visible which have potential to provide access to cavities between roof and attics.</p> <p>Roost category: 2a</p> <p>More recent brick buildings adjacent to the farm have lower potential.</p>	

			<p>Roost category: 2b</p> <p>Anecdotal report from landowner (Mrs. Laurie) that bats are often seen flying around the trees adjacent to the house; and there was a bat [species not known] in the lounge a number of years previously.</p>	
2	Marshallmark (Afton Boarding Kennels)	NS 57013 10676	<p>Stone whitewashed cottage with pitched slate roof and Velux-style windows. Bat roost (pipistrelle species) present on the south-facing side of the building, as evidenced by small number of droppings on the wall below gutter.</p> <p>Roost category: 1a</p> <p>Adjacent kennels and brick outhouse have corrugated metal roofs and have lower roost potential.</p> <p>Roost category: 2b</p>	

3	Farm house	NS 57172 10620	<p>Red stone building with slate roof. No detailed survey undertaken.</p> <p>Roost category: Unknown</p>	
4	Enoch Bank Cottage	NS 57203 10623	<p>Bungalow of modern construction. No detailed surveys undertaken.</p> <p>Roost category: Unknown</p>	
5	Dalleagles Farm	NS 57286 10618	<p>Stone whitewashed farm house and outbuildings with slate roofs. No detailed surveys undertaken.</p> <p>Roost category: Unknown</p>	

6	Dalleagles Terrace	NS 57661 10613	<p>Row of four terraced semi-detached cottages in rendered brick with pitched tile roofs.</p> <p>Bats observed flying around the cottages in 2013 during surveys (pers. Obs. C. Hopkins) and homeowner of one of the buildings stated that they had a bat roost in the house.</p> <p>Roost category: 1b</p>	
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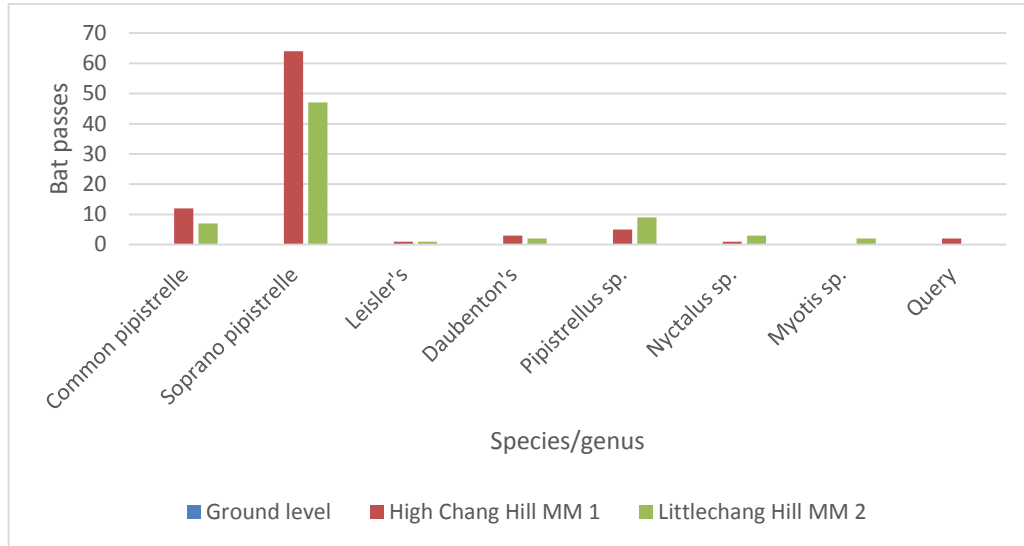


Appendix B Bat activity data

Table B.1 – Bat passes at ground level and at height for Enoch Hill and Littlechang Hill

	Common pipistrelle	Soprano pipistrelle	Leisler's	Daubenton's	Pipistrellus sp.	<i>Nyctalus</i> sp.	<i>Myotis</i> sp.	Query	Total
Ground level									
High Chang Hill MM 1	12	64	1	3	5	1	0	2	88
Littlechang Hill MM 2	7	47	1	2	9	3	2	0	71
Height									
High Chang Hill MM 1	3	8	5	0	2	0	0	0	18
Littlechang Hill MM 2	10	52	1	1	8	3	2	1	78
Total	32	171	8	6	24	7	4	3	255

Graph B.1 – Species composition of bat activity at ground level



Graph B.2 – Species composition of bat activity at height

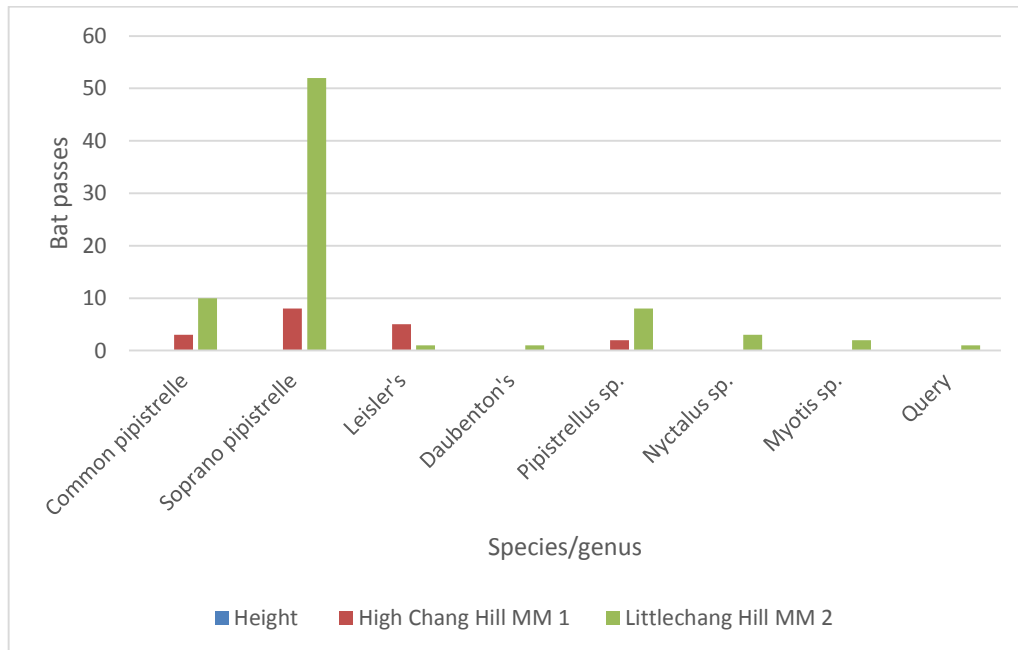




Table B.2 At-height bat activity data across the entire survey period

		High Chang Hill Met Mast		Littlechang Hill Met Mast	
GROUND LEVEL	n	Mean wind speed (m/s)	Max wind speed (m/s)	Mean wind speed (m/s)	Max wind speed (m/s)
Common pipistrelle	19	4.03	7.53	3.85	8.31
Soprano pipistrelle	102	5.13	9.24	4.87	8.79
Daubenton's bat	4	3.17	4.92	3.19	4.59
Leisler's bat	2	4.27	5.48	4.30	6.19
<i>Myotis</i> sp.	2	4.76	5.67	3.01	3.91
<i>Nyctalus</i> sp.	4	3.83	6.94	3.47	7.72
Pipistrelle species	13	4.87	6.67	3.86	7.24
Query	2	5.74	6.06	5.13	6.29
HEIGHT					
Common pipistrelle	11	4.24	12.69	3.88	10.38
Soprano pipistrelle	55	5.87	12.3	5.60	10.43
Daubenton's bat	1	6.71	6.71	6.23	6.23
Leisler's bat	5	3.00	4.87	2.93	5.61



		High Chang Hill Met Mast		Littlechang Hill Met Mast	
GROUND LEVEL	n	Mean wind speed (m/s)	Max wind speed (m/s)	Mean wind speed (m/s)	Max wind speed (m/s)
<i>Myotis</i> species	2	6.51	6.52	5.93	5.99
<i>Nyctalus</i> sp.	2	5.34	5.99	4.01	4.80
<i>Pipistrelle</i> sp.	9	5.11	7.99	5.41	7.72
Query	1	1.41	1.41	1.83	1.83

Table B.3 Glen bat activity – weather conditions

	Wind speed*	Relative humidity	Temperature
16-17 September	5.1	13.2	10.4
17-18 September	5.0	14.1	12.2
18-19 September	7.2	14.0	12.8
19-20 September	2.5	12.7	11.8
20-21 September	3.2	11.3	7.3
21-22 September	5.1	11.4	8.1
22-23 September	5.1	11.3	10.3



23-24 September	7.4	9.6	8.8
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*The weather conditions experienced during the glen detector surveys were for moderate wind speeds, low relative humidity and low-average temperatures, although it should be noted that the data were taken from the Littlechang met mast which is at higher altitude and more exposed than the detector locations themselves; the actual observed wind speeds are anticipated to have been marginally lower and temperatures higher.

Appendix 11.F

Fisheres Baseline Report

Enoch Hill Wind Farm

1. FISHERIES BASELINE STUDY

1.1 Introduction

This report sets out a description of the fisheries baseline conditions found within the river catchments potentially affected by the proposed Enoch Hill Wind Farm.

The majority of the proposed Enoch Hill Wind Farm study area (taken as the area within the red line boundary) is situated within the River Nith catchment (Consultation Figure ref.32965 Gla033.wor doggt). Only the tip of two headwaters (Bitch Burn and Strathwiggan Burn) belong to the River Dee catchment, with these watercourses being located along the southern edge of the study area. All of these watercourses are within the Solway Tweed River Basin District.

1.2 River Nith Catchment

1.2.1 Catchment Description and Management

The River Nith has a catchment area of approximately 1,556 km². With its source starting off in the forestry of Prickeny Hill, Logan Hill and Scaur Hill close to Carsphairn, the river journeys a length of approximately 98 km through Dumfries and Galloway and then enters into the Solway Firth at Glencaple Village, south of Dumfries. The management of the migratory salmonid species present in the catchment is undertaken by the Nith District Salmon Fishery Board (NDSFB). Both the Atlantic salmon (*Salmo salar*) and sea trout (*Salmo trutta*) populations are economically important, although some of the non-salmonid species also provide good angling (e.g. grayling (*Thymallus thymallus*) and pike (*Esox lucius*)). Recreational angling takes place downstream from the study area and the New Cumnock Angling Association is the local fishing organisation. Over the last four years, Atlantic salmon populations within the catchment have been in decline, with the sea trout populations having also been in decline when compared to 2003. The River Nith is listed as one of the top ten in Scotland for salmonid production.

The Nith Catchment Fishery Trust (NCFT) was set up in 2009 by the NDSFB and the NCFT assists in the management, education and conservation of all fish species within the River Nith catchment. In 2008, the River Nith Catchment Fishery Management Plan set out the proposed management activities that were identified in order to maintain and improve the fishery. This document was recently reviewed in 2013. A hatchery is in operation on the Nith catchment and restocking of salmon and sea trout takes place within the river system. Through consultation with the NDSFB¹, stocking is confirmed to have taken place in this area previously: NDSFB has been involved in the stocking of the Connel Burn in recent years and New Cumnock Angling Association has conducted stocking of trout in the area.

Water quality issues exist in the catchment area due to the presence of surface coal mining.

¹ Email correspondence between Anita Hogan (AMEC) and Jim Henderson (NDSFB) dated 09/09/2013.

1.2.2 Desk-based Study

Scottish Natural Heritage's Sitelink website indicates that there are no statutory nature conservation designated sites within the study area or within the surrounding water catchment area. The Solway Firth is designated as a Special Area of Conservation (SAC), with qualifying features of interest comprising mainly marine features, but also including sea lamprey (*Petromyzon marinus*) and river lamprey (*Lampetra fluviatilis*). This site is considered to be too far away for any potential impact upon the River Nith headwaters to have any effect upon this European designated site.

SEPA's river basin interactive mapping does not classify most of the tributaries within this catchment that are present within the study area. Only Knockburnie Burn is classified, being given a status of 'good'. Knockburnie Burn merges with Lane Burn, where classification status changes to 'moderate', then flows into the main River Nith where water classification remains at 'moderate' until Sanquhar. It then becomes of 'good' status for the remainder of the way to Dumfries.

A search of the Scotland's Environment interactive mapping facility does not highlight any known fish migration barriers within the River Nith or the tributaries present within the study area. The information on the NDSFB website also shows that salmon have been caught and sampled in the Upper Nith as part of a salmon genetic research project so this information would suggest that the River Nith tributaries within the site boundary are likely to support salmonid populations and depending upon habitat quality, could also support brook lamprey (*Lampetra planeri*) and European eel (*Anguilla Anguilla*).

General notes on each individual watercourse within the study area and their associated habitats were recorded during protected species surveying (AMEC, 2013²). No barriers to fish passage were identified, although small series of waterfalls are present on some of the tributaries (Dalleagles Burn and Knockburnie Burns). One tributary, Redhall Burn, has a small pond feature associated with it. All were determined as comprising suitable salmonid juvenile habitat, although some may contain pockets of gravel also suitable for spawning and redd construction.

The NDSFB Fisheries Management Plan and website describe the species of fish present within the river system as including Atlantic salmon, sea trout, brook lamprey, sea lamprey, brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), grayling, pike, perch (*Perca fluviatilis*), tench (*Tinca tinca*), bream (*Abramis brama*), stone loach (*Barbatula barbatula*), minnow (*Phoxinus phoxinus*), European eel and stickleback species (Gasterosteidae). Invasive non-native species are present in the catchment and include the North American signal crayfish (*Pacifastacus leniusculus*) which has been recorded recently within a loch in the lower section of the catchment.

1.2.3 Electrofishing Data

The NDSFB hold electrofishing data of relevance to the study area, spanning the period of 2008 to 2012 (Email consultation, dated 09/09/2013).

² AMEC (2013). Enoch Hill Wind Farm. Protected Species (2013) Baseline Report. Draft Report. November 2013.

1.3 River Dee Catchment

1.3.1 Catchment Description and Management

The River Dee, River Ken and Water of Deugh are the main rivers that make up the Kirkcudbrightshire River Dee system, which has a catchment area of approximately 1,036 km². With its source starting off in the Merrick Hills, the Rhinns of Kells and the Glenkens, the river journeys a length of approximately 80 km through Dumfries and Galloway and then enters into the Solway Firth at Kikcudbright. Both the Bitch Burn and Strathwiggan Burn are located within the upper catchment, flowing into the Water of Deugh, which in turns flows through Kendoon Loch, then Loch Ken further downstream, into the Water of Ken and then into the main stem of the River Dee, eventually flowing out into the sea at Kirkcudbright.

The management of the migratory salmonid species present in the catchment is undertaken by the Dee District Salmon Fishery Board (Kirkcudbrightshire) (DDSF). The Galloway Fisheries Trust (GFT) also has an interest in the River Dee catchment. The GFT is a charitable organisation which was formed in 1988, by a number of neighbouring District Salmon Fishery Boards in Dumfries and Galloway. The aim of the GFT is to undertake research, provide advice and complete practical works to protect and enhance aquatic biodiversity, particularly fish species, living in the freshwaters across Dumfries and Galloway. A hatchery is in operation on the Dee catchment.

1.3.2 Desk-based Study

SEPA's river basin interactive mapping does not classify Bitch Burn or Strathwiggan Burn, but the Water of Deugh which Bitch Burn flows into is classified as 'heavily modified' and of 'bad ecological potential'. Pochriegavin Burn, which Strathwiggan Burn flows into, is classified as being of 'moderate' status. Pochriegavin Burn flows into the Water of Deugh downstream of Bitch Burn.

A search of the Scotland's Environment interactive mapping facility suggests the presence of an impassable, man-made barrier to fish at Glenhoul on the Water of Deugh. This would result in Atlantic salmon and sea trout not being able to naturally migrate further upstream from this point. A hatchery is in operation on the Dullarg Burn and stocking activity takes place, however, above this is an impassable structure, so some populations of stocked salmonids may be present, albeit in limited densities. The exact frequency and location of stocking activity is currently unknown. Local populations of brown trout are likely to be present within the Bitch Burn and Strathwiggan Burn.

Consultation with the Galloway Fisheries Trust's website indicates that the North American signal crayfish is abundant within Loch Ken (further down the Dee catchment) and its feeder burns. This is an invasive, non-native aquatic species and is recorded as having a detrimental effect upon the natural fish populations within the Dee catchment, particularly Loch Ken, through predation, competition for habitat and erosion from borrowing into banks.

European eel are reported to be absent from the Dee catchment, with an Eel Management Plan in place to try and restore eel to the catchment, primarily by adapting existing salmonid fish ladders and other migration barriers to allow eels to migrate into the catchment. European eel are also caught below the Tongland Dam and transported further upstream.

1.3.3 Electrofishing Data

As no migratory fish (e.g. salmon or European eel) are naturally present within the study area or upstream of the fish barrier at Glenhoul, electrofishing data would be of limited value to this study. It is not anticipated that electrofishing data for stocked fish and for brown trout would need to be obtained and impact assessment work would proceed on the basis that brown trout are the only aquatic species that may be present and of interest.

1.3.4 Consultations

The Association of Salmon Fishery Boards (ASFB) was contacted by the Scottish Government as part of the Scoping process, but did not respond.

Marine Scotland Science's Freshwater Laboratory was also consulted as part of the scoping process and provided a response to the Scottish Government. Marine Scotland Science provided details of their remit, useful sources for information and guidance documents, requested that all relevant District Salmon Fishery Boards were consulted and that if salmonids and economically valuable fish species and populations would be impacted upon then a programme of monitoring works would be required. They also requested site-specific baseline information to be included in the ES and if this was not of a detailed level then fisheries survey work would be requested by Marine Scotland Science.

The GFT submitted a response to the Scottish Government in February 2013 with respect to the Enoch Hill Wind Farm Scoping Report. GFT were commenting in this instance on behalf of the Kirkcudbrightshire Dee District Salmon Fishery Board (DDSFB), upon whose jurisdictional area the Proposed Development borders. GFT do not cover the River Nith catchment. At this time the GFT requested further information on the wind farm infrastructure layout and advised that if all construction activity remains out with the Kirkcudbrightshire Dee catchment (namely the Prickeny Burn, Strathwiggan Burn and Bitch Burn catchments) then GFT are happy that there is minimal impact on the Kirkcudbrightshire Dee.

1.4 Conclusions

It is likely that the River Nith tributaries present within the study area contain suitable habitat for spawning and juvenile Atlantic salmon, sea trout and brown trout, along with potential for some of the other coarse fish species to be found within the River Nith. European eel may also be found in these waters. As the economic value of the River Nith fishery was valued in 2012 as worth £2 million, all of the key species are potentially present within the site boundary and the site boundary is likely to provide key juvenile and spawning habitat, these are considered to be important watercourses in terms of fisheries interest.

Based upon the SEPA classification data, the River Dee tributaries within the site boundary are considered to be of poorer water quality and lacking natural populations of migratory salmonids. It is possible that some stocked populations are present and local populations of brown trout will also be present. The Bitch Burn and Strathwiggan Burn are not considered to be important watercourses in terms of fisheries interest.

Table 1 sets out the fish species likely to be present within the various tributaries that are within or immediately out with the Proposed Development. The nature conservation value for each receptor is also listed.

Table 1 Value of Aquatic Ecology Receptors and Distribution

Watercourse	Aquatic Receptor	Ecology	Nature Value	Conservation	Note
River Nith					
Connel Burn Polga Burn Blarene Burn Redhall Burn Straid Burn Dalleagles Burn Trough Burn Crocraie Burn Catlock Burn Littlechang Burn Polmath Burn plus minor unnamed tributaries	Atlantic salmon Sea trout Brown trout Brook lamprey Rainbow trout Grayling Pike Perch Tench Bream European eel Stone loach Minnow Stickleback		National National District District District District District District District District District Local Local Local		Water quality is unknown as SEPA does not monitor or classify these tributaries. No known impassable barriers to fish migration, good habitat present for juvenile fish and spawning activity.
Knockburnie Burn Spout Burn	Atlantic salmon Sea trout Brown trout Brook lamprey Rainbow trout Grayling Pike Perch Tench Bream European eel Stone loach Minnow Stickleback		National National District District District District District District District District District Local Local Local		Watercourse is classified as good status. No known impassable barriers to fish migration, good habitat present for juvenile fish and spawning activity.
River Dee / Water of Deugh					
Bitch Burn	Brown trout Potential Atlantic salmon (stocked)		District District		Impassable natural features recorded downstream.
Strathwigin Burn	Brown trout Potential Atlantic salmon (stocked)		District District		Impassable natural features recorded downstream.

1.5 Constraints Identification / Site Specific Design Mitigation

- Ensure that no crossing of the Bitch Burn is required in order to access turbines 11 and 12 and that an appropriate buffer zone is applied around this burn and associated wet area (minimum of 50m buffer zone recommended as requested by

Marine Scotland Science). This will ensure that the GFT remain happy that there will be minimal impact upon the River Dee catchment arising as a result of construction;

- Apply a standard 50 m buffer zone around all tributaries and watercourses within the study area that are part of the River Dee catchment;
- A greater buffer should be placed around the tributaries within the River Nith catchment due to salmonid sensitivities. A buffer of 100m as opposed to 50m is suggested. Under current design layout, this would apply to Connel Burn, Trough Burn, Catlock Burn, Littlechang Burn and Knockburnie Burn). This would affect three proposed turbines, with Turbines 7, 17 and 19 would need to be resited;
- Minimise crossings of mapped tributaries on River Nith catchment. The completion of fish habitat surveys should be undertaken for watercourse crossings on the River Nith catchment to allow placement of crossings in suitable areas, avoiding key spawning gravels and fry emergence habitat;
- Where river crossings are proposed the Scottish Executive guidance “River Crossings and Migratory Fish” (2000) <http://www.scotland.gov.uk/Topics/marine/science/Publications/publicationslatest/rivercrossings> should be consulted in addition to SEPA’s “Engineering in the Water Environment Good Practice Guide Construction of River Crossings” (http://www.sepa.org.uk/water/water_regulation/guidance/engineering.aspx).

1.6 Further Recommendations

- Purchase of electrofishing data from NCFT/NDSFB to further inform ES;
- Salmonids, European eel and potentially brook lamprey are present in the watercourses within the study area and immediately downstream. Pre, during and post-construction monitoring programme should be drawn up and agreed with the NDSFB, GFT / DDSFB and Marine Scotland Science. This should include electrofishing, macroinvertebrate and water quality monitoring. The monitoring is unlikely to need to include the Dee catchment if the design layout avoids Bitch Burn. A commitment to produce a Monitoring Plan needs to be included within the Environmental Statement and any Habitat Management Plan that may be produced.

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Appendix 11.G

Electrofishing Baseline Survey Report

**Electrofishing Survey
To Assess Juvenile Salmonid Populations
And Other Species of Fish
In Watercourses In The Vicinity Of
The Proposed
Enoch Hill Wind Farm**

**Volume 1
Summer 2014
Baseline survey**



**Commissioned by
AMEC**

**Survey undertaken by
J. Henderson
Director**

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Cover photograph
Brown trout from Dalleagles Burn (Site 15)

1 Introduction

1.1 Background

The River Nith is a river of major importance as a salmon and sea trout fishery, and is the largest river in south west Scotland. It has its source in Ayrshire and flows through Dumfriesshire, spanning approximately one hundred kilometres to its estuary in the Solway Firth, a total catchment area of 1200 square kilometres (SEPA, 2005).

The annual catch of migratory salmonids is of significant economic importance to this rural area. An economic survey has been conducted and that revealed that the Nith accounts for £ 2.2 million being spent in the local economy (Leslie, 2000). There are net fishing interests in the estuarial reaches, with Haaf netting a commonly used method. There are a range of fixed nets on the western boundary, still within the Nith District Salmon Fishery Board area of jurisdiction. Angling is widespread over most of the main stem and some larger tributaries of The Nith. Net fishing and angling produced a joint catch of 1617 salmon and grilse and 903 sea trout during 2012 (Marine Scotland, 2013).

1.2 Nith District Salmon Fishery Board (NDSFB)

The NDSFB is a statutory body constituted under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003, tasked with the management of migratory salmonid species within their catchment area. The Board is empowered to conduct works and execute measures to safeguard, improve and enhance stocks of migratory salmonids within its jurisdictional area. The NDSFB has no remit to manage non-migratory species other than with the permission of riparian owners and only where management of these species would be deemed to be in the furtherance of migratory species. The NDSFB is active and works in areas of fisheries protection, restocking hatchery programmes, habitat restoration and predator control (NDSFB, 2013).

1.3 E.ON

E.ON is the company that are proposing to construct a wind farm at Enoch Hill near to the town of New Cumnock in East Ayrshire, South West Scotland. Whilst these proposals are at an early stage, E.ON and their consultants AMEC are in the process of gathering the necessary information required to further their proposals. The consultation process and environmental information that has to be gathered to support a wind farm proposal is considerable due to the nature of these projects and the environments in which they are located. NDSFB was consulted by AMEC in relation to the Enoch Hill proposals due to their status as a statutory fisheries management organisation having jurisdiction over the foot print of the proposed wind farm.

1.4 Enoch Hill Wind Farm

The site at Enoch Hill, where it is proposed to construct a wind farm, is utilised for agricultural purposes and would be considered as "hill ground" suitable for rough grazing. The neighbouring land to the west and south of the Enoch Hill site is utilised for commercial coniferous forestry purposes. In an attempt to improve the quality of the land and its potential for both agriculture and forestry, the ground on Enoch Hill and the surrounding area has undergone extensive drainage in the past. On Enoch Hill this has taken the form of ditches being dug at regular intervals across the hillside taking account of the contours of the land. These ditches have performed their desired function and drawn water, focusing it into the manmade channels but in reality they have created the start of permanent channels which ultimately form the source of many of the small tributaries of the River Nith.

The Enoch Hill site is subject to heavy rain fall and is traversed by many small watercourses, most of which drain to the River Nith catchment. Some of these watercourses are known to contain fish and all have the potential to convey adverse environmental impacts down catchment. In discussions between AMEC and NDSFB it was considered appropriate to conduct electrofishing surveys to establish baseline fisheries data during the summer of 2014.



Lamprey found at Site 19 in the Lane Burn

2 This Study

2.1 Aims

This study set out with the following aims:

- (a) To utilise a replicable and efficient capture technique for all species of fish, suitable for the watercourses within the vicinity of the proposed Enoch Hill Wind Farm site and surrounding catchment.
- (b) To assess juvenile salmonid population densities, up catchment, downstream and near to the site of proposed construction of the wind farm and associated road infrastructure, pre-construction.
- (c) Conduct habitat surveys of proposed crossing points for the wind farm road infrastructure.
- (d) To note all species of fish captured during the course of electrofishing operations.
- (e) To produce data to assist in the environmental policy, considerations and safeguards which may be implemented for the general protection of the watercourses in the vicinity of the proposed wind farm, its road infrastructure and ultimately the River Nith catchment or its environs.
- (f) To make recommendations on how best this construction project can be completed with minimal impacts on all species of fish, from an informed position, based on facts.

2.2 Feasibility

In order to accurately survey numbers of juvenile salmonids present in the vicinity of the Enoch Hill wind farm site, this study had to take account of the time of year when electrofishing was conducted, and the height of water and general conditions at time of survey. For these reasons the survey was conducted during the summer to ensure efficiency of capture was optimum.

2.3 Site Selection

This study conducted electrofishing surveys on watercourses within the catchment of the proposed wind farm site. The sites were selected according to their location in relation to any potential run off from the wind farm site during the construction phase and where possible, sites were selected above and below the confluence of two watercourses. Control sites were also surveyed as part of this study. The electrofishing sites were chosen for their accessibility and their habitat containing “typically” juvenile salmonid riffles (see appendices 1 & 2 for electrofishing survey site map and site photographs).

3 Methods

3.1 Equipment

3.1.1 *Electrofishing apparatus*

The generator used was a 5.5 horse power petrol driven model specifically designed for electrofishing. This was linked to an *Electracatch International* controller unit (WFC6-HV). This equipment was used to supply a smooth direct current to the anode, and was set at 200 volts at each site fished. The electrofishing apparatus used was accompanied by a current PAT test certificate and had undergone its daily safety check. The control unit was linked to a stationary cathode of braided copper (placed in the stream) and one mobile anode, which consisted of a two metre pole with a stainless steel ring (used to draw fish) and an operator controlled switch (see appendix 3, photograph 1).

3.1.2 *Ancillary equipment*

A banner net and dip nets with 1.3 metre handles attached were used to capture stunned fish. Conductivity and temperature was recorded at each site using an Extech ExStikII Conductivity/TDS/Salinity meter. Due to the location of some of the sites and the wet ground conditions a Honda 4X4 All-terrain Vehicle was used for access (see appendix 3, photograph 2). The appropriate qualifications were held by the members of staff driving the vehicle.

3.1.3 *Personnel*

To conduct this electrofishing survey, NDSFB utilised the services of their own staff. They are qualified and experienced in the use of electrofishing equipment and capable of conducting such research. The Scottish Fisheries Co-ordination Centre (SFCC) protocol for electrofishing was adhered to throughout this survey.

For their personal protection all personnel wore floatation vests and waders. All personnel could swim. All members of the team were qualified in first aid, and first aid equipment was available in the Fishery Board vehicle present throughout the survey.

3.2 Techniques

3.2.1 *Electrofishing methodology*

To accurately assess the population of juvenile salmonids in sites, located upstream, downstream and within close proximity of the Enoch Hill Wind Farm site, a method of electrofishing was adopted which could efficiently capture the appropriate age classes of these species. The method adopted entailed selecting natural features on the river which provided boundaries to each electrofishing site. Features such as shallow riffles at the top and bottom of a section of river were typically utilised. Once a site had been selected, the electrofishing team systematically worked from downstream to upstream following a carefully agreed pattern removing all fish caught. Working in an upstream direction prevents any sediment, caused by wading in the river, from obscuring the working area (see appendix 3, photograph 3).

The anode operator was able to draw stunned fish downstream, assisted by the current, towards the banner net which was lifted clear of the water after each sweep, to permit the removal of captured fish for transfer into water-filled buckets.

This method of capture for salmonids also captured all other species present in the sites. All fish were returned, unharmed to their original capture sites on completion of examination and data recording.

3.2.2 *SFCC Habitat Survey methodology*

Habitat surveys were carried out in accordance with the Scottish Fisheries Co-ordination Centre habitat survey methodology (SFCC 2007). The stretch identified on each burn was surveyed and the following information was recorded: upstream and downstream GPS points, length surveyed, altitude, water level, channel width data, water depth, substrate types, channel characteristics, flow types, riparian vegetation, spawning areas and obstructions. From this information productive habitat can be identified as well as unproductive areas and obstructions to fish passage.

3.3 **Data Recording**

All fish captured were removed from the survey sites, placed in water-filled buckets and allowed to recover from the temporary stunning effects of electrofishing. They were anaesthetised, using (Benzocaine solution – Ethyl 4 – Aminobenzoate), dissolved in Acetone, then examined and data was recorded (see section 4). The area electrofished at each site was measured and recorded. A global positioning system was employed to record the exact location of each site. A conductivity/temperature meter was used to record data at each site (see appendix 4). This data is useful when assessing water quality and suitability for fish.

All sites were photographed to provide an accurate record of conditions at the time of survey (see appendix 2). Photographs can also be used to assess the quality of each site with regard to its potential as a salmonid habitat i.e. a record of vegetation present within the riparian zone at each site.

3.3.1 *Salmonid species*

Salmonid species were counted and recorded as:

Salmon fry (O⁺) which refers to a young fish less than one year old, resulting from spawning at end of 2013.

Salmon parr (1⁺) which refers to a young fish which is older than one year old, resulting from spawning at end of 2011/2012.

Trout fry (O⁺) which refers to a young fish less than one year old, resulting from spawning at end of 2013.

Trout parr (1⁺) which refers to a young fish which is older than one year old, resulting from spawning at end of 2011/2012, or earlier in the case of larger specimens.

Age determination of salmonids has been assessed by the length of individuals captured from each fishing site (see appendix 3, photograph 4).

3.3.2 *Non salmonid species*

The presence of non salmonid species was recorded at each survey site and population densities were recorded.

4 Results Of Baseline Electrofishing Surveys 2014

Watercourse	Site code	Location	Easting	Northing	Sampling date	Salmon fry (/100m ²)	Salmon parr (/100m ²)	Trout fry (/100m ²)	Trout parr (/100m ²)	Other species present
Nith	1	Downstream of road bridge at Nith Lodge	253723	609290	02/06/14	9	16	38	3	SL
Polmath Burn	2	Upstream from road bridge on Dalleagles Road	254490	609906	02/06/14	0	0	0	0	-
Knockburnie Burn	3	At proposed crossing, near source	255563	607284	23/07/14	Not fished due to very low water conditions				
Knockburnie Burn	4	Upstream from wooden 4X4 bridge, at proposed crossing	255463	608300	23/07/14	0	0	0	0	-
Knockburnie Burn	5	D/S of farm culvert	256485	610702	02/06/14	0	0	17	0	SL, M
Un-named tributary of Knockburnie Burn	6	20 m upstream from confluence with Knockburnie Burn	256580	610719	02/06/14	0	0	48	0	SL
Knockburnie Burn	7	80m downstream of confluence with un-named burn	256658	610775	02/06/14	0	0	8	0	SL, M
Lane Burn	8	Downstream of road bridge	257400	611252	21/07/14	0	0	13	2	SL, M
Littlechang Burn	9	400m upstream from confluence with trib, near proposed crossing point	256078	607561	23/07/14	Not fished due to very low water conditions				

Key to other species:

E	-	Eel	M	-	Minnow
SL	-	Stone Loach	L	-	Lamprey
SB	-	Stickleback	G	-	Grayling
F	-	Flounder	P	-	Pike

Key to classification of salmonids per 100m²

absent
Very poor
Poor
Moderate
Good
Excellent

4 Results Of Baseline Electrofishing Surveys 2014

Watercourse	Site code	Location	Easting	Northing	Sampling date	Salmon fry (/100m ²)	Salmon parr (/100m ²)	Trout fry (/100m ²)	Trout parr (/100m ²)	Other species present
Tributary of Littlechang Burn	10	400m upstream from confluence with Littlechang, at proposed crossing	256319	607563	23/07/14	Burn dry – not fished				
Catlock Burn	11	Near proposed crossing point	256523	607731	23/07/14	Not fished due to very low water conditions				
Crocradie Burn	12	Upstream of confluence with Trough Burn	257234	609691	26/07/14	0	0	39	4	-
Trough Burn	13	Upstream of confluence with Crocradie Burn	257246	609681	26/07/14	0	0	9	4	-
Dalleagles Burn	14	Downstream of confluence with Trough Burn	257266	609705	26/07/14	0	0	53	0	-
Dalleagles Burn	15	Upstream from Dalleagles Farm	257297	610025	26/07/14	0	0	4	19	-
Dalleagles Burn	16	80m upstream of road bridge at Littlemark	257401	610716	21/07/14	0	0	26	5	SL
Straid Burn	17	500m upstream of Straid Burn	257910	610246	27/07/14	0	0	0	0	-
Redhall Burn	18	Upstream of bridge at Straid Farm	257988	610648	27/07/14	Burn dry – not fished				

Key to other species:

E	-	Eel	M	-	Minnow
SL	-	Stone Loach	L	-	Lamprey
SB	-	Stickleback	G	-	Grayling
F	-	Flounder	P	-	Pike

Key to classification of salmonids per 100m²

absent
Very poor
Poor
Moderate
Good
Excellent

4 Results Of Baseline Electrofishing Surveys 2014

Watercourse	Site code	Location	Easting	Northing	Sampling date	Salmon fry (/100m ²)	Salmon parr (/100m ²)	Trout fry (/100m ²)	Trout parr (/100m ²)	Other species present
Lane Burn	19	Upstream of ford below Burnside Village	258331	611246	26/07/14	0	0	0	0	High densities of lamprey, M
Polga Burn	20	Downstream of ATV ford	258036	607846	23/07/14	0	0	0	0	-
Polga Burn	21	50m upstream of confluence with Connel Burn	258552	607732	23/07/14	0	0	0	0	-
Connel Burn	22	20m upstream of confluence with Polga Burn	258533	607802	23/07/14	0	0	0	0	-
Connel Burn	23	100m downstream of Polga Burn	258590	607798	23/07/14	0	0	0	94	-
Barlene Burn	24	Downstream of track up to sheep pen	259231	610350	26/07/14	0	0	0	0	-
Barlene Burn	25	Downstream of Brockloch	259122	610851	26/07/14	Burn dry – not fished				
Nith	26	Upstream from Boig Road Bridge	259460	613834	05/08/14	0	28	0	2	M, SL
Afton Water	27	Upstream of Blackcraig Bridge	263165	607999	21/07/14	31	46	26	36	-

Key to other species:

E	-	Eel	M	-	Minnow
SL	-	Stone Loach	L	-	Lamprey
SB	-	Stickleback	G	-	Grayling
F	-	Flounder	P	-	Pike

Key to classification of salmonids per 100m²

absent
Very poor
Poor
Moderate
Good
Excellent

5 Results of Habitat Surveys

Water depth was measured at all survey sites. At the time of surveying the water depths were very low in all of the watercourses due to the time of year as can be seen below. In sites 3, 9, 10 and 11 electrofishing surveys could not be carried out due to the extremely low water conditions.

Site code	Wet width (m)	Bed visible (%)	0 – 20cm	21 – 40 cm	41 – 80cm	>80cm
3	0.20	100	100	0	0	0
4	1.20	100	90	10	0	0
9	0.30	100	100	0	0	0
10	0.15	100	100	0	0	0
11	0.20	50	100	0	0	0

A record of the percentage of each substrate type was recorded at each survey site. The substrate types are categorised according to the following: High Organic – HO (includes peat), Silt – SI, Sand – SA, Gravel – GR, Pebble – PE, Cobble – CO, Boulder – BO, Bedrock – BE and Obscured – OB. All of the surveyed burns cut through peat so the majority of substrate type was classified as high organic.

Site code	HO	SI	SA	GR	PE	CO	BO	BE	OB
3	85	0	0	10	5	0	0	0	0
4	30	0	0	20	40	10	0	0	0
9	70	0	0	20	10	0	0	0	0
10	80	0	0	10	10	0	0	0	0
11	80	0	0	10	10	0	0	0	0

The percentage of flow types was recorded for each site using the following categories: Still marginal – SM, Deep pool – DP, Shallow pool – SP, Deep Glide – DG, Shallow glide – SG, Run – RU, Riffle – RI, Torrent – TO. Due to the low water levels flow was very slow bordering on marginal.

Site code	SM	DP	SP	DG	SG	RU	RI	TO
3	0	0	0	0	100	0	0	0
4	20	0	20	0	30	0	30	0
9	0	0	0	0	80	0	20	0
10	10	0	0	0	80	0	10	0
11	10	0	0	0	70	0	20	0

Each stretch was also surveyed for the percentage of fish cover provided along the banks. This was in the form of undercut banks, draped bankside vegetation, marginal vegetation, root structures in the water and rocks. The majority of fish bank cover was provided by undercut banks and draped vegetation. The condition of the banks was assessed and the percentage of erosion, collapse and trampling was recorded. The percentage of potential spawning habitat was recorded to indicate the potential productivity of the watercourse.

Site code	Fish cover %	Erosion %	Collapse %	Trampling %	Predominant land use	Spawning habitat %
3	90	20	90	0	Moorland	0
4	25	0	10	10	Moorland	0
9	80	10	35	0	Moorland	0
10	80	10	17.5	0	Moorland	0
11	80	10	30	0	Moorland	10

6 Discussion

6.1 Distribution of juvenile salmonids

At the time when these surveys were being conducted, within Scotland and in particular Ayrshire, drought conditions prevailed. This explains the reasons why so many of the minor watercourses were dry and thus not capable of sustaining fish

Juvenile salmonids were found to be present in the lower sections of most of the main watercourses surveyed. The majority of the small tributaries and upper watercourses were found to not contain juvenile salmonids.

The Polmath Burn flows directly into the River Nith approximately 5.5 kilometres downstream from its source and although the Polmath Burn did not contain fish at the site surveyed it could act as a direct conduit of dirty/polluted water into the River Nith. The Nith contains juvenile salmon and trout as well as other species such as stone loach, minnow and lamprey.

The Knockburnie Burn contains juvenile trout in its lower reaches and flows into the Lane Burn which is known to contain juvenile trout, minnows, stone loach and lamprey. No fish were found to be present in the upper reaches of the Knockburnie Burn.

The Little Chang, Catlock and the un-named tributary of the Little Chang do not contain suitable habitat for fish to inhabit. They flow directly into Crocradie Burn which was found to contain juvenile trout in excellent densities. The Trough Burn was found to also contain juvenile trout but at lower densities, likely due to a small fall near its confluence with the Dalleagles Burn limiting fish passage. The Dalleagles Burn contains good to excellent densities of juvenile trout. The Straid and Redhall Burns flow into the lower Dalleagles Burn but do not contain any fish as they are known to dry up during periods of low rainfall.

The Barlene Burn was found to contain no fish. The lower section of this burn is known to dry up during hot summers. It is thought that this may be due to old deep shaft and surface mining operations having taken place in this location. The Barlene Burn discharges into the Laneburn below Burnside Village. Site 19 on the Lane Burn at this location contained no juvenile salmonids but had high densities of lamprey. Lampreys are protected under EU Habitats Directive.

No fish were found to be present in the Polga Burn although sufficient habitat was present and there were no obvious restrictions to movement between the Connel Burn and the Polga Burn. It is possible that the high water temperatures experienced at the time of surveying may have caused any fish present to be displaced downstream into the Connel. This would also explain the very high densities of trout parr found only 200 metres downstream in the Connel Burn. The Connel Burn is a tributary of the Nith which contains juvenile salmon and trout.

6.2 Habitat Surveys

Habitat surveys were carried out on five sites which had been identified as potentially being subject to disturbance from the installation of the road infrastructure. At the time of survey water levels were very low and although there was water present in all of burns surveyed, the water levels at site 3 on the Knockburnie Burn, site 9 on the Littlechang Burn, site 10 on the un-names tributary of the Littlechang and site 11 on the Catlock Burn were

so low that juvenile fish surveys could not be carried out i.e. water levels below 5cm. The habitat surveys carried out on these burns showed that these burns, even under higher water conditions, would be unlikely to hold juvenile salmonids due to the lack of suitable spawning material or in-stream cover from substrate.

The habitat survey carried out at site 4 on the Knockburnie Burn showed that the burn at this location contained limited spawning substrate although habitat for juveniles was available. Electrofishing surveys confirmed no juvenile salmonids were present at this location.

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Mr Kerr, Sauchie Mains Farm, Maybole

Mr William Logan, Brockloch Farm, New Cumnock

Appendix 1 - Map of survey locations



Appendix 2 – Site photographs



Site 1 - Nith



Site 2 – Polmath Burn



Site 3 – Knockburnie Burn



Site 4 – Knockburnie Burn



Site 5 – Knockburnie Burn



Site 6– Knockburnie Burn

Site photographs - continued



Site 7 – Knockburnie Burn



Site 8 – Lane Burn



Site 9 – Littlechang



Site 10 – Tributary of Littlechang



Site 11 – Catlock Burn



Site 12 – Crocradie Burn

Site photographs - continued



Site 13 – Crocradie Burn



Site 14 – Dalleagles Burn



Site 15 – Dalleagles Burn



Site 16 – Dalleagles Burn



Site 17 – Straid Burn



Site 18 – Redhall Burn

Site photographs - continued



Site 19 – Lane Burn



Site 20 – Polga Burn



Site 21 – Polga Burn



Site 22 – Connel Burn



Site 23 – Connel Burn



Site 24 – Barlene Burn

Site photographs - continued



Site 25 – Barlene Burn



Site 26 – Nith



Site 27 – Afton

Appendix 3 – General photographs



Photograph 1 – Electrofishing equipment



Photograph 2 - All-terrain vehicle and equipment



Photograph 3 – Electrofishing



Photograph 4 - Salmonid age classes

Appendix 4 – Environmental and habitat factors

Site code	Wet width (m)	Altitude (m)	Conductivity (µs)	Temperature (°C)	Flow	In-stream cover	Fish bank cover	Bank face vegetation	Buffer zone vegetation	Spawning Habitat	Full SFCC habitat survey
1	5.00	271	219	14.7	Low	Excellent	DR, UC	Simple	Simple	Good	No
2	0.90	302	248	15.3	Low	Good	DR, UC	Simple	Complex	Moderate	No
3	0.20	481	86	17.7	V. Low	Poor	DR, UC	Simple	Simple	Poor	Yes
4	1.20	390	130	22.2	Low	Good	DR, UC, MA	Simple	Simple	Moderate	Yes
5	3.00	255	315	17.2	Low	Excellent	RK	Simple	Uniform	Good	No
6	1.60	227	386	17.2	Low	Good	DR	Bare/ Simple	Uniform	Moderate	No
7	3.25	223	328	18.0	Low	Excellent	DR	Bare/ Simple	Uniform	Good	No
8	2.50	215	295	22.0	Low	Excellent	DR	Complex	Complex	Good	No
9	0.30	460	116	17.2	V. Low	Poor	UC	Bare	Simple	Poor	Yes
10	0.15	455	110	17.6	V. Low	Poor	UC	Bare	Simple	Poor	Yes
11	0.20	448	145	16.9	V. Low	Poor	UC	Bare	Simple	Poor	Yes
12	3.25	273	130	19.5	Low	Excellent	None	Complex	Complex	Good	No
13	1.60	268	242	23.6	Low	Excellent	None	Simple	Simple	Good	No
14	3.50	266	191	21.0	Low	Excellent	DR	Simple	Simple	Good	No

Fish bank cover: UC – Undercut, DR – Draped, MA – Marginal, RT – Roots, RK – Rocks, OTH – Other

Vegetation: Bare – Bare ground, Uniform – One vegetation type, Simple – 2-3 vegetation types, Complex – 4 or more vegetation types including scrub/trees.

Appendix 4 – Environmental and habitat factors

Site code	Wet width (m)	Altitude (m)	Conductivity (µs)	Temperature (°C)	Flow	In-stream cover	Fish bank cover	Bank face vegetation	Buffer zone vegetation	Spawning Habitat	Full SFCC habitat survey
15	2.30	256	229	20.9	Low	Excellent	DR	Complex	Complex	Good	No
16	2.50	227	210	22.1	Low	Good	None	Simple	Simple	Moderate	No
17	0.80	276	233	25.5	Low	Moderate	UC	Bare	Simple	Poor	No
18	n/a	232	n/a	n/a	Dry	Good	n/a	Simple	Complex	Good	No
19	4.50	214	256	22.1	Low	Poor	DR	Simple	Complex	Poor	No
20	0.5	403	180	21.0	Low	Good	UC	Uniform	Uniform	Moderate	No
21	0.9	341	147	20.2	Low	Excellent	UC	Simple	Simple	Moderate	No
22	0.7	346	178	22.8	Low	Good	UC, DR	Simple	Simple	Moderate	No
23	1.3	341	155	24.2	Low	Excellent	UC	Simple	Simple	Good	No
24	0.6	277	190	21.4	Low	Good	UC	Simple	Simple	Moderate	No
25	n/a	245	n/a	n/a	Dry	Excellent	n/a	Simple	Simple	Good	No
26	3.2	264	108	21.9	Low	Excellent	RK	Bare	Complex	Moderate	No
27	3.2	264	108	21.9	Low	Excellent	RK	Bare	Complex	Moderate	No

Fish bank cover: UC – Undercut, DR – Draped, MA – Marginal, RT – Roots, RK – Rocks, OTH – Other

Vegetation: Bare – Bare ground, Uniform – One vegetation type, Simple – 2-3 vegetation types, Complex – 4 or more vegetation types including scrub/trees.

Appendix 11.H

Freshwater Pearl Mussel Baseline Report



Enoch Hill Wind Farm: Freshwater Pearl Mussel Baseline Report

1. Introduction

Amec Foster Wheeler Environment & Infrastructure UK Ltd (Amec Foster Wheeler) was commissioned by EON Climate & Renewables Ltd. (E.ON) to undertake baseline ecology surveys at land included within the site boundary of the proposed Enoch Hill Wind Farm Site (hereafter referred to as the "Site"). This report provides details of the methods applied and results obtained from a protected species survey focussing specifically on freshwater pearl mussels (*Margaritifera margaritifera*), which was undertaken in November 2014.

2. Legislation

In Scotland, the freshwater pearl mussel receives full legal protection under Schedule 5 of the Wildlife and Countryside Act (WCA) 1981 (as amended). Under this legislation, it is an offence to intentionally or recklessly:

- ▶ Kill, injure or take a wild invertebrate listed on Schedule 5;
- ▶ Damage, destroy or obstruct access to any structure or place which such an animal uses for shelter or protection; and
- ▶ Disturb such an animal when it is occupying a structure or place for that purpose.

It is also an offence to:

- ▶ Possess or control, sell, offer for sale or possess or transport for the purpose of sale any live or dead invertebrate listed on Schedule 5 or any derivative of such an animal.

Knowingly causing or permitting any of the above acts to be carried out is also an offence.

In addition, freshwater pearl mussel is listed on the Scottish Biodiversity List (SBL)¹ as a species for which conservation action is needed and to which the avoidance of negative impacts are critical.

3. Methods

3.1 Desk Study

Given that records for freshwater pearl mussel are treated as confidential and information on their distribution is not publicly available, only a high-level desk study was possible using NBN Gateway within the 10km grid squares adjacent to the Site.

¹ The UK BAP was replaced by the 'UK Post-2010 Biodiversity Framework' (July 2012) which covers the period 2011-2020. This framework is implemented individually by each of the four countries in the UK. Following the publication of the new framework the UK BAP partnership no longer operates but many of the tools and resources originally developed under the UK BAP still remain in use. Within Scotland, the UK Post-2010 Biodiversity Framework is co-ordinated through the Biodiversity Action Reporting System (BARS) which is an online tool which contains a list of Scottish priority habitats and species (also known as The Scottish Biodiversity List [SBL]).



The SNH Sitelink website² was consulted to search for statutory designated sites, particularly Special Areas of Conservation (SACs) specifically designated for freshwater pearl mussel.

Following the completion of electrofishing surveys³, the Nith District Salmon Fishery Board (NDSFB) was consulted⁴ to enquire regarding their views and to obtain advice on the potential presence of freshwater pearl mussel, based on the data obtained during their surveys and their understanding of the habitats present within the surveyed watercourses.

No other desk studies or consultations were completed as part of this assessment.

3.2 Survey Area

Survey requirements were scoped and identified based on the site layout included in the design chill in September 2014 as shown on Figure 1⁵. Four water crossings were identified within the Site on Knockburnie Burn, Littlechang Burn and Catlock Burn at the following grid references:

- ▶ Crossing Point 1 – NS 55680 08492;
- ▶ Crossing Point 2 – NS 56132 07676;
- ▶ Crossing Point 3 – NS 56310 07724; and
- ▶ Crossing Point 4 – NS 56486 07794.

As a general rule and in accordance with standard survey protocols (described further in section 3.4), surveys were completed 100m upstream and 500m downstream from the proposed crossing points where access was safe and possible.

3.3 Surveyors and Survey Conditions

Surveys were undertaken on 18 October 2014 by Amec Foster Wheeler Ecologist Sian Jones (SNH licence Number 30901) with assistance from Amec Foster Wheeler Ecologist Rachel Finan. All surveyors were trained in safe working practices i.e. thigh waders were worn, with surveyors working in pairs: one surveyor in the water with a life jacket worn and the other on the bankside with a throw rope.

Survey work can only be undertaken in periods of low water flow, so generally survey work cannot be undertaken between October and March. However, as the optimal conditions are solely determined by weather and river conditions (e.g. low river flow levels, suitable light conditions) and this survey was undertaken in a period of calm, dry, warm weather with good overhead light conditions (which followed a prolonged period of unsettled weather with heavy rain), resulting in good visibility and low flowing, clear running water, the timing of these surveys during the month of October is not considered a constraint or to be sub-optimal on this occasion.

3.4 Freshwater Pearl Mussel Survey Methods

Surveys were completed using standard methods^{6,7} and best practice guidelines were followed during the completion of the surveys as follows:

² <http://gateway.snh.gov.uk/sitelink/searchmap.jsp> (Accessed 26 February 2015)

³ NDSFB (2014). Electrofishing Survey to Assess Juvenile Salmonid Populations and other species of fish in watercourses in the vicinity of the proposed Enoch Hill Wind Farm.

⁴ Pers. comm. via email between Amec Foster Wheeler Principal Ecologist Anita Hogan and the Director of NDSFB Jim Henderson. 20 October 2014.

⁵ AMEC (2014). Enoch Hill Wind Farm. Public Exhibition. Site Layout. September 2014.

⁶ Young MR, Hastie LC & Cooksley SL (2003). Monitoring the Freshwater Pearl Mussel, *Margaritifera*. Conserving Natura 2000 Rivers Monitoring Series No. 2, English Nature, Peterborough

⁷ SNH Freshwater Pearl Mussel Survey Guidelines. Freshwater pearl mussel survey protocol for use in site-specific projects. <http://www.snh.gov.uk/docs/A372955.pdf>. Accessed 17 March 2015



- ▶ A general survey was completed of each watercourse and its substrate types by walking along the banks and/or by wading in the water;
- ▶ In suitable areas of habitat, the watercourse was entered and a detailed survey of the substrate was completed using a bathyscope⁸;
- ▶ Given the limited areas of suitable habitat recorded, 50m transects using the bathyscope (as recommended) were not possible and areas surveyed were no more than ~10-15m in length.

As mentioned above, a distance of 100m upstream of the water crossing was surveyed, along with 500m downstream.

4. Results

4.1 Desk Study

- ▶ Seven historic records (dated between 1962 and 1989) for freshwater pearl mussels were included within the NBN Gateway database for the 10km grid squares surrounding the Site;
- ▶ Consultation with NDSFB in combination with the results of their electrofishing surveys indicated the unsuitability of the habitat for freshwater pearl mussel in Littlechang Burn, the unnamed tributary of the Littlechang Burn and the Catlock Burn given the absence or limited amount of suitable habitat conditions that were present (pockets of gravel / sediment and suitable flow conditions). In addition, migratory fish species such as Atlantic salmon and trout were recorded in the lower reaches of the Knockburnie Burn but not in the upper reaches within the Site, with the watercourses offering limited suitable spawning habitat although some habitat for juvenile salmonids was present.

4.2 Freshwater Pearl Mussel Survey

No freshwater pearl mussels were recorded during the completion of the surveys in 2014.

Suitable habitat for freshwater pearl mussel can be summarised as follows:

- ▶ Occasional and often isolated areas of suitable habitat were recorded within each watercourse;
- ▶ The most suitable habitat was recorded within Knockburnie Burn and within the main stem of the Crocradie Burn (fed by the waters from Littlechang Burn, its unnamed tributary and the Catlock Burn);
- ▶ Habitat suitability within Littlechang Burn, its unnamed tributary and the Catlock Burn reduced as the gradient increased.

⁸ The Aquascope Underwater Viewer was used as supplied by NHBS. <http://www.nhbs.com/title/185837/large-aquascope-underwater-viewer-bathyscope>



Table 4.1 Watercourse Habitat Descriptions

Name	Description	Suitable/Unsuitability for Freshwater Pearl Mussel
Knockburnie Burn (which includes crossing point 1)	<p>This watercourse flows from south to north, parallel to the western site boundary and the adjacent forestry plantation. At the fence line at NS 55273 07962, the watercourse changes direction and flows from west to east. Approximately 100m upstream of the crossing point the watercourse is ~1.5m wide and slow moving with algae present and a water depth of ~20cm. Banks are heavily grazed with soft rush present. Some overhanging, peaty banks are present with evidence of erosion and subsidence. The bed substrate is composed of pebbles, cobbles and some gravel. Land use nearby constitutes sheep grazed upland marshy grassland and heathland.</p> <p>Channel width is variable along the stretch of watercourse within the survey area.</p> <p>Channel narrows to ~1m at ~30m from the crossing point with water flow decreasing and depth increasing.</p> <p>At the crossing point the channel narrows (~0.5m) and the depth of the water reduces to 10-15cm (i.e. too shallow for freshwater pearl mussel).</p> <p>At ~114m downstream, bedrock was identified in the middle of the channel with pebbles/cobbles along the edges. In addition, scattered boulders were present along the banks e.g. at NS 55783 08602.</p> <p>At ~200m downstream of the crossing point, similar substrate and bank profiles were recorded.</p> <p>At ~270m downstream, suitable substrate was recorded in the channel. Water depth is ~15-20cm. Gentle water flow. Peaty, overhanging banks. Heavily vegetated.</p> <p>A deep pool was present at @280m (~30cm water depth). More boulders were recorded within this area.</p> <p>At ~330m downstream, and on the other side of a fence line, the watercourse narrows to @0.5m and water flow increases. There is evidence of spate events and high channel flow at various locations along the entire stretch of the watercourse but particularly at this location.</p> <p>The watercourse widens out again further downstream, with a cobble/pebble substrate, watercourse width of 1-1.5m, and the bank profile is similar to that previously described.</p> <p>At ~500m, there is evidence of erosion with overhanging and/or collapsed banks.</p>	Suitability exists along this watercourse within isolated stretches.
Littlechang Burn – Tributary a (which includes crossing point 2))	<p>There is lots of evidence of erosion and landslides in the steep sided, high banked sides of the burn in the lower sections.</p> <p>The watercourse is ~1m wide in places with steep banks. Lots of stones and debris are present in the channel.</p> <p>At the crossing point, the watercourse is overgrown with vegetation and the surrounding land is flat and heavily vegetated. The banks are peaty with overhangs. There is evidence of erosion.</p> <p>Upstream, a similar bank profile and watercourses structure exists as at the crossing point.</p> <p>No suitable habitat for spawning upstream of the crossing point was recorded in this watercourse.</p>	Limited suitability overall
Littlechang Burn – Tributary b (which includes crossing point 3)	<p>There is lots of evidence of erosion and landslides in the steep sided, high banked sides of the burn in the lower sections.</p> <p>The watercourse is ~1m wide in places with steep banks. Lots of stones and debris are present in the channel.</p> <p>Possible obstruction to fish migration was recorded in the channel at NS 55986 08260.</p> <p>Obstruction to fish migration was recorded in the channel at NS 56019 08230.</p> <p>At the crossing point, the watercourse is overgrown with vegetation and the surrounding land is flat and heavily vegetated. The banks are peaty with overhangs. There is evidence of erosion.</p> <p>Upstream, a similar bank profile and watercourses structure exists as at the crossing point.</p> <p>No suitable habitat for spawning upstream of the crossing point was recorded in this watercourse.</p>	Limited suitability overall

Name	Description	Suitable/Unsuitability for Freshwater Pearl Mussel
Catlock Burn (which includes crossing point 4)	<p>There is lots of evidence of erosion and landslides in the steep sided, high banked sides of the burn in the lower sections i.e. near where the Catlock Burn meets the Littlechang Burn.</p> <p>Obstacles (in the form of boulders and substrate in the channel) in the lower sections are all deemed to be passable by fish.</p> <p>Obstacles at NS 56248 08465 – there is presence of a landslide which has altered the course of the watercourse. Large pools were present along with flooded bankside vegetation. This is likely to have been an associated event of sedimentation in the water downstream of this landslide.</p> <p>Bedrock was evident at NS 56321 08339.</p> <p>An area of suitable habitat was identified at NS 56398 08233 but there is evidence that this has also suffered from disturbance from erosion/disturbance events.</p> <p>Another landslide was recorded at NS 56407 08210 – this is likely to have occurred earlier in 2014 due to the regrowth of vegetation.</p> <p>A pool was recorded at NS 56416 08153.</p> <p>Upstream of this pool, the bank profile changes as does the channel. The watercourse narrows and banks are steep and heavily vegetated. The gradient on the surrounding land shallows.</p> <p>At the crossing point, the watercourse is choked with vegetation and the surrounding land is flat and heavily vegetated. The banks are peaty with overhangs and on occasion, large clumps of earth were identified within the channel which blocked the watercourse e.g. at NS 56214 07894.</p> <p>Upstream, a similar bank profile and watercourses structure exists as at the crossing point.</p> <p>No suitable habitat for spawning upstream of the crossing point was recorded in this watercourse.</p>	Limited suitability overall

5. Evaluation and Conclusions

Overall the habitats and watercourses surveyed within the Site offered limited potential for freshwater pearl mussel and no freshwater pearl mussel were recorded during the targeted surveys completed in 2014. This assessment of low suitability was based on the following rationale which was obtained using data collected by NDSFB and from the targeted surveys for freshwater pearl mussel:

- ▶ Evidence of flood events such as flattened vegetation were evident on all watercourses thereby reducing the suitability of the watercourses as events such as flash flooding increase sedimentation within watercourses therefore reducing their suitability;
- ▶ Areas of silt accumulation⁹ were recorded, particularly within Knockburnie Burn;
- ▶ Large stretches of bedrock were recorded within the watercourses. Certain stages of the lifecycle of the freshwater pearl mussel e.g. the larval stage known as glochidia require sandy or gravelly substrate in which to settle and grow and adult freshwater pearl mussel also need soft sediment in which to burrow;
- ▶ Evidence of recent disturbance events e.g. landslides and bank erosion, were recorded along all watercourses. Events such as these would further reduce the likelihood of freshwater pearl mussel being recorded within watercourses due to the increase in sedimentation within the watercourses;
- ▶ All watercourses surveyed were flowing through areas of peat with little/no bankside shading from herbaceous vegetation, scrub and bankside trees recorded which would in turn reduce their suitability to support freshwater pearl mussel;
- ▶ The two tributaries of Little Chang Burn and the Catlock Burn were assessed as providing limited suitability for freshwater pearl mussel based on the habitat conditions present. This was further

⁹ Siltation of watercourses is known to be one of the factors affecting active recruitment of freshwater pearl mussels (Skinner, A, Young M & Hastie L (2003). Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers Ecology Series No. 2 English Nature, Peterborough)

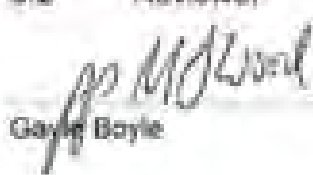
confirmed from the results of the electrofishing surveys which indicated that these watercourses do not contain suitable habitat for fish to inhabit. This in turn would reduce the likelihood of freshwater pearl mussel being present;

- ▶ Juvenile trout were identified in the lower reaches of the Knockburnie Burn during the electrofishing surveys. This watercourse flows into the Lane Burn which is known to contain juvenile trout, minnows, stone loach and lamprey. However, no fry or parr from salmon, trout and/or any fish species were recorded at the sampling point closest to the proposed crossing point of the Knockburnie Burn during the electrofishing surveys and juvenile fish were deemed to be absent from the upper reaches of this watercourse. During the freshwater pearl mussel surveys, only limited and isolated stretches along the Knockburnie Burn were assessed as providing suitable habitat for freshwater pearl mussel.

5.1 Author


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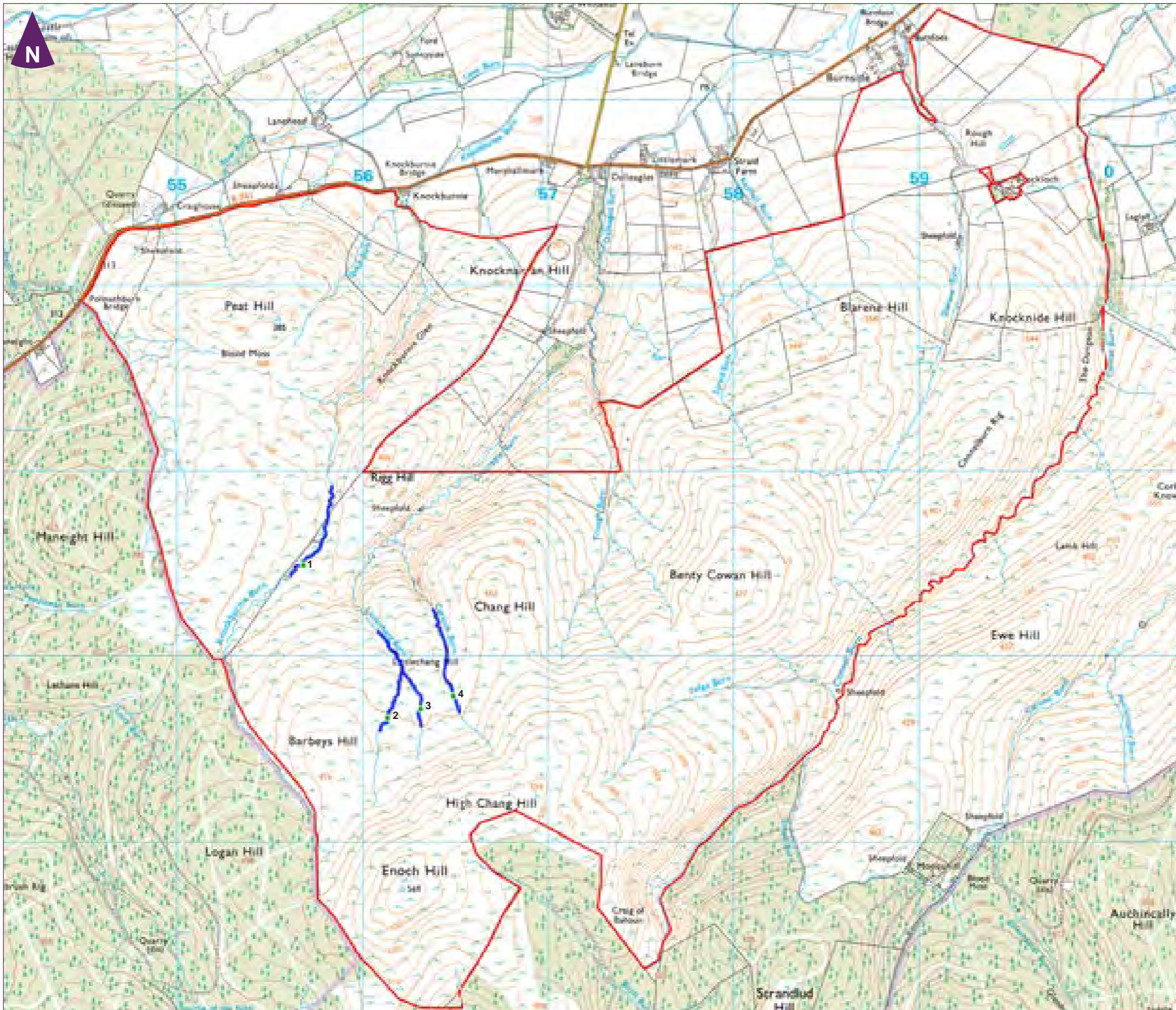
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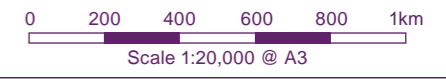
Figure 1 Freshwater Pearl Mussel Survey Areas





Key

- Site boundary
- Proposed crossing points
- Freshwater pearl mussel survey areas



Client

Enoch Hill Wind Farm
Environmental Statement



Figure 1
Freshwater Pearl Mussel Survey Areas

Appendix 11.I

Otter and Water Vole Survey Report 2015



Technical note: Enoch Hill Wind Farm Otter and Water Vole Survey 2015

1. Introduction

Amec Foster Wheeler Environment & Infrastructure UK Ltd (Amec Foster Wheeler) was commissioned by E.ON Climate & Renewables Ltd. (E.ON) to undertake a repeat otter and water vole survey within a defined study area based on the design freeze layout of the proposed Enoch Hill Wind Farm (the “Proposed Development”). The Proposed Development is located to the south of Dalleagles, near New Cumnock, in East Ayrshire with a central grid reference of E 257360, N 608630.

Surveys for protected species including otter (*Lutra lutra*) and water vole (*Arvicola amphibius*) were undertaken in 2012, 2013 and 2014 and were reported previously (Amec Foster Wheeler, 2015¹) and concluded that otter is present on site, although signs of water vole have never been confirmed. The report considered that surveys for water vole should be repeated if submission of the Environmental Statement (ES) be delayed beyond August 2015. As it is comparatively easy to include a survey for otter, this report describes the study area and methods employed for a survey of both otter and water vole within those areas of the Development Site which would be potentially affected by the Proposed Development.

The legal and policy background behind the protection of these species has not changed since the production of the 2015 report and the aims of this Technical Note are therefore:

- ▶ To assess the presence or potential presence of otter and water vole within the study area;
- ▶ To assess these species' use of features within the study area; and
- ▶ To identify potential conflicts between these species and the Proposed Development.

It is intended that the results of this survey will be used to inform the baseline of the ES.

2. Methods

2.1 Study Area

The study area for the update (2015) otter and water vole surveys is shown in **Figure 2.1** and is defined according to the design freeze layout of the Proposed Development.

In accordance with survey guidelines for wind farm developments² a survey radius of 250m around all proposed wind turbines and associated infrastructure (including site compounds, laydown areas, borrow pit search areas and substations) and a distance of 100m up-and downstream of indicative access track locations were included within the study area. The recommended study area for water vole surveys has been

¹ Amec Foster Wheeler (2015). Enoch Hill Wind Farm. Protected Species (2013-2014) Baseline Report. Prepared on behalf of E.ON.

² <http://www.snh.org.uk/publications/on-line/wildlife/otters/effects.asp>. Accessed 24 August 2015.



defined as being up to 500m from large scale developments which affect several hundred metres of habitat³ however the effects on watercourses are taken to be smaller in scale (affecting a total of five minor watercourses) and therefore the same study area as is defined for otter is considered appropriate.

2.2 Otter Survey

Standard survey methods for otter were followed whereby the banks of watercourses were inspected for signs of otter⁴ and for potential resting sites. Evidence for otter presence includes: spraints (faeces) – which are often located on prominent features within the channel or on the bank (including weirs, bridges, rocks, tree roots, confluences of burns and other riverside features); boneless spraints; slides; and footprints – located in soft mud, silt or sand banks. This methodology conforms to SNH guidance⁵. Any field sign locations identified within the newly defined study area during 2013 and 2014 survey work (such as the holt along Knockburnie Burn) were reassessed as part of the 2015 survey work, with presence/absence of these signs noted. Terminology is as follows:

- ▶ **Resting Site** – collective term for holts and couches used in the Conservation (Natural Habitats & c.) Regulations 1994 (as amended in Scotland) (The Habitats Regulations⁶);
- ▶ **Potential resting site** – a site considered to provide suitable resting habitat together with inconclusive signs of use or potential use;
- ▶ **Holt** – an underground, resting site, often underneath heather root matrices or within tree roots;
- ▶ **Couch** – an above ground resting site that can be used for sleeping or grooming;
- ▶ **Breeding site** – a term used to identify an area of land in which otters breed, within which a natal holt is located;
- ▶ **Natal holt** - a discrete holt that is used by the female to birth the cubs and where they can remain for up to three months; and
- ▶ **Nursery area** - an area within a breeding site with high levels of activity associated with cubs. Holts within these areas are considered unlikely to be the primary natal holts where cubs are born.

Notes on general site habitat suitability for otter were also recorded. Suitable otter habitat provides access to freshwater, sufficient prey, resting and breeding sites that are secure from direct disturbance. In terms of resting sites, otters can utilise a range of above and below-ground structures in their home range and in freshwater habitat can often sleep above ground and in open areas⁷. In terms of a potential breeding sites (within which a natal holt is located), data tend to be sparse and in some instances contradictory, which may reflect the fact that females tend to choose remote and secretive locations, often some distance away from the watercourse, upstream along small tributaries, within reedbeds, scrub/woodland and sometimes in open ground (e.g. on peatland sites in Shetland and other upland areas in Scotland)⁸. It is considered likely that a breeding site would be adjacent to a good supply of food, be free from significant disturbance and be at low potential of flooding. As much of the study area is extensively farmed (sheep grazing) the surveys were

³ E.g. Strachan, R., Moorhouse, T. and Gelling, M. (2011) The water vole conservation handbook. 3rd Edition. WildCRU, Oxford.

⁴ Chanin, P. (2003). Monitoring the otter *Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series No. 10. English Nature, Peterborough.

⁵ SNH (2008) Otters and Development. Scottish Wildlife Series.

<http://www.snh.org.uk/publications/online/wildlife/otters/default.asp>

⁶ The Habitats Regulations translate into national law the *EC Directive on the Conservation of Natural Habitats and Wild Flora and Fauna, 92/43/EEC, 1992*

⁷ Kruuk, H., Carss, D.N. Conroy, J.W.H. & Gaywood, M.J.. 1998. Habitat use and conservation of otters *Lutra lutra* in Britain: a review.

Symposia of the Zoological Society of London, 71, 119-134. In: Kruuk, H. 2006. Otters: ecology, behaviour and conservation. Oxford University Press.

⁸ Liles, G. 2003. Otter Breeding Sites: Conservation and Management. Conserving Natura 2000 Rivers Conservation Techniques Series

No. 5, English Nature Peterborough.

restricted to watercourses except where adjacent (within ~10m of bank tops) suitable habitats for resting sites were present such as woodland, scrub or coarse grassland.

2.3 Water Vole Survey

Standard survey methods for water voles were followed whereby watercourses within the study area were inspected for signs of water vole, i.e. droppings – including those deposited in well-used territorial latrines – footprints; feeding stations with characteristic cut vegetation close to the water's edge; runways in vegetation; and burrows. Notes were taken on the general suitability of watercourses to support water vole, including details of burn geomorphology and riparian and emergent vegetation.

Habitats were classed as being unsuitable if they were heavily modified either by bankside engineering works or grazing; if they lacked suitable food plants such as a range of grasses, rushes and herbs; or if the banks were overly rocky or otherwise unsuitable for burrowing (including in heavily shaded forestry plantations). This methodology has been adapted from the Water Vole Conservation Handbook⁹ which states that:

“A field survey...should include all areas of habitat suitable for water voles which could be directly affected by the proposals, and should extend some distance from the site boundaries to inform impact assessment and mitigation...the distance from the site which will need to be surveyed in detail will be dependent on the nature and magnitude of potential impacts...”

In addition, watercourses were searched for signs of the presence of American mink (*Neovison vison*) which is a non-native species and a predator of water vole.

3. Results

Otter Survey Results

The study area for the 2015 surveys is illustrated on **Figure 2.1** and included sections of Polmath Burn, Polga Burn, Trough Burn, Knockburnie Burn, Littlechang Burn, Catlock Burn, Crocradie Burn, Bitch Burn, Connel Burn and minor tributaries of the watercourses.

The focus of otter activity recorded in September 2015 was along Polmath Burn, located along the western boundary of the Site. A single potential resting site was recorded along Polmath Burn with 10 spraint locations and two potential locations of otter feeding remains. Activity was also recorded along Knockburnie Burn, Catlock Burn, Crocradie Burn and Polga Burn. No confirmed otter holts or couches were recorded in these areas.

All evidence of otter recorded during the surveys in 2015 and their locations are shown in **Table 3.1** below and in **Figure 2.1**.

Table 3.1 Otter Field Signs

Watercourse	Target Note Number	Grid Reference	Feature	Description
Knockburnie Burn	1	NS 55312 07907	Otter spraint(s)	A single old otter spraint on rock
	2	NS 55793 08626	Otter spraint(s)	Four old otter spraints on rock
	3	NS 55821 08728	Otter spraint(s)	A single old otter spraint on boulder
	4	NS 55822 08779	Otter spraint(s)	A moderately fresh otter spraint on rock

⁹ Strachan, R., Moorhouse, T. and Gelling, M. (2011) The water vole conservation handbook. 3rd Edition. WildCRU, Oxford.



Watercourse	Target Note Number	Grid Reference	Feature	Description
	5	NS 55816 08988	Otter spraint(s)	An old otter spraint on rock
	6	NS 55842 09051	Otter spraint(s)	A single old otter spraint on rock in middle of the Burn
Crocradie Burn	7	NS 56377 08807	Otter spraint(s)	A single old otter spraint on large boulder
	8	NS 56341 08791	Otter spraint(s) and Potential otter resting site	Dry areas with rocks and stones to the east of the burn with an old otter spraint on one of the rocks
Catlock Burn	9	NS 56462 08005	Otter spraint(s)	A single old otter spraint on rock
Polga Burn	10	NS 58247 07855	Otter spraint(s)	A single old otter spraint on rock
Polmath Burn	11	NS 54503 09895	Otter spraint(s)	A single old otter spraint on rock under grey willow
	12	NS 54531 09871	Otter spraint(s)	Three old otter spraints on rock in middle of stream
	13	NS 54553 09855	Otter spraint(s)	A single old otter spraint on rocky slope above pool of water
	14	NS 54577 09827	Otter spraint(s)	A single fresh spraint on rock in stream
	15	NS 54635 09789	Otter spraint(s)	A single old otter spraint on rock
	16	NS 54632 09782	Otter spraint(s)	A single old otter spraint
	17	NS 54664 09743	Otter spraint(s)	A single old spraint on boulder
	18	NS 54671 09731	Potential otter feeding remains	Old bones on a rock in the stream
	19	NS 54669 09721	Otter spraint(s)	Two old spraints on rock
	20	NS 54674 09688	Otter spraint(s)	Two old spraints on rock
	21	NS 54701 09636	Potential otter feeding remains; and Potential otter resting site	Small bones and potential resting site on an area of large boulders at the side of stream
	22	NS 54705 09557	Otter spraint(s)	A single old spraint on rock in middle of stream

Water Vole Survey Results

No evidence of water vole was recorded within the study area in line with the 2014 survey, which also recorded a similar result. The majority of the 2015 study area includes the upper reaches of the aforementioned watercourses and as such these provide limited potential for water vole due to the unsuitability of banks for burrow creation, shallow water depth and being generally located within very exposed positions. Only the lower reaches of Polmath Burn and Knockburnie Burn on the western boundary of the study area provide low to moderate potential for water vole where there are sections of earth bank.



4 Recommendations

As outlined within the previous report¹, since otter signs have been recorded across the study area, at least a 50m buffer should be assigned to all watercourses, apart from at water crossings. Water crossings should avoid potential resting sites and should be constructed in a manner so as to allow through passage of otter. Pre-construction surveys should be undertaken in the areas of proposed water crossings and construction mitigation will need to be included, such as water quality protection and protection of otters from accidental injury (i.e. by covering exposed pipes etc).

No water vole signs were recorded in the study area and therefore no specific mitigation measures for this species have been outlined. However, implementing mitigation for otter should ensure that water voles are protected if any move on to the site prior to the start of construction.

5 Conclusion

The results of the 2015 otter and water vole surveys are generally very similar to those recorded during previous surveys undertaken in 2013 and 2014. Watercourses in the study area provide suitable commuting and foraging opportunities for any otters resident within the local area. Spranks were noted in a number of locations, although these were more prevalent in the lower courses of the study area, where watercourses are generally larger. Potential resting sites are similarly restricted to the lower sections of the water courses and were identified along Crocodile Burn and Pointeth Burn in 2015.

No evidence of water vole activity was recorded in the study area during 2015. The majority of the watercourses within the study area offer limited suitability for this species and potential is restricted to the lower sections of Knockburnie Burn and Pointeth Burn.

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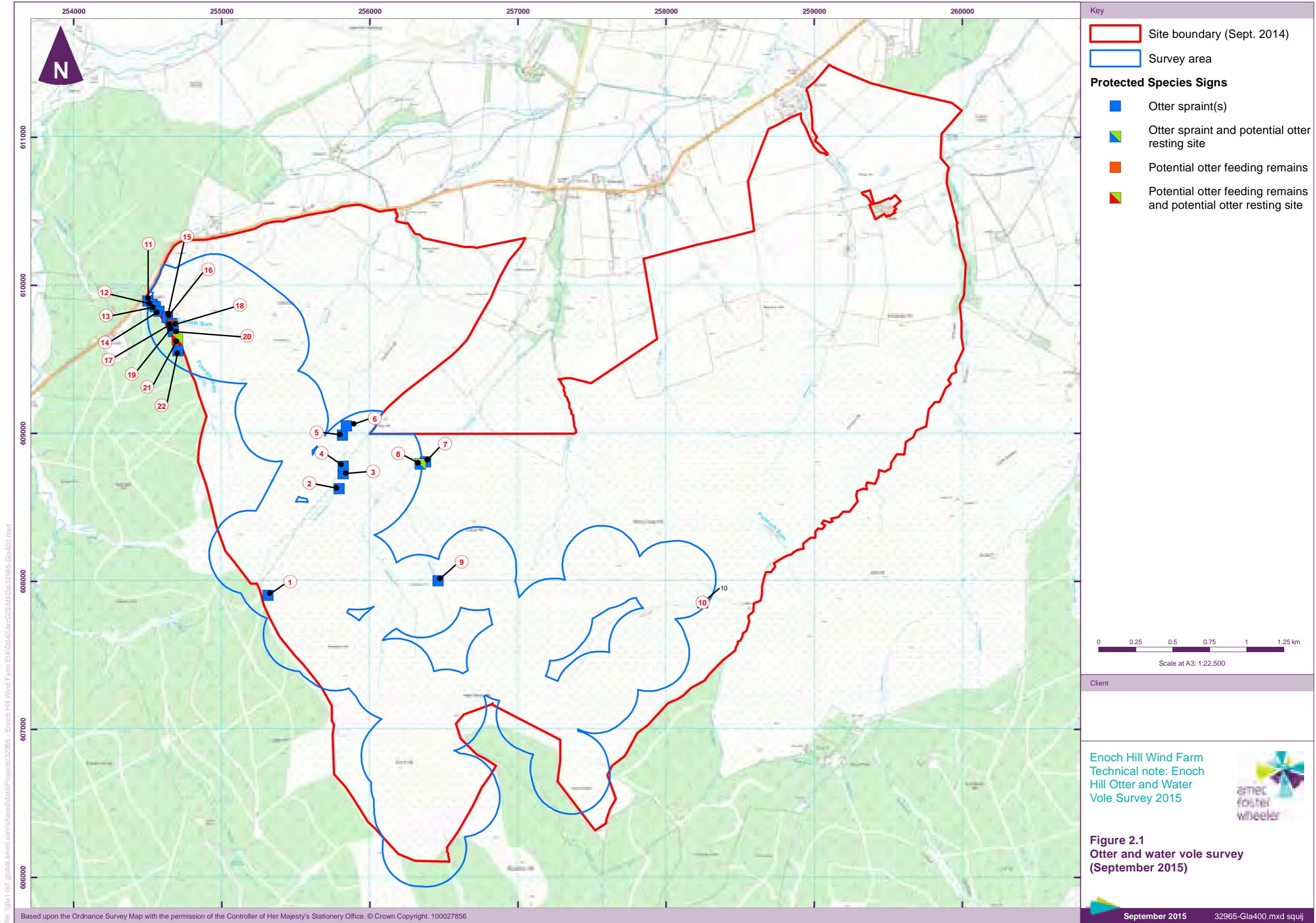
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Appendix 12.A

Baseline Ornithology Report – Winter Season 2011/12

Dalleagles Proposed Wind Farm - Wintering Ornithology Report



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Dalleagles Proposed Wind Farm - Wintering Ornithology Report

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Introduction



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1 Introduction

- 1.1 AECOM were commissioned by E.on to undertake a desk study, consultation, and ornithological field surveys during autumn and winter at the location of the proposed Dalleagles wind farm. The proposed development site is located on the Ayrshire/Galloway border near New Cumnock, approximate central grid reference (NGR) NS 570 089 (Figure 1.1). The proposed wind farm layout on which this report and the surveys underpinning it are based is shown on Figure 1.2.
- 1.2 The wind farm design has been through several design iterations to date, with previous designs including in excess of 40 turbines spread across the open habitats of the upper and lower slopes of the proposed development site between Enoch Hill, Peat Hill and Connelburn Rigg, plus an area of plantation woodland surrounding Strandlud Hill to the south east. The design currently under consideration includes 23 turbines of 80 m hub and maximum blade tip height of 126.5 m (such as the Siemens SWT 93) mostly across the upper slopes of Chang Hill, Barbeys Hill, High Chang, Enoch Hill and Benty Cowan Hill (Figure 1.2).
- 1.3 The proposal in its current form is known to both AECOM and E.on as Enoch Hill wind farm, however this report refers to the proposed Dalleagles wind farm throughout as it describes baseline surveys that were commissioned to underpin assessment of an older wind farm layout under that name. The survey methods and the results described herein are entirely suitable for the assessment of Enoch Hill wind farm in its current form.
- 1.4 This report describes current policy and legislation in relation to birds and wind farms, as well as the methodologies used to undertake the desk study and field surveys. The baseline conditions within and surrounding the proposed development site with respect to wintering birds are defined. A summary is given of the key ornithological risks to the proposed development that are apparent from the wintering bird surveys and any further surveys likely to be required in order to complete the ornithological assessment of the proposal.

The report is structured as follows:

- **Section 2** – Legislation and Policy Background
- **Section 3** – Methodology
- **Section 4** – Results
- **Section 5** – Summary and Recommendations

Legislation and Policy Background



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2 Legislation and Policy Background

2.1 Statutory Legislation/Policy

2.1.1 This section sets out the legislation and policy initiatives specific to birds. Key legislation for birds in Scotland is summarised in Table 2.1.

Table 2.1: Summary of Legislation/Policy in Scotland with regard to birds

Legislation/Policy	Description
EC Wild Birds Directive (<i>European Directive 2009/147/EC on the conservation of wild birds</i>)	<p>Council Directive 2009/147/EC on the conservation of wild birds, commonly referred to as the Birds Directive creates a comprehensive scheme of protection for all wild bird species naturally occurring in the European Union.</p> <p>The directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of habitats for endangered as well as migratory species (listed in Annex I), especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species. Since 1994 all SPAs form an integral part of the Natura 2000 ecological network.</p>
Wildlife and Countryside Act, 1981, as amended by the Nature Conservation (Scotland) Act 2004 and the Wildlife and Natural Environment (Scotland) Act 2011	<p>Under the WCA1981 (as amended) all breeding birds receive protection from destruction of nests and eggs whilst in use. Bird species listed in Schedule 1 of the WCA 1981 (as amended); receive special protection under this legislation, being protected by special penalties at all times, including against disturbance when breeding. For species listed on Schedule 1A (currently white tailed eagle <i>Haliaeetus albicilla</i> only), intentional or reckless harassment is also made illegal away from the nest and outside the breeding season. This would include disturbance at roost sites. Schedule A1 lists birds whose habitually-used nests may not be intentionally or recklessly damaged, destroyed or otherwise interfered with when <i>not</i> in use (also currently white tailed eagle only).</p>
Wildlife and Natural Environment (Scotland) Act 2011	<p>The Wildlife and Natural Environment (Scotland) Act came in to force in 2011 with the aim to modernise outdated laws and to strengthen the law on wildlife and the natural environment, making it more efficient, effective and proportionate.</p> <p>Under this legislation, wild birds, their nests, and eggs receive protection under Part 2 of the Act.</p>
Nature Conservation (Scotland) Act 2004	<p>This Act places a duty on every public body to further the conservation of biodiversity consistent with the proper exercise of their functions. It also strengthens the legal protection for threatened species.</p>
Scottish Planning Policy 2010	<p>The Scottish Planning Policy (SPP) came into force in February 2010 and succeeds the National Planning Policy Guidelines (NPPGs) in Scotland including NPPG 14 natural heritage. The SPP encourages the restoration of deteriorated habitats and discourages further fragmentation of wildlife corridors. Developments should aim to enhance existing or create new habitats where appropriate. The SPP also highlights the importance of protected areas and species, and enforces the safeguarding of such habitats of importance.</p>
The UK Biodiversity Action Plan (UK BAP)	<p><i>The UK BAP was launched in 1994 and updated in 2007 with the main aim 'To conserve and enhance biological diversity within the UK, and to contribute to the</i></p>

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Legislation/Policy	Description
	<p><i>conservation of global biodiversity through all appropriate mechanisms'. The UK BAP comprises a series of Action Plans for 'priority' habitats and species, determined by the fact that they are either globally threatened or are rapidly declining in the UK. The Action Plans outline measures required to conserve these priority habitats and species.</i></p> <p>The national strategy for biodiversity is delivered at a local level via Local Biodiversity Action Plans (LBAPs). The proposed development site is covered by the provisions of the Ayrshire LBAP, which includes six Species Action Plans (SAPs) for birds including black grouse (<i>Tetrao tetrix</i>), corncrake (<i>Crex crex</i>), hen harrier (<i>Circus cyaneus</i>), lesser whitethroat (<i>Sylvia curruca</i>) and song thrush (<i>Turdus philomelos</i>).</p>
The Scottish Biodiversity List	<p>The Scottish Biodiversity List is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation. The primary purpose of the list is to help public bodies carry out their duty 'to further the conservation of biodiversity' as introduced in The Nature Conservation (Scotland) Act 2004 by identifying the species and habitats which are the highest priority for biodiversity conservation in Scotland.</p> <p>The criteria for selecting species featuring on the list include scientific criteria and a social criterion based on a survey of the Scottish public.</p> <p>The Scottish Biodiversity List was published in 2005 to satisfy the requirement under Section 2(4) of The Nature Conservation (Scotland) Act 2004.</p>

2.2 Royal Society for the Protection of Birds (RSPB) Birds of Conservation Concern

- 2.2.1 The RSPB (2009) has published lists of Birds of Conservation Concern (BoCC). Red List species are those whose breeding population or range is rapidly declining (50% or more in the last 25 years), recently or historically, and those of global conservation concern. Amber List species are those whose breeding population is in moderate decline (25 – 49% in the last 25 years), rare breeders, internationally important and localised species and those of unfavourable conservation status in Europe.
- 2.2.2 These lists confer no legal status, however they are useful when assessing the significance of predicted impacts and determining the level of mitigation that may be required when birds are affected by development or any other activity. Furthermore, inclusion on the Red List is a factor in determining the species for which BAPs are developed.

Methodology



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3 Methodology

3.1 Consultation

- 3.1.1 Consultation was undertaken with Scottish Natural Heritage (SNH) and the Royal Society for the Protection of Birds (RSPB) Scotland, including discussion of the survey scope and methodologies undertaken throughout the wintering survey period at the proposed development site.
- 3.1.2 Site - specific information or existing knowledge of the ornithological interests of the proposed development site and its surroundings were also requested, including roosts or nesting sites of sensitive species and any known flyways or migratory routes that cross the site.
- 3.1.3 The Scottish Wildlife Trust was also contacted to establish their interest in being consulted on the proposals.

3.2 Desk Study

- 3.2.1 Ornithological records within the proposed development site and the surrounding area (the Study Area) were requested from a number of third parties. For the purposes of this assessment the Study Area is defined as up to 5 km from the proposed development site boundary for species records and up to 15 km from the proposed development site boundary for designated wildlife sites of ornithological interest.
- 3.2.2 There is currently no operational ecological records centre for Ayrshire, however ornithological records were requested from the following organisations:
- Dumfries and Galloway Environmental Record Centre;
 - Scottish Ornithologists Club;
 - Scottish Wildlife Trust; and
 - Strathclyde Raptor Study Group.

3.3 Vantage Point (VP) Surveys

- 3.3.1 VP surveys were carried out following the guidance published by Scottish Natural Heritage (SNH, 2005, revised 2010). This involved recording the flights of target bird species through the air space that will be occupied by the proposed wind turbines. Key characteristics of each recorded flight included the flight duration, flight path and estimated flying height of birds at time intervals. The choice of target species was made in line with guidance in SNH (2005, revised 2010) and was informed by the results of the data searches and a reconnaissance site visit.
- 3.3.2 Target species were therefore: raptors, owls, waders and other water birds listed on Annex 1 of the EC Birds Directive and Schedule 1 of the Wildlife and Countryside Act, red grouse (*Lagopus lagopus*) and black grouse (*Tetrao tetrix*).

Choice of Survey Area and VP Locations

- 3.3.3 The topography of the proposed development site is characterised by a series of steep sided hills and gullies that separate a number of gently sloping moorland plateaus. The largest of the hills (Enoch Hill) reaches 569 AOD. Five VPs were required to provide adequate visual coverage of the proposed turbine locations and the airspace immediately around them.
- 3.3.4 The turbine layout and proposed development site boundary are shown on Figure 1.2 along with the VP locations which are summarised in **Table 3.1**. The VP locations were chosen to serve the purposes of assessing an older and more extensive wind farm layout than the one shown, however they are equally relevant to the current layout.

Table 3.1: Summary of Vantage Points

Name	NGR (showing error)	Notes
Peat Hill	NS55854 09659 (22 ft)	Looking south, upslope across Blood Moss, Rigg Hill, along Knockburnie Glen towards plantation.
Blarene	NS58716 09799 (22ft)	Looking south along the slopes of Benty Cowan Hill and across Connelburn Rigg

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Name	NGR (showing error)	Notes
High Chang North	NS56454 07286	North west slope of High Chang Hill, looking north west towards Peat Hill.
High Chang East	NS57242 07739	Eastern slopes of High Chang Hill, looking across upper slopes of Benty Cowan Hill, Connelburn Rigg and Strandlud Hill.
High Chang South	NS56680 07099	Close to fence line along top of High Chang Hill, looking South across plantation, west towards Strandlud Hill and East across Enoch Hill.

3.3.5 The topography of the proposed development site imposed some limitations on the VP locations that will need to be acknowledged and accounted for when analysing the survey results, particularly when carrying out predictive modelling of bird mortality through the use of a Collision Risk Model (CRM). These are:

- Best practice is to place VPs at least 500 m from the nearest turbine, which presents a risk of the surveyor biasing the survey results, however some of the VPs were placed within the turbine cluster or closer than 500 m.
- There were significant areas of overlap between the viewsheds from a number of the VPs.
- Some areas were not visible from any of the VPs, particularly the areas of low lying land in a number of valley bottoms.

3.3.6 The limitations defined above can be accommodated and their impact on the analysis ultimately minimised through the mathematical provisions built into the CRM (for example the derivation of predicted flight activity per annum per unit area from recorded flight rates per unit area surveyed for many species) and the use of multiple models constructed for groups of turbines that are visible but sufficiently distant from individual VPs.

3.3.7 Viewsheds of slightly greater than 180° were used at Peat Hill, Blarene and High Chang East. This deviates slightly from SNH guidance, however it was decided in these cases that the benefits of this approach outweighed the drawbacks. The approach taken has the following advantage:

- Surveyors could use geographical and landscape features to determine more accurately the viewing arcs when in the field
- The areas viewed could include potentially important landscape features (such as gorges, stream valleys and woodland areas) where bird activity might be significant and / or otherwise unseen from other VPs.

Recording Effort

3.3.8 VP watches of around 3 hours in duration were carried out across all parts of the day, including dusk and dawn periods to allow detection of any bird movements to and from roosts, and / or crepuscular species. Surveys were carried out in any weather conditions except for extreme high winds, driving precipitation and conditions of poor visibility such as fog, in which birds were impossible to record.

3.3.9 Forty - two hours of VP survey were carried out at each VP, spread more or less evenly across the months of September 2011 – March 2012 inclusive, with the exception of Blarene (37.5 hours) and High Chang East (45 hours). Blarene was adopted following the abandonment of a VP on Benty Cowan Hill in October 2011 for reasons of poor access and visibility at this location.

Focal animal sampling

3.3.10 The Survey Area was scanned constantly until a target species was detected in flight. Once detected, the target species was watched until it ceased flying or was lost from view. The time of detection and the duration of the flight were recorded. Since it would be impossible for a surveyor to make a constant record of changes in bird height and keep track of the bird's position, the method allows for bird height to be recorded at time intervals of 15 - seconds (at the point of detection T=0 s, then T=15 s, T=30 s and so on). The birds' flying height was estimated at each time interval by recording it in one of the predetermined height bands shown below. These approximate the indicative dimensions of the proposed turbines. The height bands are:

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- <10m.
- 10 - 30m.
- 31 – 80m.
- 81 – 130m.
- >130m.

- 3.3.11 The minimum and maximum height of the rotor blades (the Rotor Swept Height, (RSH) is represented by the height bands 31 – 80 m and 81 – 130 m. Birds flying through the wind farm at these heights would be at risk of collision with the rotor blades. The number of intervals recorded at each height enables the overall time each species spent within a given height band to be determined retrospectively using the time interval data and from this the risk of collision for each target species can be determined using the CRM. Inferences about the relative risk to each target species can be made from the time interval data without using a CRM; such narrative is included in the results section of this report.
- 3.3.12 Additional notes about the behaviour, sex and age of the target birds were made whenever possible. Target species flights within the proposed development area were prioritised over flights across the wider area beyond the boundary of the proposed development site and turbines, however flights outside the site boundary were recorded to aid the assessment of core flight areas wherever possible.
- 3.3.13 The route followed by each target species detected was plotted on a field map and cross referenced with the recording forms. Display flights, aggressive interactions with other birds or any other behavioural activity of interest were recorded on the VP form. Flight lines and flight attribute data were digitised in a GIS and stored for the purposes of a CRM, should one be needed.

3.4 Winter Walkover Surveys

- 3.4.1 The walkover surveys comprised a combination of Common Birds Census (CBC) – style transect survey (Marchant, 1993, Gilbert *et al.*, 1998) and scanning of open areas using high powered optical equipment in order to record flocks of wintering birds, waders, wildfowl and overflying raptors and any signs of field use by flocks of geese, such as aggregations of droppings. Where the proposed development site abuts plantation woodland, transect routes followed the woodland edge in order to identify bird activity visually or aurally.
- 3.4.2 The Survey Area covered all land within the proposed development site boundary plus up to 600 m beyond the edge of the proposed development boundary where access to these areas was available. Land beyond the proposed development site boundary was scanned using optical equipment from the edge of the development boundary and other useful vantage points where access was restricted.
- 3.4.3 Seven field counts were undertaken on a monthly basis between September 2011 and March 2012 inclusive.

Results



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4 Results

4.1 Consultation

4.1.1 A response was received from SNH requesting further information with regards to the proposals for the site and further information relating to the survey methodologies being undertaken. Further information relating to the VP locations and viewsheds was submitted, along with a summary of the target species recorded up to the date of consultation. Copies of the correspondence between AECOM and SNH are included as Appendix 4.1. In summary, the key advice points were:

- Survey work appears to comply with SNH bird survey guidance with respect to wintering birds, however more information is needed to determine whether a representative sample of bird flight activity has been collected.
- Survey work is incomplete and SNH expect survey work to be continued throughout 2012.
- Additional work may be required as a consequence of survey results, specifically where species not targeted by current survey criteria are recorded.
- SNH expressed concerns about the viewsheds of VPs 1 [Peat Hill], 4 [Blarene] and 7 [High Chang East], which appear to be greater than 180 degrees.
- Some of the vantage points are very close to proposed turbine locations, [SNH] would advise that a buffer of at least 500m is maintained to prevent observer biases.

4.1.2 No response was received from RSPB Scotland or the Scottish Wildlife Trust.

4.2 Desk Study

Statutory Designated Sites

4.2.1 Muirkirk and North Lowther Uplands SPA is approximately 7.5 km north east of the proposed development site at its closest point. The SPA regularly supports populations of European importance of five Annex I species; wintering and breeding hen harrier (*Circus cyaneus*), breeding short-eared owl (*Asio flammeus*), merlin (*Falco columbarius*), peregrine (*Falco peregrinus*) and golden plover (*Pluvialis apricaria*).

4.2.2 Airds Moss Special Area of Conservation (SAC), approximately 12 km to the north, is designated as one of the few remaining areas of relatively low-altitude blanket bog in south-west Scotland.

4.2.3 There are also thirteen Sites of Special Scientific Interest (SSSI) within or partially within 15 km of the proposed development site (two of which are designated at least in part for their ornithological interest and which are shown in **bold** type). These are listed below:

- | | |
|-----------------------------|---------------------------|
| ▪ Barlosh Moss | ▪ Fountainhead |
| ▪ Benbeoch | ▪ Lagrae Burn |
| ▪ Bogton Loch | ▪ Loch Doon |
| ▪ Dalmellington Moss | ▪ Lugar Sill |
| ▪ Dunaskin Glen | ▪ Muirkirk Uplands |
| ▪ Ness Glen | |
| ▪ Nith Bridge | |
| ▪ Polhote and Polneul Burns | |

4.2.4 Bogton Loch SSSI is approximately 8.5 km south west of the proposed development site. It is designated for its breeding bird assemblage and open water transition fen. The breeding bird assemblage includes song thrush (*Turdus philomelos*), grasshopper warbler (*Locustella naevia*), spotted flycatcher (*Muscicapa striata*), willow tit (*Poecile montanus*), reed bunting (*Emberiza schoeniclus*) and, sporadically, a small colony of black-headed gulls (*Chroicocephalus ridibundus*).

4.2.5 Muirkirk Uplands SSSI is approximately 7.5 km north east of the proposed development site. It is designated for breeding hen harrier, non-breeding hen harrier, breeding short-eared owl, and a breeding bird assemblage including teal (*Anas crecca*), hen harrier, buzzard (*Buteo buteo*), merlin, peregrine, short-eared owl, red grouse (*Lagopus lagopus*),

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golden plover, dunlin (*Calidris alpina*), snipe (*Gallinago gallinago*), curlew (*Numenius arquata*), redshank (*Tringa totanus*), whinchat (*Saxicola rubetra*), stonechat (*Saxicola torquatus*), wheatear (*Oenanthe oenanthe*) and ring ouzel (*Turdus torquatus*), as well as for geological and habitat features.

Non-Statutory Wildlife Sites

- 4.2.6 There are two Scottish Wildlife Trust reserves; Dalmellington Moss (approximately 8 km west) and Knockshinnoch Lagoon (approximately 2.6 km north east). The latter site is of ornithological interest and is described by SWT as 'a migration stop between the Solway Firth and the Clyde Estuary, with pools and marshland for breeding and wintering birds'.
- 4.2.7 There is a RSPB reserve approximately 13 km to the north on Airds Moss, which is managed by grazing for breeding waders and wintering hen harriers.
- 4.2.8 There are three Important Bird Areas (IBAs) that are partially within 15 km of the proposed development site, the boundaries of which are not concurrent with those of the other site designations. These are:
- North Lowther Hills, approximately 7.5 km to the north east, which supports a range of breeding upland bird species,
 - Airds Moss and Muirkirk Uplands, approximately 12 km to the north, which achieves IBA status due to populations of breeding peregrine and hen harrier
 - Galloway Forest Park, approximately 10.5 km to the south west, which supports a range of breeding waders and water birds.

Species Records

- 4.2.9 Records of Annex 1 breeding raptor sites within the Study Area were provided by the South Strathclyde Raptor Study Group. The locations of breeding sites are sensitive and are provided by the Raptor Study Group subject to strict conditions of confidentiality. Consequently these records are restricted to a confidential Annex and are not reproduced here.

4.3 Vantage Point Surveys

- 4.3.1 Five target species were recorded in flight during the VP surveys. Analysis of these flights and an assessment of perceived collision risk are included in **Table 4.2**. Flight lines for each target species are displayed in **Figures 4.1 – 4.5**
- 4.3.2 Table 4.3 lists these and other target species that were recorded during the winter walkovers (i.e. not during a formal VP survey). The total species count is 44 when the results of the two survey methods are combined.

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Table 4.2: Summary target species flight data analysis and perceived collision risk (red type indicates proportion of time spent at rotor height and therefore at potential risk of collision with rotor blades)

Species	Number of flights	Total flight time recorded (s)	Vertical distribution of flight time			Perceived risk of collision	Reasoning
			< 30 m	31 – 130 m	> 130 m		
Golden plover <i>Pluvialis apricaria</i>	32	14,832	42%	48%	10%	Medium	Moderate numbers of flights, concentrated on upper slopes of site and particularly near Enoch Hill.
Goshawk <i>Accipiter gentilis</i>	3	205	4%	96%	0%	Low	Majority of flight not over or through turbines. .
Merlin <i>Falco columbarius</i>	2	25	100%	0%	0%	Low	Fast and generally low – flying. Little flight time and not at rotor height.
Snipe <i>Gallinago gallinago</i>	1	30	100%	0%	0%	Low	Small populations with limited tendency to take flight over winter. Small and fast flying.
Red grouse <i>Lagopus lagopus</i>	2	90	100%	0%	0%	Low	Small numbers of birds. Not prone to long flights at significant height.

Capabilities on project:
Environment

- 4.3.3 An overriding observation is that there were relatively few flights of any of the target species when compared with the majority of AECOM's previous wind farm experience. For the majority of species there were too few recorded flights to detect reliably any patterns of flight activity. However a number of key observations can be made:
- Golden plover was by far the most frequently recorded species, the majority of flight activity being over Enoch Hill and High Chang (though its distribution was generally widespread as evidenced by the results of these and the walkover surveys). Birds were recorded in modest sized flocks ranging from 1 to 43 individuals. Flight activity was more or less evenly distributed between rotor height and other heights either below or above rotor height.
 - Black grouse was not detected in flight during the VP surveys though it was recorded making occasional flights during walkover surveys.
 - All other target species were widespread over open moorland habitats.
- 4.3.4 Significant proportions of the overall flight time were observed at rotor height for goshawk and golden plover only. Of these two species, significant amounts of flight time close to the proposed turbines were noted only for golden plover.
- 4.3.5 The majority of flight activity for most species was characterised by relatively short flights at low height, which is generally indicative of a fairly sedentary wintering bird population that is resident to the proposed development site and its immediate surroundings rather than long distance migratory movements across the site (the assumption being that these would be biased toward greater flight durations and heights). The flight lines shown in Figures 4.1 – 4.5 support this assertion for most species except, perhaps, goshawk, which is known to make high – circling displays throughout the year (Hardey *et al.*, 2006).
- 4.3.6 Flights of a number of other species were recorded, including kestrel (*Falco tinnunculus*), grey heron (*Ardea cinerea*), and greylag goose (*Anser anser*). The latter 2 species were responsible for only 2 flights across the wind farm between them. Kestrel was widespread and frequently encountered during both walkover and VP surveys and it is likely that there is a small resident population in the area that hunts across the open habitats here. Nevertheless only 4 flights were recorded for this species during the VP watches. None of these species were at significant risk of collision by virtue of their low overall flight times, low bird numbers and spatial distribution of flights.

4.4 Walkover Surveys

- 4.4.1 Forty – three species were recorded during the walkover surveys (Table 4.3). The assemblage included a mix of resident and wintering passerines, geese, waders and birds of prey, most of which are common and widespread species. However there were several significant records in terms of the species rarity, conservation status and / or vulnerability to impacts from wind farm developments. These were:
- Hen harrier – a single male was recorded flying south over the plantations that flank the western edge of the proposed development area in late September. This was an unconfirmed record given its distance from the surveyor, however the geographical context of the proposal site (i.e. between a number of sites designated for populations of this species) suggests that this species is present in the wider area.
 - Merlin – a single male was recorded in September;
 - Black grouse – a single male was recorded at Connelburn Rig in March. In February a single bird was recorded flying over Blood Moss in the direction of the B741.
 - Golden Plover – small flocks were frequently recorded throughout the wintering period, with peak numbers occurring in autumn and March. The majority of the birds were recorded on the upper slopes and plateaus of High Chang Hill, Chang Hill, Benty Cowan Hill, Blarene Hill, Rig Hill and Barbeys Hill. The highest peak counts were 90, 30 and 18 (the peak count of 90 birds was recorded on 2nd November 2011 at High Chang Hill). Surveyors also noted a feeding flock numbering around 200 birds within a few kilometres of the proposed development, which is indicative of a reasonable wintering population of golden plover in the area.
 - Unidentified over-flying swan species – it is possible that the flock of five over-flying swans were whooper swan (*Cygnus cygnus*), which is a Schedule 1 and Amber List species.

Capabilities on project:
Environment

- 4.4.2 A small number of waterfowl (teal, goosander *Mergus merganser* and Canada goose *Branta canadensis*) were recorded at a wetland near Brockloch. Small numbers of waders including oystercatcher (*Haematopus ostralegus*) were recorded on in-bye pasture in this area. Woodcock (*Scolopax rusticola*) was recorded on a single occasion near Connel Burn. There were no other records of geese or other waterfowl and waders despite systematic attempts to detect them on the pastures that flank the B741, where feeding flocks might have been expected to occur.
- 4.4.3 Grouse species were represented by a small resident population of red grouse and occasional records of black grouse, indicative of a small resident population.
- 4.4.4 Small wintering populations of passerines were recorded in the open moorland habitats including: meadow pipit (*Anthus pratensis*), skylark (*Alauda arvensis*) and a single record of snow bunting (*Plectrophenax nivalis*). Records of wheatear in early autumn referred to passage migrant birds. Small feeding flocks of redwing (*Turdus iliacus*) and fieldfare (*Turdus pilaris*) were recorded consistently throughout winter, especially on the lower (northern) hill slopes and the enclosed pasture flanking the B741.
- 4.4.5 Ravens (*Corvus corax*) were recorded on most surveys feeding within and overflying the proposed development site, which suggests that there is at least 1 resident pair within or close to the survey area. It is likely that this species will breed in similar numbers within or close to the proposed development site.
- 4.4.6 The wintering bird assemblage occurring within the coniferous plantation woodland included species typical of the habitat such as thrushes, finches and tit species, lesser redpoll (*Carduelis cabaret*), goldcrest (*Regulus regulus*), occasional great spotted woodpecker (*Dendrocopos major*), sparrowhawk (*Accipiter nisus*) and jay (*Garrulus glandarius*). A small population of common crossbill (*Loxia curvirostra*) was detected within the plantations that surround the proposed development area.

Table4.3: Birds recorded during wintering bird surveys 2011 - 12 (see footnotes). Red type indicates target species for the purposes of VP surveys.

Species	Conservation Status	VP Surveys	Walkover Surveys
Grey Heron <i>Ardea cinerea</i>		A single flight record	Rarely recorded
Unidentified Swan <i>Cygnus</i> sp			5 unidentified swans were recorded flying SW over Chang Hill on 7/12/11
Canada Goose <i>Branta canadensis</i>			A single record near Brockloch 15/03/12
Teal <i>Anas crecca</i>	Amber ⁴		8 birds near Brockloch on 15/03/12
Goosander <i>Mergus merganser</i>			A single record near Brockloch on 15/03/12
Hen Harrier <i>Circus cyaneus</i>	EC1 ¹ , WC1A ² , Red ³	Not recorded	Unconfirmed sighting of a single male over-flying coniferous woodland near Enoch Hill (September 2011)
Goshawk	WC1A	Occasional on VP surveys	

Capabilities on project:
Environment

Species	Conservation Status	VP Surveys	Walkover Surveys
<i>Accipiter gentilis</i>			
Common Buzzard <i>Buteo buteo</i>			Frequently recorded
Merlin <i>Falco columbarius</i>	WC1A ² , Amber ⁴	Occasional flights across upper slopes of site.	Single male recorded near High Chang Hill on 30/09/12
Kestrel <i>Falco tinnunculus</i>	Amber	Occasional records, widespread	Frequently recorded (at least 3 different birds)
Sparrowhawk <i>Accipiter nisus</i>			Recorded occasionally close to plantation woodland
Red Grouse <i>Lagopus lagopus</i>	Amber ⁴	Occasional records across upper slopes and at plantation edges	Frequently recorded in small numbers
Black Grouse <i>Tetrao tetrix</i>	Red ³	Not recorded	Single male at Connelburn Rig on 14/03/12 and overflying Blood Moss in February
Oystercatcher <i>Haematopus ostralegus</i>		Not recorded	1 pair recorded on 15/03/12
Golden Plover <i>Pluvialis apricaria</i>	EC1 ¹ , Amber ⁴	Flight activity widespread across the survey area. The most frequently recorded target species.	Frequently recorded in small numbers (refer to individual species account) across open habitats
Snipe <i>Gallinago gallinago</i>	Amber ⁴	Occasional records of a single bird	Occasionally recorded in small numbers
Woodcock <i>Scolopax rusticola</i>	Amber ⁴	Not recorded	Single record at Connelburn
Great Black-backed Gull <i>Larus marinus</i>	Amber ⁴		Single record of 2 over-flying birds
Great Spotted Woodpecker <i>Dendrocopos major</i>			Occasionally recorded in woodland areas
Wood pigeon			Small numbers associated mostly with woodlands

Capabilities on project:
Environment

Species	Conservation Status	VP Surveys	Walkover Surveys
<i>Columba palumbus</i>			
Skylark <i>Alauda arvensis</i>	Red ³		Frequently recorded across open habitats
Meadow Pipit <i>Anthus pratensis</i>	Amber ⁴		Common and widespread across open habitats in Autumn. Few present over winter (from November to February)
Northern Wheatear <i>Oenanthe oenanthe</i>	Amber ⁴		Small numbers particularly on the in-bye pasture in the northern parts of the proposed development area.
Robin <i>Erithacus rubecula</i>			Frequently recorded in woodland areas.
Blackbird <i>Turdus merula</i>			Occasionally recorded in woodland areas
Redwing <i>Turdus iliacus</i>	WC1A ² , Red ³		Frequently recorded in small numbers especially across lower slopes in the northern part of the proposed development area
Fieldfare <i>Turdus pilaris</i>	WC1A ² , Red ³		Frequently recorded in small numbers across open habitats, particularly on the lower (northern) slopes.
Song Thrush <i>Turdus philomelos</i>	Red ³		Occasionally recorded in woodland areas
Chaffinch <i>Fringilla coelebs</i>			Widespread in woodland habitats
Coal Tit <i>Parus ater</i>			Frequently recorded in woodland areas
Great Tit <i>Parus major</i>			Occasionally recorded in woodland areas
Goldcrest <i>Regulus regulus</i>			Small numbers recorded in woodland areas
Jay <i>Garrulus glandarius</i>			Occasionally recorded in woodland areas

Capabilities on project:
Environment

Species	Conservation Status	VP Surveys	Walkover Surveys
Raven <i>Corvus corax</i>			Frequently recorded in small numbers over flying the site
Carrion Crow <i>Corvus corone</i>			Frequently recorded over wooded areas and open habitats
Jackdaw <i>Corvus monedula</i>			Occasionally recorded mostly over woodland areas
Magpie <i>Pica pica</i>			Widespread in association with woodland, woodland edge, pasture and dwellings.
House Sparrow <i>Passer domesticus</i>	Red ³		Single record at Straid Farm
Lesser Redpoll <i>Carduelis cabaret</i>	Red ³		Occasionally recorded in small numbers
Common Crossbill <i>Loxia curvirostra</i>			Recorded consistently in woodland areas in small numbers
Linnet <i>Carduelis cannabina</i>	Red ³		Occasionally recorded in small numbers
Goldfinch <i>Carduelis carduelis</i>			Occasionally recorded
Bullfinch <i>Pyrrhula pyrrhula</i>	Amber ⁴		Occasionally recorded, associated with woodland habitat
Snow Bunting <i>Plectrophenax nivalis</i>	WC1A, Amber ⁴		Single record on 7/12/11

¹ EC1 species included in Annex 1 of EC Birds Directive 1979 (79/409/EEC).

² WCA1 species included in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

³ Red species included on the RSPB Red list of Birds of Conservation Concern

⁴ Amber included on the RSPB Amber list of Birds of Conservation Concern

Summary and Recommendations



Capabilities on project:
Environment

5 Risk Summary and Recommendations

5.1 Results summary and discussion of risk

- 5.1.1 The wintering bird surveys have shown that, overall, the proposed development site does not appear to support large numbers of birds over winter and there are relatively few records of species that are regarded as being of high conservation status or especially sensitive to the potential impacts of wind farm developments.
- 5.1.2 The wintering bird assemblage is generally rather impoverished, particularly on the upper slopes of the proposed development, with very few records of geese, swans or ducks overflying the site or feeding on or close to it. Waders were almost exclusively represented by small groups of golden plover predominantly on the moorland habitat and these birds were responsible for the moderate amounts of flight activity recorded during the VP surveys. A larger flock numbering around 200 was seen in the wider area as a surveyor was driving home after a survey, which suggests some potential for larger numbers to be present in winter. Other waders, including snipe and oystercatcher, were present only in very small numbers, though the presence of snipe was consistent on the moorland habitats throughout winter.
- 5.1.3 Golden plover is of high conservation status and potentially sensitive to the impacts of wind farms where large numbers of birds are involved or where there is a confirmed functional link between a given development site and a site designated for their presence, such as a SPA. However this species is generally widespread in winter and there is currently no evidence that the birds recorded at Dalleagles present a significant risk to the proposed development, based on preliminary analysis of recorded flights (in terms of overall duration spatial distribution). It is, however, expected that this species will breed within the proposed development area on the open moorland plateaus that characterise the upper reaches of the proposed development site. This should be regarded as a potential though not necessarily insurmountable risk to the proposal.
- 5.1.4 Other records of potentially sensitive birds include black grouse and goshawk overflying the proposed development area, their movements suggesting resident populations in or close to the plantation woodlands surrounding the site. Black grouse are known to be prone to collisions even with static objects (such as deer fences) and do make flights at height in some circumstances. However the available survey data suggest that significant interactions between these birds and the proposed turbines would be unlikely. The risks to red grouse are likely to be those of displacement from feeding and breeding areas rather than those of collision mortality. The risk to this species is anticipated at this stage to be low.
- 5.1.5 There were also records of wintering fieldfare and redwing flocks, although the numbers recorded were moderate and their presence as a common and widespread winter migrant throughout the UK means that only in exceptional circumstances (i.e. very large numbers concentrated in a small area) should they be regarded as a significant risk to the proposed development. Skylark and meadow pipit were commonly recorded and it is therefore likely that these species will breed within the proposed development area, along with other ground nesting birds (which are likely to include a number of wading birds).
- 5.1.6 Other records of note include a small group of snow bunting, a migrant which is often recorded in northern parts of the UK over winter. This is likely to be an occasional and transient presence in the area and therefore presents very little risk to the proposal.
- 5.1.7 Raven was frequently recorded overflying the site and it is likely that there is at least one pair holding territory nearby. This species may present some risk of collision but this is likely to be low given the number and spatial distribution of flights. The species is not of high conservation concern.
- 5.1.8 Potentially of greatest significance was a brief and unconfirmed sighting of a male hen harrier flying southwards over the plantation woodland to the west of the proposed development boundary. It is possible, given the distribution of wintering and breeding sites for this species throughout northern Britain, that the proposed development area would be used opportunistically by this species as a hunting ground as it moves between wintering and breeding sites, or that the proposed development is on a flyway route regularly used by hen harriers. It is impossible at this stage to determine how significant this potential risk is in reality, however breeding bird surveys at the site may shed more light on this.

Capabilities on project:
Environment

- 5.1.9 Anecdotal notes from the surveyors also highlight an unconfirmed sighting of peregrine, an observation that is supported in principle by the data received from the South Strathclyde RSG. While the record cannot be verified, this is a species that typically occupies large home ranges with multiple breeding sites, any one of which may be used in a given breeding season. While there is little suitable nesting habitat for this species within or immediately adjacent to the proposed development site, its presence as a risk species cannot be ruled out at this stage (the key risk in this case would be expected to be collision mortality).
- 5.1.10 Barn owl is known to nest in a number of locations in the wider area. The key risks at this stage appear to be those of disturbance to nests and young caused by construction and operation of the proposed turbines. Collision risk for this species is likely to be low; barn owl flights are typically close to the ground when hunting. Furthermore, there have been no records of this species during any of the wintering bird surveys and it is unlikely that hunting barn owls will make forays across the higher ground on which the proposed turbines will be located. It is expected that the majority of barn owl activity would occur over the less exposed low lying ground to the north of the proposed development area and potentially along the edges of adjacent plantations.
- 5.1.11 It is difficult to determine the overall risk of collision mortality posed by the proposed turbines, however the results of the wintering survey suggest that it is low or zero for most species over winter. To date, only golden plover appears to be at risk of collision mortality on a scale that would be regarded as significant. However this statement carries a significant caveat that it is based on preliminary analysis of flight data and is not supported by a formal collision risk modelling exercise. Furthermore any attempt to predict bird collision mortality should always be based on at least one full year's data, including surveys carried out across all seasons in which target species would be expected to occur. In this case, all of the target species could be present on a year-round basis.
- 5.1.12 The overall level of ornithological risk to the proposed development, based on the wintering surveys and third party data received, is **Low – Moderate**. There is a significant element of uncertainty associated with this judgement because it is based on an incomplete data set that has, to date, identified a number of high risk species that are likely to be present in the wider area and that might interact with the proposed development in as yet undefined ways.
- 5.1.13 The preliminary assessment above is based on the consideration of this wind farm alone and does not include any element of cumulative assessment of the impact of this proposal in combination with other schemes in the wider area, including operational, proposed and consented (but not yet built) wind farms. Such considerations would form an essential part of a robust impact assessment should this proposal be taken forward to a planning application.

5.2 Key risks to the proposal and recommendations for further work

- 5.2.1 The key risks to the proposal discussed in paragraphs 5.1.1 – 5.1.12 are condensed and summarised in Table 5.1, which also identifies further surveys that might be required to enable a robust assessment of the potential impacts of the proposal on birds.
- 5.2.2 Breeding bird surveys commissioned by Eon are ongoing and include both generic methods (breeding bird census and VP surveys) and species – specific work for a number of species. A judgement on the requirement for any other species – specific surveys was made after analysis of the combined results of the wintering bird surveys and the data search.

Capabilities on project:
Environment

- 5.2.3 Breeding raptors may be present within the wider area. It is therefore recommended that surveys for these species be carried out and the results assessed against those of the more generic surveys that are ongoing, which include breeding bird census and VP watches.

Capabilities on project:
Environment

Table 5.1: Summary of Potential Risks to Ornithological Receptors and Further Recommendations

Receptor	Key Potential Impact(s)	Likelihood of occurrence	Further surveys required	Status
Ground nesting birds including waders (all seasons)	Displacement and habitat loss Disturbance / prevention of nesting and successful breeding	High (all)	Breeding census	Ongoing
Woodland passerine species	Displacement and habitat loss Disturbance / prevention of nesting and successful breeding	Low (all)	Breeding census	Ongoing
Red Grouse	Displacement Disturbance / prevention of breeding Collision	Moderate Moderate Low	Breeding census and VP surveys	Ongoing
Black Grouse	Displacement Disturbance / prevention of breeding Collision	Low Low Low - moderate	Breeding black grouse surveys and VP surveys	Ongoing
Barn Owl	Displacement Disturbance / prevention of breeding Collision	Low – moderate (all)	Breeding barn owl surveys and VP surveys	Ongoing
Hen harrier and peregrine	Collision Displacement from hunting areas Barrier effects to movement across the site	Low - moderate	Breeding VP surveys	Ongoing
Merlin and Goshawk	Displacement from hunting areas Collision Displacement from nests / territories	Low - moderate Low Unknown	Breeding VP surveys Breeding VP surveys Species specific breeding surveys	Ongoing Ongoing Recommended

Capabilities on project:
Environment

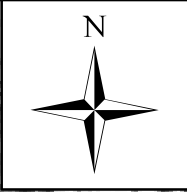
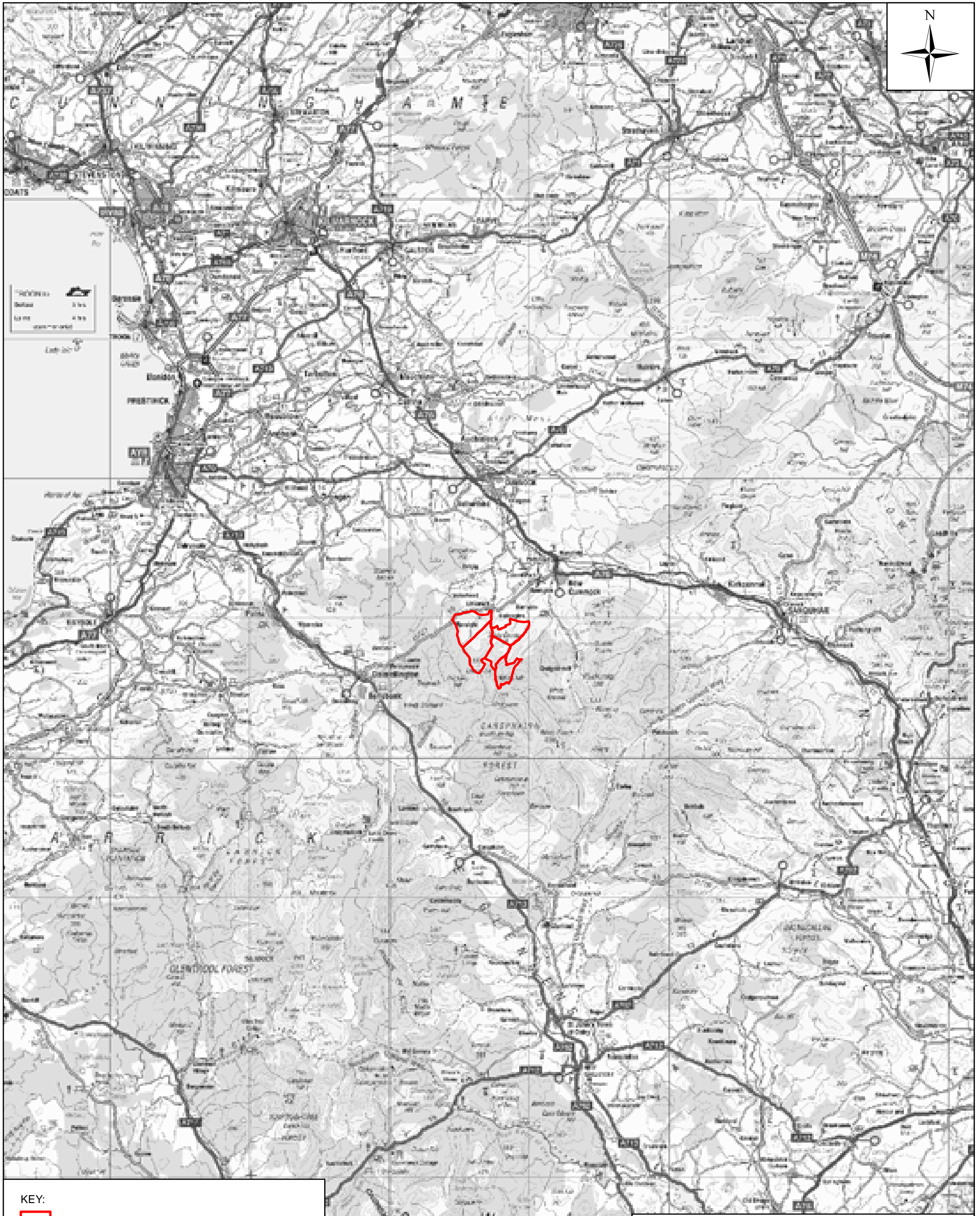
6 References


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Capabilities on project:
Environment

7 Figures

- Figure 1.1** Site Location
- Figure 1.2** VP Locations and Proposed Layout
- Figure 4.1** Golden Plover Flight Lines
- Figure 4.2** Goshawk Flight Lines
- Figure 4.3** Merlin Flight Lines
- Figure 4.4** Snipe Flight Lines
- Figure 4.5** Red Grouse Flight Lines



KEY:
 Survey Area

0 10,000 Metres

Client:

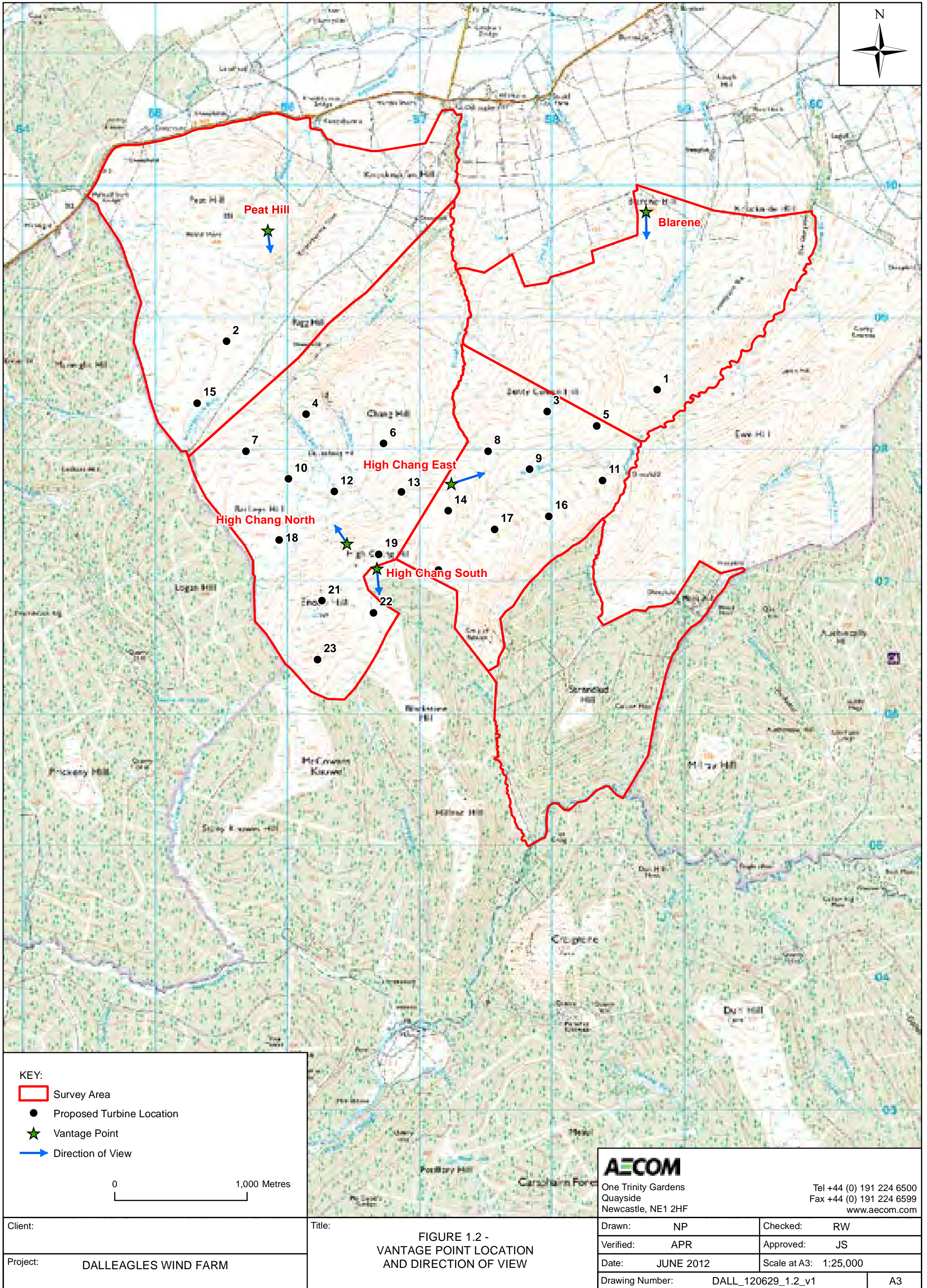
Project: **DALLEAGLES WIND FARM**

Title:

**FIGURE 1.1 -
SITE LOCATION PLAN**

AECOM
 One Trinity Gardens
 Quayside
 Newcastle, NE1 2HF
 Tel +44 (0) 191 224 6500
 Fax +44 (0) 191 224 6599
 www.aecom.com

Drawn: NP	Checked: RW
Verified: APR	Approved: JS
Date: JUNE 2012	Scale at A3: 1:250,000
Drawing Number: DALL_120629_1.1_v1	A3



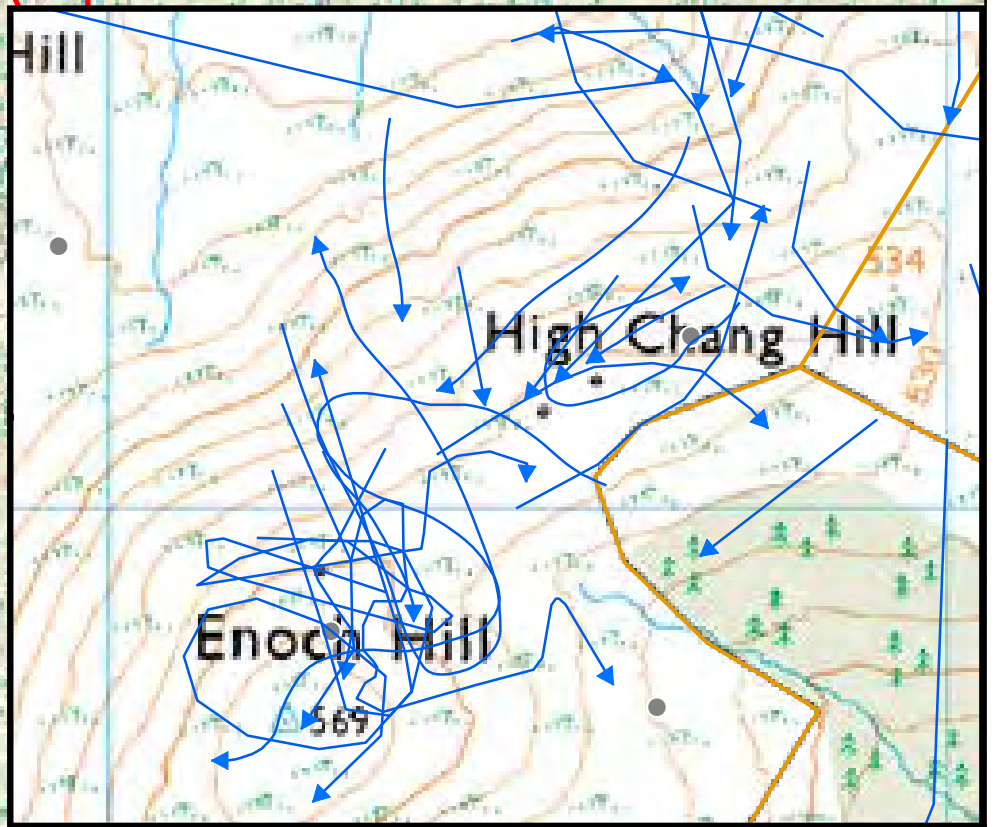
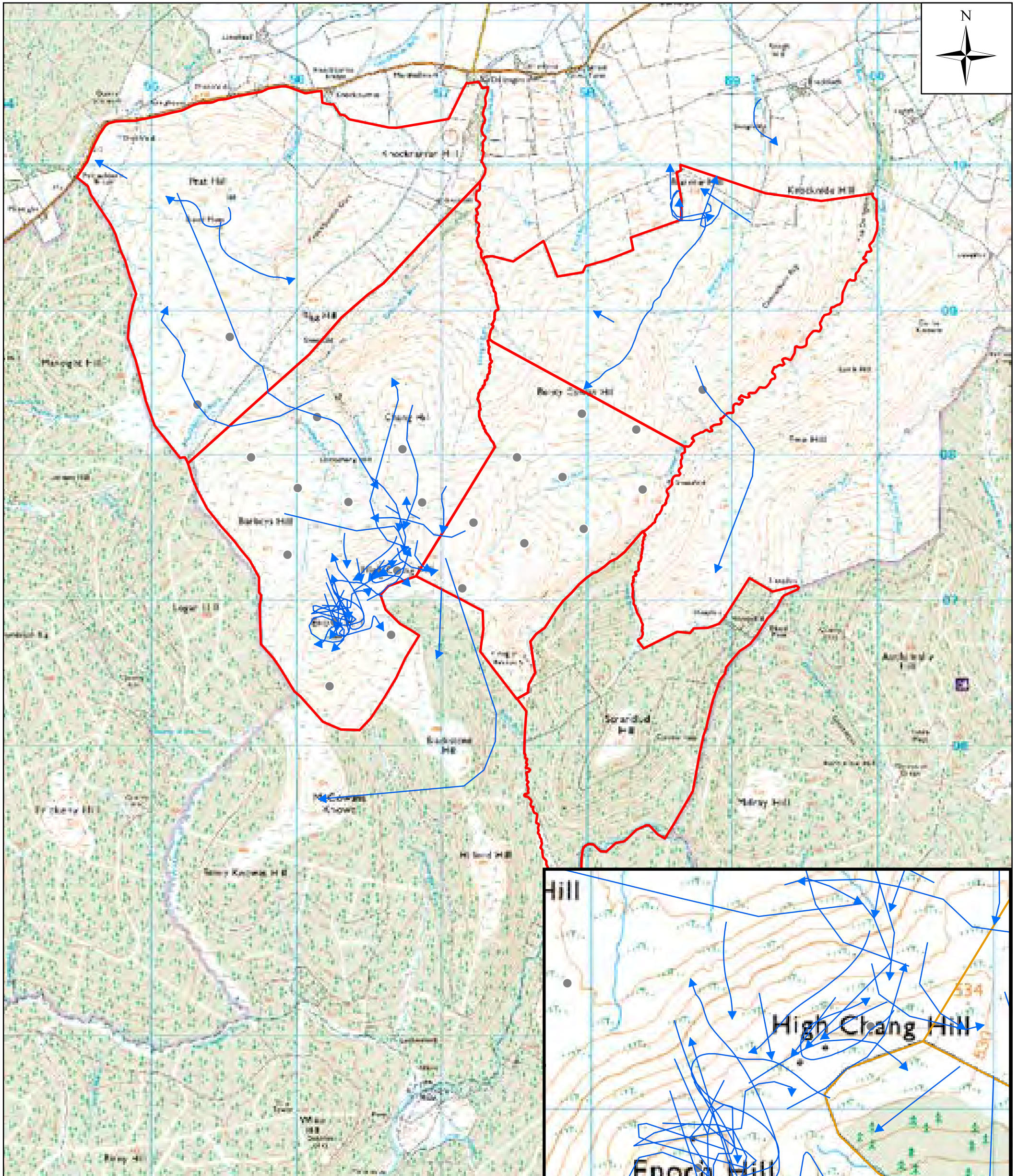
- KEY:**
- Survey Area
 - Proposed Turbine Location
 - ★ Vantage Point
 - Direction of View

0 1,000 Metres

Client:	
Project:	DALLEAGLES WIND FARM

Title:	FIGURE 1.2 - VANTAGE POINT LOCATION AND DIRECTION OF VIEW
--------	--

AECOM		Tel +44 (0) 191 224 6500	
One Trinity Gardens		Fax +44 (0) 191 224 6599	
Quayside		www.aecom.com	
Newcastle, NE1 2HF		Drawn: NP	Checked: RW
Verified: APR		Date: JUNE 2012	Approved: JS
Drawing Number: DALL_120629_1.2_v1		Scale at A3: 1:25,000	
			A3



- KEY:
- Survey Area
 - Proposed Turbine Location
 - ➔ Flight Line

0 1,000 Metres

Client:
Project: DALLEAGLES WIND FARM

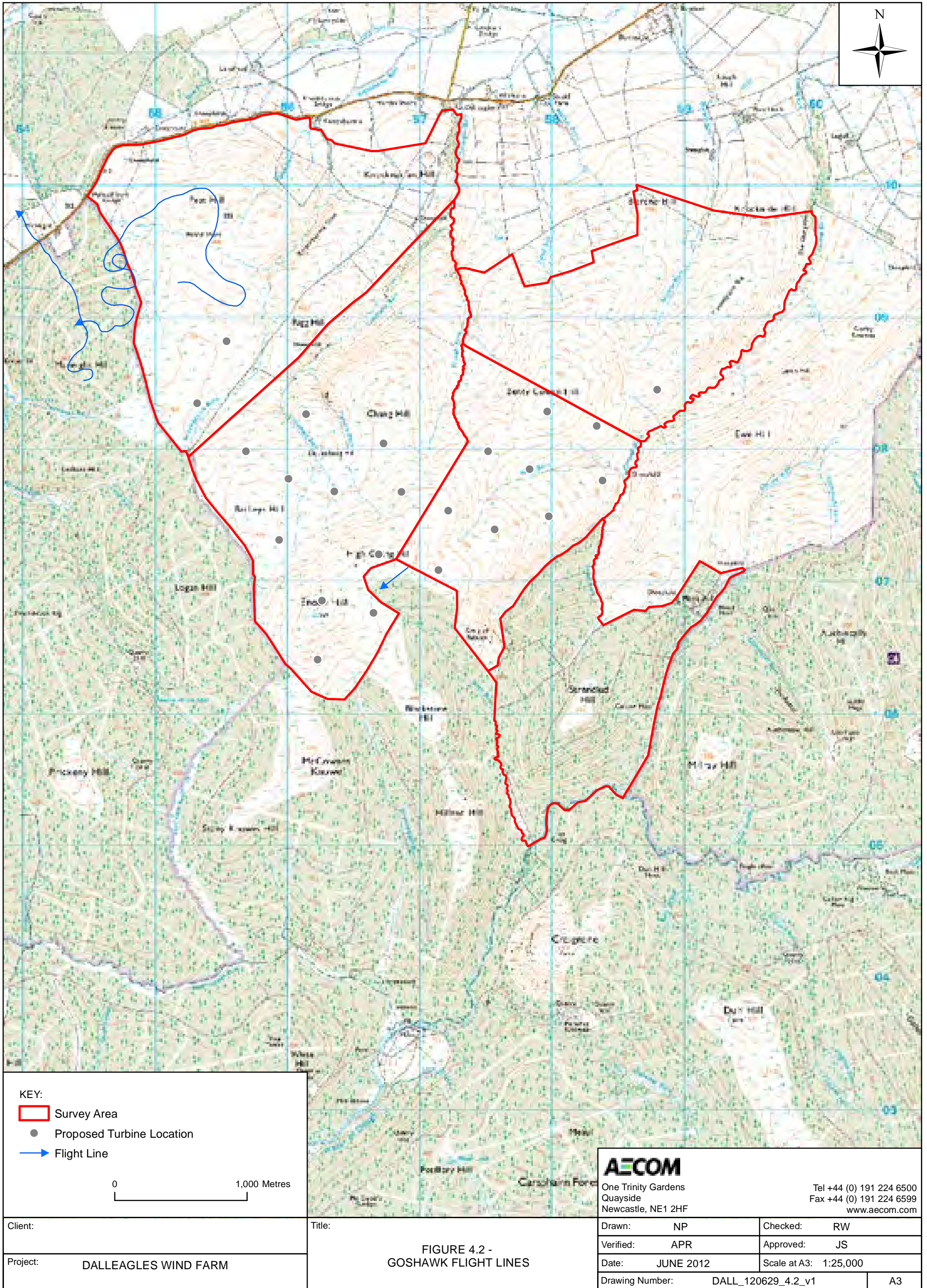
Title:
FIGURE 4.1 - GOLDEN PLOVER FLIGHT LINES

AECOM

One Trinity Gardens
Quayside
Newcastle, NE1 2HF

Tel +44 (0) 191 224 6500
Fax +44 (0) 191 224 6599
www.aecom.com

Drawn: NP	Checked: RW
Verified: APR	Approved: JS
Date: JUNE 2012	Scale at A3: 1:25,000
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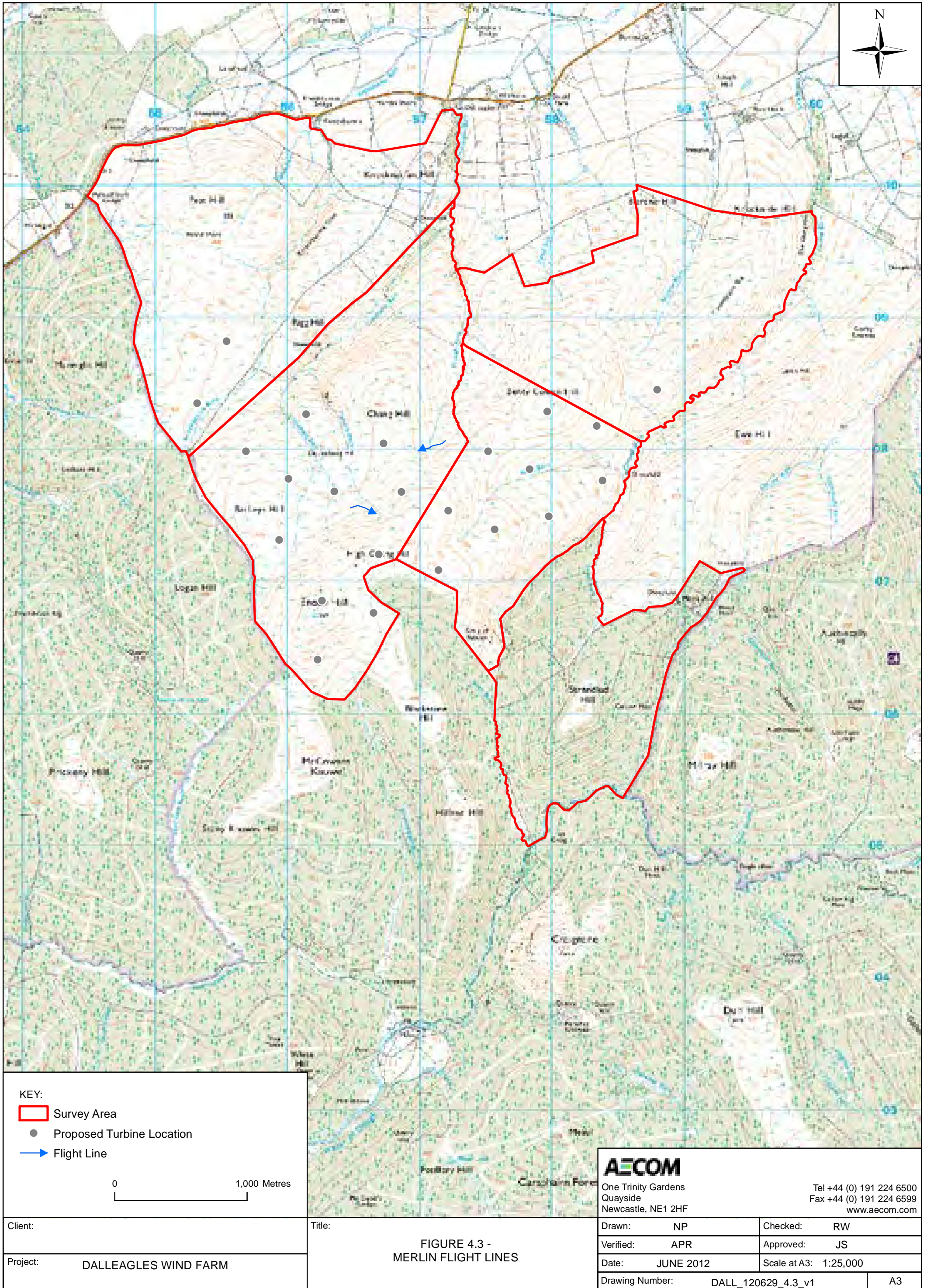
- KEY:
- Survey Area
 - Proposed Turbine Location
 - Flight Line

0 1,000 Metres

Client:	
Project:	DALLEAGLES WIND FARM

Title:	FIGURE 4.2 - GOSHAWK FLIGHT LINES
--------	-----------------------------------

 One Trinity Gardens Quayside Newcastle, NE1 2HF		Tel +44 (0) 191 224 6500 Fax +44 (0) 191 224 6599 www.aecom.com	
Verified: APR	Approved: JS		
Date: JUNE 2012	Scale at A3: 1:25,000		
Drawing Number: DALL_120629_4.2_v1	A3		




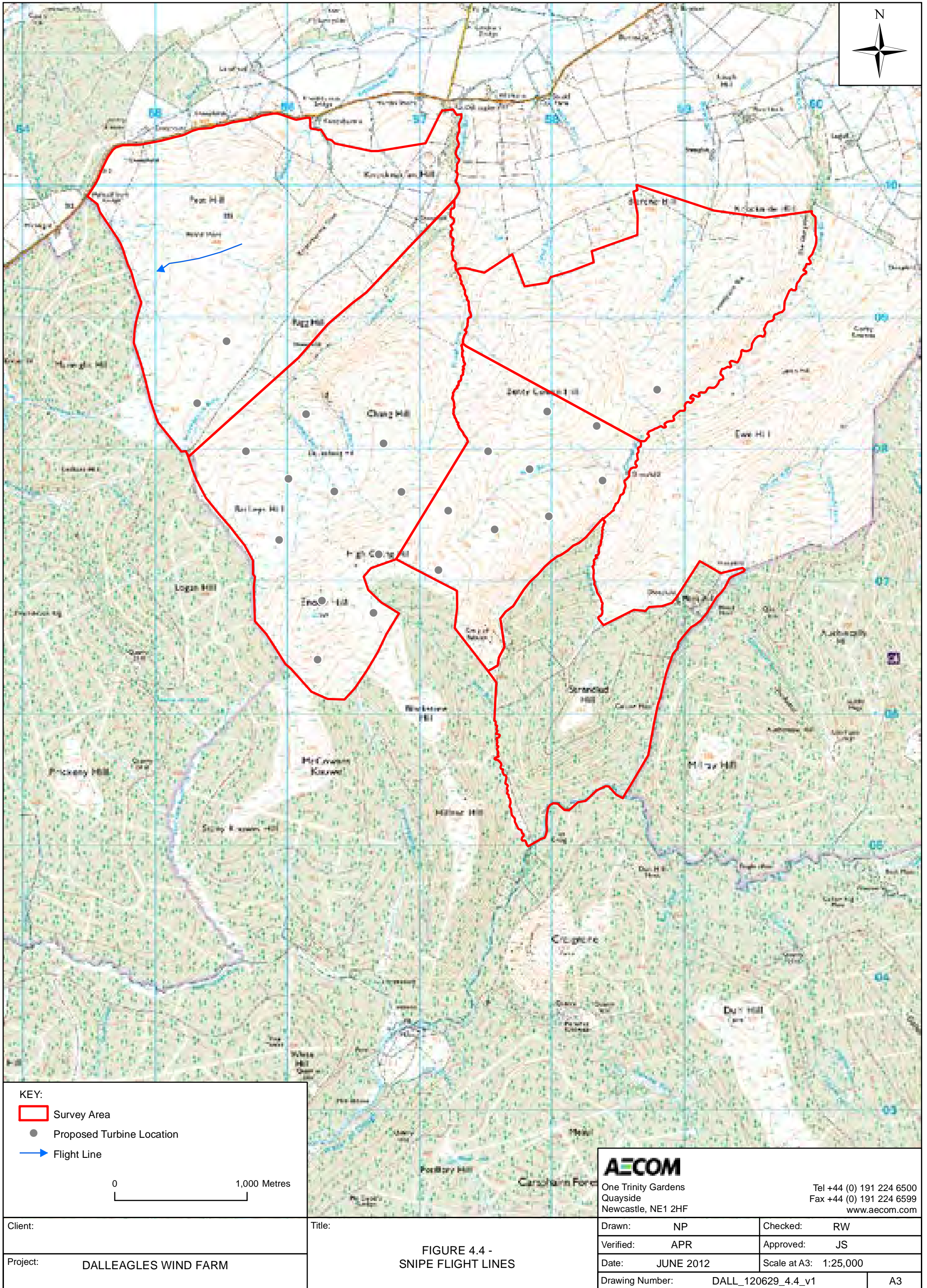
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- Survey Area
 - Proposed Turbine Location
 - Flight Line

0 1,000 Metres

Client:	
Project:	DALLEGLES WIND FARM

Title:	FIGURE 4.3 - MERLIN FLIGHT LINES
--------	----------------------------------

 One Trinity Gardens Quayside Newcastle, NE1 2HF		Tel +44 (0) 191 224 6500 Fax +44 (0) 191 224 6599 www.aecom.com	
Verified: APR	Approved: JS		
Date: JUNE 2012	Scale at A3: 1:25,000		
Drawing Number: DALL_120629_4.3_v1	A3		



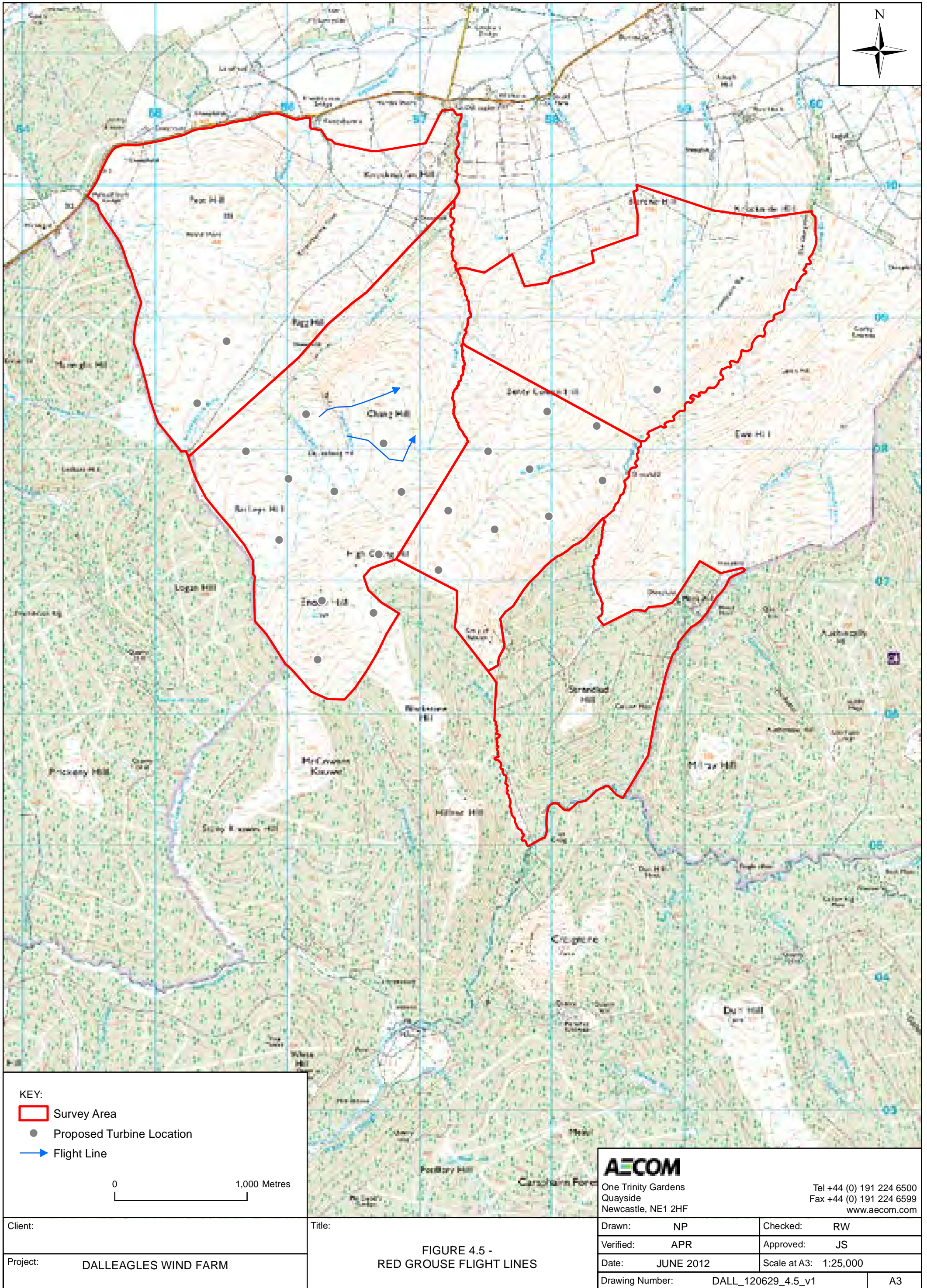
- KEY:
- Survey Area
 - Proposed Turbine Location
 - Flight Line

0 1,000 Metres

Client:	
Project:	DALLEAGLES WIND FARM

Title:	FIGURE 4.4 - SNIPE FLIGHT LINES
--------	------------------------------------

AECOM One Trinity Gardens Quayside Newcastle, NE1 2HF		Tel +44 (0) 191 224 6500 Fax +44 (0) 191 224 6599 www.aecom.com	
Verified: APR	Approved: JS		
Date: JUNE 2012	Scale at A3: 1:25,000		
Drawing Number: DALL_120629_4.4_v1	A3		



- KEY:
- Survey Area
 - Proposed Turbine Location
 - Flight Line

0 1,000 Metres

Client:	
Project:	DALLEAGLES WIND FARM

Title:	FIGURE 4.5 - RED GROUSE FLIGHT LINES
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		One Trinity Gardens Quayside Newcastle, NE1 2HF www.aecom.com		Tel +44 (0) 191 224 6500 Fax +44 (0) 191 224 6599	
		Drawn: NP	Checked: RW	Verified: APR	Approved: JS
Date: JUNE 2012	Scale at A3: 1:25,000		Drawing Number: DALL_120629_4.5_v1		
					A3

Capabilities on project:
Environment

Appendices

Appendix 4.1 Consultations with Scottish Natural Heritage

From: Wardle, Richard T
Sent: 08 November 2011 14:16
To: dorothy.simpson@snh.gov.uk
Cc: Range, Andrew; King, Lorraine M
Subject: Commercial in confidence: Dalleagles wind farm request for ornithology consultation

Follow Up Flag: Follow up
Flag Status: Completed

Commercial in confidence: Dalleagles wind farm proposal.

Dear Dorothy

Following our telephone conversation last week i write to you to seek your advice, comment or guidance on the ornithological assessment of a proposed wind farm near Dalleagles, East Ayrshire. The wind farm in its current (indicative) layout includes up to 44 turbines set across the land between Dalleagles village to the north and Strandlud Hill to the south, all of which would be within the development area shown on the attached plan, centred on national grid reference NS572 087, immediately to the south of the B741.

We are currently carrying out the following surveys on a monthly basis over a period of 7 months from September 2011 – March 2012 inclusive:

- Field counts of birds on open habitats.
- Vantage point (VP) watches totalling 6 hours per VP at 5 different VPs that have been selected to give visual coverage of the proposed turbines and as much of the areas beyond the turbines as possible at the minimum rotor swept height.

The choice of VPs has been determined from field visits to test suitable locations followed by viewshed analysis in a GIS. The field counts involve walking across the site using binoculars and spotting scopes to scan open habitats within the development area and up to 600 m beyond it. Areas of plantation woodland surrounding the wind farm development area are more difficult to survey, especially since they are all subject to restricted access. We are therefore directing survey transects along the plantation edges and rides wherever possible.

By the end of March next year, we will therefore have carried out 7 field counts and 42 hours of VP survey from each of the 5 VPs. We are also carrying out a desk based assessment to acquire information on designated sites of ornithological interest and to obtain third party ornithological data for the locality, which at this stage will include internet searches for designated sites of ornithological interest. Key data sources will include the Ayrshire branch of the Scottish Ornithologists Club and the Strathclyde arm of the Scottish Raptor Study Group. A decision will be made, based on the findings of the surveys described above, on what further surveys are likely to be required.

We would be very grateful for any comment, advice or guidance you can provide with respect to the survey approach described above and any sources of third party data that you would recommend we consult. If you hold any site – specific information or know of any significant ornithological features of

the area such as roosts or nesting sites of sensitive species, flyways or migratory routes that cross the site then we would be grateful if you could share this with us.

Kind regards
Richard



Dalleagles - WFDA -
Map 2.pdf

Richard Wardle

Principal Ecologist, Environment
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richard.wardle@aecom.com

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www.aecom.com

From: Blair Urquhart [Blair.Urquhart@snh.gov.uk]
Sent: 11 November 2011 12:35
To: Wardle, Richard T
Cc: Range, Andrew; Dorothy Simpson; King, Lorraine M
Subject: Commercial in confidence: Dalleagles wind farm request for ornithology consultation

Follow Up Flag: RTW to review
Due By: 16 November 2011 12:34
Flag Status: Completed

Dear Richard

thank you for your e-mail of 8 November. Dorothy has asked me to respond to your query.

The proposal

Advice is sought on the proposed ornithological methodologies for a windfarm development at Dalleagles, near New Cumnock. The development proposed, to-date, would consist of forty-four wind turbines. No information has been provided regarding the specifications of the turbines, such as hub height, rotor diameter etc.

Survey methods

Considerable guidance on information requirements for wind farm applications can be found at –

<http://www.snh.gov.uk/planning-and-development/renewable-energy/onshore-wind/>

This includes detailed guidance on ornithological survey effort, assessment methods and cumulative effects.

Designated site information

Access to designated site information can be found at: <http://www.snh.org.uk/snhi/> and then by searching Site link.

Comments on surveys conducted to date

Whilst it would appear that survey work conducted to date complies with our Bird Survey guidance with regard to survey effort during the winter period, it is impossible for us verify whether a representative sample of bird flight activity has been gathered. No information has been presented regarding the spatial and temporal coverage of the area in question. We would require to see the vantage point locations, the viewshed from each vantage point and a detailed breakdown of watches conducted (including dates, start/finish times, weather conditions, target species observed etc). We will also require the dates, start/finish times etc for the winter walk-over surveys.

Furthermore, the survey work is still incomplete and we will expect that VP observations (in addition to breeding bird surveys, breeding raptor survey etc) will continue throughout 2012. It is not clear from your email if this is the intention. As a minimum, survey work should meet our guidelines to enable a valid assessment of the impacts to be determined. It should be noted that additional work may be required as a consequence of survey results, specifically where species not targeted by current survey criteria, are recorded.

Based on the information available to me the above is about as much advice that I can give at this time. I hope you find it of use.

Regards,

Blair

Blair Urquhart
Policy & Advice - Renewables
Scottish Natural Heritage
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Kilmory
Lochgilphead
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From: Wardle, Richard T
Sent: 07 December 2011 17:43
To: Blair Urquhart
Cc: Range, Andrew; Dorothy Simpson; King, Lorraine M
Subject: RE: Commercial in confidence: Dalleagles wind farm request for ornithology consultation
Attachments: Dalleagles - Indicative Turbine layout.pdf; VP1.doc; VP3.doc; VP4.doc; VP7.doc; VP8.doc
Follow Up Flag: Follow up
Flag Status: Completed

Blair

Thanks for getting back to me about this and please accept my apologies for my delayed response. Please see the attached documents and some comments that i've added to your response below. I've provided some more information as requested, however detailed survey results and a detailed breakdown of the surveys are not readily available for much of the work at this stage as the results are being trickle fed back to me from our surveyors, so i've attempted to provide some summary information. It might be more useful to forward a more substantial summary of the surveys when we have completed the majority or all of the winter survey work. In the mean time i've attempted to provide some information that should give you an idea of the results to date and enable you to form some sort of opinion on the methods used, visual coverage etc.

Kind regards

Richard

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A layout is provided for information. Please note this is a slightly older plan that doesn't show the proposed turbines sited around Strandlud Hill, of which there are 5. We are working on the assumption that turbines will be of 126m maximum height to blade tip, 92m rotor diameter and 80m hub height.

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The VP locations and viewsheds from each are shown on the attached screenshots. The minimum height visible from the VPs was set at 30m (minimum rotor swept height plus a margin for error and changes to turbine specification) – red areas are not visible and green is visible from the VP at the minimum height of 30m.

I can provide a detailed breakdown of the survey times, dates etc when I have received more of these from our surveyors, however we are trying to work to the following, extreme weather conditions and accessibility permitting:

VP surveys stratified such that about two thirds of the survey at each VP are at either dawn or dusk and the remainder is between these times.

Walkover surveys between dawn and dusk generally but with records also made during movements to and from VPs (most of which require significant amounts of walking across the site) at dawn and dusk.

I have not been able to review the records in detail however so far we have recorded the following target species:

Golden plover in moderate numbers (maximum flock within the proposal site of 43. Flights generally northwest/southeast across the site and circling flights involving small numbers of birds across the higher ground around Enoch Hill, High Chang and Benty Cowan. Larger flocks up to 260 in the wider area recorded when driving to and from site)

Merlin (single birds flying close to the ground across the higher ground)

A single Goshawk flying towards the young plantation woodland to the south of the site)

The following are (or have been for a time) also present:

Red grouse over the open moorland and woodland edges

Meadow pipit, wheatear, skylark and occasional snow bunting on open ground

Ravens, kestrel and buzzard have been observed occasionally overflying the site

Fieldfare in flocks of up to around 160

We have yet to record any geese or waders on the pastures adjacent to the B741 and there have been no overflying geese at all on the surveys.

Birds detected in adjacent woodland have been mostly common passerines – tits, finches, jays, goldcrest, lesser redpoll plus occasional crossbill.

Furthermore, the survey work is still incomplete and we will expect that VP observations (in addition to breeding bird surveys, breeding raptor survey etc) will continue throughout 2012. It is not clear from your

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The work is ongoing. It is likely that a decision will be made about how to proceed once the winter surveys have been completed.

Based on the information available to me the above is about as much advice that I can give at this time. I hope you find it of use.

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From: Blair Urquhart [Blair.Urquhart@snh.gov.uk]
Sent: 19 December 2011 15:05
To: Wardle, Richard T
Cc: Range, Andrew; Dorothy Simpson; King, Lorraine M
Subject: RE: Commercial in confidence: Dalleagles wind farm request
forornithology consultation

Follow Up Flag: RTW to review
Due By: 09 January 2012 10:56
Flag Status: Flagged

Hi Richard

thanks for sending this through.

I have concerns regarding the viewsheds of VPs 1, 4 & 7, as they would appear to be greater than 180 degrees. Can you confirm this is **not** the case, and that observers are recording within a 180 degree viewshed.

It is difficult to see if the proposed turbine array is adequately covered. Can you provide me with a cumulative viewshed map with the most up to date turbine layout superimposed. Each viewshed should be a different colour to aid interpretation.

It would appear that some of the vantage points are very close to proposed turbine locations, we would advise that a buffer of at least 500m is maintained to prevent observer biases.

cheers

Blair

[Blair Urquhart](#)

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>>> "Wardle, Richard T" <richard.wardle@aecom.com> 07/12/2011 17:43 >>>

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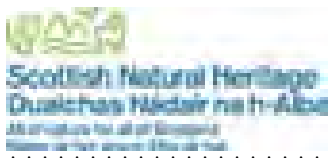
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Regards,

Blair

[Blair Urquhart](#)

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Appendix 12.B

Baseline Ornithology Report – Breeding Season 2012

Enoch Hill Proposed Wind Farm - Breeding Ornithology Report



Prepared by: 
Richard Wardle
Principal Ecologist

Checked by:
Cormac Loughran
Associate Director

Approved by: 
Lorraine King
Regional Director

Enoch Hill Proposed Wind Farm - Breeding Ornithology Report

Rev No	Comments	Checked by	Approved by	Date
0	Draft for internal review			06/11/12
1	For issue	CM	LMK	20/11/12

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Job No 60186006

Reference Re02

Date Created November 2012

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Introduction



Capabilities on project:
Environment

1 Introduction

- 1.1 AECOM were commissioned by E.on to undertake a desk study, consultation, and ornithological field surveys, spread across a period of approximately 10 months between September 2011 and July 2012 at the location of a proposed wind farm near Dalleagles, East Ayrshire. The field surveys covered the autumn, winter, spring and summer seasons to record the activities of migrant, wintering and breeding birds. The results of the autumn and winter surveys, carried out between September 2011 and March 2012 inclusive, are reported in AECOM (2012). This report presents the results of the spring and summer surveys carried out between April and July inclusive, 2012.
- 1.2 The proposed development site is located on the Ayrshire/Galloway border near New Cumnock, approximate central grid reference (NGR) NS 570 089 (Figure 1.1). The proposed wind farm layout on which this report and the surveys underpinning it are based is shown on Figure 1.2.
- 1.3 The proposed wind farm has been through several design iterations to date, with previous designs including in excess of 40 turbines spread across the open habitats of the upper and lower slopes of the proposed development site between Enoch Hill, Peat Hill and Connelburn Rigg, plus an area of plantation woodland surrounding Strandlud Hill to the south east. This layout was referred to as "Dalleagles Wind Farm". The design currently under consideration includes 23 turbines of 80 m hub and maximum blade tip height of 126.5 m (such as the Seimens SWT 93) mostly across the upper slopes of Chang Hill, Barbeys Hill, High Chang, Enoch Hill and Benty Cowan Hill. The current design is referred to herein as "Enoch Hill Wind Farm". The survey area and number of Vantage Points required to cover it have been reduced (in comparison with the wintering surveys) to reflect the smaller scheme size, however regardless of this the breeding and wintering surveys can be regarded as compatible for the purposes of assessing the current wind farm proposal.
- 1.4 This report summarises current policy and legislation in relation to birds and wind farms, as well as the methodologies used to undertake the desk study and field surveys. The baseline conditions within and surrounding the proposed development site with respect to wintering birds are defined. A summary is given of the key ornithological risks to the proposed development that are apparent from the wintering bird surveys and any further surveys likely to be required in order to complete the ornithological assessment of the proposal. It does not include any kind of detailed ornithological impact assessment – any such assessment should be undertaken separately in order to inform a wider Environmental Impact Assessment of the wind farm proposal, if required.
- 1.5 The report is structured as follows:
 - **Section 2** – Legislation and Policy Background
 - **Section 3** – Methodology
 - **Section 4** – Results
 - **Section 5** – Summary and Recommendations

Legislation and Policy Background



Capabilities on project:
Environment

2 Legislation and Policy Background

2.1 Statutory Legislation/Policy

2.1.1 This section sets out the legislation and policy initiatives specific to birds. Key legislation for birds in Scotland is summarised in Table 2.1.

Table 2.1: Summary of Legislation/Policy in Scotland with regard to birds

Legislation/Policy	Description
EC Wild Birds Directive (<i>European Directive 2009/147/EC on the conservation of wild birds</i>)	<p>Council Directive 2009/147/EC on the conservation of wild birds, commonly referred to as the Birds Directive creates a comprehensive scheme of protection for all wild bird species naturally occurring in the European Union.</p> <p>The directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of habitats for endangered as well as migratory species (listed in Annex I), especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species. Since 1994 all SPAs form an integral part of the Natura 2000 ecological network.</p>
Wildlife and Countryside Act, 1981, as amended by the Nature Conservation (Scotland) Act 2004 and the Wildlife and Natural Environment (Scotland) Act 2011	<p>Under the WCA1981 (as amended) all breeding birds receive protection from destruction of nests and eggs whilst in use. Bird species listed in Schedule 1 of the WCA 1981 (as amended); receive special protection under this legislation, being protected by special penalties at all times, including against disturbance when breeding. For species listed on Schedule 1A (currently white tailed eagle <i>Haliaeetus albicilla</i> only), intentional or reckless harassment is also made illegal away from the nest and outside the breeding season. This would include disturbance at roost sites. Schedule A1 lists birds whose habitually-used nests may not be intentionally or recklessly damaged, destroyed or otherwise interfered with when <i>not</i> in use (also currently white tailed eagle only).</p>
Wildlife and Natural Environment (Scotland) Act 2011	<p>The Wildlife and Natural Environment (Scotland) Act came in to force in 2011 with the aim to modernise outdated laws and to strengthen the law on wildlife and the natural environment, making it more efficient, effective and proportionate.</p> <p>Under this legislation, wild birds, their nests, and eggs receive protection under Part 2 of the Act.</p>
Nature Conservation (Scotland) Act 2004	<p>This Act places a duty on every public body to further the conservation of biodiversity consistent with the proper exercise of their functions. It also strengthens the legal protection for threatened species.</p>
Scottish Planning Policy 2010	<p>The Scottish Planning Policy (SPP) came into force in February 2010 and succeeds the National Planning Policy Guidelines (NPPGs) in Scotland including NPPG 14 natural heritage. The SPP encourages the restoration of deteriorated habitats and discourages further fragmentation of wildlife corridors. Developments should aim to enhance existing or create new habitats where appropriate. The SPP also highlights the importance of protected areas and species, and enforces the safeguarding of such habitats of importance.</p>

Capabilities on project:
Environment

Legislation/Policy	Description
The UK Biodiversity Action Plan (UK BAP)	<p><i>The UK BAP was launched in 1994 and updated in 2007 with the main aim 'To conserve and enhance biological diversity within the UK, and to contribute to the conservation of global biodiversity through all appropriate mechanisms'. The UK BAP comprises a series of Action Plans for 'priority' habitats and species, determined by the fact that they are either globally threatened or are rapidly declining in the UK. The Action Plans outline measures required to conserve these priority habitats and species.</i></p> <p>The national strategy for biodiversity is delivered at a local level via Local Biodiversity Action Plans (LBAPs). The proposed development site is covered by the provisions of the Ayrshire LBAP, which includes six Species Action Plans (SAPs) for birds including black grouse (<i>Tetrao tetrix</i>), corncrake (<i>Crex crex</i>), hen harrier (<i>Circus cyaneus</i>), lesser whitethroat (<i>Sylvia curruca</i>) and song thrush (<i>Turdus philomelos</i>).</p>
The Scottish Biodiversity List	<p>The Scottish Biodiversity List is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation. The primary purpose of the list is to help public bodies carry out their duty 'to further the conservation of biodiversity' as introduced in The Nature Conservation (Scotland) Act 2004 by identifying the species and habitats which are the highest priority for biodiversity conservation in Scotland.</p> <p>The criteria for selecting species featuring on the list include scientific criteria and a social criterion based on a survey of the Scottish public.</p> <p>The Scottish Biodiversity List was published in 2005 to satisfy the requirement under Section 2(4) of The Nature Conservation (Scotland) Act 2004.</p>

2.2 Royal Society for the Protection of Birds (RSPB) Birds of Conservation Concern

- 2.2.1 The RSPB (2009) has published lists of Birds of Conservation Concern (BoCC). Red List species are those whose breeding population or range is rapidly declining (50% or more in the last 25 years), recently or historically, and those of global conservation concern. Amber List species are those whose breeding population is in moderate decline (25 – 49% in the last 25 years), rare breeders, internationally important and localised species and those of unfavourable conservation status in Europe.
- 2.2.2 These lists confer no legal conservation status of statutory protection for the birds listed, however they are useful when assessing the significance of predicted impacts and determining the level of mitigation that may be required when birds are affected by development or any other activity. Furthermore, inclusion on the Red List is a factor in determining the species for which BAPs are developed.

Methodology



Capabilities on project:
Environment

3 Methodology

3.1 Consultation

- 3.1.1 Consultation was undertaken with Scottish Natural Heritage (SNH) and the Royal Society for the Protection of Birds (RSPB) Scotland, including discussion of the survey scope and methodologies undertaken at the proposed development site.
- 3.1.2 Site - specific information or existing knowledge of the ornithological interests of the proposed development site and its surroundings were also requested, including roosts or nesting sites of sensitive species and any known flyways or migratory routes that cross the site.
- 3.1.3 The Scottish Wildlife Trust was also contacted to establish their interest in being consulted on the proposals.

3.2 Desk Study

- 3.2.1 Ornithological records within the proposed development site and the surrounding area (the Study Area) were requested from a number of third parties. For the purposes of this assessment the Study Area is defined as up to 5 km from the proposed development site boundary for species records and up to 15 km from the proposed development site boundary for designated wildlife sites of ornithological interest.
- 3.2.2 There is currently no operational ecological records centre for Ayrshire, however ornithological records were requested from the following organisations:
- Dumfries and Galloway Environmental Records Centre;
 - Scottish Ornithologists Club;
 - Scottish Wildlife Trust; and
 - Strathclyde Raptor Study Group.

3.3 Vantage Point (VP) Surveys

- 3.3.1 VP surveys were carried out following the guidance published by Scottish Natural Heritage (SNH, 2005, revised 2010). This involved recording the flights of target bird species through the air space that would be occupied by the proposed wind turbines. Key characteristics of each recorded flight included the flight duration, flight path and estimated flying height of birds at time intervals. The choice of target species was made in line with guidance in SNH (2005, revised 2010) and was informed by the results of the data searches and a reconnaissance site visit.
- 3.3.2 Target species were therefore: raptors, owls, waders and other water birds listed on Annex 1 of the EC Birds Directive and Schedule 1 of the Wildlife and Countryside Act, red grouse (*Lagopus lagopus*) and black grouse (*Tetrao tetrix*). Records of secondary target species movements were also made. These included Raven (*Corvus corax*), kestrel (*Falco tinnunculus*) and other water birds and waders not listed on Annex 1 or Schedule 1 of the above legislation.

Choice of Survey Area and VP Locations

- 3.3.3 The topography of the proposed development site is characterised by a series of steep sided hills and gullies that separate a number of gently sloping moorland plateaus. The largest of the hills (Enoch Hill) reaches 569 AOD. Following redesign of the proposed wind farm, which was characterised by a significant reduction in the number and footprint of the turbines, adequate visual coverage of the proposed development and the airspace around it was achieved with 3 VPs (compared with 5 VPs for the wintering surveys).
- 3.3.4 The turbine layout and proposed development site boundary are shown on Figure 1.2 along with the VP locations which are summarised in **Table 3.1**. Viewing arcs of 180° were watched from each of the VPs.

Table 3.1: Summary of Breeding Survey Vantage Points

Name	Numerical ref.	NGR	Notes
Rigg Hill	2	NS 56140 09045	From Rigg Hill, looking directly south
Connelburn Rigg	N/A	NS 59013 08834	From Connelburn Rigg, looking south west along ridge towards Benty Cowan ad High Chang Hill.
High Chang South	8	NS56680 07099	Close to fence line along top of High Chang Hill, looking South across plantation, west towards Strandlud Hill and East across Enoch Hill.

Capabilities on project:
Environment

- 3.3.5 The topography of the proposed development site imposed some limitations on the VP locations that will need to be acknowledged and accounted for when analysing the survey results, particularly when carrying out predictive modelling of bird mortality through the use of a Collision Risk Model (CRM). These are:
- Best practice is to place VPs at least 500 m from the nearest turbine, which presents a risk of the surveyor biasing the survey results, however some of the VPs were placed within the turbine cluster or closer than 500 m.
 - There were areas of overlap between the viewsheds from a number of the VPs.
 - Some areas were not visible from any of the VPs, particularly the areas of low lying land in a number of valley bottoms.

- 3.3.6 The limitations defined above can be accommodated and their impact on the analysis ultimately minimised through the mathematical provisions built into the CRM (for example the derivation of predicted flight activity per annum per unit area from recorded flight rates per unit area recorded for many species) and if necessary the use of multiple models constructed for groups of turbines that are visible but sufficiently distant from individual VPs.

Recording Effort

- 3.3.7 VP watches of between 1.5 and 3 hours in duration were carried out across all parts of the day, including dusk and dawn periods to allow detection of any bird movements to and from roosts, and / or crepuscular species. Surveys were carried out in any weather conditions except for extreme high winds, driving precipitation and conditions of poor visibility such as fog, in which birds were impossible to record.
- 3.3.8 Up to thirty-seven hours of VP survey were carried out at each VP across the months of April 2012 – July 2012 inclusive, with a small number of surveys completed in early August. The mean survey effort per VP was 36.25 hours.

Focal animal sampling

- 3.3.9 The Survey Area was scanned constantly until a target species was detected in flight. Once detected, the target species was watched until it ceased flying or was lost from view. The time of detection and the duration of the flight were recorded. Since it would be impossible for a surveyor to make a constant record of changes in bird height and keep track of the bird's position, the method allows for bird height to be recorded at time intervals of 15 - seconds (at the point of detection $T=0$ s, then $T=15$ s, $T=30$ s and so on). The birds' flying height was estimated at each time interval by recording it in one of the predetermined height bands shown below. These approximate the indicative dimensions of the proposed turbines. The height bands are:
- <10m.
 - 10 - 30m.
 - 31 – 80m.
 - 81 – 130m.
 - >130m.
- 3.3.10 The minimum and maximum height of the rotor blades (the Rotor Swept Height, RSH) is represented by the height bands 31 – 80 m and 81 – 130 m. Birds flying through the wind farm at these heights would be at risk of collision with the rotor blades. The number of intervals recorded at each height enables the overall time each species spent within a given height band to be predicted retrospectively using the time interval data and from this the risk of collision for each target species can be determined using the CRM. Preliminary inferences about the relative risk to each target species can be made from the time interval data without using a CRM; such narrative is included in the results section of this report.
- 3.3.11 Additional notes about the behaviour, sex and age of the target birds were made whenever possible. Target species flights within the proposed development area were prioritised over flights across the wider area beyond the boundary of the proposed development site and turbines, however flights outside the site boundary were recorded to aid the assessment of core flight areas wherever possible.
- 3.3.12 The route followed by each target species detected was plotted on a field map and cross referenced with the recording forms. Display flights, aggressive interactions with other birds or any other behavioural activity of interest were recorded on the VP form. Flight lines and flight attribute data were digitised in a GIS and stored for the purposes of a CRM, should one be needed.

Capabilities on project:
Environment

3.4 Breeding Bird Walkover Surveys

- 3.4.1 Walkover surveys were carried out using a Common Birds Census (CBC) – style transect survey (Marchant, 1983, Gilbert *et al.*, 1998), with pauses to scan open habitat using high powered optical equipment in order to record flocks of birds on the ground.
- 3.4.2 The Survey Area covered all land within the footprint of the turbine array plus up to 500 m beyond it where access to these areas was available. Land beyond the proposed development site boundary was scanned using optical equipment from the edge of the development boundary and other useful vantage points where access was restricted. Where the proposed development area abuts plantation woodland that cannot otherwise be accessed, transect routes followed the woodland edge in order to identify bird activity visually or aurally.
- 3.4.3 Three walkover surveys were carried out at monthly intervals in April, May and June 2012 in suitable conditions (i.e. wind speeds not more than Beaufort 5 and not in conditions of poor visibility or continuous rain) between about 09.00 hrs and 18.00 hrs. While the standard approach to this survey method is to walk transects between early morning and midday, the method was adapted to cover all species present across open moorland and woodland edge habitats, which includes a smaller proportion of songbirds and includes species such as waders and grouse that are active more or less equally at all times of day. The Brown and Shepherd survey for upland breed waders was not used because the survey was not specific to wading birds, and the VP surveys had shown only a minimal presence of waders at the proposal site.

3.5 Black Grouse surveys

- 3.5.1 Black grouse surveys were undertaken in line with the methodology recommended in SNH (2005, updated 2010). Potential lek sites were identified (including woodland rides and clearings, forest edges, open moorland or grassland with scattered woodland) and visited twice during May within 2 hours of dawn and in suitable weather conditions. If a lek location was confirmed it was revisited within 3 days (weather conditions permitting) to count the number of males and females seen
- 3.5.2 Black grouse surveys were carried out in all suitable habitat up to 1.5 km from the turbines, accessibility permitting.

3.6 Barn Owl surveys

- 3.6.1 Barn owl surveys were undertaken between May and July 2012, using a methodology with several clearly defined steps.
- 3.6.2 Firstly, suitable nesting habitat was identified (hollow mature trees, farm outbuildings, bale stacks) up to 1 km from the wind farm site. Potential nesting sites were identified from the surveyor's knowledge of the proposal site and surrounding area gathered during surveys carried out across the 2011-12 winter season and inspection of OS maps and aerial photographs.
- 3.6.3 Potential sites that could be accessed were inspected for signs of barn owl presence (pellets, feathers, white splashes).
- 3.6.4 Each potential site, including those that could not be accessed directly, was subsequently watched from strategic vantage points around dusk to identify adult birds exiting / entering the suspected nest site and to attempt to identify the presence of owlets. Details of the VPs used are restricted to a separate confidential Annex report. Birds carrying food to the site were taken as evidence of breeding as this indicates that the bird is provisioning either its mate or its offspring at the nest. Nest inspections were not necessary.
- 3.6.5 Immediately following some of the VP surveys for all target species, surveyors made a number of stops when returning from dusk VP watches to scan the surrounding area for any movements of barn owl across the proposal site, particularly for flights that would bring barn owls into conflict with potential turbines.
- 3.6.6 Simultaneous surveys at different locations were undertaken by three surveyors on the evening of 3rd July 2012.

Results



Capabilities on project:
Environment

4 Results

4.1 Consultation

- 4.1.1 Consultation with SNH has been ongoing for the approximate duration of both the wintering and the breeding ornithology surveys. Following the winter survey work SNH's position was, in summary:
- Survey work appears to comply with SNH bird survey guidance with respect to wintering birds, however more information is needed to determine whether a representative sample of bird flight activity has been collected.
 - Survey work is incomplete and SNH expect survey work to be continued throughout 2012.
 - Additional work may be required as a consequence of survey results, specifically where species not targeted by current survey criteria are recorded.
 - SNH expressed concerns about the viewsheds of VPs 1 [Peat Hill], 4 [Blarene] and 7 [High Chang East], which appear to be greater than 180 degrees.
 - Some of the vantage points are very close to proposed turbine locations, [SNH] would advise that a buffer of at least 500 m is maintained to prevent observer biases.
- 4.1.2 Copies of the correspondence between SNH and AECOM regarding the points above are provided in Appendix 4.1 of the wintering ornithology report.
- 4.1.3 A new SNH case officer was assigned to this project in 2012 with whom further correspondence was carried out in order to arrive at a satisfactory conclusion regarding the placement of VPs and the size of some of the viewing arcs from a number of VPs. Table 4.1 summarises the questions asked by SNH and the answers provided by AECOM. Copies of the correspondence relating to these queries are included as Appendix A to this report. Overall SNH were satisfied with the answers provided and had no further comments.
- 4.1.4 No response was received from RSPB Scotland or the Scottish Wildlife Trust.

Table 4.1: Summary of consultation with SNH

SNH comment	AECOM response
Concern about a number of VPs with viewing arcs > 180° (during winter surveys)	These were used in some cases to give visual coverage of habitat features that it was felt might have been used by target species but that otherwise would have been difficult to watch effectively. Bird activity was insufficient to raise concerns about surveyors missing significant amounts of flight activity from these VPs as a result of using larger viewing arcs.
Has concealment been used to minimise observer displacement of birds?	Yes, surveyors have sheltered beneath ponchos held up by tent poles on some occasions and on most others a small, very lightweight "tent" known as a basha was used.
Have simultaneous watches been carried out in which a surveyor is within the viewshed observed from another VP?	No, some viewsheds overlap but there are no cases where a VP is within the viewshed observed from another. Simultaneous watches have been carried out but this becomes irrelevant given the consideration made above.

Capabilities on project:
Environment

4.2 Desk Study

4.2.1 The desk study was reported in the wintering ornithology report. For the sake of clarity the results are repeated here. There have been no additional data searches and no further information received from third parties since the winter ornithology report was issued.

Statutory Designated Sites

4.2.2 Muirkirk and North Lowther Uplands SPA is approximately 7.5 km north east of the proposed development site at its closest point. The SPA regularly supports populations of European importance of five Annex I species; wintering and breeding hen harrier (*Circus cyaneus*), breeding short-eared owl (*Asio flammeus*), merlin (*Falco columbarius*), peregrine (*Falco peregrinus*) and golden plover (*Pluvialis apricaria*).

4.2.3 Airds Moss Special Area of Conservation (SAC), approximately 12 km to the north, is designated as one of the few remaining areas of relatively low-altitude blanket bog in south-west Scotland.

4.2.4 There are also thirteen Sites of Special Scientific Interest (SSSI) within or partially within 15 km of the proposed development site (two of which are designated at least in part for their ornithological interest and which are shown in **bold type**). These are listed below:

- Barlosh Moss
- Benbeoch
- **Bogton Loch**
- Dalmellington Moss
- Dunaskin Glen
- Ness Glen
- Nith Bridge
- Polhote and Polneul Burns
- Fountainhead
- Lagrae Burn
- Loch Doon
- Lugar Sill
- **Muirkirk Uplands**

4.2.5 Bogton Loch SSSI is approximately 8.5 km south west of the proposed development site. It is designated for its breeding bird assemblage and open water transition fen. The breeding bird assemblage includes song thrush (*Turdus philomelos*), grasshopper warbler (*Locustella naevia*), spotted flycatcher (*Muscicapa striata*), willow tit (*Poecile montanus*), reed bunting (*Emberiza schoeniclus*) and, sporadically, a small colony of black-headed gulls (*Chroicocephalus ridibundus*).

4.2.6 Muirkirk Uplands SSSI is approximately 7.5 km north east of the proposed development site. It is designated for breeding hen harrier, non-breeding hen harrier, breeding short-eared owl, and a breeding bird assemblage including teal (*Anas crecca*), hen harrier, buzzard (*Buteo buteo*), merlin, peregrine, short-eared owl, red grouse (*Lagopus lagopus*), golden plover, dunlin (*Calidris alpina*), snipe (*Gallinago gallinago*), curlew (*Numenius arquata*), redshank (*Tringa totanus*), whinchat (*Saxicola rubetra*), stonechat (*Saxicola torquatus*), wheatear (*Oenanthe oenanthe*) and ring ouzel (*Turdus torquatus*), as well as for geological and habitat features.

Non-Statutory Wildlife Sites

4.2.7 There are two Scottish Wildlife Trust reserves; Dalmellington Moss (approximately 8 km west) and Knockshinnoch Lagoon (approximately 2.6 km north east). The latter site is of ornithological interest and is described by SWT as 'a migration stop between the Solway Firth and the Clyde Estuary, with pools and marshland for breeding and wintering birds'.

4.2.8 There is a RSPB reserve approximately 13 km to the north on Airds Moss, which is managed by grazing for breeding waders and wintering hen harriers.

Capabilities on project:
Environment

- 4.2.9 There are three Important Bird Areas (IBAs) that are partially within 15 km of the proposed development site, the boundaries of which are not concurrent with those of the other site designations. These are:
- North Lowther Hills, approximately 7.5 km to the north east, which supports a range of breeding upland bird species,
 - Airds Moss and Muirkirk Uplands, approximately 12 km to the north, which achieves IBA status due to populations of breeding peregrine and hen harrier
 - Galloway Forest Park, approximately 10.5 km to the south west, which supports a range of breeding waders and water birds.

Species Records

- 4.2.10 Records of Annex 1 breeding raptor sites within the Study Area were provided by the South Strathclyde Raptor Study Group. The locations of breeding sites are sensitive and are provided by the Raptor Study Group subject to strict conditions of confidentiality. Consequently these records are restricted to a confidential Annex report and are not reproduced here.

4.3 Vantage Point Surveys

- 4.3.1 Three primary and one secondary target species were recorded in flight during the VP surveys. Analysis of these flights and an assessment of perceived collision risk are included in Table 4.2. Flight lines for each target species are displayed in Figures 4.1 – 4.4.
- 4.3.2 Table 4.3 lists all species recorded during all of the surveys, including from VPs. The total species count is 32 when the results of the VP and CBC survey methods are combined. Incidental bird records and those accumulated from species – specific surveys bring the count to 35 species.

Capabilities on project:
Environment

Table 4.2: Summary target species flight data and perceived collision risk (red type indicates proportion of time spent at Rotor Swept Height RSH and therefore at potential risk of collision with rotor blades).

Species	Number of flights	Total flight time recorded (s)	Vertical distribution of flight time			Perceived risk of collision	Reasoning
			< 30 m	31 – 130 m	> 130 m		
Golden plover <i>Pluvialis apricaria</i>	5	18,485	19%	56%	25%	Medium	Low number of flights located on Enoch Hill, High Chang Hill, Rigg Hill, Benty Cowan Hill, Connelburn Rig and Ewe Hill. Flock sizes produce relatively large amounts of flight time for small numbers of flights overall.
Curlew <i>Numenius arquata</i>	4	311	39%	61%	0%	Low	A small number of flights generally on the perimeter of the site not near to the bulk of the turbines.
Merlin <i>Falco columbarius</i>	1	40	100%	0%	0%	Low	The only recorded merlin flight was significantly below RSH on Enoch Hill.
Raven <i>Corvus corax</i>	14	1,468	79%	21%	0%	Low	Most flights were below RSH. Flight activity was limited overall by virtue of small numbers of individuals in each recorded flight.
Peregrine*	1	82	0%	100%	0%	Low	This is the only peregrine flight recorded during any of the surveys carried out since September 2011.

* Incidental record made outwith any formal survey period.

Capabilities on project:
Environment

- 4.3.3 An overriding observation is that there were relatively few flights of any of the target species when compared with the majority of AECOM's previous wind farm experience. For the majority of species there were too few recorded flights to detect reliably any patterns of flight activity. However a number of key observations can be made:
- Golden plover flights were mostly recorded on and between Benty Cowan Hill, Connelburn Rig and Ewe Hill. Flights at Rotor Swept Height (RSH) accounted for 56% of the total. The majority of flights were attributable to small flocks numbering around 30 birds. The occurrence of these flights predominantly in April suggests that, rather than breeding within the proposal site, golden plover were more likely to have bred on land nearby. Furthermore there was no evidence of any display flights or other indications of breeding within the proposal site.
 - Four individual curlew flights were recorded over Connelburn Rig, Benty Cowan Hill, Enoch Hill and Barbey's Hill. Flights at RSH accounted for 61% of total flight time recorded.
 - One merlin flight was observed on top of Enoch Hill below RSH.
 - Raven was recorded as a secondary target species. Flights were relatively numerous, the majority of recorded flight activity taking place over and between Benty Cowan Hill, Ewe Hill and Connelburn Rigg. Birds were recorded in small "flocks" ranging from 1 to 3 individuals. Flight activity was mostly below rotor height with 21% at RSH.
 - A single peregrine flight at RSH was recorded while a surveyor was returning from a VP watch. This was the only record of peregrine mad during any of the surveys carried out since work began in September 2011.
- 4.3.4 Excluding peregrine, for which only one flight has been recorded, significant proportions of the overall flight time were observed at rotor height for golden plover and curlew only. Of these two species, significant amounts of flight time close to the proposed turbines were noted only for golden plover.

4.4 Walkover Surveys

- 4.4.1 Table 4.3 lists the species recorded during all surveys. Twenty - nine species were recorded during the walkover surveys, of which four were target species. The assemblage included a mix of breeding and over-flying passerines, geese, waders and birds of prey, most of which are common and widespread species. However a number of species were recorded that can be regarded as important in terms of their rarity, conservation status and / or vulnerability to impacts from wind farm developments. These were:
- Skylark *Alauda arvensis* (red list) was numerous throughout the open areas of the proposal site with many males in song flight.
 - Meadow pipits *Anthus pratensis* (amber list) were almost as numerous as skylark, with evidence of breeding recorded across many of the open areas of the proposal site.
 - Curlew *Numenius arquata* (amber list) was infrequent however there was evidence of breeding for this species, including birds in song.
 - One record of Cuckoo *Cuculus canorus* (red list), was heard in a wooded area near to Small Burn.
 - Lesser redpoll *Carduelis cabaret* (red list) was encountered throughout the season.
- 4.4.2 Reasonably large populations of meadow pipit and skylark were recorded on the open moorland habitats. Dipper (*Cinclus cinclus*) was seen on two occasions on water bodies in the open areas of the site. Wheatear (*Oenanthe oenanthe*) and whinchat (*Saxicola rubetra*) were not particularly numerous, most of the records for them being on Connelburn Rig and Connel Burn.
- 4.4.3 Two occurrences of curlew were recorded near to Knockburnie Glen and between Ewe Hill and Lamb Hill. There were no other records of waders. This observation adds weight to the assertion made that, based on the VP observations, golden plover did not breed within the proposal site. There were no records at all of geese, ducks, swans or other waterfowl during any of the surveys.
- 4.4.4 At least one pair of red grouse was seen around Barbey's Hill and Enoch Hill with the potential for another to be present, as indicated by the presence of a male bird on High Chang Hill.
- 4.4.5 Ravens (*Corvus corax*) were recorded on occasion on the periphery of the site and on Chang Hill in small numbers. The VP surveys showed that this species roams quite widely across the higher ground of the proposal site.

Capabilities on project:
Environment

4.4.6 The breeding bird assemblage occurring within the coniferous plantation woodland included species typical of the habitat such as thrushes, finches and tit species, lesser redpoll, goldcrest (*Regulus regulus*), willow warbler (*Phylloscopus trochilus*), siskin (*Carduelis spinus*) and buzzard (*Buteo buteo*). A single cuckoo (*Cuculus canorus*) was recorded in a wooded area near to Small Burn. A small population of common crossbill (*Loxia curvirostra*) was detected within the plantations that surround the proposed development area in the South-West.

Table 4.3: Birds recorded during breeding bird surveys 2012. Red type indicates target species for the purposes of VP surveys

Species	Conservation Status (see footnotes)	VP Surveys	Walkover Surveys
Common Buzzard <i>Buteo buteo</i>			Frequently recorded in April, May and June.
Kestrel <i>Falco tinnunculus</i>	Amber	No records	Scarce record for site, 1 record in April and one in June.
Merlin <i>Falco columbarius</i>	EC1, WCA1, Amber	1 flight over Enoch Hill.	No records
Red Grouse <i>Lagopus lagopus</i>	Amber	No records	Pair on northern slope of Barbey's Hill in June, pair on Enoch Hill and single male on High Chang Hill in May.
Golden plover <i>Pluvialis apricaria</i>	Amber	5 records with up to 33 birds in one flight, 29 and 22 birds in subsequent flights.	No records
Great Black-backed Gull <i>Larus marinus</i>	Amber		Single record of 1 over-flying bird.
Wood pigeon <i>Columba palumbus</i>			One record on perimeter at north-west of site.
Skylark <i>Alauda arvensis</i>	Red		Frequently recorded across open habitats in all survey months.
Meadow Pipit <i>Anthus pratensis</i>	Amber		Common and widespread across open habitats. Recorded on all surveys.
Northern Wheatear <i>Oenanthe oenanthe</i>	Amber		Scarce, only recorded once in May and 3 times in June.
Robin <i>Erithacus rubecula</i>			Frequently recorded in woodland areas.
Blackbird			Occasionally recorded in woodland

Capabilities on project:
Environment

Species	Conservation Status (see footnotes)	VP Surveys	Walkover Surveys
<i>Turdus merula</i>			areas
Song Thrush <i>Turdus philomelos</i>	Red		Occasionally recorded in woodland areas in April and May.
Mistle thrush <i>Turdus viscivorus</i>	Amber		One record in north-western woodland bordering site.
Chaffinch <i>Fringilla coelebs</i>	EC1		Widespread in woodland habitats
Dunnock <i>Prunella modularis</i>	Amber		Occasionally recorded in woodland areas.
Coal Tit <i>Parus ater</i>			Occasionally recorded in woodland areas, largest population in June.
Marsh Tit <i>Poecile palustris</i>	Red		Scarce occurrences in April and June.
Pied wagtail <i>Motacilla alba yarrellii</i>			One record in May and one in June near Connel Burn.
Goldcrest <i>Regulus regulus</i>			Small numbers recorded in woodland areas in April and May.
Raven <i>Corvus corax</i>		A number of flights with between 1 – 3 birds mostly on Benty Cowan Hill and Connelburn Rig.	Occasional occurrences in open habitats.
Carrion Crow <i>Corvus corone</i>			Occasionally recorded over wooded areas and open habitats
Curlew <i>Numenius arquata</i>	Amber	Four flights observed mostly close to the periphery of the proposed site with two flights between Connelburn Rig and Benty Cowan Hill.	Occasional occurrences in April.
Cuckoo <i>Cuculus canorus</i>	Red		One record in a wooded area in May.
Wren			Frequent records in wooded areas of the site.

Capabilities on project:
Environment

Species	Conservation Status (see footnotes)	VP Surveys	Walkover Surveys
<i>Troglodytes troglodytes</i>			
Willow Warbler <i>Phylloscopus trochilus</i>	Amber		Frequent records in wooded areas of the site.
Whinchat <i>Saxicola rubetra</i>	Amber		Localised records in June including a family unit.
Lesser Redpoll <i>Carduelis cabaret</i>	Red		Occasionally recorded in wooded areas in June.
Common Crossbill <i>Loxia curvirostra</i>	WCA1		Recorded in woodland areas in small numbers
Siskin <i>Carduelis spinus</i>			Occasionally recorded in and around wooded areas.
Dipper <i>Cinclus cinclus</i>			One record in May on Knockburnie Glen and one record in June on Connel Burn.
Peregrine <i>Falco peregrines</i>	WCA1	Incidental record. Overflying the site at RSH.	
Tawny Owl <i>Strix aluco</i>		Incidental record - A family recorded at Dalleagles Wood during barn owl surveys.	

EC1 species included in Annex 1 of EC Birds Directive 1979 (79/409/EEC).

WCA1 species included in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

Red species included on the RSPB Red list of Birds of Conservation Concern

Amber species included on the RSPB Amber list of Birds of Conservation Concern

Capabilities on project:
Environment

4.5 Incidental Records

- 4.5.1 A male peregrine (*Falco peregrinus*) was seen whilst a surveyor walked to a VP. It flew North-East from Rigg Hill towards Knocknarran Hill, a flight that was timed at 82 seconds, all of which was at RSH. This species was not recorded during any of the VP watches or the other formal surveys. No evidence of breeding was recorded for this species and there is virtually no suitable nesting habitat within the proposal site.
- 4.5.2 A family of Tawny Owls (*Strix aluco*) was active at the edge of Dalleagles Wood during one of the barn owl surveys, indicating that this species probably breeds here.
- 4.5.3 Meadow pipit feathers were found beneath a plucking post on the high ground between Benty Cowan and High Chang Hill during a separate ecology survey in August 2012, indicating that merlin hunt over the site. Further evidence for merlin activity was gathered on the same occasion, when a merlin was observed in pursuit of a small unidentified passerine along the north western edge of the proposal site. The prey bird made its escape into the plantation at the edge of Maneight Hill.

Summary and Recommendations



Capabilities on project:
Environment

5 Risk Summary and Recommendations

5.1 Results summary and discussion of risk

- 5.1.1 The breeding bird surveys show that, overall, the proposed development site does not support large numbers of breeding birds and, with some notable exceptions, the proposal site and its immediate surroundings do not appear to include a large number of species that are especially sensitive to the potential impacts of wind farm development.
- 5.1.2 The breeding bird assemblage, similar to the wintering assemblage, is quite impoverished and, perhaps surprisingly, features very few breeding waders across the open moorland and high ground on which the proposed turbines would be sited. Breeding waders were represented only by occasional curlew, while golden plover records were of overflying birds only, despite the presence of suitable breeding habitat.
- 5.1.3 Golden plover is of high conservation status and potentially sensitive to the impacts of wind farms particularly where large numbers of birds are involved or where there is a confirmed functional link between a given development site and a site designated for their presence, such as a SPA. It can be considered at this site to be the largest risk to the proposal with respect to collision with proposed turbines. However despite over half of the recorded flights being at RSH, golden plover are likely to present at most a medium risk to the development due to the relatively small number of recorded flights. Furthermore, the basic analysis presented in Table 4.2 probably overestimates collision risk because it includes some flight activity that, based on the proposed turbine layout, would not pose any risk of collision with turbines. A CRM would therefore exclude some of this flight activity. Furthermore SNH guidance advocates the use of a high (98%) avoidance rate for this species (Scottish Natural Heritage Guidance, <http://www.snh.gov.uk/docs/B721137.pdf>).
- 5.1.4 The risks to red grouse are likely to be those of displacement from feeding and breeding areas rather than those of collision mortality and, based on the existing data, such impacts are likely to be relatively minor.
- 5.1.5 Skylark and meadow pipit were commonly recorded across the site and are likely to breed across the majority of the open areas of the site. Given their respective Red and Amber List status, construction work should be timed to avoid the breeding season in order to avoid disturbance and destruction of nests.
- 5.1.6 Other records of note include a number of occurrences of lesser redpoll, common crossbill and cuckoo, species that are generally found within woodland. This is likely to present very little risk to the proposal given the location of woodlands outside the boundary of the proposed site. There is some potential for the proposal to affect cuckoo indirectly through impacts on ground nesting species whose nests they parasitise (for example meadow pipit).
- 5.1.7 Ravens occasionally flew over the site and, given their widespread presence on a year – round basis (this species was also widespread in winter – see AECOM, 2012) it is likely that there is at least one pair holding territory nearby in the wider area. This species may present some risk of collision but this is likely to be low given the number and spatial distribution of flights. The species is not of high conservation concern.
- 5.1.8 Buzzards were observed frequently above woodland areas surrounding the southern extent of the proposal site though their observed activity would not put them at risk of adverse impacts from the proposal. AECOM's surveys have shown no evidence of significant risk of collision for this species. Similarly kestrels have been identified as using the site, though the level of recorded activity suggests a very low risk of adverse effects on this species.
- 5.1.9 Without formal analysis of collision risk it is difficult to determine the overall risk of collision mortality posed by the proposed turbines, however the results of the breeding surveys suggest that it is low or very low for most species during the breeding season, with the possible exception of golden plover. To date, golden plover is the only species that appears to be at risk of collision mortality on a scale that might be regarded as significant.
- 5.1.10 In addition to collision, displacement of some birds is likely to be a key consideration for the proposed development. The presence of a black grouse lek within the proposal site presents what is possibly the most significant displacement risk, though it is likely to be mitigated to some extent by its remoteness from the proposed turbines. Placement of ancillary infrastructure and the timing and methods of construction will need careful consideration to avoid potential impacts and it is recommended that SNH are consulted on this issue.

Capabilities on project:
Environment

- 5.1.11 The breeding bird assemblage across open habitat where proposed turbines would be sited is dominated by the occurrence of breeding skylark and meadow pipit; there is the potential for such birds to be displaced from their breeding territories by construction and operation of the proposal.
- 5.1.12 The overall level of ornithological risk to the proposed development, based on the wintering and breeding surveys and third party data received, is **Low – Moderate**. There is an element of uncertainty associated with this judgement principally because it is not informed by a formal CRM.
- 5.1.13 The preliminary assessment above is based on the consideration of this wind farm alone and does not include any element of cumulative assessment of the impact of this proposal in combination with other schemes in the wider area, including operational, proposed and consented (but not yet built) wind farms. Such considerations would form an essential part of a robust impact assessment should this proposal be taken forward to a planning application.
- 5.2 Key risks to the proposal and recommendations for further work**
- 5.2.1 The key risks to the proposal discussed in paragraphs 5.1.1 – 5.1.13 are condensed and summarised in Table 5.1. This identifies the key issues to be considered at the detailed impact assessment stage and the remaining knowledge gaps that may need to be filled.

Capabilities on project:
Environment

Table 5.1: Summary of Potential Risks to Ornithological Receptors and Further Recommendations

Receptor *	Key Potential Impact(s)	Likelihood of occurrence	Further action recommended
Ground nesting birds	Displacement and habitat loss Disturbance / prevention of nesting and successful breeding	High (all)	Careful controls of construction – related impacts. Detailed impact assessment and explore opportunities for mitigation and compensation measures.
Woodland passerine species	Displacement and habitat loss Disturbance / prevention of nesting and successful breeding	Low (all)	Apply suitable stand off from woodland habitats
Red Grouse	Displacement Disturbance / prevention of breeding Collision	Moderate Moderate Low	Careful controls of construction – related impacts
Peregrine	Collision Displacement from hunting areas Barrier effects to movement across the site	Negligible	None
Raptors	Displacement from hunting areas Collision Displacement from nests / territories	Low Negligible – Low Low	Apply suitable stand offs from woodland habitats.

* The wintering bird report referenced an unconfirmed sighting of hen harrier overflying the proposal site and, given the distribution of sites in northern England, Ireland, Isle of Man and Southern Scotland designated for this species, identified this as a risk to the proposal. No further records have been made of this species and it has been scoped out of further consideration here.

References



Capabilities on project:
Environment

6 References

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Gilbert, G., Gibbons, D.W and Evans, J. (1998). *Bird Monitoring Methods*. The Royal Society for the Protection of Birds, Sandy.

Highland Council. (2010). *Erection of 19 wind turbines, hard standings, anemometer mast, wind farm control building, temporary construction compound, lay down area, access tracks and 5 borrow pits at Corriemoillie Forest, Gorstan, Garve*. Ross, Skye and Lochaber Planning Applications Committee.

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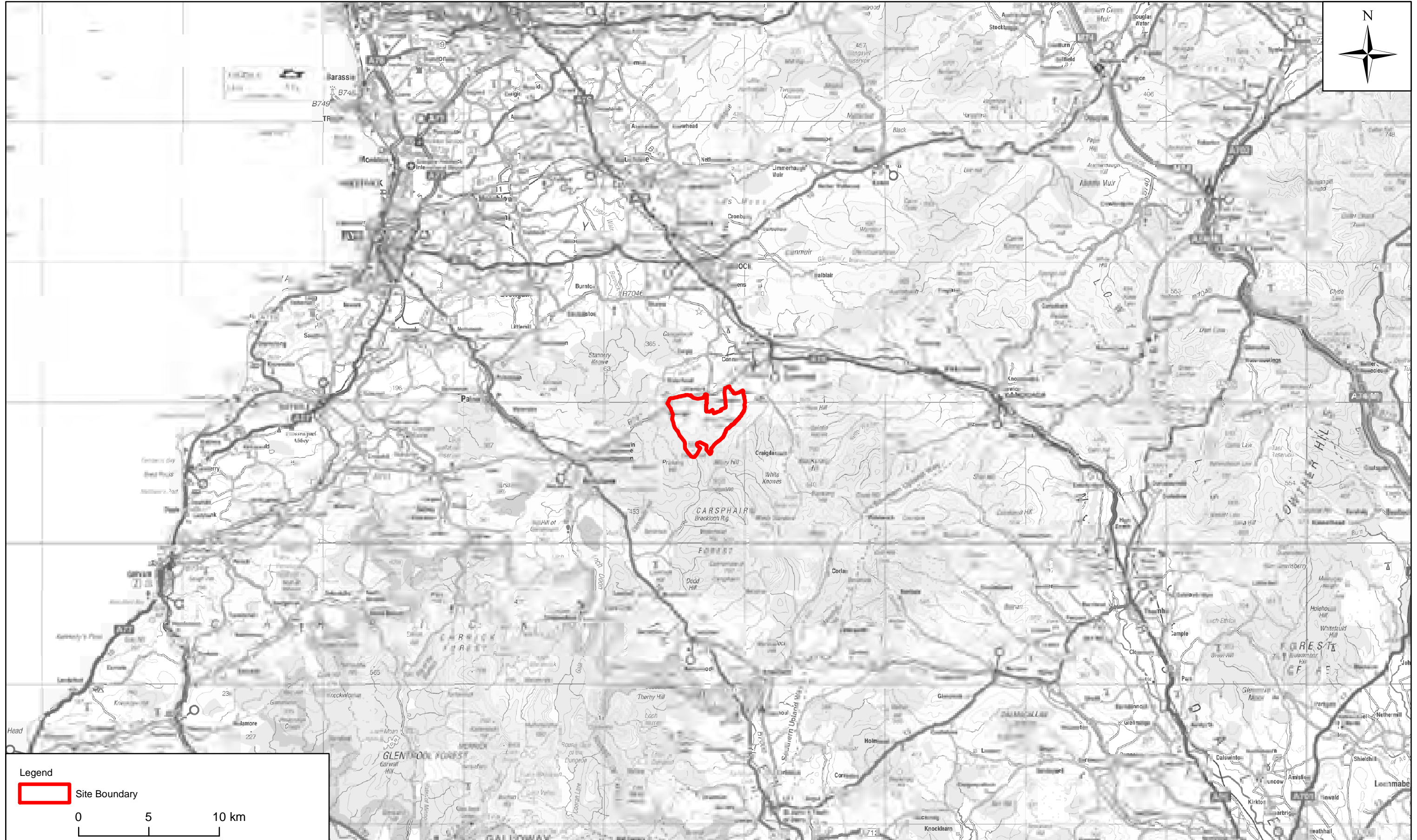
Figures



Capabilities on project:
Environment

Figures

- Figure 1.1** Site Location
- Figure 1.2** VP Locations and Proposed Layout
- Figure 4.1** Golden Plover Flight Lines
- Figure 4.2** Curlew Flight Lines
- Figure 4.3** Merlin Flight Lines
- Figure 4.4** Raven Flight Lines



Legend

Site Boundary

0 5 10 km

Client:

Project: **ENOCH HILL WIND FARM
FEASIBILITY ASSESSMENT**

Title:

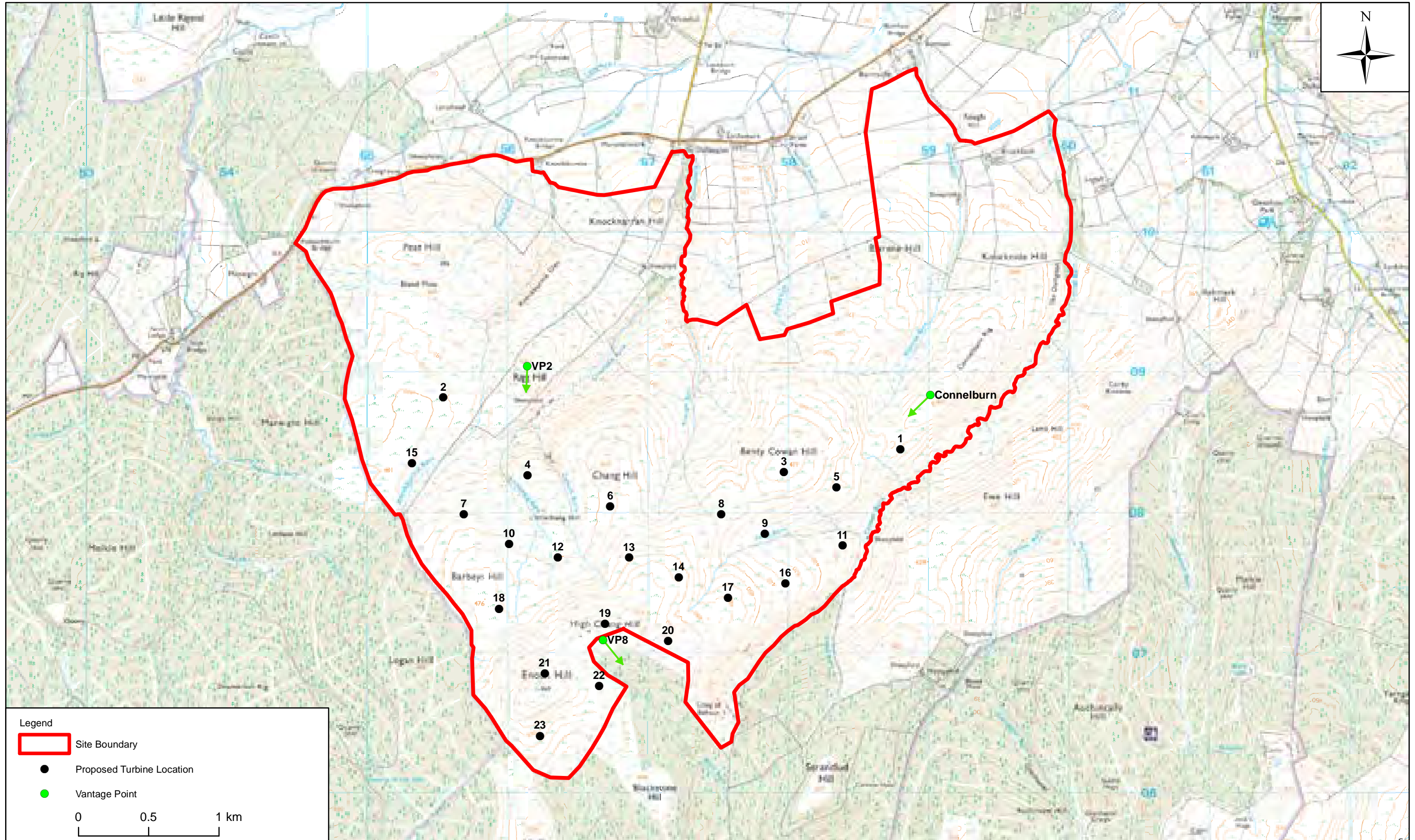
SITE LOCATION MAP

AECOM

5th Floor,
2 City Walk,
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Fax: +44 (0) 113 391 6899
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Design:	DAM	Drawn:	DAM
Chk'd:	RTW	App'd:	LMK
Date:	20/11/2012	Scale at A3:	1:250,000
Drawing Number:	FIGURE 1.1		A3



Legend

- Site Boundary
- Proposed Turbine Location
- Vantage Point

0 0.5 1 km

Client:

Project: **ENOCH HILL WIND FARM
FEASIBILITY ASSESSMENT**

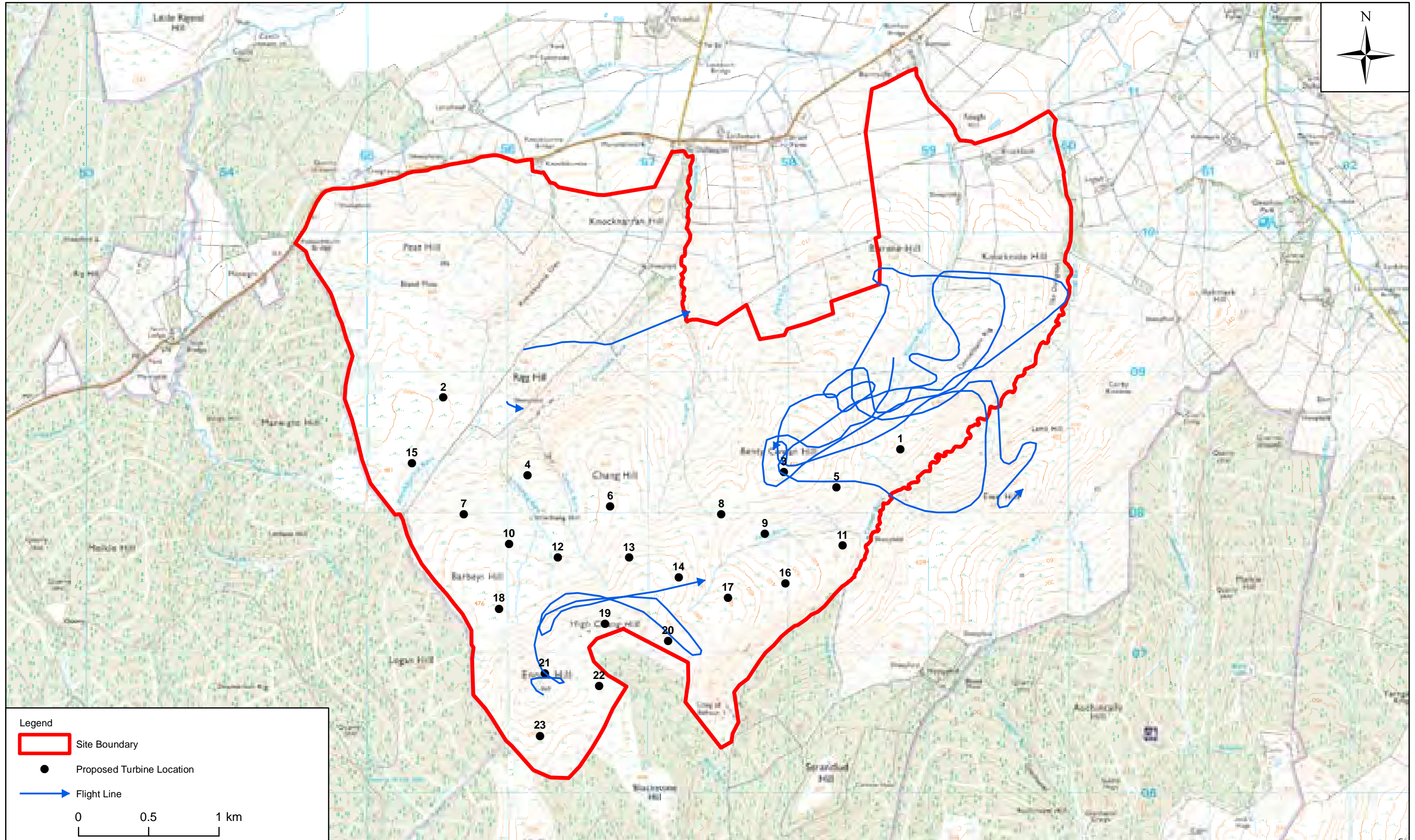
Title: **VP LOCATIONS AND PROPOSED LAYOUT**

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Drawing Number:	FIGURE 1.2		A3



Legend

- Site Boundary
- Proposed Turbine Location
- Flight Line

0 0.5 1 km

Client:

Project: **ENOCH HILL WIND FARM FEASIBILITY ASSESSMENT**

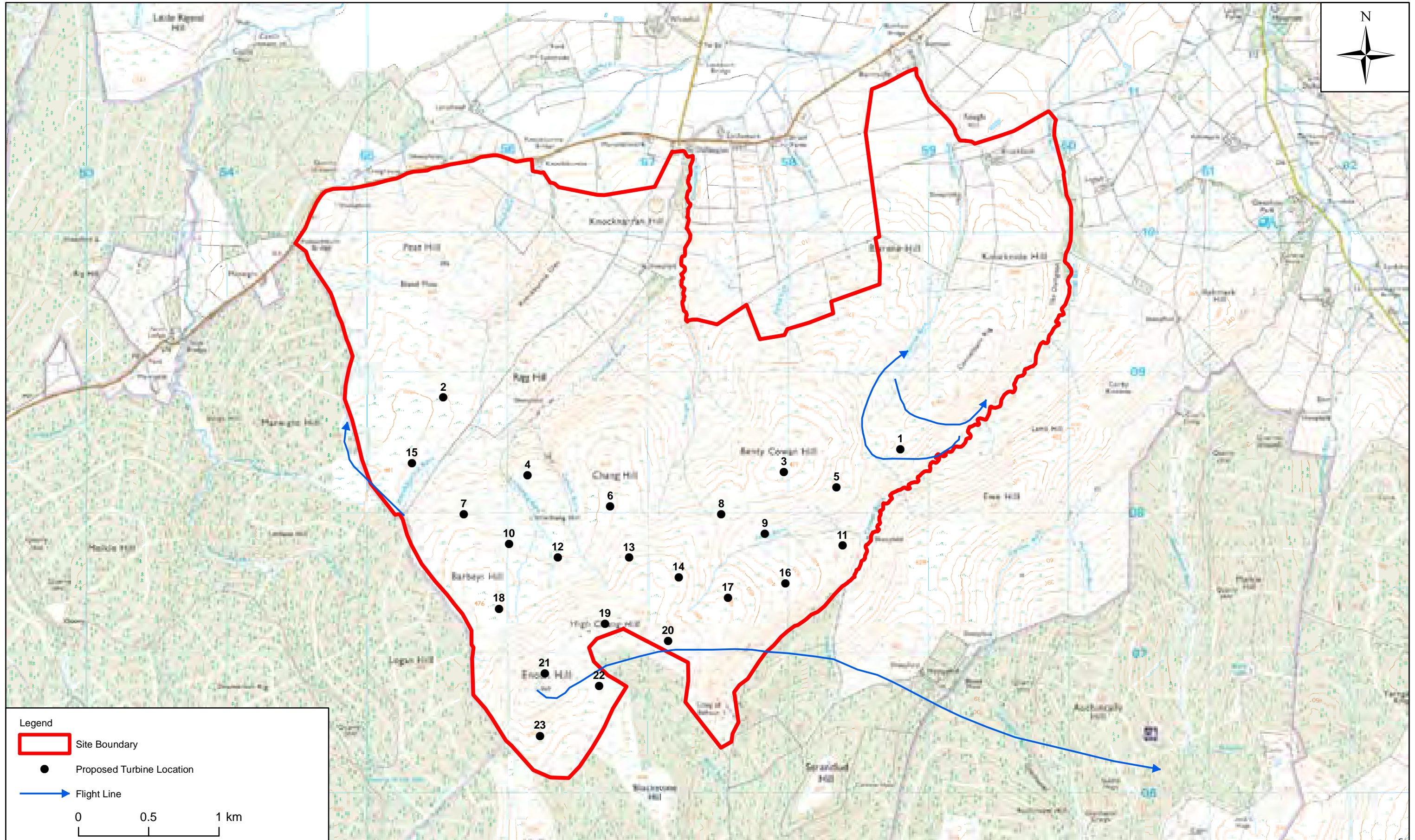
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Date:	20/11/2012	Scale at A3:	1:25,000
Drawing Number:	FIGURE 4.1		A3



Legend

- Site Boundary
- Proposed Turbine Location
- Flight Line

0 0.5 1 km

Client:

Project: **ENOCH HILL WIND FARM FEASIBILITY ASSESSMENT**

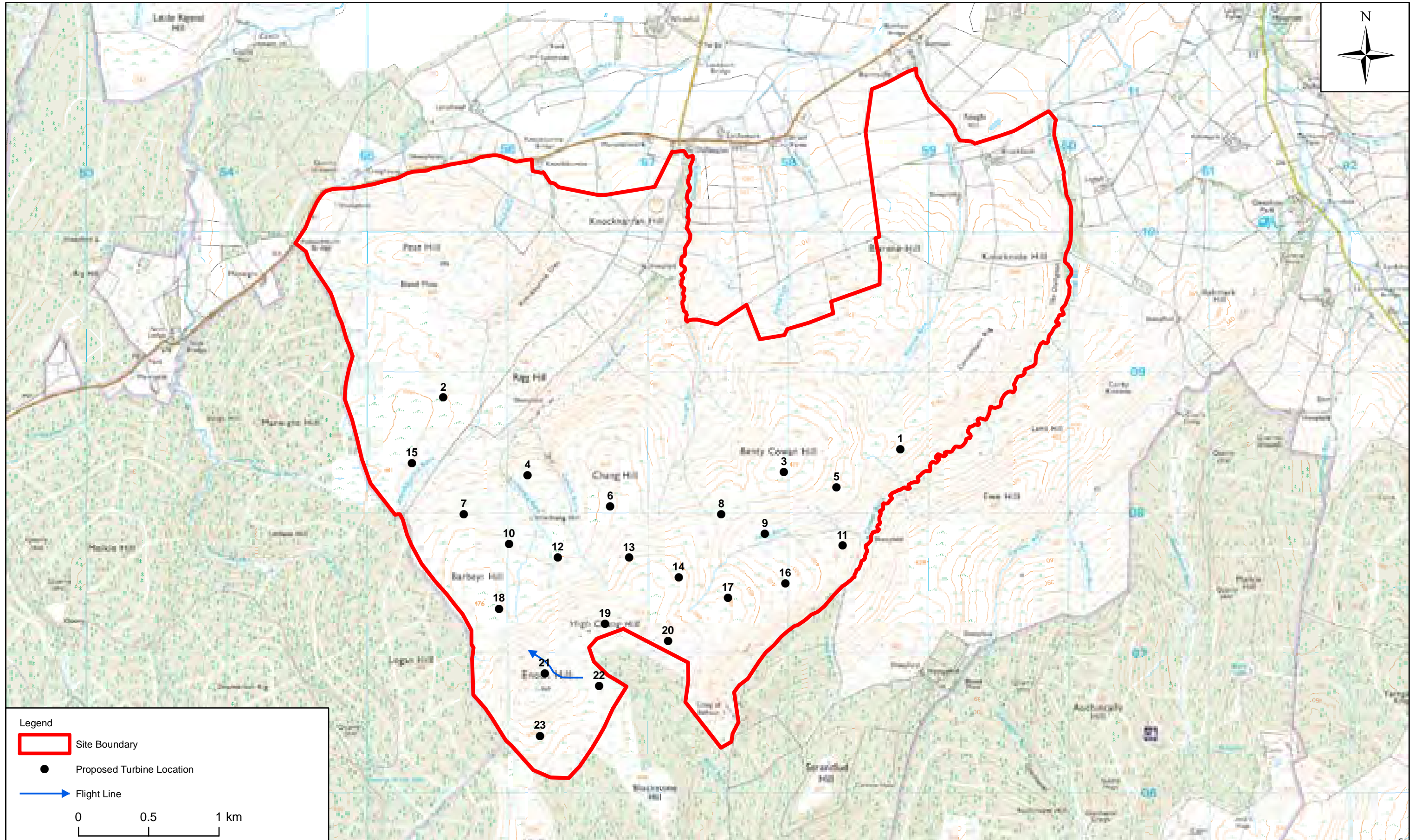
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Drawing Number:	FIGURE 4.2		A3



Legend

- Site Boundary
- Proposed Turbine Location
- Flight Line

0 0.5 1 km

Client:

Project: **ENOCH HILL WIND FARM FEASIBILITY ASSESSMENT**

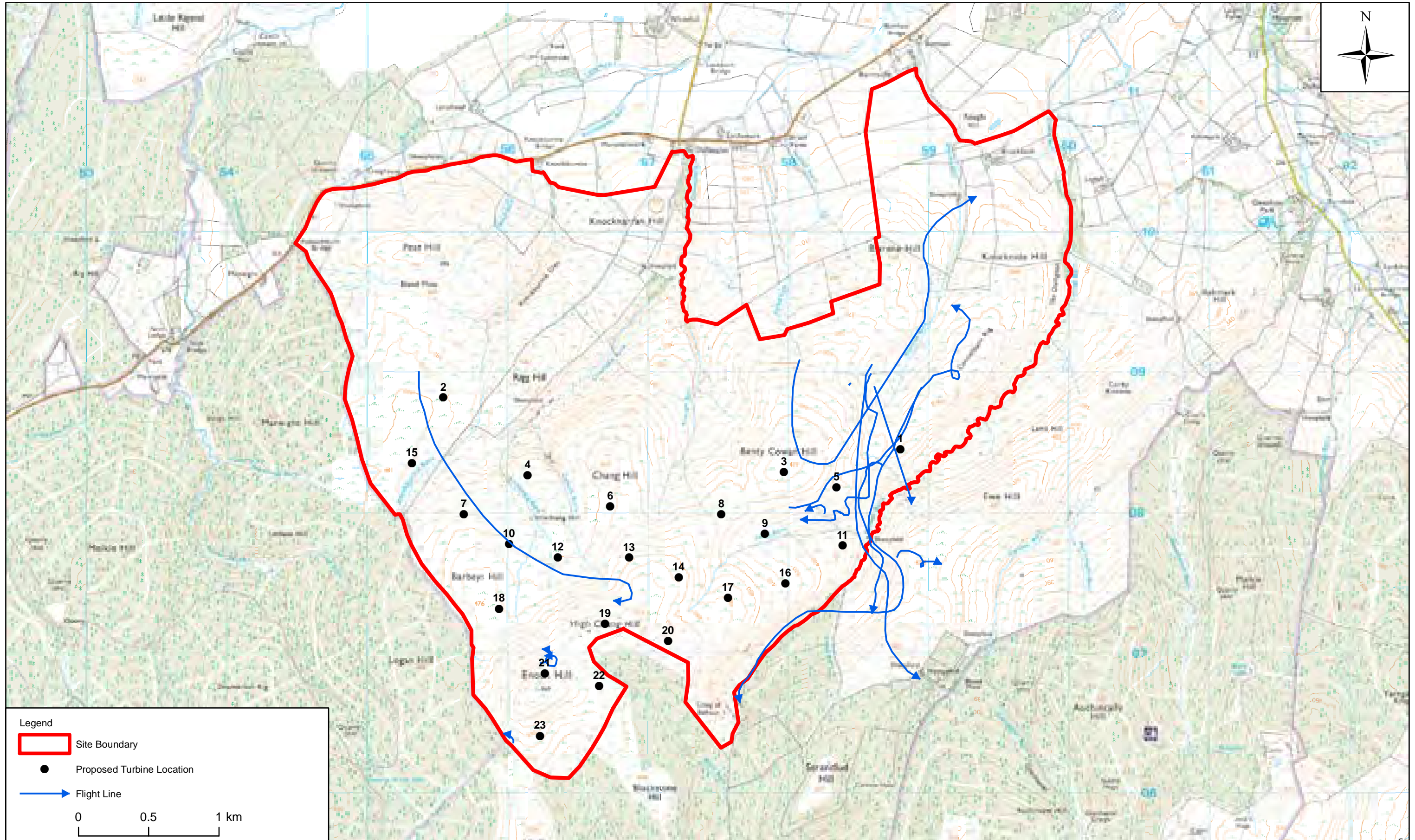
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Drawing Number:	FIGURE 4.3		A3



Legend

- Site Boundary
- Proposed Turbine Location
- ➔ Flight Line

0 0.5 1 km

Client: _____

Project: **ENOCH HILL WIND FARM
FEASIBILITY ASSESSMENT**

Title: **RAVEN FLIGHT LINES**

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Date:	20/11/2012	Scale at A3:	1:25,000
Drawing Number:	FIGURE 4.4		A3

Appendices



Capabilities on project:
Environment

Appendices

Appendix A Consultations with Scottish Natural Heritage

From: Wardle, Richard T
Sent: 23 October 2012 10:29
To: 'John Gibson'
Subject: RE: Dalleagles (Enoch Hill) Proposed e-mail for Richard Wardle

Follow Up Flag: Follow up
Flag Status: Completed

Thanks for that John – I know you’ve a difficult job to do unraveling these things and so often the minutiae of survey planning is in the consultant’s head and difficult to extract.

Thanks for taking the time to consider everything i’ve sent you – much appreciated

Kind regards
Richard

From: John Gibson [<mailto:John.Gibson@snh.gov.uk>]
Sent: 23 October 2012 09:56
To: Wardle, Richard T; Dorothy Simpson
Subject: RE: Dalleagles (Enoch Hill) Proposed e-mail for Richard Wardle

Hi Richard,

Thanks for your e-mail and various explanations which all seems fine and appreciate the topography does not always make life easy. I'm sure you'll appreciate too we have to ask these questions simply because we don't want any surprises for all concerned when things get as far as the formal planning process.

Likewise feel free to get in touch if you have any queries.

Regards,

John.

John Gibson
Operations Officer
Southern Scotland

Scottish Natural Heritage
Newton Stewart
Holmpark Industrial Estate
New Galloway Road
Newton Stewart
Wigtownshire
DG8 6BF

T: 01671 401075
F: 01671 401078
email: john.gibson@snh.gov.uk

From: Wardle, Richard T [<mailto:richard.wardle@aecom.com>]
Sent: 15 October 2012 18:03
To: John Gibson; Dorothy Simpson
Subject: RE: Dalleagles (Enoch Hill) Proposed e-mail for Richard Wardle

John

Apologies from me this time wrt delayed response. I seem to be pulled in so many directions at the moment, whcih I’m sure you can relate to. I’ll cover each item in turn (please take a look back at the layered

VP plan I sent you).

Concealment

Advice from the surveyors is that concealment of one form or another was always used for reasons of good practice but also surveyor comfort since the site is very exposed. On most occasions these took the form of a poncho supported at either end by poles to make a wind break under which the surveyor sat, or a kind of small tent known as a basha.

Simultaneous watches

Simultaneous watches have certainly been carried out at times but without interrogating the records closely I cannot say which VPs this applies to and when. I do know off the top of my head that watches were carried out on a few occasions from VP 3, 8, and 7 simultaneously and almost certainly other combinations.

The reason I have not looked in detail at the survey records is that, from Dorothy's email (below) the main problem with simultaneous watches would be where a surveyor at one VP sits within the viewshed of another, which makes sense as it might deter bird activity around a surveyor and bias results from one or more VPs. Given the viewsheds and distribution of VPs this is never the case because in winter VPs 1, 3, 4, 7 and 8 were used and in summer 2, 8 and Connelburn were used. There is overlap of viewsheds, yes, but none of the VPs sits within a viewshed from another so this should be no more than an inconvenience when modeling collision rather than a potential source of survey bias.

Size of viewing arcs

I had a difficult decision when originally choosing VPs for the winter work as, firstly, the proposal was for turbines right down the hill almost to the inbye land at knocknide Hill, secondly the topography presents serious challenges to achieving good visibility and thirdly there were also a number of habitat features I wanted to keep an eye on as I just felt that there might be some chance of "interesting" birds using them – by this I mean the plantation woodlands to the west (things like goshawk displaying above plantation and black grouse on woodland edges) and the deep cut burns and other gullies running in a generally north – south direction (which might have been used as flight lines by low flying raptors for example). It would otherwise have been quite hard to spot birds using these features.

VP1 was expanded to include more plantation and to give some coverage of the airspace above Dalleagles Burn (and the woodland here)

VP7 was expanded as this gave better visibility along the Crocradie and Trough Burns

VP4 was to give more coverage of the woodland at Dalleagles Burn and also to spot birds using Blarene Burn to access the site.

As it turned out, from all VPs regardless of position, time of day, viewing arc, time of year etc, there has been very little bird activity of note so it could be argued that extending these viewing arcs was pretty pointless, although you could also argue that it was harmless. An additional comment here wrt the larger viewing arcs and the potential to miss birds is that, with so few target species flights this to my mind becomes a minor concern at worst.

I hope that answers your questions but feel free to fire more at me as you see fit.

Kind regards
Richard

From: John Gibson [<mailto:John.Gibson@snh.gov.uk>]
Sent: 18 September 2012 14:47
To: Wardle, Richard T; Dorothy Simpson
Subject: RE: Dalleagles (Enoch Hill) Proposed e-mail for Richard Wardle

Hi Richard,

Apologies for the delay in picking this up, got tied up with an office move and a house move within a week so am just about getting back on track with things.

I've had a look at the viewsheds and will just wait on any further information you have as regards timing of individual VP watches, overlap and any concealment issues. The only other outstanding issue or question relates to viewsheds of more than 180 degrees. Looking at viewsheds 1 and 4 I can't see any reason why there would need to be in excess of 180 degrees, as whichever sector(s) would be lost to limit the view to 180, turbine locations are well within view and none on the periphery of the arc so all in I see no issue unless there is some other reason.

Perhaps you can give me an update on this site when you have time.

Regards,

John

John Gibson
Operations Officer
Southern Scotland
01671 401075

From: Wardle, Richard T [<mailto:richard.wardle@aecom.com>]
Sent: 17 August 2012 10:04
To: Dorothy Simpson
Cc: John Gibson
Subject: RE: Dalleagles (Enoch Hill) Proposed e-mail for Richard Wardle

Thanks Dorothy

I'm glad the information was useful to you. I'm unsure about the concealment issue as the surveys have been carried out by sub consultants however i'm sure i remember a comment from them to the effect that they were using small collapsible tents or similar. I will go back to the surveyors on this and the question of simultaneous VP watches as, if this has happened, it will depend which VPs were used simultaneously.

Thanks again for the advice
Richard

From: Dorothy Simpson [<mailto:Dorothy.Simpson@snh.gov.uk>]
Sent: 17 August 2012 09:53
To: Wardle, Richard T
Cc: John Gibson
Subject: Dalleagles (Enoch Hill) Proposed e-mail for Richard Wardle

Richard

Thank you for the further information particularly the viewshed data. As an update on our new staff resource for this case, my colleague who works in SNH office in Dumfries is going to lead on the case for SNH. His name is John Gibson and his contact details are; tel 01387 247010 e-mail john.gibson@snh.gov.uk. John will take over this case but I am forwarding some comments in relation to the 2 issues from your earlier e-mails:

1. In relation to the issue of surveyor interference with results due to proximity to turbines we offer the following comment:

It will be useful to know if concealment has been used to minimise displacement by the observer and if simultaneous watches have been carried out from 2 or more VPs - where there is the danger of one observer sitting within the viewshed of another VP and displacing birds.

2. In relation to the viewshed of more than 180 degrees this concern here is that scanning more than 180 degrees means you are more likely to miss flights as you will lose sight of part of the arc when viewing the bits beyond 180 on the opposite side.

This is less of a problem if it is only parts of the buffer around the turbines that could be overlooked, if however it includes a number of turbines that are only covered by the extreme part of an arc from a single VP it probably is a problem.

As noted above my colleague John Gibson will follow up with a further response once he has considered the viewshed data that we received today. He may also seek clarification from you on the question of observer concealment or simultaneous watches. I will ask John to contact you with his this information within the next 2 weeks.

I hope this will be in time should further action be needed. If not, please contact John or myself.
Dorothy

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Thoiribh an aire airson adhbharan gnothaich, 's dòcha gun tèid

Appendix 12.C

Baseline Ornithology Report – Winter Season 2012/13

E.ON Climate & Renewables UK Developments Ltd

Enoch Hill Wind Farm

Appendix 12C: Ornithology Baseline Report Winter 2012-13



AMEC Environment & Infrastructure UK Limited

March 2015

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Document Revisions

No.	Details	Date
01	First Draft for Client Review	23/09/2013
02	Draft Report to be appended to ES	20/03/2015
03	Final	27/07/2015

Report for

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E.ON Climate & Renewables

Enoch Hill Wind Farm

Appendix 12C: Ornithology Baseline Report Winter 2012-13

AMEC Environment & Infrastructure
UK Limited

March 2015



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BOD 19001 - DHS 03997

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Executive Summary

This report documents the methods employed and results obtained from the programme of bird surveys undertaken throughout the 2012/13 non-breeding season at the proposed Enoch Hill Wind Farm and surrounding area. The scope of the surveys was determined with regard to the nature of the proposed development, knowledge of the distribution of sensitive bird species in the area and the relevant guidance documents produced by Scottish Natural Heritage (SNH). Surveys were undertaken between September 2012 and March 2013 inclusive. In brief, the survey programme included 36 hours of observation from each of five vantage points (VP). VP surveys focussed on the initial turbine layout plus a surrounding buffer zone of at least 200m (in practice, a large swathe of surrounding land was observed). Once monthly walkover surveys were undertaken between September and March, focussed on recording flocks of wildfowl and waders. These surveys extended to 1km from the initial turbine layout where access permitted (i.e. there was no access beyond the site boundary to the south).

The survey results indicate that the land around the initial turbine layout is unexceptional with regards to the activity of target bird species. The habitats in this area are dominated by bog habitat typified by grasses, sphagnum and rushes with some enclosed pasture in the northern part of the site and extensive coniferous plantations on the eastern, western and southern boundaries. A range of target species was recorded, each in low numbers. Ravens maintained a presence throughout the winter with up to five birds noted ranging across the site and a minimum of two birds recorded in all months. Raptors were extremely scarce with single records of Merlin and Peregrine flying over the moorland. Wildfowl and wader activity was low throughout the winter period with moderate numbers of Golden Plover present early in survey period peaking at 105 birds and no records from December onward with the exception of two birds in February. No other wildfowl or waders were recorded. Black Grouse were recorded at the beginning and end of the winter period with a peak of four birds present in October.



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Figure 3.5	Walkover Golden Plover Flights	After Page 18



1. Introduction

E.ON Climate & Renewables UK Developments Ltd (E.ON) is investigating the feasibility of constructing and operating a wind farm at Enoch Hill, located approximately 5km south-west of New Cumnock, Ayrshire. The Site is located at approximate central grid reference NS 573 086 and is hereafter referred to as Enoch Hill (or the 'development site'). AMEC Environment & Infrastructure UK Ltd (AMEC) was commissioned by E.ON to undertake ornithological surveys at Enoch Hill during the 2012-13 non-breeding bird season. This followed a survey programme initiated in autumn 2011 by AECOM on behalf of E.ON which encompassed a range of breeding and wintering bird surveys based on SNH 2010¹ guidance (outlined within AECOM report²).

1.1 Purpose of this Report

The purpose of this report is to provide E.ON with details of the methodology and results of the winter bird surveys undertaken at Enoch Hill between September 2012 and March 2013. The information contained within this report can be used to inform the detailed assessment of predicted impacts on birds that would be presented in any subsequent Environmental Statement if the Site is progressed. This report could also be used as a consultation document in any communication with SNH, RSPB and other key stakeholders.

1.2 Site Description

The location of the Site and the Site boundary are illustrated in **Figure 1.1**. The Site is dominated by blanket bog habitat interspersed with strands of rushes, with a small number of enclosed heavily grazed pastures in the north. The Site is bordered by coniferous plantation to the south, east & west. A number of small stream valleys flow north through the site, originating on the higher ground along the southern boundary of the site. The streams converge both on and off site with the larger ones being the Knockburnie Burn, Connel Burn & Dalleagles Burn which feed into the River Nith approximately 2km north of the site. There are three small settlements, Burnside, Dalleagles and Knockburnie just to the north of the site along with several farmsteads immediately outside of the site boundary. Within the site boundary, in the north-west, is Brockloch Farm, a small farmstead.

1.3 Background and Scope

The key issues relating to birds and wind farms are as follows:

- The effects of direct habitat loss due to land take by wind turbine bases, tracks and ancillary structures;

¹ Scottish Natural Heritage (2010) Survey methods for use in the assessment of the impacts of onshore wind farms on bird communities.

² AECOM (2012) Dalleagles proposed wind farm – wintering ornithology report.

- The effects of disturbance displacement of birds from the proximity of the wind turbines. Such disturbance may occur as a consequence of construction work, or due to the presence of the wind farm close to nest or feeding sites or on habitual flight routes; and
- The effects of collision with rotating turbine blades (i.e. killing or injury of birds), which is of particular relevance for sites located in areas with high raptor activity or which support large concentrations of waterfowl.

With regards to the first issue, total land take by wind farm infrastructure generally represents a very small proportion of a site. Therefore the permanent loss of nesting and foraging habitat for birds tends to be very small and will generally have little effect on bird populations. At most wind farm sites it is the latter two issues, collision risk and displacement, which may potentially be more significant.

A range of guidance documents have been produced relating to the assessment of bird/wind farm interactions and the following publications and guidelines in particular have been influential in determining the scope of the works at Enoch Hill:

- Scottish Natural Heritage (SNH, 2010). Survey methods for use in assessment of the impacts of proposed onshore windfarms on bird communities. SNH Advisory Services and National Strategy; and
- Scottish Natural Heritage (2006). Assessing significance of impacts from onshore windfarms on birds outwith designated areas. SNH, Battleby.

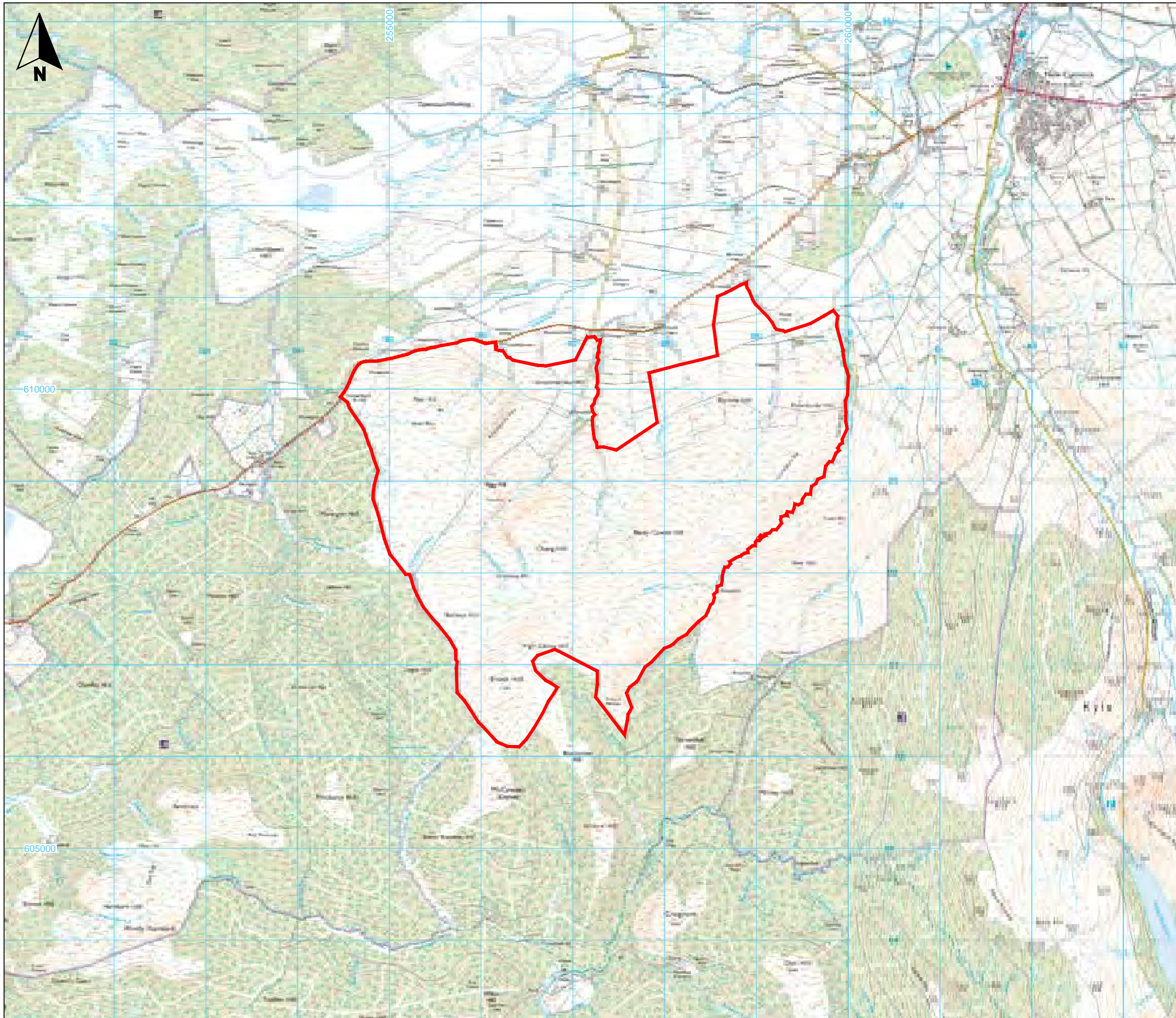
SNH guidance recommends that field surveys should be focussed on those species of high nature conservation value for which there is potential for an impact which might be judged significant and adverse. In most circumstances these 'target species' tend to be limited to those more highly protected species and other species of conservation concern which, as a result of their flight patterns or response behaviour, may be subject to impact from wind farms. SNH 2010 refers readers to three species lists which describe protected species and species of conservation concern:

- Species listed under Annex 1 of the EC Directive of the Conservation of Wild Birds, commonly referred to as the Birds Directive;
- Species listed under Schedule 1 of the Wildlife & Countryside Act 1981 (as amended); and
- Species listed on the Birds of Conservation Concern Red List.

In addition, consideration is given to migratory species which are either rare or vulnerable, or warrant special consideration on account of the proximity of migration routes, or breeding, moulting, wintering or staging areas in relation to the proposed wind farm. Consideration is also given to species occurring at the site in regionally or nationally important numbers and species identified nationally or locally as of conservation concern within Biodiversity Action Plans and Planning Policy Lists and any other species for which the site hosts a particular concentration.


At Enoch Hill, it was decided that target species would include all Schedule 1 listed raptors, Annex 1 waders, all geese, swans and ducks (excluding mallard) and other notable species that are potentially vulnerable to impacts from wind farms (e.g. black grouse). Secondary species (i.e. given a secondary level of priority during recording) included all non-target raptor, wader and wildfowl species, plus raven, gulls and notable counts of other species.





Key

 Site boundary

0 m  2000 m
Scale 1:40,000 @ A3

Enoch Hill Wind Farm
Baseline Ornithology Report - Winter
Season 2012-13

Figure 1.1
The Site

May 2015
32965-Gla32a.dwg parkj



2. Methods

2.1 Desk Study

The presence of Special Protection Areas (SPAs), Ramsar sites and Sites of Special Scientific Interest (SSSIs) within 15km of the Site boundary for which designation was primarily for birds was determined by accessing the Multi-Agency Geographical Information for the Countryside (MAGIC)³ and SNH Sitelink⁴ websites. Previous studies, principally the AECOM wintering birds baseline report (2012), were used to inform what the likely target species would be and to ensure the survey design properly effectively documented these.

2.2 Bird Surveys

The key objective of the wintering bird surveys at Enoch Hill was to establish whether any species or populations of nature conservation importance made regular use of the Site or adjacent areas, or the airspace above the Site. A programme of surveys were undertaken, between 28 September 2012 and 18 March 2013, further details of which are provided below.

2.2.1 Vantage Point Surveys, Non-Breeding 2012-13

VP surveys, based upon the method statement prepared by Mike Madders for Scottish Natural Heritage (SNH 2010) were undertaken between 05 October 2012 and 26 March 2013. This method focuses on identifying flight-paths of target species such as raptors and allows any regularly used flight lines to be identified, allowing turbine locations to be altered where necessary to reduce collision risk to birds. The data generated can also be used to estimate the theoretical risk of collision with turbines by incorporation into a suitable model.

The Madders methodology guidance is that vantage-points should be chosen parsimoniously to achieve maximum Site visibility from the minimum number of locations such that all parts of the survey area are within 2km of a vantage-point. Five vantage points were identified as being sufficient to survey the initial 23 turbine layout during the 2012/13 non-breeding period, the locations of which were:

- VP1 – On Peat Hill looking south (NS 55543 09814);
- VP2 – On Enoch Hill looking north (NS 56216 06749);
- VP3 – On Enoch Hill looking south (NS 56216 06749);
- VP4 – On Blarene Hill looking south (NS 5869409813); and
- VP5 – On Benty Cowan Hill looking south (NS 57985 08339).

³ MAGIC website – <http://magic.defra.gov.uk>

⁴ SNH Sitelink website - <http://gateway.snh.gov.uk/sitelink/index.jsp>

The view-sheds, illustrating what is visible at a height of 34m and above, from each of the five VPs are illustrated in **ES Chapter 12 - Figure 12.3b**. The 34m height represents the likely low sweep height of the turbines and this was used to illustrate the viewsheds. As the turbine model has not been selected for the array at the time of writing 30m was used in field observation as the conservative lower limit for collision risk modeling.

A total of 36 hours of vantage point observation (VPO) was undertaken at each VP. Dates and times of the VP watches are provided in **Tables 2.1 – 2.5** below. Surveys were conducted in a range of representative weather types.

Table 2.1 Vantage Point 1 Survey Information, Non-breeding Season 2012-13.

Date	Time	Hours	Wind	Cloud Cover	Precipitation and Temperature	Visibility	Sunrise/ Sunset Time (where applicable)
VP1							
10.10.12	15.45-18.45	3	2/SW	6/8	Nil	>2k	18.28
15.10.12	15.45-18.45	3	1/SW	2/8	Nil, 9c	>2k	18.15
02.11.12	10.00-13.00	3	4/WNW	8/8	Rain, 4c	>2k	
14.11.12	13.45-16.45	3	2/SW	8/8	Drizzle, 10c	>1.5k	16.12
04.12.12	08.00-11.00	3	2/NW	8/8	Sleet, 1c	>2k	08.25
18.12.12	13.30-16.30	3	2/SE	6/8	Nil, 5c	>2k	15.46
15.01.13	13.45-16.45	3	1/E	1/8	Nil, 1c	>2k	16.19
17.01.13	07.45-10.45	3	2/S	7/8	Nil; -3c	>2k	08.31
18.02.13	15.30-18.30	3	1/SE	0/8	Nil, 5c	>2k	17.29
27.02.13	16.00-19.00	3	0/-	0/8	Nil, 7c	>2k	17.48
18.03.13	16.00-19.00	3	4/E	8/8	Snow Showers, 0c	>2k	18.27
26.03.13	16.40-19.40	3	4/ENE	6/8	Nil, 0c	>2k	18.43
Total		36					

Table 2.2 Vantage Point 2 Survey Information, Non-breeding Season 2012-13.

Date	Time	Hours	Wind	Cloud Cover	Precipitation and Temperature	Visibility	Sunrise/ Sunset Time (where applicable)
VP2							
12.10.12	11.30-14.30	3	5/W	8/8	Showers	>2k	
17.10.12	11.30-14.30	3	5/SE	8/8	Heavy Showers	>2k	
01.11.12	11.00-14.00	3	2/SW	3/8	Nil, 1c	>2k	

Date	Time	Hours	Wind	Cloud Cover	Precipitation and Temperature	Visibility	Sunrise/ Sunset Time (where applicable)
13.11.12	13.45-16.45	3	6/SW	8/8	Rain	>2k	16.13
05.12.12	09.00-12.00	3	1/WNW	0/8	Nil, -3c	>2k	
12.12.12	13.45-16.45	3	2/SW	8/8	Nil, -2c	>1.5k	15.45
08.01.13	13.45-16.45	3	4/W	8/8	Nil	>2k	16.07
16.01.13	10.30-13.30	3	2/SSE	8/8	Nil, -3c	>2k	
07.02.13	10.30-13.30	3	2/NW	8/8	Nil, 0c	>2k	
21.02.13	11.15-14.15	3	4/SSE	5/8	Nil, -1c	>2k	
01.03.13	12.00-15.00	3	2/N	0/8	Nil, 8c	>2k	
05.03.13	15.45-18.45	3	2/NE	3/8	Nil, 5c	>2k	18.00
Total		36					

Table 2.3 Vantage Point 3 Survey Information, Non-breeding Season 2012-13.

Date	Time	Hours	Wind	Cloud Cover	Precipitation and Temperature	Visibility	Sunrise/ Sunset Time (where applicable)
VP3							
12.10.12	08.00-11.00	3	4/W	8/8	Showers	>2k	
17.10.12	08:00-11:00	3	5/SE	8/8	Rain	>2k	
01.11.12	14.45-17.45	3	3/SW	4/8	Nil, 1c	>2k	16.36
13.11.12	10.15-13.15	3	6/SW	8/8	Drizzle, Showers, 10c	>2k	
05.12.12	13.00-16.00	3	2/WNW	0/8	Nil, -3c	>2k	15.48
12.12.12	10.00-13.00	3	2/SW	8/8	Snow/Sleet, -2c	>1.5k	
08.01.13	10.00-13.00	3	4/W	8/8	Drizzle	>2k	
16.01.13	14.00-17.00	3	3/SSW	8/8	Nil	>2k	16.21
07.02.13	14.45-17.45	3	2/NNW	8/8	Ni, 0cl	>2k	17.06
21.02.13	15.00-18.00	3	4/SSE	5/8	Nil, -1c	>2k	17.36
01.03.13	15.30-18.30	3	2/N	4/8	Nil, 6c	>2k	17.52
05.03.13	11.45-14.45	3	1/NE	1/8	None; 4c	>2k	
Total		36					

Table 2.4 Vantage Point 4 Survey Information, Non-breeding Season 2012-13.

Date	Time	Hours	Wind	Cloud Cover	Precipitation and Temperature	Visibility	Sunrise/ Sunset Time (where applicable)
VP4							
05.10.12	15.45-18.45	3	2/WSW	6/8	Showers	>2k	18.40
10.10.12	11.40-14.40	3	2/SW	4/8	Nil	>2k	
08.11.12	14.15-17.15	3	4/NW	8/8	Drizzle	>2k	16.22
14.11.12	10.00-13.00	3	3/SW	8/8	Drizzle, 10c	>2k	
13.12.12	13.45-16.45	3	3/S	5/8	Nil, -1c	>2k	15.45
18.12.12	09.30-12.30	3	0/-	7/8	Nil, 3c	>2k	
10.01.13	12.00-15.00	3	1/SE	1/8	Nil, 0c	>2k	
15.01.13	09.45-12.45	3	0/-	2/8	Nil, -1c	>2k	
06.02.13	10.30-13.30	3	4/NNW	0/8	Nil; 0c	>2k	
27.02.13	11.30-14.30	3	0/-	0/8	Nil, 8c	>2k	
05.10.12	15.45-18.45	3	2/WSW	6/8	Showers	>2k	18.40
10.10.12	11.40-14.40	3	2/SW	4/8	Nil	>2k	
Total		36					

Table 2.5 Vantage Point 5 Survey Information, Non-breeding Season 2012-13.

Date	Time	Hours	Wind	Cloud Cover	Precipitation and Temperature	Visibility	Sunrise/ Sunset Time (where applicable)
VP5							
05.10.12	11.30-14.30	3	2/WSW	6/8	Showers, 10c	>2k	
15.10.12	11.00-14.00	3	2/SW	2/8	Nil, 9c	>2k	
02.11.12	14.30-17.30	3	3/WNW	6/8	Heavy Showers	>2k	16.34
08.11.12	10.30-13.30	3	4/NW	7/8	Nil, 6c	>2k	
04.12.12	13.30-16.30	3	0/-	7/8	Occasional Drizzle, 1c	>2k	15.48
13.12.12	09.30-12.30	3	2/SSE	7/8	Nil, -1c	>2k	
10.01.13	08.00-11.00	3	0/-	2/8	Nil, -3c	>2k	08.38
17.01.13	14.00-17.00	3	4/S	6/8	Nil, 1c	>2k	16.22
06.02.13	14.45-17.45	3	4/N	2/8	Nil; 1c	>2k	17:04
18.02.13	11.30-14.30	3	1/SE	0/8	Nil, 5c	>2k	

Date	Time	Hours	Wind	Cloud Cover	Precipitation and Temperature	Visibility	Sunrise/ Sunset Time (where applicable)
04.03.13	11.0-14.00	3	1/NNE	0/8	Nil, 4c	>2k	
26.03.13	12.30-15.30	3	4/ENE	6/8	Nil, 0c	>2k	
Total		36					

2.2.2 Walkover Surveys, Non-breeding season 2012-13

In addition to the vantage-point surveys, 'walkover' surveys around the Site and surrounding area were carried out, with the aim of recording the winter bird community. These were conducted by walking set routes and recording all species of conservation concern detected along the route and in areas visible from it. The routes were designed to ensure that land within 1km of the initial 23 turbine layout was surveyed, subject to access restrictions, to best assess the community present. In actuality the areas of restricted access within the 1km buffer were largely intensive forestry and not suitable for the main target species: wildfowl and waders. The survey area comprised of the entire area within the Site boundary illustrated in **Figure 1.1**. The methodology followed that recommended in SNH 2010 for lowland/farmland species, which is similar to a generic territory mapping survey, walking pre-plotted routes slowly, stopping to scan with binoculars and a telescope (where necessary). For each bird detected, species, number, sex (where possible to determine), activity and any relevant behavioural notes were recorded.

Seven walkover surveys were conducted between 28 September 2012 and 28 March 2013. Dates and times of the winter walkovers are provided in **Table 2.6** below.

Table 2.6 Winter Walkover Survey Information, Non-breeding Season 2012-13.

Survey Number	Date	Survey Period	Wind	Cloud Cover	Precipitation and Temperature	Visibility
1	28.09.12	09.00-14.00				
2	11.10.12	0830-16.00	4/SW		Occasional Light Rain	>2k
3	12.11.12	0830-16.00	4/SSW	8/8	Drizzle, Showers, 10c	>2k
4	14.12.12	09.00-16.00	4/SE	8/8	Snow, turning to rain, 0c	>2k
5	18.01.13	09.00-15.30	5/SSE	8/8	Snow, -2c	>2k
6	27.02.13	09.00-16.00	2/NNE	0/8	5c	>2k
7	27.03.13	10.00-17.00	3/E	6/8	1c	>2k



3. Results

3.1 Desk Study

The MAGIC website indicates that the following Special Protection Areas (SPAs) and Ramsar sites present within 20km and ornithological SSSIs present within 10km of the development site:

Table 3.1 Statutory Ornithological Sites within the Search Area

Site Name	Designation	Approximate Distance/Direction from Site	Reasons for Designation/Notification
Muirkirk and North Lowther Uplands	SPA	11km/N	Breeding populations of short-eared owl, hen harrier, merlin, peregrine falcon and golden plover; and overwintering hen harrier.
Bogton Loch	SSSI	8.5km/SW	Nationally important breeding bird assemblage (grasshopper warbler, spotted flycatcher, willow tit, reed bunting and black-headed gull).
Muirkirk Uplands	SSSI	11km/N	Nationally important breeding bird assemblage (teal, hen harrier, buzzard, merlin, peregrine, short-eared owl, red grouse, golden plover, dunlin, snipe, curlew, redshank, whinchat, stonechat and ring ouzel). Internationally important breeding populations of short-eared owl and hen harrier. Nationally important wintering population of hen harrier.

Table 3.2 Non-Statutory Sites of Ornithological Interest within the Search Area

Site Name	Approximate Distance/Direction from Site	Reasons for Designation/Notification
Ancient woodland	0km/N	An area identified as Ancient Woodland is present centred approximately at grid ref NS 572103 which lies on the site boundary near Dalleagles. There are no species of ornithological interest known at this site.

Previous records contained within the AECOM Wintering Ornithology Report suggest that there are schedule 1 raptors nesting within 5km of the site boundary. Two species, barn owl (5 pairs) and peregrine falcon (2 pairs) are reported to have bred in this area. Further details are contained within the aforementioned report. These records are fully explored in **ES Chapter 12 - Confidential Appendix 12F**.

Consultation is ongoing with RSPB Scotland and the South Strathclyde Raptor Group for up to date records.

The AECOM Wintering Report shows low levels of site utilisation by target species with only three recorded in the non-breeding season 2011-12. Moderate numbers of golden plover flights were noted centred largely on the Enoch Hill-High Chang ridge. Three flights of goshawk were noted over the forests and two merlin flights over the open moor were also recorded. The latter were not at rotor sweep height.

3.2 Bird Surveys

3.2.1 Vantage Point Surveys

The following 6 target species were recorded during VP surveys: peregrine falcon, merlin, golden plover, whooper swan and black grouse. Details of target species flights are provided in **Table 3.3**, with flight lines illustrated in **Figures 3.1 – 3.5**. Birds recorded were considered to be at collision-risk at heights between 30-150m with regard the heights of the proposed turbines.

Table 3.3 Vantage Point Survey Results – Target Species Flights, Non-breeding Season 2012-13.

Flight No.	Date	Time	VP	Species	No. of birds	Height Band						Comments
						<10m	10-20m	20-30m	30-40m	40-150m	>150m	
Whooper Swan (see Figure 3.1)												
1	01.11.12	16.53	3	WS	23						90	Flew over at 200m+
Black Grouse (see Figure 3.2)												
1	10.10.12	17.43	1	BK	2		45	30				Both males. Landed.
2	12.10.12	13.07	2	BK	4	15	15	30				Females.
3	14.11.12	14.25	2	BK	2	45						Males.
4	01.03.13	14.25	2	BK	1	30						Male.
Peregrine Falcon (Figure 3.3)												
1	16.01.13	15.16	3	PE	1	30	15					-
Merlin (Figure 3.3)												
1	05.10.12	11.51	5	ML	1	75						-
Golden Plover (Figure 3.4)												
1	05.10.12	13.48	5	GP	16				45	75		-
2	05.10.12	18.30	4	GP	12				105			Variable flight height between 5-40m. Lost from view in valley.
3	17.10.12	13.56	2	GP	20	90						-
4	01.11.12	11.43	2	GP	80		15	15	15	45	120	Flew out of sight at approximately 150m height.
5	01.11.12	13.00	2	GP	120						165	At approximately 200m height.
6	06.02.13	15.54	5	GP	2	45						-
7	27.02.13	13.30	4	GP	1				60			-



3.3 Vantage Point Secondary Species Summaries

The following secondary species were recorded during VP watches, with peak counts in brackets: buzzard (2) and kestrel (1). In total there were six records of secondary species in the non-breeding season 2012-13. Three records were in October with single records in December, January and February. Buzzard was recorded in October, December and February with two records from VP4 and one record from VP3. Only one record of buzzard was recorded at collision risk height (30-150m). Raven were present throughout the season with 27 flights across the VP program involving a high count of five birds. The final secondary species record is of a kestrel seen north of VP2 in October at collision risk height.

3.3.1 Walkover Survey Results, Non-breeding Season 2012-13

Table 3.4 provides details of those target, secondary and other species of designated conservation concern recorded during walkover surveys. Whilst the emphasis of these surveys is to locate flocks of wildfowl and waders, they also provide an opportunity to collect information on usage by the wider wintering bird assemblage, hence the wide range of species documented at Enoch Hill.

Table 3.4 Walkover Survey Results, Non-breeding Season 2012-13.

Visit Number	Date	Species	Count	Activity	Comments
Target and Secondary Species:					
Black Grouse					
2	10.10.12	BK	2	Loafing	Females E of High Chang.
6	27.02.13	BK	1	Loafing	Male on Chang Hill.
Buzzard					
2	10.10.12	BZ	2	Fly	Two birds circling over Blarene Hill.
Merlin					
1	28.09.12	ML	1	Fly	Chasing GP east over High Chang.
Golden Plover					
1	28.09.12	GP	12	Fly	S from Peat Hill.
1	28.09.12	GP	1	Fly	W from Benty Cowan.
1	28.09.12	GP	1	Perched	Alarm calling on High Chang.
1	28.09.12	GP	60	Fly	Chased by ML E over High Chang.
1	28.09.12	GP	1	Perched	At High Chang.
1	28.09.12	GP	28	Fly	E at Enoch Hill.
1	28.09.12	GP	2	Fly	S at High Chang.
2	10.10.12	GP	80	Fly	W at Blarene Hill.

Visit Number	Date	Species	Count	Activity	Comments
3	12.11.12	GP	2	Perched	N of High Chang.
Snipe					
2	10.10.12	SN	1	Perched/Fly	Flushed E of Benty Cowan near Connel Burn.
2	10.10.12	SN	1	Perched/Fly	Flushed W of Benty Cowan.
2	10.10.12	SN	1	Perched/Fly	Flushed S of Benty Cowan near Connel Burn.
2	10.10.12	SN	1	Perched/Fly	Flushed S of Barbeys Hill.
2	10.10.12	SN	1	Perched/Fly	Flushed N of Peat Hill.
5	18.01.13	SN	1	Perched/Fly	Flushed in enclosure at Brockloch Farm.
5	18.01.13	SN	1	Perched/Fly	In enclosure W of Blarene Hill.
6	28.02.13	SN	1	Perched/Fly	In enclosure W of Blarene Hill.
Raven					
1	28.09.12	RN	4	Fly	ENE at Enoch Hill.
Other species recorded:					
1	None noted.				
2	Carrion crow, meadow pipit.				
3	Magpie, carrion crow, chaffinch, meadow pipit.				
4	Magpie, carrion crow, chaffinch, meadow pipit, lapwing, house sparrow, fieldfare, redwing.				
5	Meadow pipit, wren, carrion crow.				
6	Crow, skylark, magpie.				
7	Chaffinch, crow, skylark.				

3.3.2 Incidental Records, Non-breeding season 2012-13

A total of 5 incidental records of target or secondary species were noted in the non-breeding season 2012-13. These consisted of three records of snipe and two records of golden plover. All records aside from a single snipe were of birds seen in October 2012 and this is likely due to the harsh weather, including extensive snow cover throughout the non-breeding period. The extraneous record refers to a single snipe flushed in January 2013. All three records of snipe refer to single birds that were flushed and the golden plover records were of a single bird flushed and a carcass found, perhaps as a result of a predation event.

3.3.3 Key Species Summaries

Whooper Swan

Whooper swans were recorded on one occasion during the season, with a flight recorded from VP 3 on 1/11/2012 flying at over 200m. Whooper swan is an Annex 1 species and is listed on the BoCC amber list due to its breeding

rarity and localised winter populations. The current British population is estimated at 11,000 birds (Musgrove *et al.* 2013) with 4,142 birds in Scotland (Forrester *et al.* 2007). Whooper swan is considered a common passage bird in Ayrshire with smaller numbers wintering (Simpson, 2012) with a peak count of 156 in October 2010 at Tarbolton.

Black Grouse

Black grouse were recorded on four occasions from VPs with three records up to the 14/11/2012 and a single record later in the season on 1/3/2013. These records related to both males and females with a maximum count of four birds. Records come from VP1 and VP2. There were an additional two records from walkover surveys with two birds on 10/10/2012 and a single bird on 27/2/2013.

Black grouse is listed on the BoCC red list as due to a population decline of over 50% in the last 25 years (Eaton *et al.* 2009). The British population was estimated at 5,100 males (Musgrove *et al.* 2013). 3,344 males were recorded in Scotland (Forrester *et al.* 2007) with 800 males in South-West Scotland. Black grouse are considered common in Ayrshire (Simpson, 2012).

Merlin

A single merlin was recorded on a walkover survey on 28/9/2012 on Chang Hill. Merlin is a Schedule 1 species and is a BoCC amber list species based on its status as a species with unfavourable conservation status in Europe. The current UK population is estimated to be 1,160 pairs (2008 survey; from Holling *et al.* 2012). Merlin need open areas with a plentiful supply of birds to hunt and secure sites for breeding (Ratcliffe, 1993), with most nests in heather with lesser numbers nesting in trees. Merlin is considered common in winter and less regular on passage in Ayrshire (Simpson, 2012). Etheridge *et al.* (2013) states that there were 11 breeding pairs in South Strathclyde in 2011.

Peregrine

Peregrine was recorded on one occasion with a bird seen from VP3 on 5/10/12. Peregrine is an Annex I and Schedule I listed species, and a BoCC amber list species based on its unfavourable conservation status in Europe (Eaton *et al.*, 2009). It is also listed on the Scottish Biodiversity list. In the UK, the population is estimated to be 1,530 pairs (Holling *et al.* 2012), with 33 pairs in South Strathclyde (Etheridge *et al.* 2013). Peregrines need open areas with a plentiful supply of birds to hunt, and secure sites for breeding (Ratcliffe, 1993); most eyries and roosts are generally located on cliffs, crags or tall man-made structures.

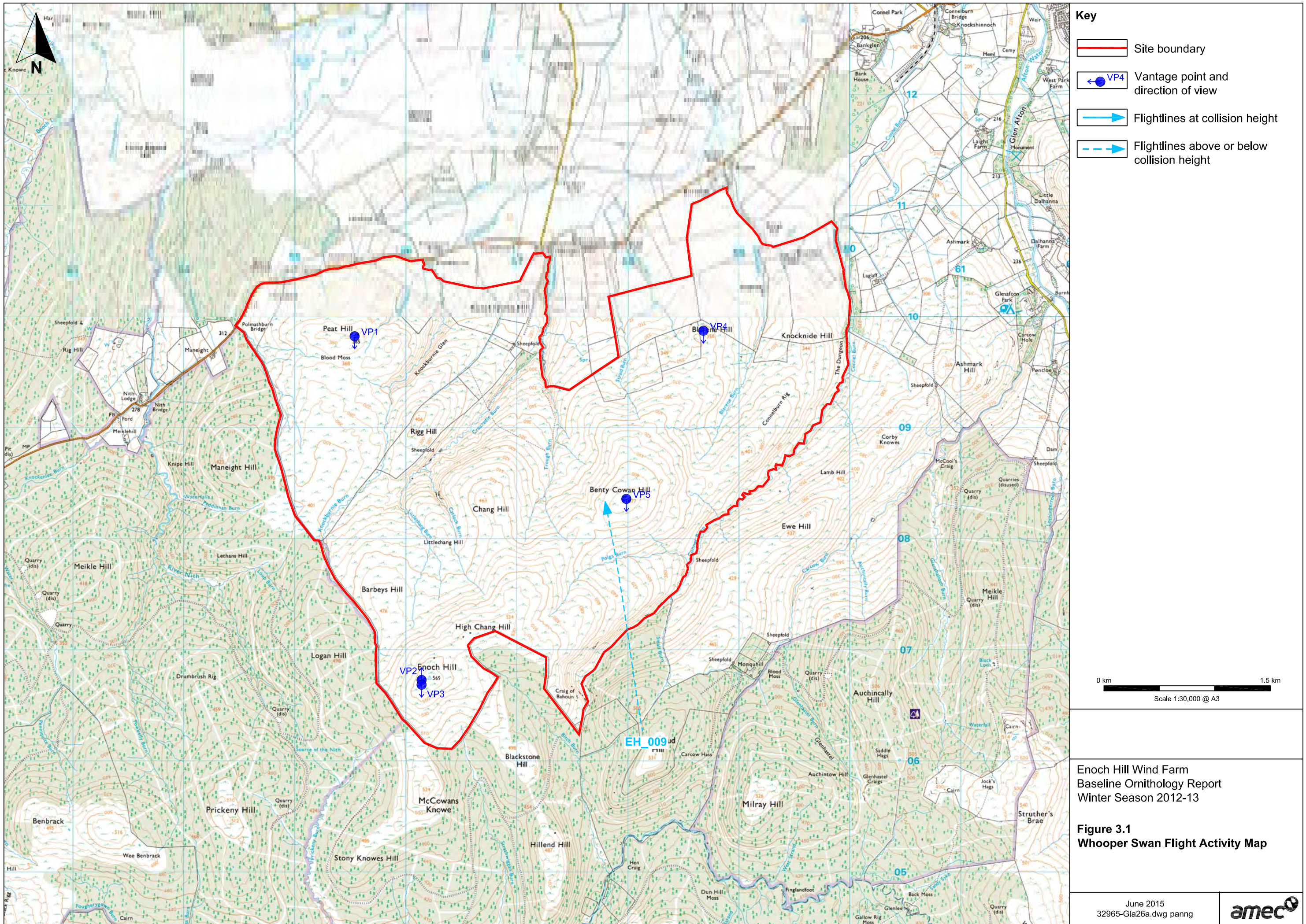
Golden Plover

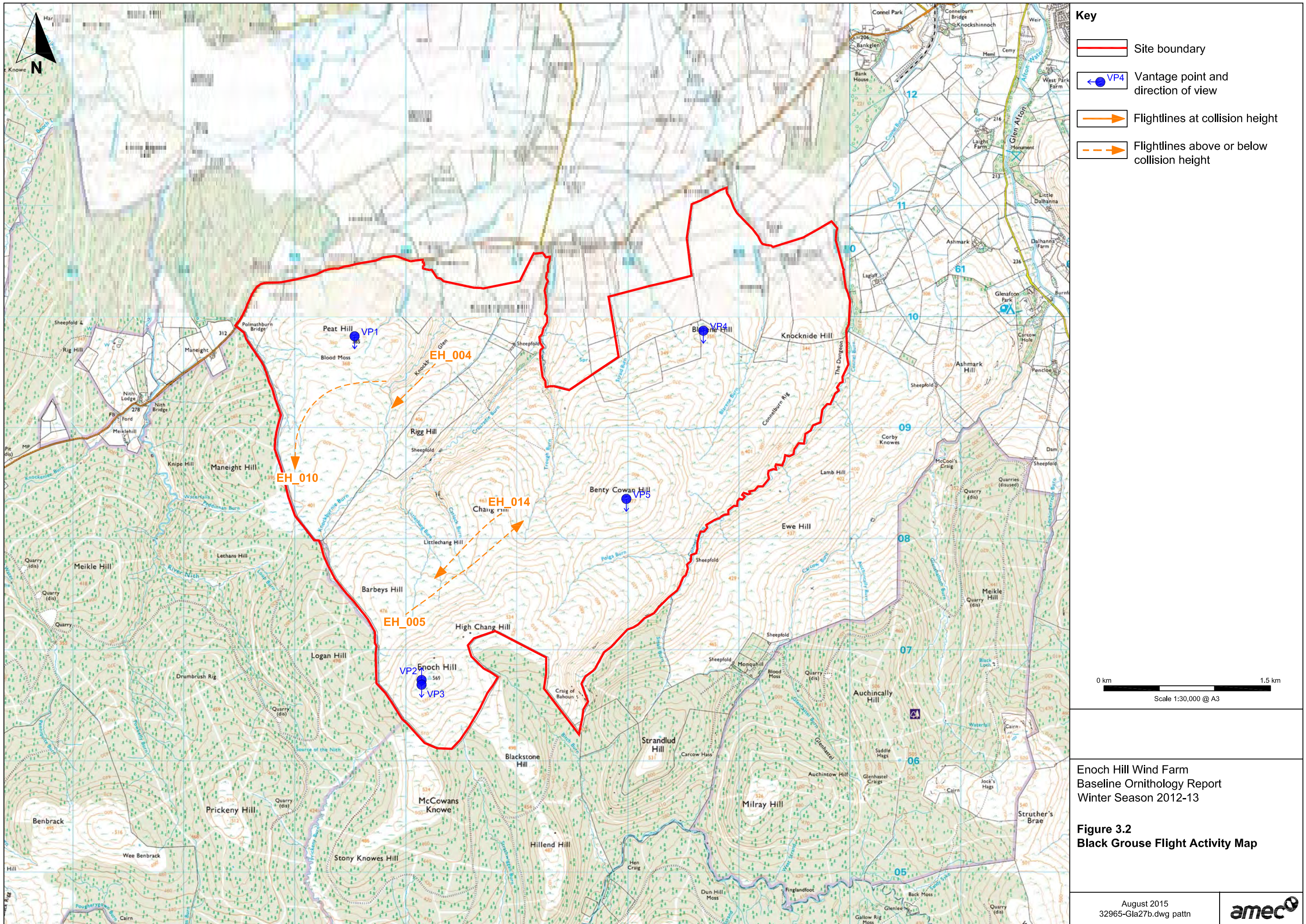
Golden plover were recorded regularly during passage periods with seven flights from VPs and nine walkover records. The latest records during autumn passage were on 1/11/2012 and the first record of the spring passage was on 6/2/2013. The highest count on site was 120 birds recorded from VP2 on 1/11/2012.

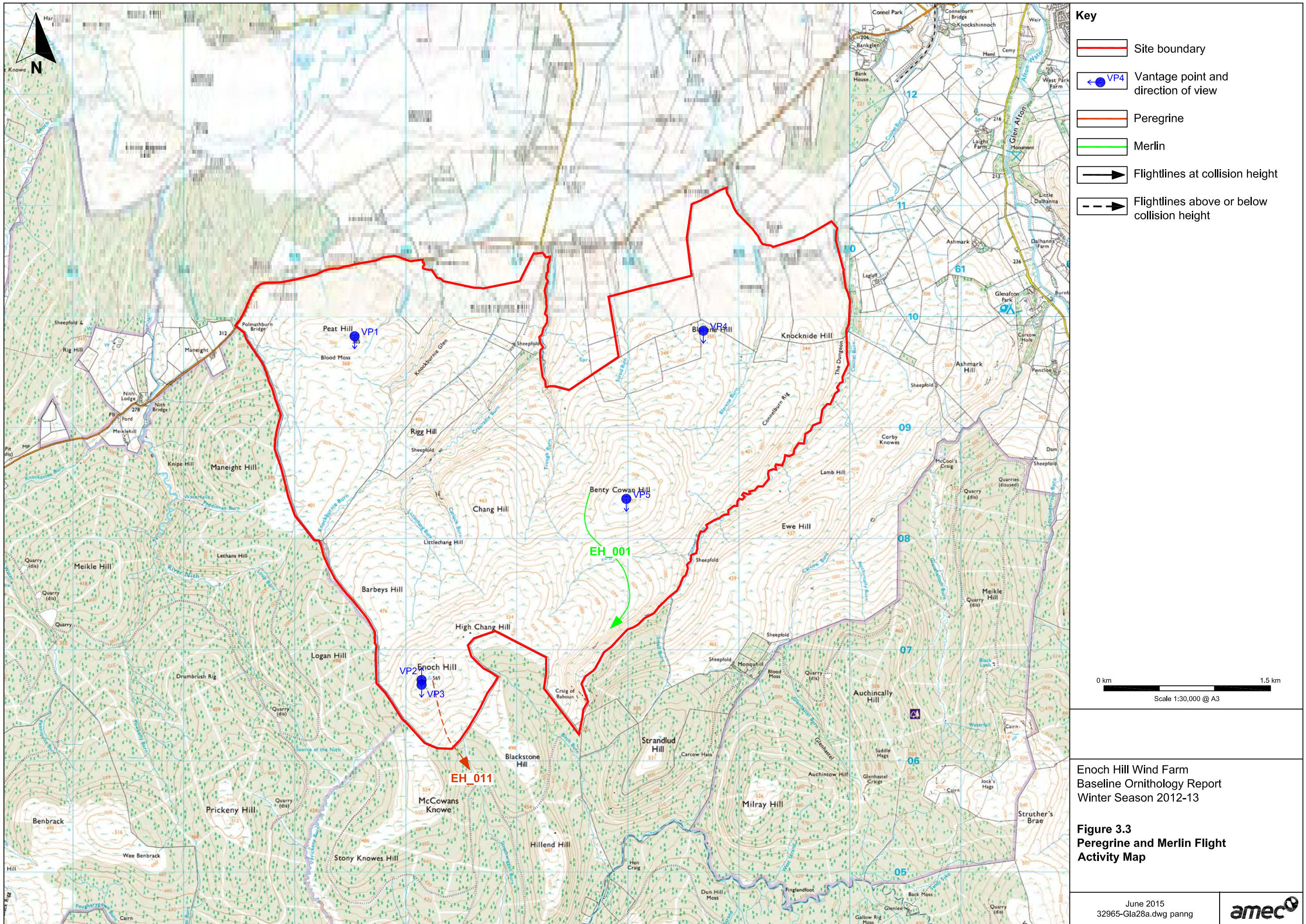
Golden plover is specially protected as an Annex 1 listed species and is also listed on the BoCC amber list as at least 20% of the European non-breeding population is found in within the UK (Eaton *et al.* 2009). The

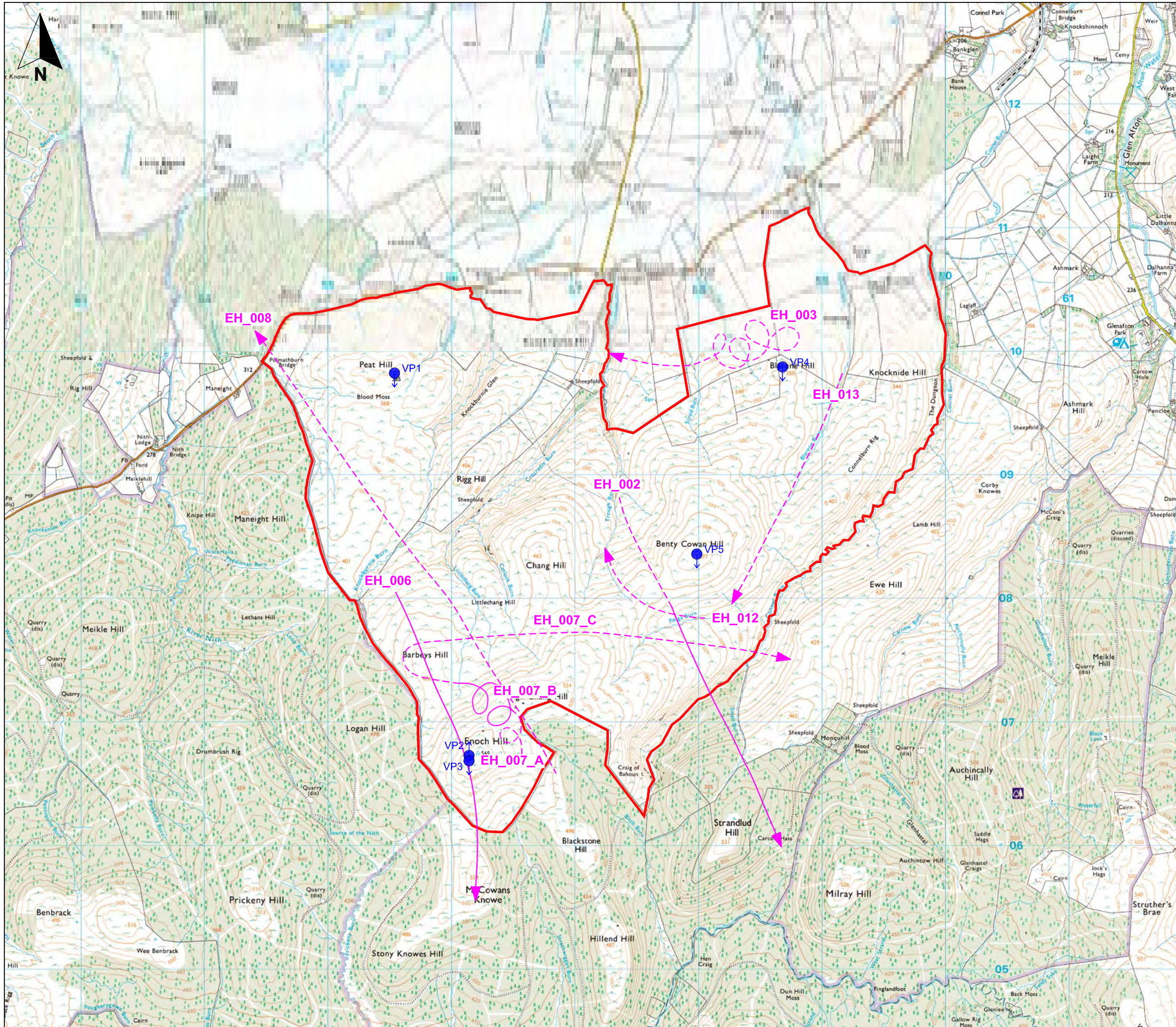


overwintering British population was estimated at 400,000 individuals in 2006-07 (Musgrove et al. 2013). Golden plover is considered a common passage and winter visitor to Ayrshire (Simpson, 2012).









- Key**
- Site boundary
 - ← VP4 Vantage point and direction of view
 - Flightlines at collision height
 - - - → Flightlines above or below collision height

0 km 1.5 km
Scale 1:30,000 @ A3

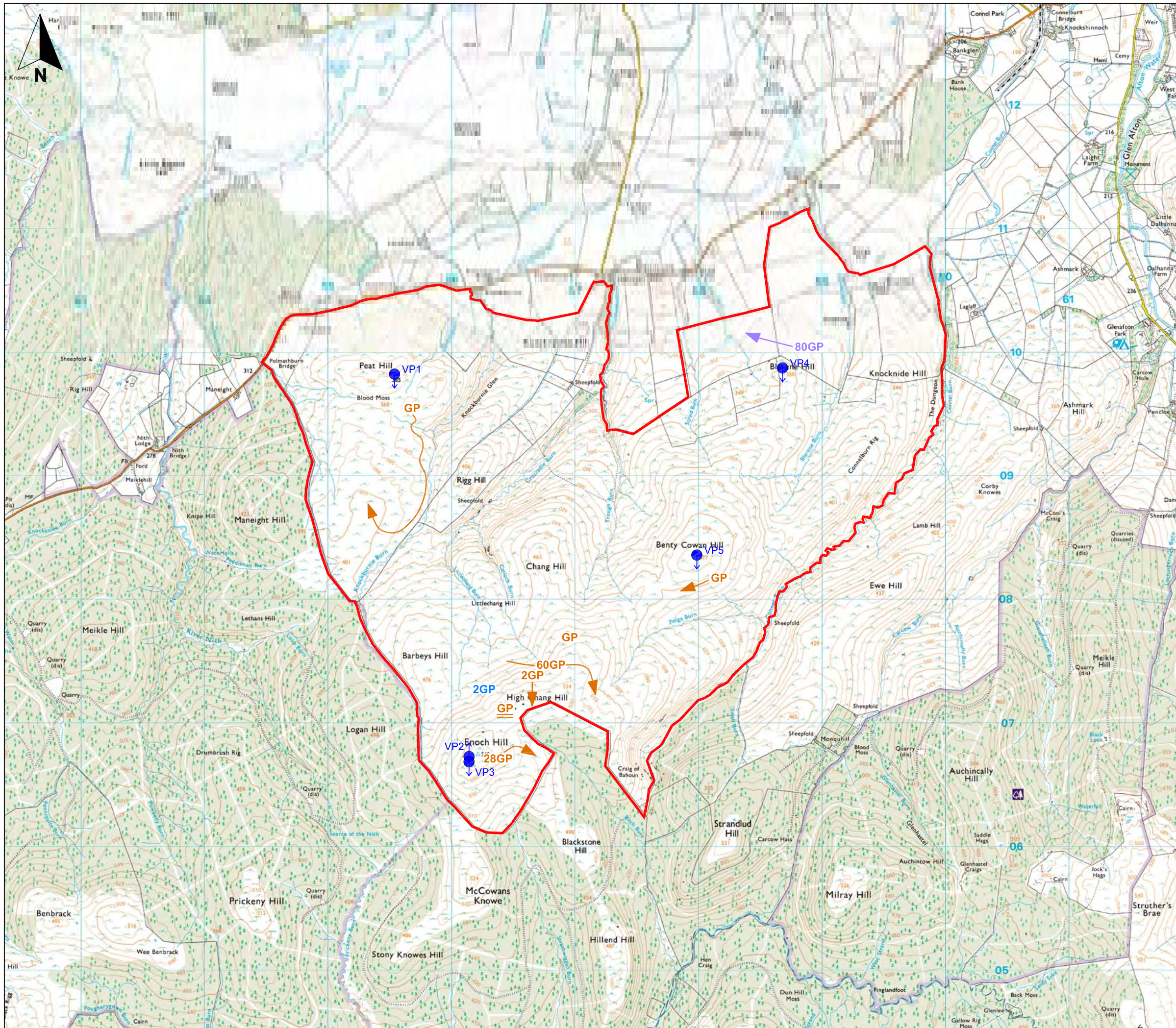
Enoch Hill Wind Farm
Baseline Ornithology Report
Winter Season 2012-13

Figure 3.4
Golden Plover Flight Activity Map

June 2015
32965-Gla29a.dwg panng



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Key

- Site boundary
- ← ● VP4 Vantage point and direction of view
- GP September 2012
- GP October 2012
- GP November 2012

0 km 1.5 km
 Scale 1:30,000 @ A3

Enoch Hill Wind Farm
 Baseline Ornithology Report
 Winter Season 2012-13

Figure 3.5
Golden Plover Winter Transect Activity Map

March 2015
 32965-Gla31a.dwg panng



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Appendix 12.D

Baseline Ornithology Report – Breeding Season 2013

E.ON Climate & Renewables UK Developments Ltd

Enoch Hill Wind Farm

Appendix 12D: Baseline Ornithology Report - Breeding Season 2013



AMEC Environment & Infrastructure UK Limited

March 2015

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Enoch Hill Wind Farm

Appendix 12D: Baseline Ornithology Report - Breeding Season 2013

AMEC Environment & Infrastructure
UK Limited

March 2015

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Executive Summary

Purpose of this Report

- During the breeding season of 2013, a series of surveys were undertaken to determine the baseline bird activity on the site of a proposed wind farm at Enoch Hill, located approximately 3km South-West of New Cumnock, Ayrshire. These were the second breeding bird surveys undertaken at the site, following those completed by AECOM in 2012;
- The scope of surveys followed that recommended in SNH 2010 guidance, consisting of vantage point (VP) observation (42 hours from each VP), Black Grouse lek surveys (two visits), breeding raptor survey (four visits) and breeding wader survey (four visits);
- A search of statutory ornithological sites from within 20km of the site indicates that there is a single Special Protection Area or Ramsar site present, the Muirkirk and North Lowther Uplands, located approximately 7km north and designated for upland breeding raptors and golden plover and wintering Hen Harrier;
- Vantage point surveys recorded a total of twelve flights of five target species: Greylag Goose, Barnacle Goose, Golden Plover, Merlin and Peregrine. Three flights were at collision risk height comprising two Barnacle Goose flights and a single Golden Plover flight;
- No Annex 1 or Schedule 1 raptors were recorded breeding on Site. A single pair of Merlins bred off-Site within the 2km buffer around the core survey area (i.e. the indicative area in which turbines may be sited). The habitats on Site are of poor quality for ground nesting raptors and owls due to the dominance of rough pasture and white moor;
- A single displaying Black Grouse was recorded during lek surveys, located outside of the core survey area. Field signs indicating evidence of a lek site were also identified in one location within the core survey area. In addition, two non-displaying males were recorded during the lek surveys, outwith the core area. The species was recorded on five occasions outside of lek surveys, with a peak of two individuals recorded and records from across the Site including Enoch Hill, Peat Hill, Benty Cowan Hill and Knockburnie Burn;
- Three Curlew territories were recorded on or adjacent to the Site.



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Appendix B	Survey Programme
Appendix C	Survey Results

1. Introduction

1.1 About this Document

AMEC Environment & Infrastructure UK Ltd (AMEC) was commissioned by E.ON Climate & Renewables UK Developments Ltd to undertake bird surveys during the breeding season of 2013 (April to August inclusive) at the site of a proposed wind farm development at Enoch Hill in Ayrshire. This report describes the methods and results of the surveys, which were designed to be suitable to inform the preparation of an Environmental Statement for the development. The Site has previously been surveyed for birds in winter season 2011-12 and breeding season 2012 by AECOM and by AMEC in winter season 2012-13.

1.2 Site Description

The Site is located at Enoch Hill within the county of East Ayrshire. The Site setting is illustrated in **Figure 1.1**. The site boundary, core survey area and species-specific buffer zones are illustrated in **Figure 1.2**. Access was available to land within the site boundary only.

The Site is dominated by open moorland with primarily bog and rough grassland habitats. The North-Eastern part of the Site supports enclosed pastures which are heavily grazed by livestock. The Site is bordered by coniferous plantation to the south, east and west. A number of small streams flow northwards through the Site, originating on the higher ground along the southern boundary. Within the Site boundary, in the North-East, there is a single small farmstead, Brockloch Farm.

1.3 Background and Scope

The key issues relating to birds and wind farms are as follows:

- The effects of direct habitat loss due to land take by wind turbine bases, tracks and ancillary structures;
- The effects of disturbance and displacement of birds from the proximity of the wind turbines. Such disturbance may occur as a consequence of construction work, or due to the presence of the wind farm close to nest or feeding sites or on habitual flight routes; and
- The effects of collision with rotating turbine blades (i.e. killing or injury of birds), which is of particular relevance for sites located in areas with high raptor activity or which support large concentrations of waterfowl.

With regards to the first issue, total land take by wind farm infrastructure generally represents a very small proportion of a site. Therefore the permanent loss of nesting and foraging habitat for birds tends to be very small and will generally have little effect on bird populations. At most wind farm sites it is the latter two issues, collision risk and displacement, which may potentially be more significant.

Ornithological work carried out at Enoch Hill was based primarily on Scottish Natural Heritage (SNH) guidance. A range of guidance documents have been produced relating to the assessment of bird/wind farm interactions and the following publications and guidelines in particular have been influential in determining the scope of the works at Enoch Hill:

- Scottish Natural Heritage, 2005, revised 2010. *Survey methods for use in assessment of the impacts of proposed onshore windfarms on bird communities*. SNH Advisory Services and National Strategy. This guidance was amended in August 2013 following the completion of the 2013 breeding bird surveys at Enoch Hill, however the survey programme does adhere to these amended guidelines;
- Scottish Natural Heritage, 2006. *Assessing significance of impacts from onshore windfarms on birds outwith designated areas*. SNH, Battleby.

SNH guidance recommends that field surveys should be focussed on those species of high nature conservation value for which there is potential for an impact which might be judged significant and adverse. In most circumstances these “target species” tend to be limited to those protected species and other species of conservation concern which may be subject to impact from wind farms.

SNH 2013 guidance states that there are three overarching species lists which describe protected species and species of conservation concern from which target species may be drawn:

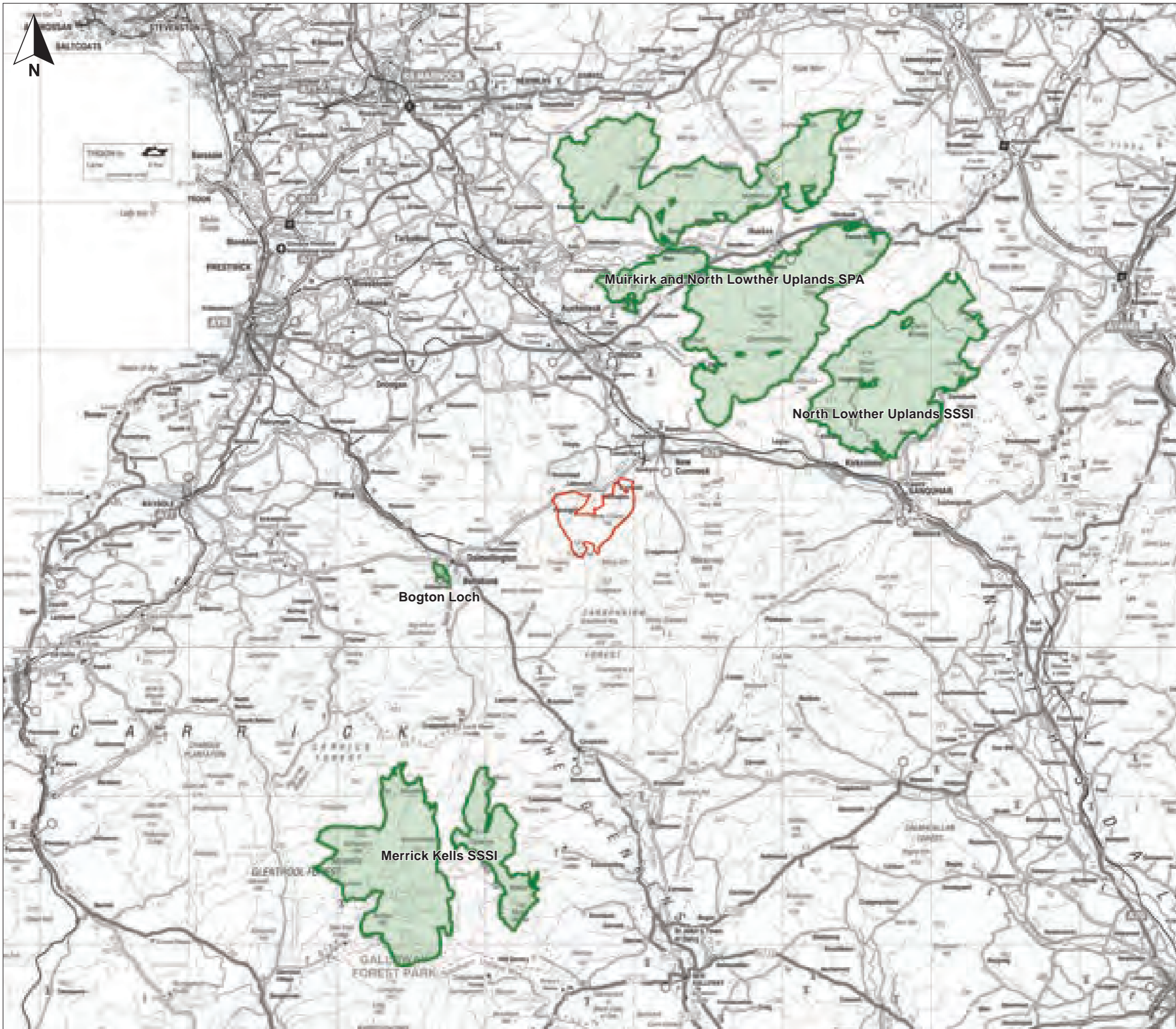
- Special Protection Areas (SPA) designated species and those listed under Annex 1 within the *Directive 2009/147/EC on the conservation of wild birds*, commonly referred to as the Birds Directive;
- Species listed under Schedule 1 of the *Wildlife & Countryside Act 1981* (as amended); and
- Species listed under the red list of Birds of Conservation Concern (BoCC).

In addition, consideration should also be given to species identified within Local Biodiversity Action Plans. Target species should be limited to those likely to be affected by wind farms. Research indicates that passerine species are not significantly affected by wind farms. Many species included on the BoCC red list are passerines and therefore care should be exercised when considering red list species for inclusion as targets.

It may be appropriate to collect information regarding non-target species, particularly those of regional conservation concern, termed ‘secondary species’. Recording of such species is subsidiary to the recording of target species.

Target and secondary species at Enoch Hill were selected following a data and literature review as detailed in **Section 2**.

For the purposes of this report, nomenclature follows that of the British Ornithologist Union (BOU 2013). Scientific names for all species mentioned in the text and tables are included in **Appendix A**.



Key

- Site Boundary
- Designated Ornithological Sites

0 5km 10km 15km
Scale 1:250,000 @ A3



Enoch Hill Wind Farm
Baseline Ornithology Report – Breeding
Season 2013

Figure 1.1
Location of the Site and Designated
Ornithological Sites

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Key

- Accessible area boundary
- Core survey area
- 600m boundary from core area
- 1.5km boundary from core area
- 2km boundary from core area

Note: Viewsheds based on lower blade swept height of 34m

0 500m 1km 1½km

Scale 1:30,000 @ A3



Enoch Hill Wind Farm
Baseline Ornithology Report – Breeding Season 2013

Figure 1.2
Survey areas

2. Desk Study

2.1 Literature Review and Consultation

2.1.1 Scope

The presence of Special Protection Areas (SPAs), Ramsar sites and ornithological Sites of Special Scientific Interest (SSSIs) within 20km was determined by accessing the Multi-Agency Geographical Information for the Countryside (MAGIC) website. Details of cited features of designated sites were obtained from the SNH SiteLink website.

A desk study has been undertaken previously, and is fully documented in the 2012-13 winter bird report (AMEC Document 32965GGOS018). This is summarised in **Section 2.1.2** below.

Bird surveys at the Site were undertaken during 2012/2013 winter season by AMEC. Additionally wintering bird surveys were carried out in 2011/12 and breeding bird surveys in 2012 by AECOM. The results from these surveys were reviewed when determining the scope of the 2013 breeding bird survey programme.

Records of breeding Schedule 1 raptors nesting on the Site or in areas within 5km of the Site boundary were provided by the South Strathclyde Raptor Study Group to AECOM for the 2012 breeding season (and are detailed in the 2012 breeding season report).

2.1.2 Results

The Muirkirk and North Lowther Uplands is the only SPA or Ramsar site located within 20km of the Site. The SPA is notified for breeding Short-eared Owl, Hen Harrier, Merlin, Peregrine and Golden Plover, and wintering Hen Harrier.

Three SSSIs which list ornithological interest as a reason for notification lie within 20km of the Site: Merrick Kells, Bogton Loch and North Lowther Uplands (most of this site is designated as an SPA as part of the Muirkirk and North Lowther Uplands).

Table 2.1 provides details of statutory ornithological sites within the search area and **Figure 1.1** illustrates the locations of designated ornithological sites within the search area.

Table 2.1 Statutory Ornithological Sites within the Search Area

Site Name	Approximate distance and direction from site	Reasons for designation/notification (JNCC Website)	Potential connectivity with the Site
Muirkirk and North Lowther Uplands SPA	7km/NE	Short-eared Owl (26 breeding pairs) Hen Harrier (29 breeding pairs and 12 overwintering individuals) Merlin (six breeding pairs) Peregrine (nine breeding pairs) Golden Plover (154 breeding pairs)	Short-eared Owl (most foraging flights are recorded within 2km of nest sites, suggesting that the core range is 2kms, but foraging up to 4-5kms away from the nest site has been recorded). Hen Harrier (regularly forages between 2-4kms but up to 10km during the breeding season and forages within 6-16kms of communal winter roosts). Merlin (regularly forages between 4-5kms from the nest during the breeding season, with a maximum recorded distance of 8kms). Peregrine (70% of foraging flights are recorded within 2km of nest sites, suggesting that the core range is 2kms). Golden Plover (forages a maximum of 10.7km away from breeding sites).
Merrick Kells SSSI	16km/SW	Breeding bird assemblage of national importance.	Species not cited.
Bogton Loch SSSI	8.5km/W	Breeding bird assemblage.	Species not cited.
North Lowther Uplands SSSI	7km/NE	Nationally important breeding bird assemblage. Includes all species cited within the Muirkirk and North Lowther Uplands SPA; and also Dunlin.	See above for species also cited within the SPA. Dunlin (regularly forages up to 2km from a nest site with 3km foraging flights the furthest distance recorded).

Connectivity distances reported from Pendlebury *et al.* 2011.

2.2 Target Species

The following key species of conservation concern (target species) are considered appropriate based on the desk based study and results of previous ornithological survey work undertaken in 2011-2013:

- Protected raptors and owls: (including but not limited to those species either recorded previously on Site or known to be present in the surrounding area: Hen Harrier, Goshawk, Osprey, Merlin, Peregrine, Short-eared Owl and Barn Owl);
- Waterfowl and waders: (including Annex 1 breeding waders potentially occurring on spring and autumn passage: Golden Plover; wildfowl on passage: all geese, swans and ducks excluding non-native and common species); and
- Other species: Black Grouse and Dunlin.

The following secondary species were identified:

- Sparrowhawk, Buzzard, Kestrel;
- Oystercatcher, Lapwing, Curlew, Snipe, Woodcock; and
- Raven.



3. Methodology

3.1 Breeding Bird Surveys

3.1.1 Surveyors

All surveys were undertaken by experienced AMEC ornithologists, all of whom have extensive field experience and detailed understanding of the key methodologies recommended within SNH guidance and employed to monitor bird activity and distribution at proposed wind farm sites.

3.1.2 Vantage Point Surveys

Vantage-point (VP) watches were conducted in accordance with SNH 2010 guidance. This method focuses on identifying flight-paths of target species and allows any regularly used flight lines to be identified, allowing turbine locations to be altered where necessary to reduce collision risk to birds. The data generated can also be used to estimate the theoretical risk of collision with turbines by incorporation into a suitable model.

The SNH methodology guidance is that vantage-points should be chosen parsimoniously to achieve maximum visibility from the minimum number of locations such that all parts of the survey area are within two kilometres of a VP. Five vantage points were identified as being sufficient to survey the indicative turbine layout plus 500m buffer, the locations of which were:

- VP1 – NS 55543 09814 – view bearing 180°;
- VP2 – NS 56216 06749 – view bearing 0°;
- VP3 – NS 56216 06749 – view bearing 180°;
- VP4 – NS 5869409813 – view bearing 180°; and
- VP5 – NS 57985 08339 – view bearing 180°.

Flights were classified using the following three height bands:

- Band 1: 0 - 30m;
- Band 2: 30 – 150m; and
- Band 3: >150m.

A total of 210 hours of vantage point observation was undertaken between April 2013 and August 2013: 42 hours from each VP. A proportion of the surveys, across all VPs, were targeted at dawn and dusk in order to target periods

when bird activity tends to be elevated and to sample crepuscular species including Short-eared Owl and Golden Plover. Dates and times of the VP watches are provided in **Appendix Table B1**.

3.1.3 Moorland Breeding Bird Survey

Breeding Wader Survey

The breeding wader assemblage at the site was surveyed using the Brown & Shepherd (1993) methodology as detailed in Gilbert *et al.* (1998). The core survey area and surrounding land out to 600m was surveyed where access was available, as shown in **Figure 1.2**. Access was unavailable to the forestry to the east, west and south.

The method involved a constant search effort of 20-25 minutes within each 500 x 500m quadrat of open land and 0.8-1 minute per hectare for enclosed fields. All suitable habitat within each quadrat was approached to within 100m. Survey routes were varied between visits. Stops were made at regular intervals to scan and listen for birds and the identities and activities of birds were recorded using standard BTO notation. Four survey visits were made between April and July and surveys were undertaken between 08:30 and 18:00. Dates, times and weather conditions are provided in **Appendix Table B2**.

The total area of accessible land within 600m of the core survey area is approximately 10km², requiring between ~13 hours and 17 hours of observation per visit (not excluding unsuitable habitat). **Appendix Table B2** confirms that this was achieved on each visit, with the remaining time used to undertake temporary observation point surveys for breeding raptors as detailed below.

Breeding Raptor Survey

Habitats within the survey area (i.e. accessible land within 2km of the core survey area) are of poor quality for supporting nesting Annex 1 or Schedule 1 listed raptor species due to dominance of grass and bog habitats, and there are no previous records of such species (other than Barn Owl). Nevertheless, for completeness, the better areas of habitat with some potential for supporting ground nesting raptors were targeted with surveys from temporary observation points in line with the recommendations provided in Hardey *et al* (2006), particularly for Merlin. Contextual information from the other survey periods (i.e. VPs, waders and Black Grouse) was used, along with desk study data and habitat appraisal, to identify areas on which to focus raptor survey effort. A four visit breeding raptor survey was completed between April and July, undertaken on the same dates as the breeding wader survey (although never concurrently). In order to avoid observer disturbance influencing results, targeted areas for raptor survey were undertaken before wader survey times or were away from areas that had been subject to wader survey. Surveys were completed before 12:00h or after 16:00h. Surveys aimed to locate target species and then to observe their behaviour in order to determine where they may be nesting, particularly looking for display, territorial defence against other raptors or corvids and food passes.

3.1.4 Black Grouse Surveys

Targeted surveys for Black Grouse following the survey method detailed in Gilbert *et al.* (1998) were undertaken. The aim of these was to detect all lekking males on Site and within 1.5km of the core survey area (where access was available). The surveys were conducted on calm mornings by walking set routes to pass within 500m of all points in order to detect lek sites. When birds were discovered the number present, sex and their behaviour (foraging, lekking, resting etc.) was noted. The surveys were cold searches of the whole site. As per SNH guidelines and the method in Gilbert *et al.* (1998), two visits were undertaken between the last week in March and mid-May. Dates and times of the Black Grouse surveys are provided in **Appendix Table B3**.

3.1.5 'Incidental' Records

Birds seen outside formalised timed surveys were also recorded (i.e. those observed during walks on and off Site, on walks between vantage-points and during other breaks in survey work). Detailed notes of activity of target species were made and flights mapped.

3.1.6 Limitations

Adverse weather conditions during early spring 2013, as documented by Slingo (2013), led to the adaptation of the survey scheme, delaying the start of the distribution and abundance surveys. It is outlined in Gilbert *et al.* (1998) that Black Grouse surveys should be undertaken between the last week in March and mid-May, but with snow on the ground in March, the first survey visit was delayed until early April, with the second visit undertaken in late April and early May. Hardey *et al.* (2006) recommend that the first survey visit to detect the majority of Schedule 1 raptors be undertaken in March, but similarly to the delayed start of the Black Grouse surveys, raptor surveys began in mid-April as a response to the adverse weather.



4. Results

4.1 Breeding Bird Surveys

4.1.1 Vantage Point Surveys

Target Species

The following five target species were recorded during VP surveys: Greylag Goose, Barnacle Goose, Golden Plover, Peregrine and Merlin. Details of target species flights are provided in **Appendix Table C1**. The flight lines are illustrated in **Figure 4.1** and **Figure 4.2** (confidential appendix figure – Merlin flights).

Table 4.1 presents a summary of target species' flight activity.

Table 4.1 Summary of Target Species Flight Activity

Species	Number of individual flights recorded at collision-risk height per month				
	Apr	May	Jun	Jul	Aug
Greylag Goose	0	0	0	0	0
Barnacle Goose	130	0	0	0	0
Golden Plover	48	0	0	0	0
Peregrine	0	0	0	0	0
Merlin	0	0	0	0	0

Secondary Species

Eleven secondary species were noted on vantage point watches: - Raven, Great Black-backed Gull, Buzzard, Curlew, Kestrel, Herring Gull, Lesser Black-backed Gull, Snipe, Grey Heron, Common Gull and Redshank. Buzzard (15 records) and Raven (53 records) were noted flying over the site, associated most often with the airspace above Connelburn Rig and Benty Cowan. Ravens were also seen foraging to the west of the Site on Barbey's Hill. Kestrel was noted foraging along the western forestry edge from mid-May onward with a total of 14 records. There were 14 records of Curlew all from the northern pastures and moorland to the south of these. There were 34 records of gulls transiting over the site or foraging in the pastures to the north. Most frequent was Great-black-backed Gull (17 records), followed by Herring Gull (10), Lesser Black-backed Gull (5) and Common Gull (2).

4.1.2 Distribution and Abundance Survey Results

Breeding Wader Surveys

Table 4.2 (below) details the number of breeding wader territories recorded. **Figure 4.3** maps the results from the breeding wader surveys.

Table 4.2 Distribution and Abundance of Breeding Wader Territories

Species	Number of territories within core survey area	Number of territories within 600m buffer zone
Curlew	1	2

In addition to Curlew, Golden Plover was recorded with three records from Visit 1 comprising a flock of 23 individuals and two records of two individuals. These birds were passing through the Site on route to breeding grounds elsewhere and were not recorded on subsequent visits. A single Snipe was recorded but no breeding activity was noted and three oystercatchers were also recorded on the July visit.

Breeding Raptor Surveys

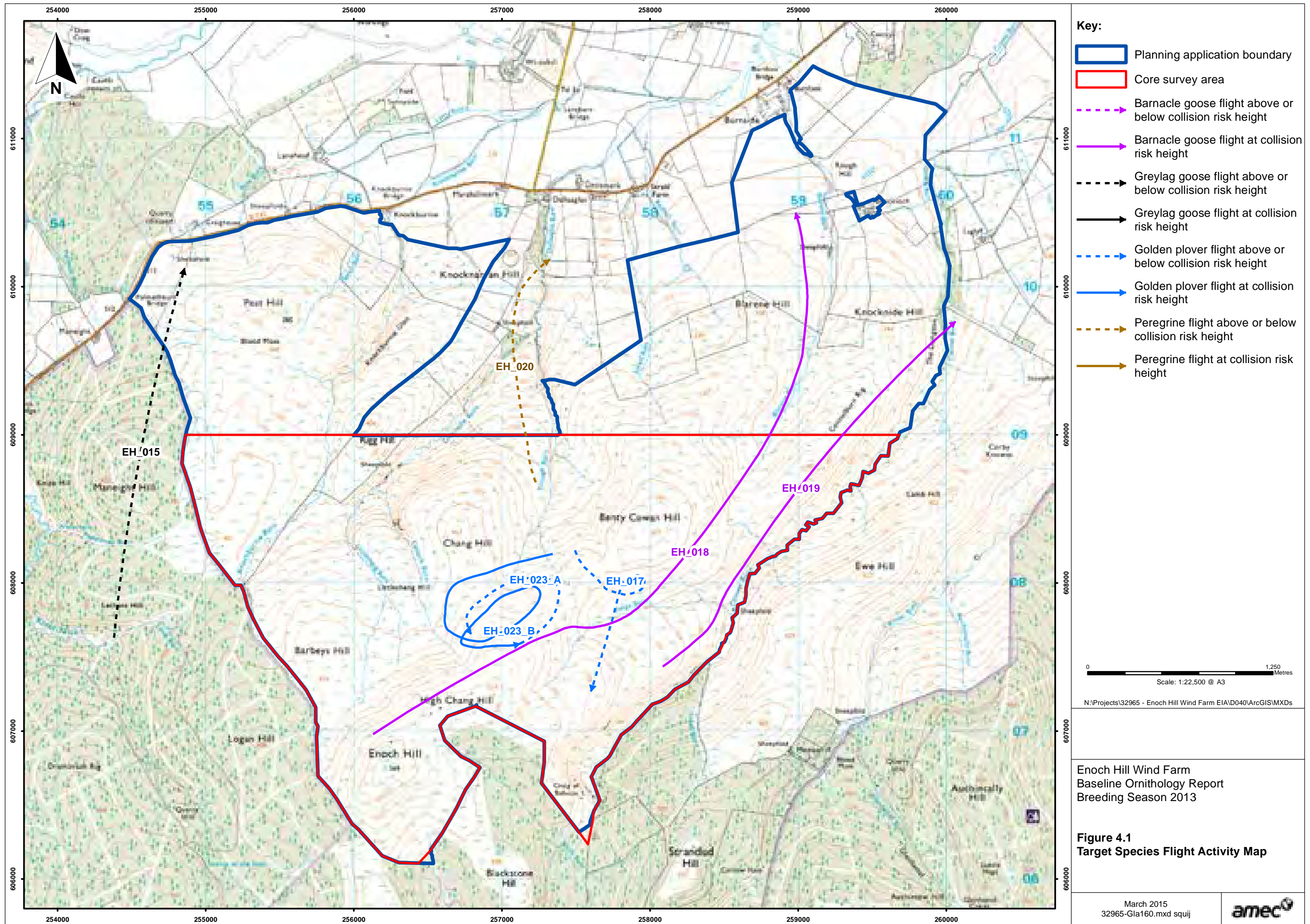
A single record of a target raptor species was obtained during the raptor surveys, a brief sighting of a Goshawk flight along a forest ride adjacent to the western Site boundary. There was no evidence of breeding Annex 1 or Schedule 1 listed raptors from within the survey area, other than the single Merlin nest site identified during Black Grouse and VP surveys (details provided in the Confidential Appendix).

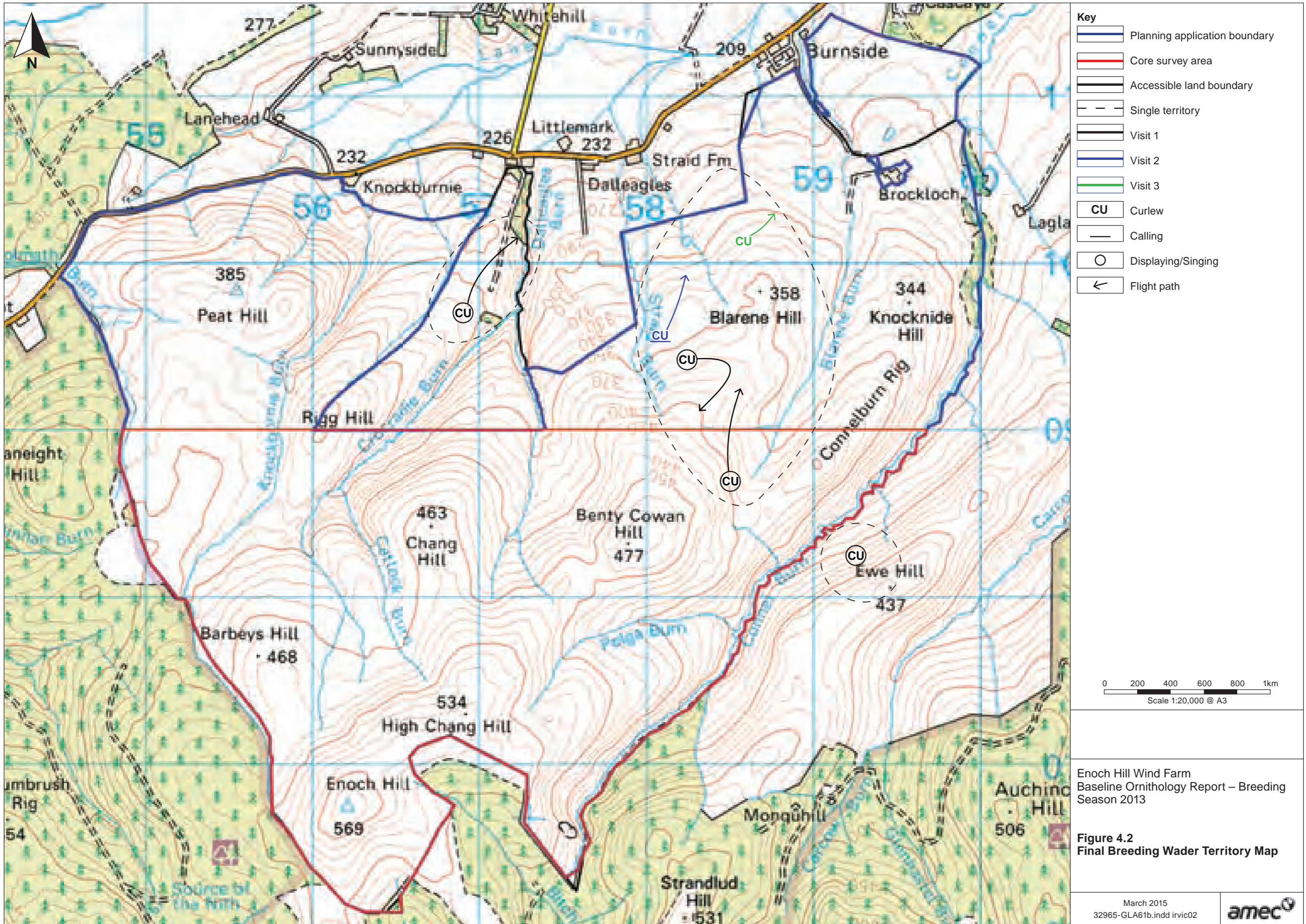
Black Grouse Surveys

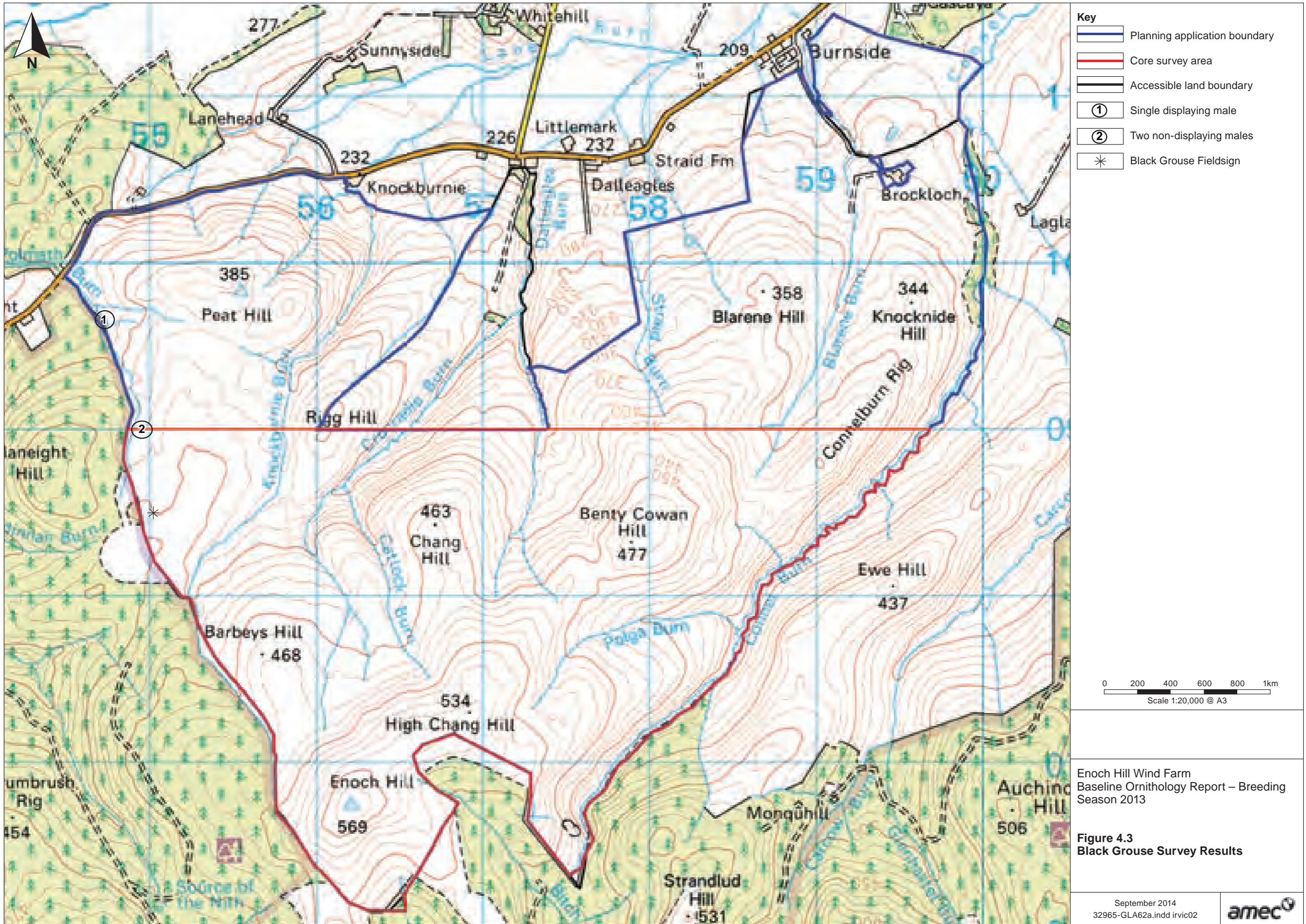
Appendix Table C2 provides details of Black Grouse sightings and signs recorded during lek surveys. Three males were recorded on the first Black Grouse survey visit on the 4th April 2013, with a single bird lekking on the forest edge near Polmathburn Bridge and a further two birds loafing North-East of Maneight Hill on the forest edge. On the forest edge South-East of Maneight Hill there was evidence of Black Grouse lekking activity in the snow including a flattened area and droppings. There were no further records of Black Grouse during lek surveys.

4.1.3 Incidental Records

Those target species recorded incidentally are detailed in **Appendix Table C3**. This included five records of Black Grouse, from across the site, which included a bird/s heard lekking on Enoch Hill and other records of non-lekking birds with a peak of two individuals. Incidental records of Black Grouse are presented in **Figure 4.5**. Golden Plover were recorded on five occasions with birds being heard but not seen during VP watches and three observations of flocks comprising 30, 20 and 20 individuals. A male Merlin was recorded from VP2 on the 19th April sitting in a tree on the forest edge (see Confidential Appendix for further details).







5. Key Species Summary

This section provides a summary of the conservation and population status for those target species recorded during the survey programme.

Greylag Goose

Greylag Goose is BoCC amber-listed based on non-breeding localisation within the UK and a UK non-breeding population of international importance (Eaton *et al.* 2009). The total UK wintering population was estimated at 230,000 individuals in 2009-10 (Musgrove *et al.* 2013). The GB wintering population of Icelandic birds was estimated at 85,000 birds (Mitchell 2013). The wintering population (as indicated by November peak counts) in South-West Scotland/North-West England was estimated at: 1,240 in 2011; 6,536 in 2010; and 3,230 in 2009 (WWT, 2012, 2011 & 2010). In South-West Scotland/North-West England, during 2012 the population was: 1,172 in October and 1,536 in November (Mitchell, 2013).

There was a single record of two Greylag Geese on the 7th April flying north along the western boundary of the Site below collision-risk height (CRH).

Barnacle Goose

Barnacle Goose is an Annex I listed species and is also BoCC Amber listed due to its localised non-breeding range in the UK (Eaton *et al.* 2009). The current UK wintering population is estimated to be 94,000 birds in 2009/10 (Musgrove *et al.* 2013). The wintering population on the Solway was estimated to be 31,000 birds in 2012/13 (WWT, 2013).

There were two records of Barnacle Geese in 2013, both on the 13th April flying North- East from Enoch Hill towards Connelburn Rig. Both flights, totalling 180 seconds, were at CRH.

Black Grouse

Black Grouse is BoCC red listed based on severe breeding population decline (Eaton *et al.* 2009). The current UK population is estimated at 5,100 lekking males, 3,344 of which were in Scotland and 800 in South-West Scotland (Musgrove *et al.* 2013). In East Ayrshire a 2007 survey found 38 lekking males at 17 sites within the Muirkirk Uplands, Glen Afton and Dunstan Hill (Zisman *et al.* 2009).

Black Grouse were recorded throughout the survey period with birds recorded largely to the North-West of the core survey area. A single bird was seen displaying along the forest edge and two other males were seen loafing close by on the 4th April. Two males were seen in several locations across the Site, being recorded from Enoch Hill in April, Benty Cowan Hill in May and Rigg Hill in June. Black Grouse males were also noted as incidental records from Enoch Hill (lekking) in April and on Peat Hill in May. Therefore a total of three lek locations were identified, with a peak of single displaying male, and a peak of three individuals recorded.

Golden Plover

Golden Plover is an Annex I listed species and is also listed on the BoCC amber list as at least 20% of the European non-breeding population is found in within the UK (Eaton *et al.* 2009). Golden Plover is also listed on the Scottish Biodiversity List. The British breeding population was estimated at 38,000-59,000 pairs (Musgrove *et al.* 2013).

There were two flights of Golden Plover recorded during VP survey, both in April and comprising flocks of 28 and 48 individuals. There were also a small number of records of birds utilising the on-Site habitats during the passage periods, with flock size of up to 27 individuals, concentrated on the higher ground in the southern part of the Site.

Peregrine

Peregrine is an Annex I and Schedule I listed species. It is also listed on the Scottish Biodiversity list. In the UK, the population is estimated to be 1,530 pairs (Holling *et al.*, 2013). The breeding population of Peregrines in South Strathclyde (incorporating Ayrshire) is 26 pairs (Etheridge, 2013). Peregrines need open areas with a plentiful supply of birds to hunt, and secure sites for breeding (Ratcliffe, 1993); most eyries and roosts are generally located on cliffs, crags or tall man-made structures.

There was a single Peregrine flight on the 13th April when a bird flew below CRH from Trough Burn north to Knocknarran Hill.

Merlin

Merlin is an Annex I and Schedule I listed species and a BoCC amber listed species due to historical declines (Eaton *et al.* 2009). The UK population is estimated to be 1,160 pairs (Holling *et al.* 2013). The population estimate for South Strathclyde (incorporating Ayrshire) is 10 pairs (Etheridge *et al.* 2013).

A single Merlin nest was identified within the survey area in 2013 and a total of six flights were recorded during VP watches, all below collision-risk height.

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Appendix A Species List

English Name	Scientific Name	English Name	Scientific Name
Greylag Goose	<i>Anser anser</i>	Carrion Crow	<i>Corvus corone</i>
Pink-footed Goose	<i>Anser brachyrhynchus</i>	Raven	<i>Corvus corax</i>
Barnacle Goose	<i>Branta leucopsis</i>	Goldcrest	<i>Regulus regulus</i>
Red Grouse	<i>Lagopus lagopus</i>	Blue Tit	<i>Cyanistes caeruleus</i>
Black Grouse	<i>Tetrao tetrix</i>	Great Tit	<i>Parus major</i>
Grey Heron	<i>Ardea cinerea</i>	Coal Tit	<i>Periparus ater</i>
Sparrowhawk	<i>Accipiter nisus</i>	Skylark	<i>Alauda arvensis</i>
Buzzard	<i>Buteo buteo</i>	Swallow	<i>Hirundo rustica</i>
Kestrel	<i>Falco tinnunculus</i>	House Martin	<i>Delichon urbicum</i>
Merlin	<i>Falco columbarius</i>	Wood Warbler	<i>Phylloscopus sibilatrix</i>
Peregrine	<i>Falco peregrinus</i>	Willow Warbler	<i>Phylloscopus trochilus</i>
Oystercatcher	<i>Haematopus ostralegus</i>	Wren	<i>Troglodytes troglodytes</i>
Golden Plover	<i>Pluvialis apricaria</i>	Blackbird	<i>Turdus merula</i>
Dotterel	<i>Charadrius morinellus</i>	Song Thrush	<i>Turdus philomelos</i>
Curlew	<i>Numenius arquata</i>	Mistle Thrush	<i>Turdus viscivorus</i>
Redshank	<i>Tringa totanus</i>	Spotted Flycatcher	<i>Muscicapa striata</i>
Woodcock	<i>Scolopax rusticola</i>	Robin	<i>Erithacus rubecola</i>
Snipe	<i>Gallinago gallinago</i>	Redstart	<i>Phoenicurus</i>
Common Gull	<i>Larus canus</i>	Wheatear	<i>Oenanthe oenanthe</i>
Lesser Black-backed Gull	<i>Larus fuscus</i>	House Sparrow	<i>Passer domesticus</i>
Herring Gull	<i>Larus argentatus</i>	Grey Wagtail	<i>Motacilla cinerea</i>
Great Black-backed Gull	<i>Larus marinus</i>	Pied Wagtail	<i>Motacilla alba</i>
Feral Pigeon	<i>Columba livia</i>	Meadow Pipit	<i>Anthus pratensis</i>
Woodpigeon	<i>Columba palumbus</i>	Chaffinch	<i>Fringilla coelebs</i>
Swift	<i>Apus apus</i>	Greenfinch	<i>Chloris chloris</i>
Great Spotted Woodpecker	<i>Dendrocopus major</i>	Siskin	<i>Carduelis spinus</i>



Appendix B

Survey Programme

Vantage Point Survey Dates

Table B1 Dates, Times and Weather Conditions during Vantage Point Surveys

Date	Survey period	Duration (hours)	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/ light, showers)	Visibility (<100m, 100-500m, 500m-2km, >2km)
VP 1						
04/04/2013	10:00-13:00	3	NNE F5	3/8	None	>2km
13/04/2013	06:00-09:00	3	SSW F5	8/8	None	>2km
19/04/2013	05:00-08:00	3	W F2	6/8	None	>2km
08/05/2013	09:00-12:00	3	SE F5-6	8/8	Showers	>2km
09/05/2013	04:30-07:30	3	SE F5	8/8	None	>2km
16/05/2013	09:30-12:30	3	SE F2-3	3/8	None	>2km
04/06/2013	15:00-18:00	3	ENE F4	4/8	None	>2km
10/06/2013	03:30-06:30	3	SW F2	8/8	None	>2km
17/06/2013	13:00-16:00	3	SE F3	8/8	None	>2km
05/07/2013	12:00-15:00	3	W F4-5	5/8	None	>2km
11/07/2013	08:00-11:00	3	NE F2	6/8	None	>2km
15/07/2013	15:30-18:30	3	NW F4-5	4/8	None	>2m
07/08/2013	15:00-18:00	3	N 0-1	6/8	None	>2km
07/08/2013	09:40-12:40	3	SW F2-3	3/8	None	>2km

Date	Survey period	Duration (hours)	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/ light, showers)	Visibility (<100m, 100-500m, 500m-2km, >2km)
Total		42				
VP 2						
07/04/2013	09:00-12:00	3	E F4	6/8	None	>2km
15/04/2013	17:30-20:30	3	SSW F6-7	8/8	Showers	>2km
19/04/2013	09:00-12:00	3	NW F1-2	5/8	None	>2km
30/04/2013	07:30-10:30	3	NW F4-5	0/8	None	>2km
09/05/2013	09:00-12:00	3	SE F5	8/8	Rain	>2km
28/05/2013	15:30-18:30	3	SE F2	8/8	Drizzle	>2km
04/06/2013	19:30-22:30	3	NE F4	7/8	None	>2km
19/06/2013	08:45-11:45	3	W F3-4	4/8	None	>2km
24/06/2013	12:15-15:15	3	NW F3	6/8	None	>2km
14/07/2013	08:00-11:00	3	W F4	3/8	None	>2km
17/07/2013	04:00-07:00	3	W F3	8/8	None	>2km
22/07/2013	12:30-15:30	3	W F2	1/8	None	>2km
07/08/2013	14:00-17:00	3	W F0-2	7/8	Occasional drizzle	>2km
08/08/2013	11:10-14:10	3	S F2-3	7/8	None	>2km
Total		42				
VP 3						
07/04/2013	13:00-16:00	3	E F4	6/8	None	>2km
13/04/2013	05:30-08:30	3	E F3-4	8/8	None	500m-2km
15/04/2013	13:30-16:30	3	SSW F6	8/8	Showers	>2km

Date	Survey period	Duration (hours)	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/ light, showers)	Visibility (<100m, 100-500m, 500m-2km, >2km)
06/05/2013	08:00-11:00	3	S F4	8/8	None	>2km
17/05/2013	15:00-18:00	3	NW F5	8/8	None	>2km
28/05/2013	19:30-22:30	3	NE F2	8/8	Drizzle	500m-2km
06/06/2013	19:15-22:15	3	NW F3	4/8	None	>2km
19/06/2013	12:45-15:45	3	W F5	3/8	None	>2km
24/06/2013	16:15-19:15	3	NW F4	7/8	None	>2km
09/07/2013	15:00-18:00	3	W F4	0/8	None	>2km
17/07/2013	08:00-11:00	3	W F4	6/8	None	>2km
22/07/2013	16:30-19:30	3	SW F2	3/8	None	>2km
07/08/2013	10:45-13:45	3	W F1	3/8	None	>2km
08/08/2013	14:55-17:55	3	S F4-5	8/8	None	>2km
Total		42				
VP 4						
06/04/2013	09:00-12:00	3	WSW F4	2/8	None	>2km
13/04/2013	11:00-14:00	3	SSW F4	7/8	None	>2km
18/04/2013	10:50-13:50	3	S F8	6/8	Showers	>2km
08/05/2013	04:30-07:30	3	ESE F6	8/8	Showers	>2km
13/05/2013	12:00-15:00	3	SW F4-6	6/8	Sleet showers	>2km
16/05/2013	14:15-17:15	3	S F3-4	6/8	None	>2km
10/06/2013	07:30-10:30	3	SE F4	5/8	None	>2km
17/06/2013	17:30-19:00	1.5	E F2	8/8	None	>2km

Date	Survey period	Duration (hours)	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/ light, showers)	Visibility (<100m, 100-500m, 500m-2km, >2km)
25/06/2013	11:15-12:45	1.5	S F2	7/8	None	>2km
08/07/2013	12:20-15:20	3	N F1	2/8	None	>2km
10/07/2013	12:00-15:00	3	NNE F2	3/8	None	>2km
11/07/2013	03:30-06:30	3	NE F2	8/8	None	>2km
15/07/2013	19:30-22:30	3	NW F4	6/8	None	>2km
07/08/2013	09:50-12:50	3	W F1-2	3/8	None	>2km
08/08/2013	10:20-13:20	3	SW F2-4	7/8	None	>2km
Total		42				
VP 5						
05/04/2013	09:00-12:00	3	NNE F5	8/8	None	>2km
12/04/2013	11:30-14:30	3	S F3	8/8	Drizzle	>2km
18/04/2013	14:50-17:50	3	SW F5-6	5/8	None	>2km
02/05/2013	07:30-10:30	3	SSW F3-4	6/8	None	>2km
13/05/2013	16:00-19:00	3	SW F5-7	7/8	Snow showers	>2km
17/05/2013	19:00-22:00	3	W F4	7/8	None	>2km
06/06/2013	15:00-18:00	3	NW F3	2/8	None	>2km
17/06/2013	14:15-17:15	3	E F1	7/8	None	>2km
08/07/2013	16:20-19:20	3	W F1-2	3/8	None	>2km
09/07/2013	11:00-14:00	3	W F3	0/8	None	>2km
10/07/2013	17:30-10:30	3	NE F2-3	8/8	None	>2km
14/07/2013	03:45-06:45	3	W F3-4	8/8	None	>2km

Date	Survey period	Duration (hours)	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/ light, showers)	Visibility (<100m, 100-500m, 500m-2km, >2km)
07/08/2013	13:30-16:30	3	WNW F2	6/8	None	>2km
08/08/2013	14:15-17:15	3	S F3-4	8/8	None	>2km
Total		42				

Distribution and Abundance Survey Dates

Moorland Breeding Bird Survey

Table B2 Dates, Times and Weather Conditions during Moorland Breeding Bird Surveys

Visit number	Date	Survey period	Area covered	Sunrise time	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/ light, showers)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Duration
1	22/04/2013	08:30-15:15	North-west	05:53	SSW F4-5	8/8	Rain	500m-2km	6hr 45m
1	23/04/2013	09:00-16:30	North-east	05:51	WSW F5	8/8	Drizzle	>2km	7hr 30m
1	25/04/2013	10:15-18:00	South-west	05:46	W F4	8/8	Rain	>2km	7hr 45m
1	26/04/2013	10:00-17:00	South-east	05:44	WNW F4	7/8	Showers	>2km	7hr
Total Duration									29 hours
2	21/05/2013	08:30-15:30	South-west	04:55	NW F4	8/8	None	>2km	7hr
2	22/05/2013	08:00-15:00	South-east	04:53	NW F5	4/8	None	>2km	7hr
2	23/05/2013	11:00-18:00	North-west	04:52	NW F6	8/8	Showers	>2km	7hr

Visit number	Date	Survey period	Area covered	Sunrise time	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/ light, showers)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Duration
2	24/05/2013	11:00-17:30	North-east	04:51	NE F5	4/8	None	>2km	6hr 30m
Total Duration									27hr 30m
3	20/06/2013	10:00-17:00	North-west	04:34	SE F4	4/8	None	>2km	7hr
3	21/06/2013	11:00-18:00	South-west	04:34	W F2	8/8	Drizzle	500m-2km	7hr
3	26/06/2013	11:30-18:30	North-east	04:36	W F4-5	4/8	None	>2km	7hr
3	27/06/2013	08:30-15:00	South-east	04:37	SW F3	8/8	Rain	>2km	6hr 30m
Total Duration									27hr 30m
4	26/07/2013	11:00-17:30	North-west	05:14	SW F4	4/8	None	>2km	6hr 30m
4	28/07/2013	08:00-15:00	South-west	05:17	SW F3-4	8/8	Showers	>2km	7hr
4	29/07/2013	12:00-18:30	South-east	05:19	SW F3	8/8	Showers	>2km	6hr 30m
4	30/07/2013	08:00-15:00	North-east	05:21	SW F5	8/8	Showers	>2km	7hr
Total Duration									27hr

Black Grouse Survey

Table B3 Dates, Times and Weather Conditions during Black Grouse Surveys

Visit number	Date	Survey period	Area covered	Sunrise time	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/ light, showers)	Visibility (<100m, 100-500m, 500m-2km, >2km)
1	04/04/2013	05:30-08:30	West	06:38	NNE F5	8/8	Snow showers	>2km
1	05/04/2013	05:30-08:30	Centre	06:35	NNE F5	8/8	None	>2km
1	06/04/2013	05:30-08:30	East	06:32	WSW F4	1/8	None	>2km
2	30/04/2013	04:30-07:30	West	05:35	NW F4	0/8	None	>2km
2	02/05/2013	04:30-07:30	Centre	05:30	SSW F2	0/8	None	>2km
2	06/05/2013	04:30-07:30	East	05:22	S F4	8/8	Drizzle	>2km



Appendix C

Survey Results

Vantage Point Survey Results

Table C1 Target species Flight Data

Flight reference number	VP Number	Date	Time	No. of birds	Flight time at 0-30m	Flight time at 30-150m	Flight time at >150m	Notes
Greylag Goose								
EH_015	2	07/04/2013	09:42	2	135	0	0	
Barnacle Goose								
EH_018	1	13/04/2013	07:24	80	0	105	0	
EH_019	1	13/04/2013	08:07	50	0	75	0	
Golden Plover								
EH_017	5	12/04/2013	11:21	28	75	0	0	
EH_023	2	19/04/2013	10:13	48	0	75	105	
Merlin * these flights are documented within ES Chapter 12 – Confidential Annex 12F – Figure 12A								
EH_016	2	07/04/2013	10:40	1	135	0	0	
EH_021	2	19/04/2013	09:30	2	30	0	0	Male and female in display flight, both landed in forest canopy.
EH_022	2	19/04/2013	09:45	1	30	0	0	Male displaying above forest.

Flight reference number	VP Number	Date	Time	No. of birds	Flight time at 0-30m	Flight time at 30-150m	Flight time at >150m	Notes
EH_024	2	19/04/2013	11:35	1	15	0	0	Male flew from perch in tree into the forest.
EH_025	5	02/05/2013	09:41	1	45	0	0	
EH_026	3	06/06/2013	19:38	1	75	0	0	
Peregrine								
EH_020	1	13/04/2013	08:19	1	60	0	0	

Distribution and Abundance Surveys

Table C2 Black Grouse Survey Results, Breeding Season 2013

Visit Number	Date	Count	Activity	Comments
Black Grouse				
1	04/04/13	1	Lekking	Male lekking near Polmathburn Bridge
1	04/04/13	2	Loafing	Two males seen loafing on edge of forest North-east of Maneight Hill.
1	04/04/13	0	Evidence	Evidence of Black Grouse activity (droppings/flattened area in snow etc.) South-east of Maneight Hill on forest edge.

Incidental Records

Table C3 Incidental Records

Date	Species	Location	Notes
07/04/2013	Black Grouse	Enoch Hill	Male heard lekking.
19/04/2013	Pink-footed Goose	West of site	Approximately 200 individuals flew North.
22/04/2014	Black Grouse	Enoch Hill	Two males flew SE.
30/04/2013	Golden Plover	Enoch Hill	Bird heard but not seen overhead.
02/05/2013	Golden Plover	Barbey's Hill	30 birds loafing.
07/05/2013	Golden Plover	Benty Cowan Hill	Bird heard but not seen overhead.
08/05/2013	Black Grouse	Peat Hill	Male flushed from top of Peat Hill when accessing VP1.
23/05/2014	Black Grouse	Trough Burn & Benty Cowan Hill	Two males.
20/06/2014	Black Grouse	Rigg Hill	Two birds flew west.
07/08/2013	Dotterel/Golden Plover	Benty Cowan Hill	Birds HNS behind VP. Loafing flock of 20+ GP seen on way up.
08/08/2013	Dotterel/Golden Plover	Benty Cowan Hill	Birds HNS behind VP. Loafing flock of 20+ GP seen on way up.

Appendix 12.E

Baseline Ornithology Report – Winter Season 2013/14

E.ON Climate & Renewables UK Developments Ltd

Enoch Hill Wind Farm

Appendix 12E: Baseline Ornithology Report – Winter Season 2013/14



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32965-04 Enoch Hill Baseline Ornithology Report - Winter 2013-14

E.ON Climate & Renewables UK Developments Ltd

Enoch Hill Wind Farm

Appendix 12E: Baseline Ornithology Report – Winter Season 2013/14

AMEC Environment & Infrastructure
UK Limited

July 2015

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Executive Summary

Purpose of this Report

This report documents the methods and results of a suite of bird surveys undertaken between September 2013 and March 2014 at the proposed Enoch Hill Wind Farm (the 'Site').

The Site is located approximately three kilometres to the South-West of the town of New Cumnock, East Ayrshire, and is dominated by grass moor managed for upland sheep grazing. The North-Eastern part of the Site has a number of enclosed pastures which are heavily grazed. The Site is bordered by coniferous plantation to the South, East and West and a minor road to the North.

The Muirkirk and North Lowther Uplands Special Protection Area (SPA) is the only SPA or Ramsar located within 20km of the Site. The SPA/Ramsar is approximately 7km away at the closest point and notified for breeding Short-eared Owl, Hen Harrier, Merlin, Peregrine and Golden Plover and wintering Hen Harrier. There are three Sites of Special Scientific Interest (SSSIs) within 20km of the Site and they are all notified for their breeding bird assemblages, Merrick Kells, Bogton Loch and the North Lowther Uplands, the latter forming part of the SPA.

Survey work comprised 210 hours of Vantage Point (VP) observation from five vantage point locations and seven winter walked transect surveys.

Five target species were recorded over the Site during the vantage point surveys: Pink-footed Goose, Black Grouse, Hen Harrier, Merlin and Golden Plover. Flight activity levels of these species were low. A single Black Grouse lek was also identified during the VP surveys.

Winter transect surveys recorded three target species: Black Grouse, Hen Harrier and Golden Plover.

In addition there were incidental records of five target species: Pink-footed Goose, Black Grouse, Dotterel, Golden Plover and Dunlin.

The most regularly recorded species were Golden Plover and Black Grouse. Golden Plover activity areas were centred on the higher hills including Enoch Hill, High Chang, Barbey's Hill and Benty Cowan. Activity was spread across the season but the majority of records were of individuals and small flocks, with most birds recorded loafing. Peak counts were recorded in March. Black Grouse were recorded between Peat Hill and Enoch Hill, with the majority of records of feeding and lekking birds around Blood Moss, including both males and females. The peak lek count was of three lekking males.



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1. Introduction

1.1 About this Document

AMEC Environment & Infrastructure UK Limited (AMEC) was commissioned by E.ON Climate & Renewables UK Developments Ltd to undertake bird surveys during the winter season of 2013/14 (September 2013 to March 2014 inclusive) at the site of a proposed wind farm development at Enoch Hill in Ayrshire. This report describes the methods and results of the surveys, which were designed to be suitable to inform the preparation of an Environmental Statement for the development. Baseline ornithological survey work was undertaken at the Site in winter 2011-12 and the 2012 breeding season by AECOM and more recently by AMEC during the 2012-13 winter and the 2013 breeding season.

1.2 Site Description

The Site is located at Enoch Hill within the county of East Ayrshire. The Site and core survey area are illustrated in **Figure 1.1**. The Site consists of the entire area within the red line boundary and the core area is delineated in blue.

The Site is dominated by white moor habitats with some extremely wet areas which are typified by grasses, *Sphagnum* sp. and *Juncus* sp. The North-East of the Site has a number of enclosed pastures which are heavily grazed by both cattle and sheep. The Site is bordered to the East by similar habitats to those found on Site, by coniferous plantation to the South and West and by a minor road and several farmsteads to the North. A number of small streams flow North through the Site, originating on the higher ground along the Southern boundary. Brockloch Farm, a small farmstead, lies within the North-Eastern part of the Site (although outwith the Site boundary).

1.3 Background and Scope

The key issues relating to birds and wind farms are as follows:

- The effects of direct habitat loss due to land take by wind turbine bases, tracks and ancillary structures;
- The effects of disturbance and displacement of birds from the proximity of the wind turbines. Such disturbance may occur as a consequence of construction work, or due to the presence of the wind farm close to nest or feeding sites or on habitual flight routes; and
- The effects of collision with rotating turbine blades (i.e. killing or injury of birds), which is of particular relevance for sites located in areas with high raptor activity or which support large concentrations of waterfowl.

With regards to the first issue, total land take by wind farm infrastructure generally represents a small proportion of a site. Therefore the permanent loss of nesting and foraging habitat for birds tends to be small and will generally have little effect on bird populations. At most wind farm sites it is the latter two issues, collision risk and displacement, which may potentially be more significant.

Ornithological work carried out at Enoch Hill was based on Scottish Natural Heritage (SNH) guidance for bird surveys at proposed wind farm sites. A range of guidance documents have been produced relating to the assessment of bird/wind farm interactions and the following publications and guidelines in particular have been influential in determining the scope of the works at Enoch Hill:

- Scottish Natural Heritage (2013). Recommended bird survey methods to inform impact assessment of onshore wind farms. <http://www.snh.gov.uk/docs/C278917.pdf>; and
- SNH (2006). Assessing significance of impacts from onshore windfarms on birds outwith designated areas. SNH, Battleby.

SNH guidance recommends that field surveys should be focussed on those species of high nature conservation value for which there is potential for an impact which might be judged significant and adverse. In most circumstances these “target species” tend to be limited to those protected species and other species of conservation concern which may be subject to impact from wind farms.

There are three overarching species lists which describe protected species and species of conservation concern:

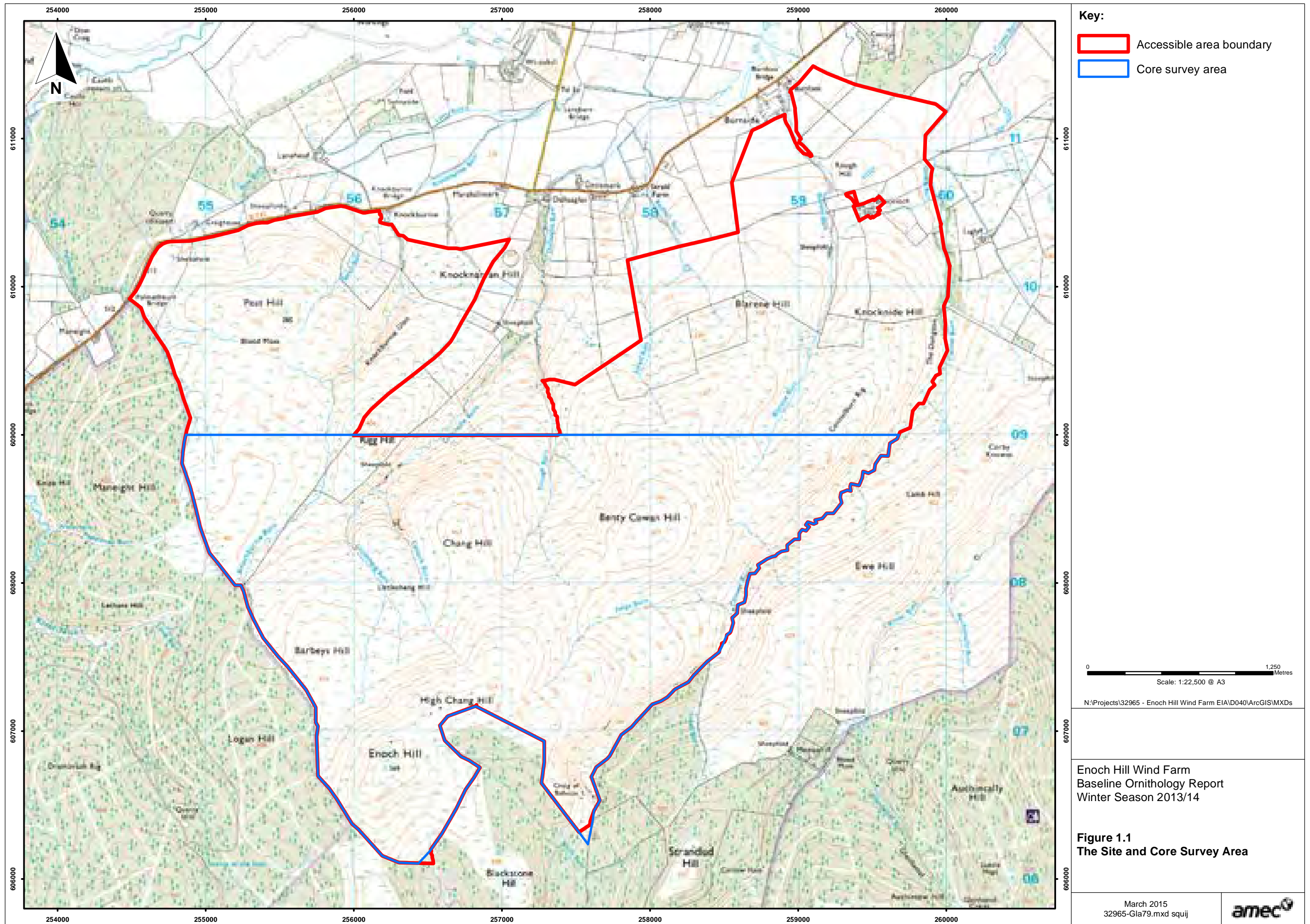
- Special Protection Area (SPA) designated species and those listed under Annex 1 within the *Directive 2009/147/EC on the conservation of wild birds*, commonly referred to as the Birds Directive;
- Species listed under Schedule 1 of the *Wildlife & Countryside Act 1981* (as amended); and
- Red listed birds of conservation concern.

In addition, consideration should also be given to species identified within Local Biodiversity Action Plans. Target species should be limited to those likely to be affected by wind farms. Research indicates that passerine species are not significantly affected by wind farms. Many species included on the BoCC red list are passerines and therefore care should be exercised when considering red list species for inclusion as targets.

It may be appropriate to collect information regarding non-target species, particularly those of regional conservation concern, termed ‘secondary’ species. Recording of such species is subsidiary to the recording of target species.

Target and secondary species at Enoch Hill were selected following a data and literature review ahead of previous fieldwork at the site, as detailed in **Section 2**, and refreshed in view of the results of the 2013 breeding season surveys.

For the purposes of this report, nomenclature follows that of the British Ornithologists’ Union (BOU 2013). Scientific names for all species mentioned in the text and tables are included in **Appendix A**.



2. Desk Study

2.1 Scope

A desk study has been undertaken previously, and is fully documented in the 2012/13 winter bird report (AMEC Doc. Reg: 32965GGOS018). This is summarised in **Section 2.2**. The Multi-Agency Geographical Information for the Countryside (MAGIC) website¹ and SNH SiteLink website² were checked for updates to statutory designated sites within 20km of Enoch Hill.

2.2 Results

The Muirkirk and North Lowther Uplands is the only SPA or Ramsar located within 20km of the Site. The SPA is notified for breeding Short-eared Owl, Hen Harrier, Merlin, Peregrine and Golden Plover; and wintering Hen Harrier. It is located approximately 7km from the Site at the closest point. Three SSSIs which list ornithological interest as a reason for notification lie within 20km of the Site, including: Merrick Kells (c.16km SW), Bogton Loch (c.8.5km W) and the North Lowther Uplands (c. 7km NE) (most of this site is designated as an SPA as part of the Muirkirk and North Lowther Uplands).

Details of ranging distances of cited species are provided within the full desk study report and indicate that the Site lies outside of the core range for most species and towards the upper limit for the others, specifically wintering Hen Harrier and breeding Golden Plover. Results from previous winter survey work at Enoch Hill has demonstrated that there is a small resident population of Black Grouse, utilisation of the Site by passage Golden Plover in both spring and autumn and low levels of target species flight activity throughout the winter period.

2.3 Target Species

The following key species of conservation concern (target species) were identified during the initial desk based study and have been refreshed in view of the results of previous ornithological survey work undertaken in 2011-13:

- Cited species of the Muirkirk and North Lowther Uplands SPA (Hen Harrier, Merlin, Peregrine, Golden Plover and Short-eared Owl);
- Protected raptors and owls (including species known to be present in the surrounding area e.g. Goshawk, Osprey, Barn Owl and Long-eared Owl);
- Waterfowl and waders (including Whooper Swan, Pink-footed Goose, Dunlin and Dotterel; but excluding feral and introduced breeding species [e.g. Canada Goose and Mallard]); and
- Black Grouse.

¹ <http://magic.defra.gov.uk/>

² <http://gateway.snh.gov.uk/sitelink/>

The following secondary species were identified to potentially occur on Site during the winter season:

- Buzzard, Sparrowhawk, Kestrel;
- Lapwing, Curlew, Snipe, Woodcock; and
- Raven.

3. Methodology

3.1 Winter Bird Surveys

3.1.1 Surveyors

All surveys were undertaken by experienced AMEC ornithologists, all of whom have extensive field experience and detailed understanding of the key methodologies recommended within SNH guidance and employed to monitor bird activity and distribution at proposed wind farm sites.

3.1.2 Vantage Point Surveys

Vantage-point (VP) watches were conducted in accordance with SNH (2013) guidance and undertaken throughout the survey period. This method focuses on identifying flight-paths of target species and allows any regularly used flight lines to be identified, allowing turbine locations to be altered where necessary to reduce collision risk to birds. The data generated can also be used to estimate the theoretical risk of collision with turbines by incorporation into a suitable model.

The SNH methodology is that vantage-points should be chosen parsimoniously to achieve maximum visibility from the minimum number of locations such that all parts of the survey area are within two kilometres of a VP. Five vantage points were identified as being sufficient to survey the core survey area (see **Figure 3.1** for view-shed mapping), the locations of which were:

- VP1 – NS 55543 09814 – view bearing 180°;
- VP2 – NS 56216 06749 – view bearing 0°;
- VP3 – NS 56216 06749 – view bearing 180°;
- VP4 – NS 5869409813 – view bearing 180°; and
- VP5 – NS 57985 08339 – view bearing 180°.

Flights were classified using the following three height bands:

- Band 1: 0 - 30m;
- Band 2: 30 - 150m; and
- Band 3: >150m.

A total of 210 hours of vantage point observation (VPO) was undertaken: 42 hours from each VP (1-5) between September 2013 and March 2014 inclusive. Dates, times and weather conditions of the VP watches are provided in **Appendix Table B1**.

3.1.3 Distribution and Abundance Surveys

Winter Transect Survey

Winter transect surveys were designed to collect information on habitat utilisation by target and secondary species, particularly aggregations of wildfowl and waders, as well as those of Scottish Biodiversity listed and BoCC red listed passerines.

The methodology involved walking a set transect route through the entire Site, stopping at suitable observation points to scan the surrounding land for target/secondary species (see **Figure 3.2**). The survey route was designed to ensure that each part of the core survey area and surrounding open ground out to 1km was visible for the purpose of detecting target/secondary species.

Information was recorded regarding the habitat type and number of birds present. For each bird detected, species, number, sex (where possible to determine), activity and any relevant behavioural notes were recorded. Surveys were completed in suitable weather conditions, with visibility greater than 2km.

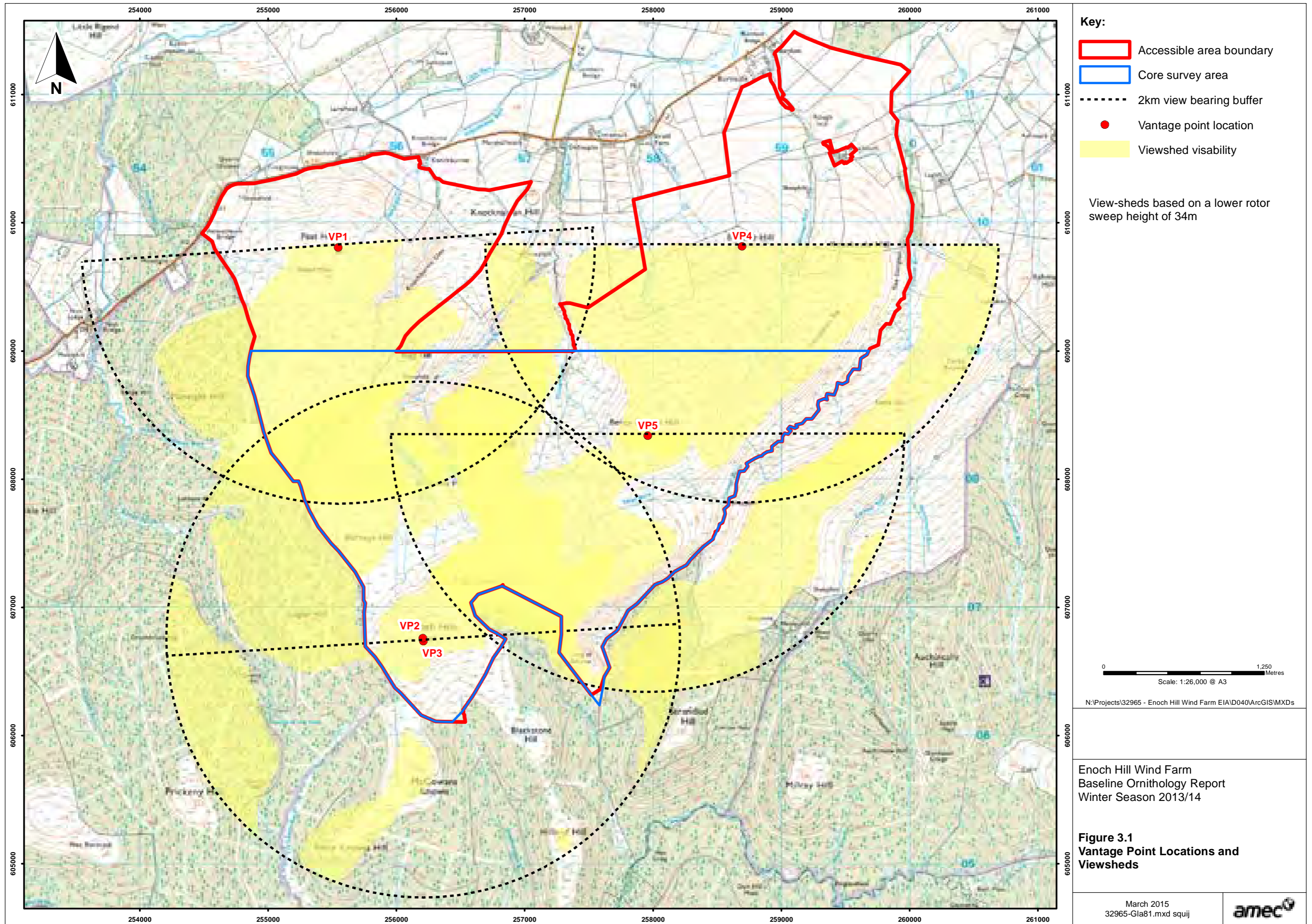
Seven monthly walked transect surveys were conducted between September 2013 and March 2014. Dates, times and weather conditions during the winter transect surveys are provided in **Appendix Table B2**.

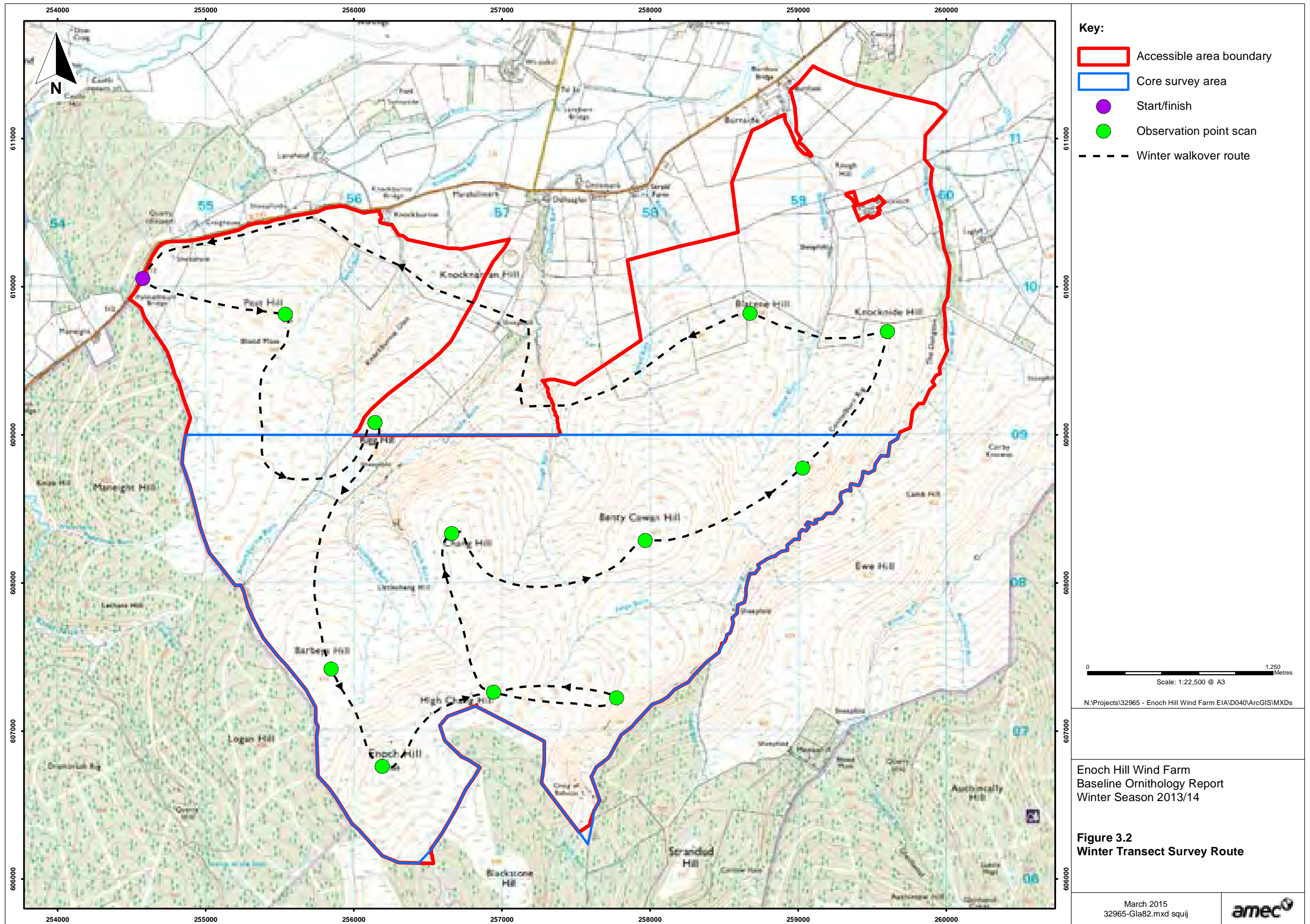
3.1.4 'Incidental' Records

Birds seen outside of formalised timed surveys were also recorded (i.e. those observed during walks on and off Site, on walks between vantage-points and during other breaks in survey work). Detailed notes of activity of target species were made and flights mapped.

3.1.5 Limitations

Surveys were conducted in accordance with SNH (2013) guidance and it is considered that there were no limitations with regard to the survey scope and methods.





4. Results

4.1 Vantage Point Surveys

4.1.1 Target Species

The following five target species were recorded during VP surveys: Pink-footed Goose, Black Grouse, Hen Harrier, Merlin and Golden Plover. Details of all target species flights are provided in **Appendix Table C1**. The flight lines are illustrated in the following figures:

- **Figure 4.1a:** Pink-footed Goose;
- **Figure 4.1b:** Black Grouse;
- **Figure 4.1c:** Hen Harrier;
- **Figure 4.1d:** Merlin; and
- **Figure 4.1e:** Golden Plover.

Table 4.1 presents a summary of target species' flight activity.

Table 4.1 Summary of Target Species' Flight Activity

Species	Number of individual flights recorded per month							Total No. Recorded	No. Of Observations
	Sep	Oct	Nov	Dec	Jan	Feb	Mar		
Pink-footed Goose	0	0	0	0	10	0	0	10	1
Hen Harrier	2	2	0	0	1	0	0	5	5
Merlin	2	2	0	0	0	0	0	4	4
Black Grouse	0	0	0	0	0	0	1	4	1
Golden Plover	60	5	28	0	27	159	423	702	25

4.1.2 Secondary Species

Secondary species recorded included: Buzzard, Kestrel, Woodcock, Snipe and Raven.

Kestrel and Buzzard were regularly recorded across the season, with birds seen hunting across the Site. Two to three Kestrels were recorded throughout the winter as well as up to four Buzzards. Snipe was occasionally recorded from all VPs. Woodcock was recorded on a single occasion from VP3. Raven was recorded during the majority of VP surveys, with around four birds active across the Site throughout the season.

4.2 Distribution and Abundance Surveys

4.2.1 Winter Transect Surveys

Details of all target and secondary species encountered during the winter transect surveys are provided in **Appendix Table C2**. Summarised information can be found below.

4.2.2 Target Species

Black Grouse, Hen Harrier and Golden Plover were the only target species that were recorded during the winter transect surveys.

Black Grouse were recorded on three of the surveys. A single male was recorded flying low from the South West onto Blood Moss in late September. The second record was of two males lekking on Blood Moss around 10am in late January. These two males dispersed to Knockburnie Burn and Knockburnie Glen. A total of three males and a female Black Grouse were recorded loafing on Blood Moss during the winter transect survey in early March.

A female Hen Harrier was recorded on two occasions, with one record of a hunting bird from Blood Moss in mid-February and a second record in early March of an individual in flight over Benty Cowan.

The most frequently recorded species during the winter transect surveys was Golden Plover, with birds recorded on all but one survey. This species was regularly active on the hills of High Chang and Benty Cowan. The peak count was of 56 individuals in early October.

4.2.3 Secondary Species

A total of five secondary species were recorded during the winter transect surveys, comprising: Buzzard, Kestrel, Snipe, Woodcock and Raven.

Buzzard was recorded on three surveys, with a peak count of five observed on 28 January. Kestrel was recorded on five of the seven winter transect surveys, with a peak count of two individuals in January. The majority of individuals were recorded on the lower slopes of the Site to the North. Snipe were also present on five of seven winter transect surveys. Almost all records were of single birds flushed from vegetation. A peak count of five Snipe was recorded during the late January survey, all from Blood Moss. Woodcock was recorded on a single survey in January with one bird recorded in flight over Chang Hill. Raven was recorded during five winter transect surveys, with a peak count of nine foraging around the Blarene Burn in November.

4.3 Incidental Records

A single flock of 48 Pink-footed Geese flying over Barbey's Hill was picked up during a walk to a VP in mid-October.

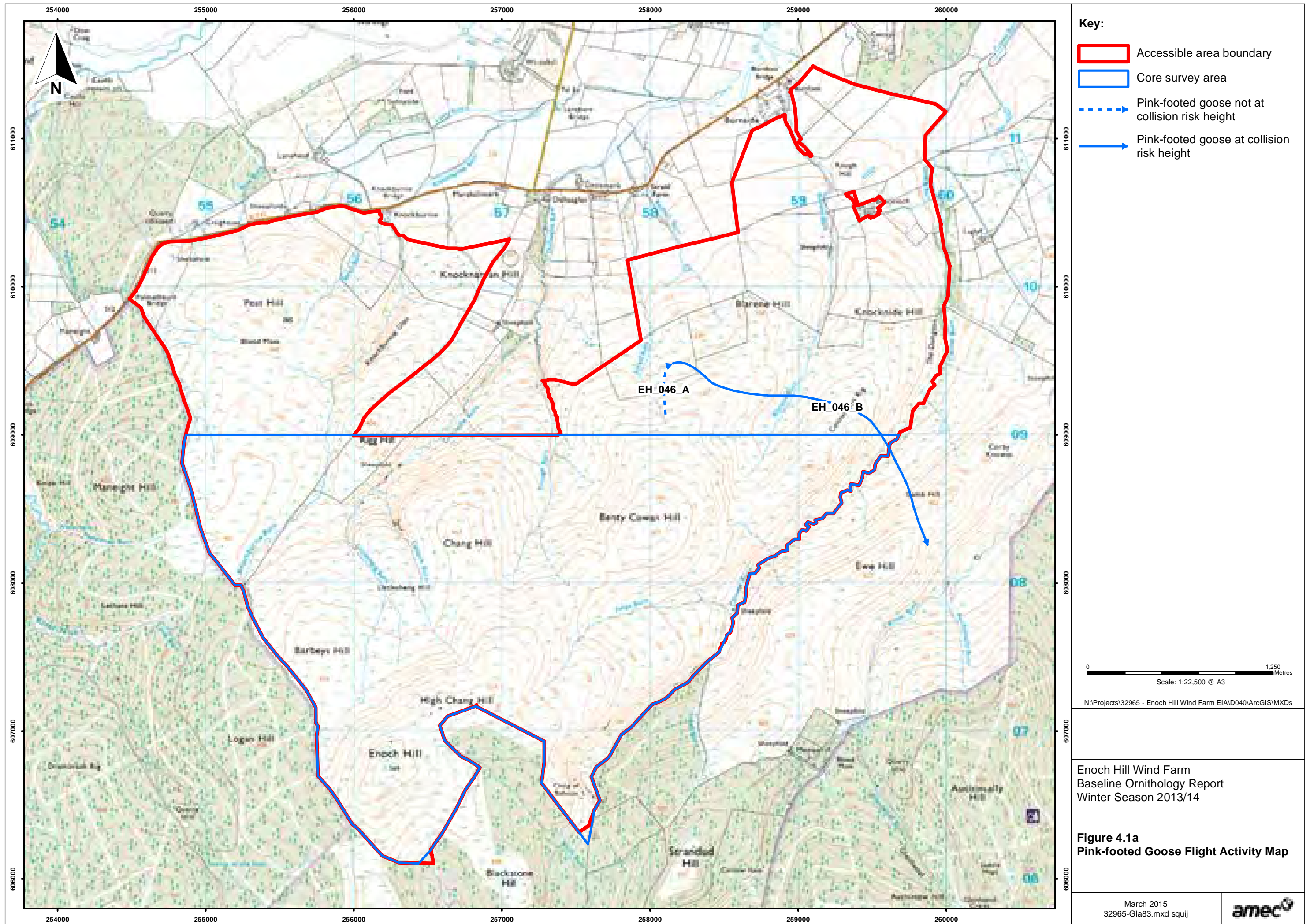
There were a total of eight individual incidental records of Black Grouse during the 2013/14 winter season. The majority of records were from the Blood Moss and Peat Hill area, with a single record of a male flushed from High Chang. The peak number was five individuals, three males and two females recorded in March around Blood Moss. At the 'Peat Hill' lek, a peak count of three lekking males was observed in December, with two displaying males present in February. All incidental records of Black Grouse are presented in **Figure 4.2**.

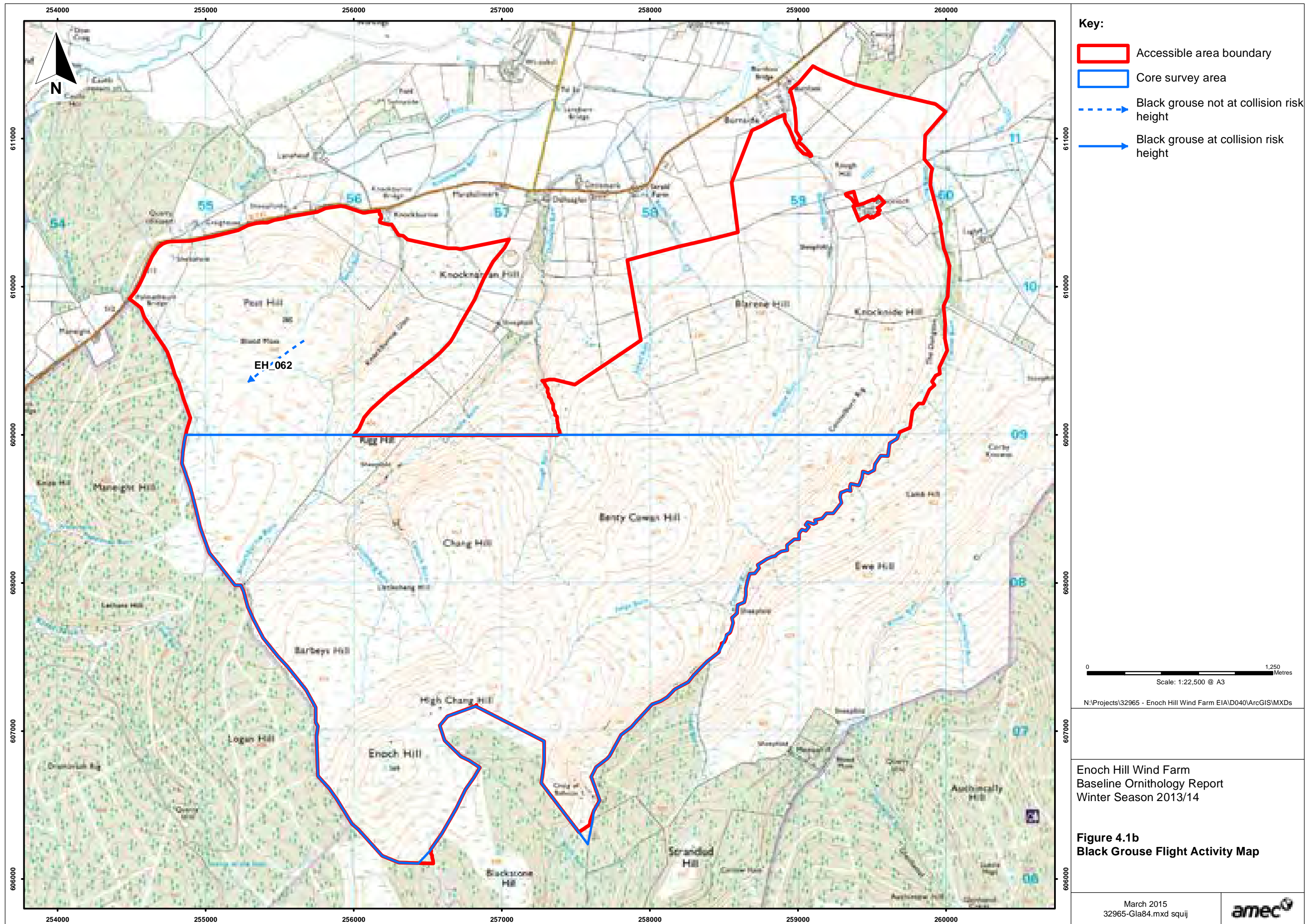
A total of 11 incidental records of Golden Plover were reported during the winter, including a single American Golden Plover. The peak flock size recorded was of 55 birds on Barbey's Hill, with a further 28 recorded on Benty Cowan on the same day in early October. The majority of other records were of single birds.

There were also single records of Dotterel in early October and of Dunlin in mid-September, with both species recorded around Benty Cowan.

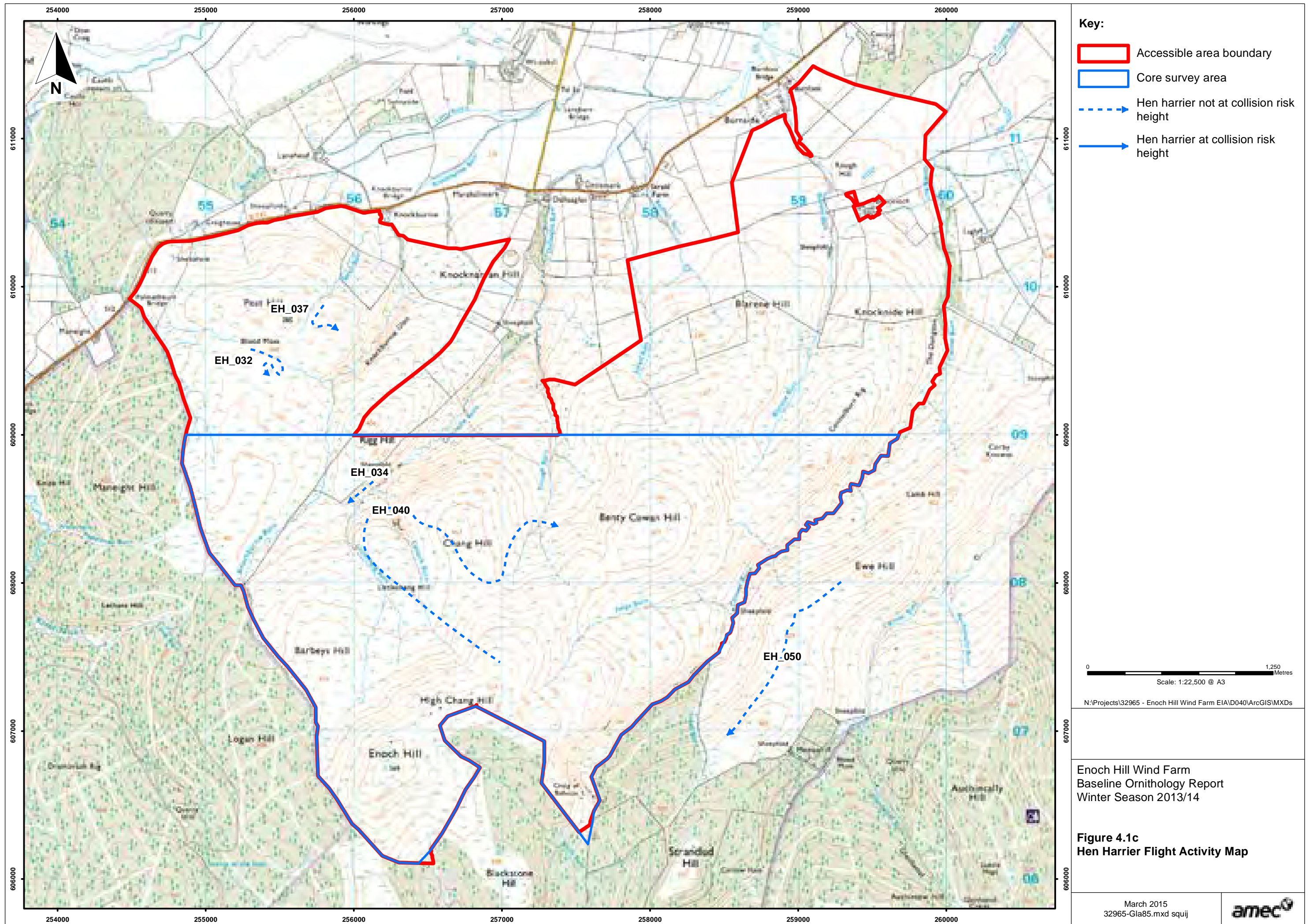
Those target species recorded incidentally are detailed in **Appendix Table C3**.

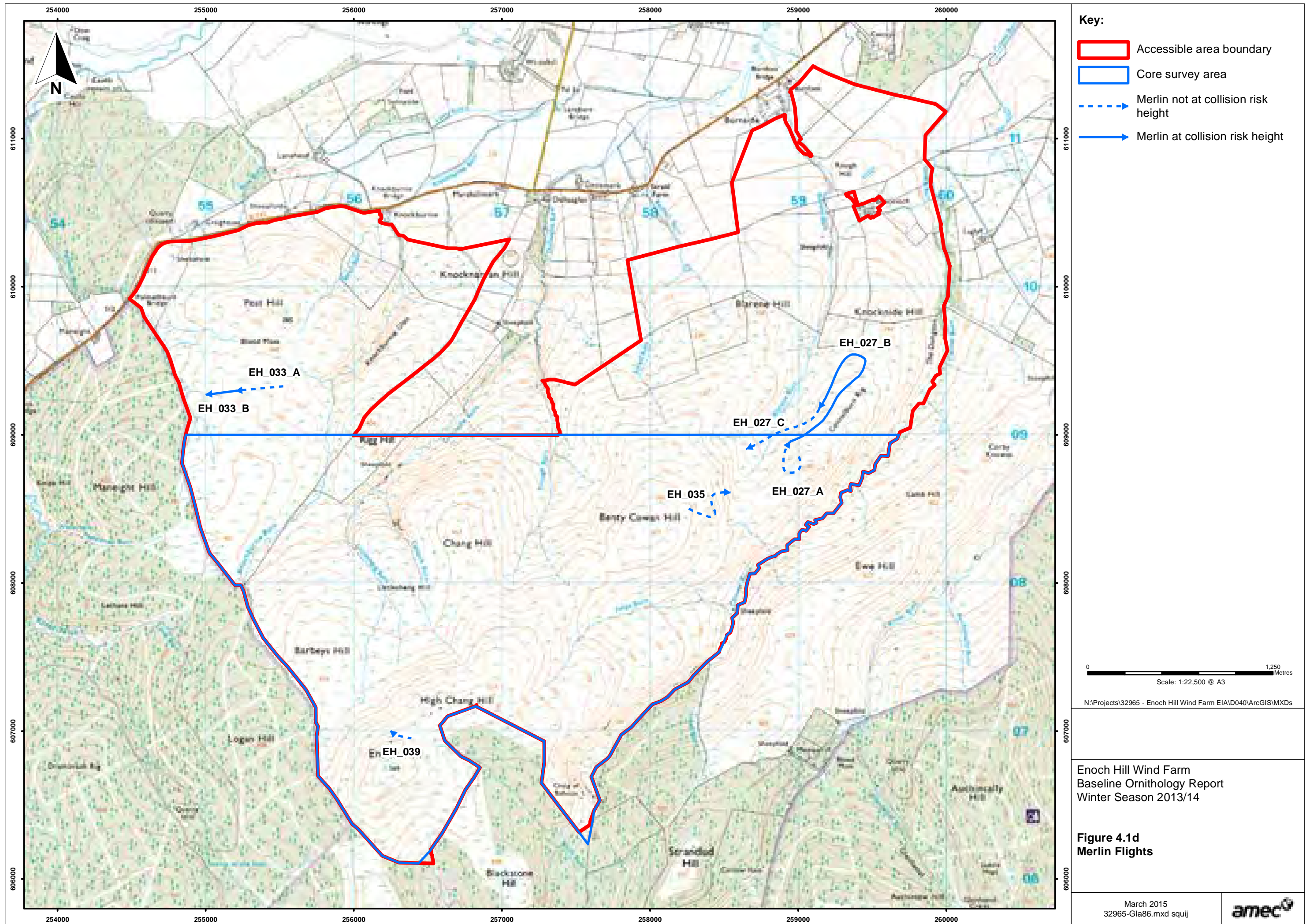


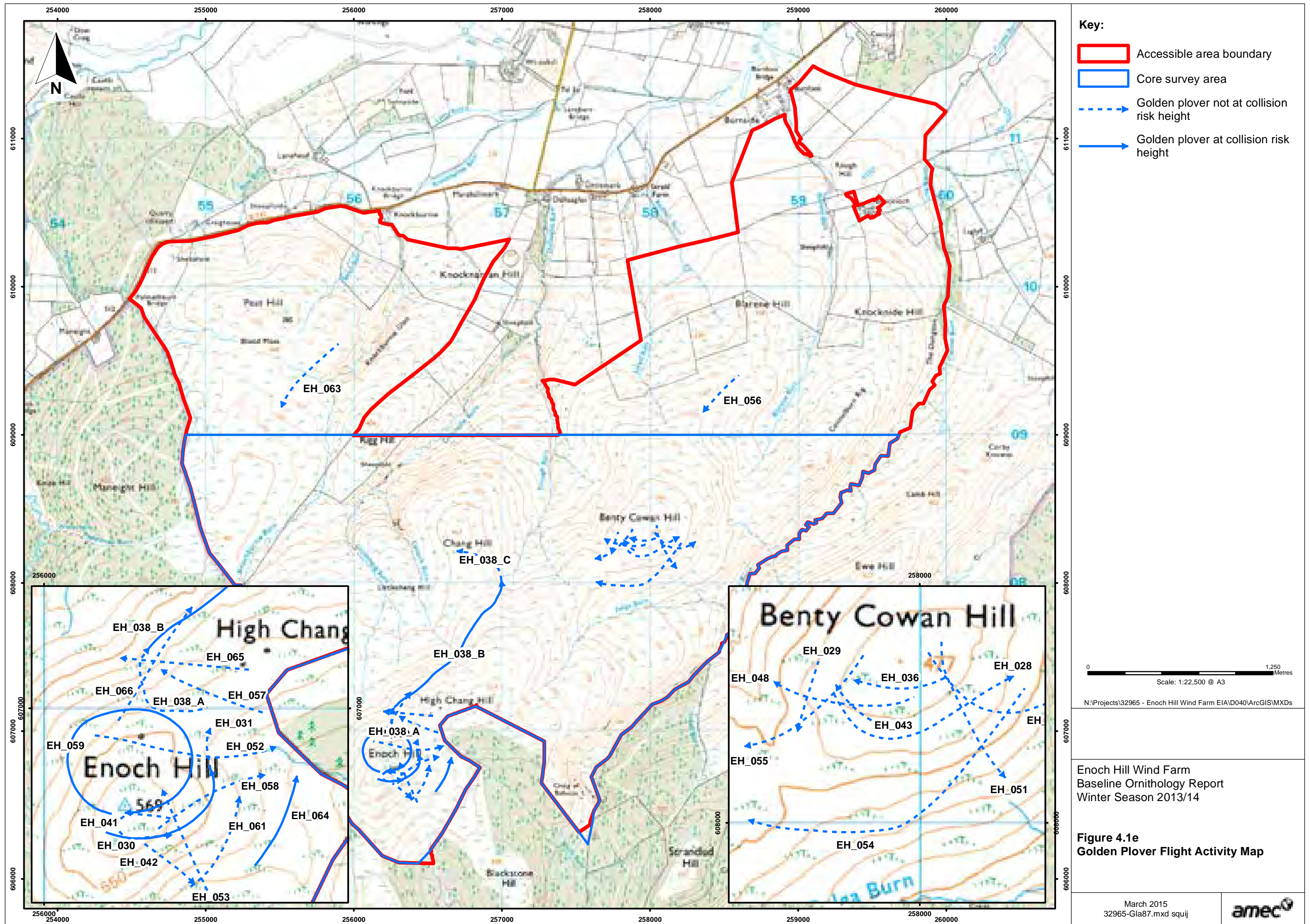




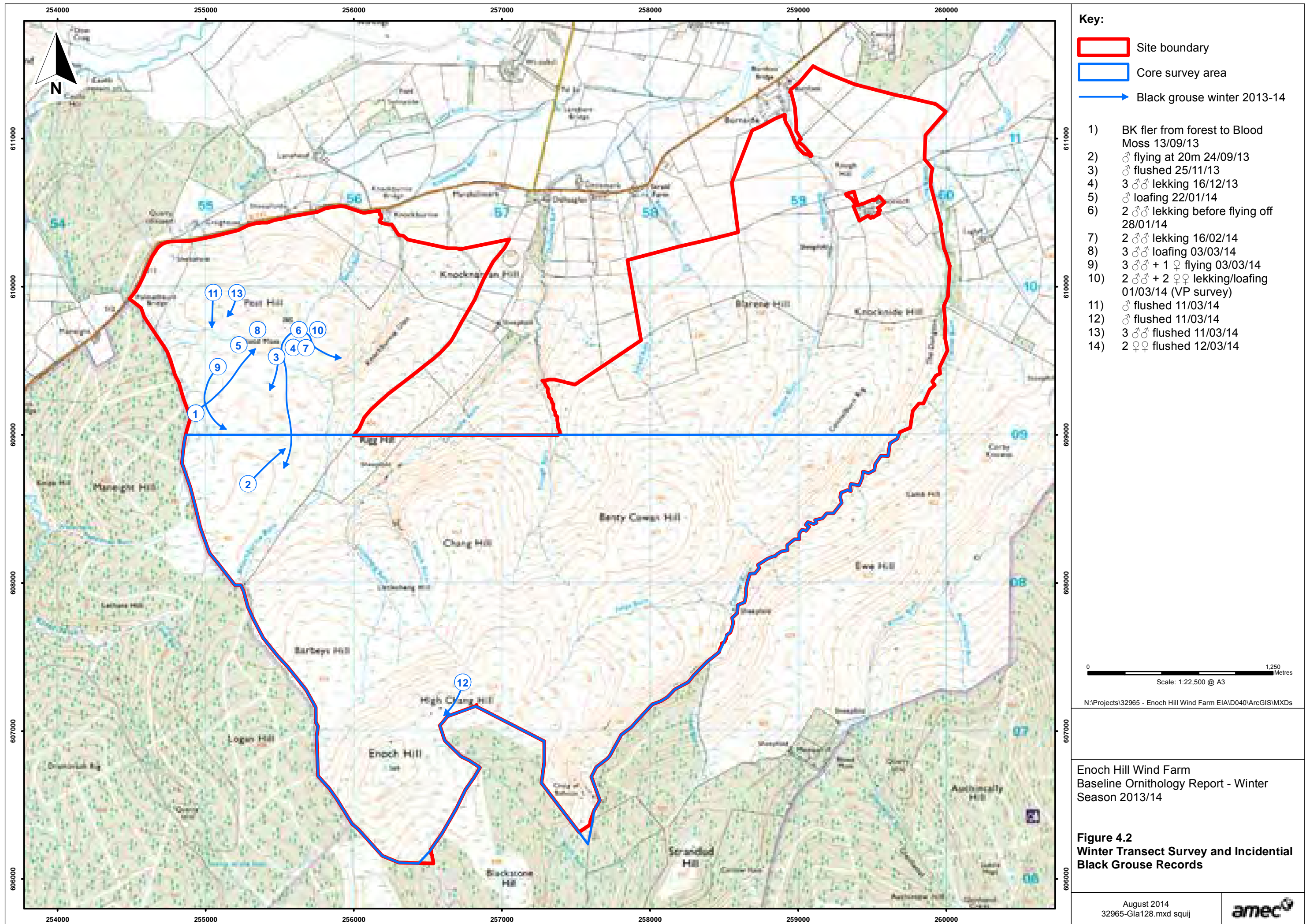
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5. Population Status of Key Species

5.1 Pink-footed Goose

Pink-footed Goose is listed on the Birds of Conservation Concern (BoCC) amber list based on its' non-breeding localisation within the UK and that at least 20% of the European non-breeding population is found in within the UK (Eaton *et al.*, 2009). The current UK population was estimated at 360,000 individuals in 2009-10 (Musgrove *et al.*, 2013). The wintering population (as indicated by November peak counts) in South West Scotland/North West England was estimated at: 4,823 in 2011/12; 5,628 in 2010/11; and 10,924 in 2009/10 (WWT 2012, 2011 & 2010). In South West Scotland/North West England, during 2012 the population was: 14,123 in October and 8,807 in November (Mitchell 2013). In Scotland, the winter arrival of this species peaks in October, after which many continue their movement South (Mitchell 2013).

Pink-footed Goose flight activity across the Enoch Hill site was low during the winter period, with a single flock of ten birds spending 156 seconds at CRH. A second flock of 48 Pink-footed Geese was recorded incidentally over Barbeys Hill in October.

5.2 Black Grouse

Black Grouse is BoCC red listed based on its' severe breeding population decline (Eaton *et al.*, 2009). This species is also listed on the Scottish Biodiversity List. The current UK population is estimated at 5,100 lekking males, 3,344 of which were in Scotland and 800 in South-West Scotland (Musgrove *et al.*, 2013). In East Ayrshire a 2007 survey found 38 lekking males at 17 sites within the Muirkirk Uplands, Glen Afton and Dunstan Hill (Zisman *et al.*, 2009). This resident species is found in upland areas of Britain, where it favours a mix of moorland fringes, marginal farmland and woodland edge (Balmer *et al.*, 2013).

Black Grouse flight activity during the winter season was low. A single record of four birds in flight was recorded from VP1 in March. The flight was below CRH and comprised of two males and two females. Black Grouse were recorded on three of the winter transect surveys with the majority of records around Blood Moss. The peak count during these surveys was of three males and a single female. There were a total of eight incidental records of Black Grouse, which were mainly centred on Blood Moss and Peat Hill. The peak number recorded was five Black Grouse and was comprised of three males and two females. A lek site at NS 55621 09642 was identified in December, with males actively lekking through to February 2014, with a peak count of three displaying males.

5.3 Hen Harrier

Hen Harrier is cited within the Muirkirk and North Lowther Uplands SPA designation and is present as a breeding (29 pairs) and wintering (12 individuals) species. Hen Harrier is an Annex 1 and Schedule 1 listed species, and a BoCC red list species (Eaton *et al.*, 2009). It is also listed on the Scottish Biodiversity List. The UK population is estimated to be 662 breeding pairs (Hayhow *et al.*, in press; in Holling and RBBP, 2012), although it is thought that

the wintering population is largely composed of British and Irish breeders (Dobson *et al.*, 2012; in Balmer *et al.*, 2013). This species is of significant conservation concern due to historical decline of the species, which has been subject to persecution in grouse-shooting areas, resulting in local extinction of the species from many parts of the UK (Balmer *et al.*, 2013).

Flight activity of Hen Harrier during the vantage point surveys was low in winter 2013/14. Five flights were recorded (all below CRH), with both male and female Hen Harriers observed. Two flights of the same male were recorded in September and a male and female was recorded in October. Another flight of a single male was recorded in January. A female Hen Harrier was recorded on two occasions during the winter transect surveys, in February and in March.

5.4 Merlin

Merlin is listed in the Muirkirk and North Lowther Uplands SPA citation, with a cited population of six breeding pairs. Merlin is listed as both an Annex 1 and Schedule 1 species, is classified as being of amber conservation status due to its historical decline in Britain (Eaton *et al.*, 2009). Merlin is also listed on the Scottish Biodiversity List. There was an estimated 1,160 breeding pairs in the UK in 2011 (Ewing *et al.*, 2011; in Holling and RBBP, 2012), with winter numbers swelled by Icelandic birds (Balmer *et al.*, 2013). In winter, this species largely avoids the higher uplands of Scotland and Wales, favouring low-lying habitats and coastal sites (Balmer *et al.*, 2013).

Merlin was only recorded during vantage point surveys and associated flight activity levels were low. A total of four individual flights were recorded, with 21 seconds of flight time spent at CRH. Both male and female Merlin were recorded, with all activity limited to autumn 2013.

5.5 Golden Plover

Golden Plover is listed in the Muirkirk and North Lowther Uplands SPA citation, with a total of 154 breeding pairs at the site. Golden Plover is an Annex 1 species and is of amber conservation status, as at least 20% of the European non-breeding population is found in within the UK (Eaton *et al.*, 2009). Golden Plover is also listed on the Scottish Biodiversity List. The UK overwintering population in 2006/07 was estimated to be 420,000 individuals (Musgrove *et al.*, 2013). Overwintering Golden Plover are recorded throughout most of the lowlands of Britain with records linked to upland sites usually occurring around February, as birds return to the margins of their breeding areas (Balmer *et al.*, 2013).

A total of 25 Golden Plover flights comprising 702 individuals were recorded during the winter season VP surveys. Flight activity was centred on the hills of Enoch and High Chang. Activity levels decreased from autumn (65 individual flights) in to the core winter period (55 individual flights), before increasing in February and March (582 individual flights). Golden Plover was also the most frequently recorded species during the winter transect surveys and was regularly active on the hills of High Chang and Benty Cowan. Incidental records of Golden Plover were often limited to single birds with higher counts recorded on Barbeys Hill and Benty Cowan in the autumn.

5.6 Dotterel

Dotterel is listed as both an Annex 1 and Schedule 1 species, is classified as being of amber conservation status due to its localised breeding status in Britain (Eaton *et al.*, 2009). Dotterel is also listed on the Scottish Biodiversity List. The UK breeding population in 1999 was estimated to be 630 males (Musgrove *et al.*, 2013). Dotterel are summer migrants and the records at Enoch Hill are likely to be of late migrants heading south to African wintering grounds (Balmer *et al.*, 2013).

There was a single incidental record of Dotterel. A loafing individual was seen at Benty Cowan in early October.

5.7 Dunlin

Dunlin is an Annex 1 species and is also listed on the Scottish Biodiversity List. Dunlin is a BoCC red listed species, based on its unfavourable conservation status in Europe, the fact that it has suffered a >50% population decline both short and long term (the last 25 and 50 years respectively), its localised breeding and non-breeding distribution in the UK and the non-breeding population in the UK is of international importance (Eaton *et al.* 2009). The Dunlin overwintering population in the UK was estimated at 360,000 individuals in 2004/05 to 2008/09 (Musgrove *et al.* 2013).

There was a single incidental record of Dunlin. A single bird was recorded calling, in-flight over Benty Cowan in mid-September.



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Appendix A

Species List

Table A1 BOU Species List and Scientific Names

BOU Species Name (2013)	Scientific Name	BOU Species Name (2013)	Scientific Name
Whooper Swan	<i>Cygnus cygnus</i>	Oystercatcher	<i>Haematopus ostralegus</i>
Pink-footed Goose	<i>Anser brachyrhynchus</i>	Dotterel	<i>Charadrius morinellus</i>
Greylag Goose	<i>Anser anser</i>	American Golden Plover	<i>Pluvialis dominica</i>
Canada Goose	<i>Branta canadensis</i>	Golden Plover	<i>Pluvialis apricaria</i>
Barnacle Goose	<i>Branta leucopsis</i>	Lapwing	<i>Vanellus vanellus</i>
Mallard	<i>Anas platyrhynchos</i>	Dunlin	<i>Calidris alpina schinzii</i>
Black Grouse	<i>Tetrao tetrix</i>	Snipe	<i>Gallinago gallinago</i>
Hen Harrier	<i>Circus cyaneus</i>	Woodcock	<i>Scolopax rusticola</i>
Goshawk	<i>Accipiter gentilis</i>	Curlew	<i>Numenius arquata</i>
Sparrowhawk	<i>Accipiter nisus</i>	Barn Owl	<i>Tyto alba</i>
Buzzard	<i>Buteo buteo</i>	Long-eared Owl	<i>Asio otus</i>
Kestrel	<i>Falco tinnunculus</i>	Short-eared Owl	<i>Asio flammeus</i>
Merlin	<i>Falco columbarius</i>	Raven	<i>Corvus corax</i>
Peregrine	<i>Falco peregrinus</i>		



Appendix B

Survey Programme

Vantage Point Survey

Table B1 Dates, Times and Weather Conditions During Vantage Point Surveys

Date	Survey period	Duration (hours)	Sunset / sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
VP1										
10/09/13	11:00-14:00	3	06:39/19:48	4/NW	6	None.	14	>2km	None.	1116 - Jet fighter flew low over site.
				4/NW	7	None.	13	>2km	None.	None.
				4/WNW	7	None.	13	>2km	None.	None.
24/09/13	11:24-14:24	3	07:04/19:11	2/W	7	None.	15	>2km	None.	None.
				3/W	8	None.	13	>2km	None.	None.
				3/W	8	Light rain shower.	12	>2km	None.	None.
02/10/13	15:35-18:35	3	07:20/18:50	5/SE	8	Light rain.	10	>2km	None.	None.
				5/SE	8	Light rain.	10	>2km	None.	None.
				4/SE	8	Moderate rain.	10	>2km	None.	None.

Date	Survey period	Duration (hours)	Sunset / sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
03/10/13	09:29-12:29	3	07:23/18:49	5-6/SE	8	None.	12	>2km	None.	None.
				5-6/SE	8	Occasional rain.	12	>2km	None.	None.
				5/S	8	Moderate rain.	12	>2km	None.	None.
15/11/13	07:50-10:50	3	07:50/16:11	2-3/SW	8	Light drizzle	8c	>2km	None.	None.
				3/SW	8	None	8c	>2km	None.	None.
				3/W	8	None	8c	>2km	None.	None.
25/11/13	10:40-13:40	3	08:09/15:57	0	5	None	5c	>2km	None.	None.
				1/NW	6	None	5c	>2km	None.	None.
				1/NW	6	None	5c	>2km	None.	None.
16/12/13	08:30-11:30	3	08:38/15:47	6/SW	8	None	3-4	>2km	None.	None.
				5/SW	6	None	3-4	>2km	None.	None.
				4/W	3	None	3-4	>2km	None.	None.
16/12/13	12:00-15:00	3	08:38/15:47	6/SW	2	None	4	>2km	None.	One person with two dogs.
				6/SW	2	None	4	>2km	None.	None.
				6/SW	4	None	3	>2km	None.	None.
22/01/14	09:30-12:30	3	08:24/16:32	6/SW	7	None	4	>2km	None.	None.
				6/SW	8	None	4	>2km	None.	None.
				6/SW	8	Light rain.	4	>2km	None.	None.

Date	Survey period	Duration (hours)	Sunset / sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
22/01/14	13:00-16:00	3	08:24/16:32	6/SW	8	Moderate rain.	5	500m-2km	None.	None.
				6/SW	8	Light rain.	5	>2km	None.	None.
				6/SW	7	Light rain.	5	500-2km	None.	None.
06/02/14	08:30-11:30	3	07:58/17:03	6/W	8	Moderate rain.	5	>2km	None.	None.
				6/W	8	None	5	>2km	None.	None.
				6/W	8	Light rain.	5	>2km	None.	None.
06/02/14	12:00-15:00	3	07:58/17:03	6/W	5	None	5	>2km	None.	None.
				5/SW	4	None	6	>2km	None.	None.
				5/SW	4	None	6	>2km	None.	None.
01/03/14	08:00-11:00	3	07:05/17:52	4/SE	1	None	3	>2km	None.	None.
				6/S	1	None	3	>2km	None.	None.
				6/S	1	None	3	>2km	None.	None.
01/03/14	11:30-14:30	3	07:05/17:52	6/S	1	None	3	>2km	None.	None.
				7/S	1	None	4	>2km	None.	None.
				6/S	1	Light rain.	4	>2km	None.	None.
Total		42 hours								

Date	Survey period	Duration (hours)	Sunset / sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
VP2										
11/09/13	11:10-14:10	3	06:40/19:45	1/NW	8	Light rain.	11	50-500m	None.	None.
				1/NW	8	Heavy rain.	12	50-500m	None.	None.
				2/WNW	8	Light drizzle.	12	50-500m	None.	None.
13/09/13	09:15-12:15	3	06:44/19:42	2/NW	8	None.	7	>2km	None.	None.
				2/NW	7	None.	9	>2km	None.	None.
				1/NW	8	None.	11	>2km	None.	None.
11/10/13	11:10-14:10	3	07:38/18:29	4/NE	8	None.	8	>2km	None.	None.
				3-4/NE	8	None.	8	>2km	None.	None.
				3-4/NE	8	None.	9	>2km	None.	None.
11/10/13	14:35-17:35	3	07:38/18:29	2-3/E	7	None.	8	>2km	None.	None.
				3/E	8	None.	8	>2km	None.	None.
				3/E	8	None.	8	>2km	None.	None.
14/11/13	13:10-16:10	3	07:48/16:13	5/NW	6	Light rain	4	>2km	None.	None.
				5/NW	3	None	6	>2km	None.	None.
				4-5/NW	2	None	5	>2km	None.	None.
26/11/13	12:13-15:13	3	08:11/15:57	1/NW	8	Light rain	7	500m-2km	None.	None.
				2/NW	8	Light rain	7	500m-2km	None.	None.
				1/NW	8	Light rain	7	500m-2km	None.	None.

Date	Survey period	Duration (hours)	Sunset / sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
04/12/13	08:57-11:57	3	08:25/15:49	2-3/NW	6	None.	3	>2km	None.	None.
				2-3/NW	7	None.	3	>2km	None.	None.
				3/NW	4	None.	3	>2km	None.	None.
11/01/14	09:00-12:00	3	08:38/16:11	5/SW	8	Light rain	2	500m-2km	100% 2cm	None.
				6/W	7	None.	2	500m-2km	100% 2cm	None.
				6/W	8	Light rain	2	500m-2km	100% 2cm	None.
11/01/14	12:30-15:30	3	08:38/16:11	6/W	7	None.	3	500m-2km	100% 2cm	None.
				6/W	7	Light rain	3	>2km	100% 2cm	None.
				6/W	7	None.	3	>2km	100% 2cm	None.
29/01/14	12:30-15:30	3	08:13/16:46	5/SE	7	None.	6	500m-2km	None.	None.
				5/SE	7	None.	6	500m-2km	None.	None.
				5/SE	7	None.	6	500m-2km	None.	None.
19/02/14	09:00-12:00	3	07:29/17:31	3/SW	7	None.	5	500m-2km	10% 10cm	None.
				3/SW	7	None.	5	500m-2km	10% 10cm	None.
				3/SW	7	None.	5	>2km	10% 10cm	None.
19/02/14	12:30-15:30	3	07:29/17:31	4/SW	6	None.	5	>2km	10% 10cm	None.
				5/SW	7	Light rain.	5	500m-2km	10% 10cm	None.
				5/SW	7	None.	5	>2km	10% 10cm	None.

Date	Survey period	Duration (hours)	Sunset/sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
24/03/14	09:00-12:00	3	06:06/18:38	7/SE	1	None.	3	>2km	None.	None.
				7/SE	1	None.	4	>2km	None.	None.
				8/SE	2	None.	4	>2km	None.	None.
24/03/14	12:30-15:30	3	06:06/18:38	8/S	1	None.	4	>2km	None.	None.
				8/S	2	None.	4	>2km	None.	None.
				8/S	2	None.	4	>2km	None.	None.
Total		42 hours								
VP3										
11/09/13	14:40-17:40	3	06:40/19:45	2/NW	8	Drizzle.	12	50-500m	None.	None.
				2/NW	8	Light drizzle.	12	50-500m	None.	None.
				2/W	8	Light drizzle.	11	50-500m	None.	None.
13/09/13	05:45-08:45	3	06:44/19:42	1/NW	2	None.	6	>2km	None.	None.
				2/NW	8	None.	7	>2km	None.	None.
				1/NW	5	None.	7	>2km	None.	None.
02/10/13	11:45-14:45	3	07:20/18:50	5/SE	8	Light rain.	10	500m-2km	None.	None.
				5/SE	8	Light rain.	10	500m-2km	None.	None.
				5/SE	8	None.	10	500m-2km	None.	None.

Date	Survey period	Duration (hours)	Sunset/sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
11/10/13	11:05-14:05	3	07:38/18:29	3/E	8	None.	8	>2km	None.	Forest machinery working.
				3/E	7	None.	8	>2km	None.	None.
				3/E	7	None.	8	>2km	None.	None.
14/11/13	09:40-12:40	3	07:48/16:13	3/NNW	5	None	4	>2km	None.	None.
				3-4/N	7	None	4	>2km	None.	None.
				4/N	8	None	4	>2km	None.	None.
26/11/13	08:58-11:58	3	08:11/15:57	2/NW	8	None	7	>2km	None.	None.
				2/NW	8	Light rain	7	500m-2km	None.	None.
				2-3/NW	8	Light rain	7	>2km	None.	None.
04/12/13	12:28-15:28	3	08:25/15:49	3/NW	3	None.	3	>2km	None.	None.
				3-4/NW	4	None.	3	>2km	None.	None.
				4/NW	3	None.	3	>2km	None.	None.
20/01/14	09:00-12:00	3	08:28/16:27	2/SW	8	None.	6	500m-2km	None.	None.
				2/SW	8	Light rain.	6	500m-2km	None.	None.
				2/W	8	Light rain.	6	500m-2km	None.	None.
20/01/14	12:30-15:30	3	08:28/16:27	2/SW	7	None.	6	>2km	None.	None.
				2/SW	7	None.	6	>2km	None.	None.
				2/SW	8	Light rain.	6	500m-2km	None.	None.

Date	Survey period	Duration (hours)	Sunset/sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
29/01/14	09:00-12:00	3	08:13-16:46	5/SE	8	Moderate rain.	5	500m-2km	None.	None.
				5/SE	8	Light rain.	5	500m-2km	None.	None.
				5/SE	8	Light rain.	5	500m-2km	None.	None.
27/02/14	09:00-12:00	3	07:10/17:48	6/W	8	Light rain.	5	500m-2km	None.	Forestry operation.
				6/W	8	Light snow.	5	>2km	None.	Forestry operation.
				6/W	8	Light snow.	5	>2km	None.	Forestry operation.
27/02/14	12:30-15:30	3	07:10/17:48	5/W	6	None.	5	>2km	None.	Forestry operation.
				5/W	7	None.	5	>2km	None.	Forestry operation.
				5/W	7	Light rain.	5	>2km	None.	Forestry operation.
23/03/14	09:00-12:00	3	06:09/18:36	7/NW	3	None.	4	>2km	None.	None.
				7/NW	4	None.	4	>2km	None.	None.
				6/NW	2	None.	5	>2km	None.	None.
23/03/14	12:30-15:30	3	06:09/18:36	5/NW	4	None.	5	>2km	None.	None.
				6/NW	4	Light snow.	6	>2km	None.	None.
				7/NW	4	None.	6	>2km	None.	None.
Total		42 hours								

Date	Survey period	Duration (hours)	Sunset/sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
VP4										
10/09/13	14:45-17:45	3	06:39/19:48	5/WNW	5	None.	15	>2km	None	None.
				6/W	3	None.	15	>2km	None	None.
				6/W	2	None.	13	>2km	None	None.
12/09/13	10:00-13:00	3	06:42/19:42	2/SW	6	None.	9	>2km	None	None.
				2/S	3	None.	11	>2km	None	None.
				3/SSW	6	None.	11	>2km	None	None.
02/10/13	11:20-14:20	3	07:20/18:50	4-5/SE	8	None.	12	>2km	None	None.
				5-6/SE	8	None.	12	>2km	None	None.
				5-6/SE	8	None.	12	>2km	None	None.
03/10/13	09:30-12:30	3	07:23/18:49	4/SSE	8	Moderate rain showers.	12	>2km	None	None.
				4-5/SSE	7	Moderate rain.	12	>2km	None	None.
				4-5/SSE	7	Moderate rain showers.	12	>2km	None	None.
15/11/13	11:45-14:45	3	07:50/16:11	2/W	8	Light drizzle	8	>2km	None	
				3/W	8	Light drizzle	8	>2km	None	
				2-3/W	8	None	8	>2km	None	
27/11/13	08:11-11:11	3	08:13/15:55	4/NW	8	None	7	>2km	None	None
				4/NW	8	None	7	>2km	None	None
				4/NW	8	None	7	>2km	None	None

Date	Survey period	Duration (hours)	Sunset/sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/ moderate/ light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
04/12/13	08:05-11:05	3	08:25/15:49	2/SW	1	None.	3	>2km	None	None.
				4/SW	1	None.	3	>2km	None	Farmer on quad with dogs, through viewshed.
				5/SW	1	None.	3	>2km	None	None.
08/01/14	08:15-11:15	3	08:41/16:06	7/WSW	5	Moderate rain.	6	>2km	None	None.
				7/WSW	3	None.	6	>2km	None	None.
				6/SW	3	None.	6	>2km	None	None.
08/01/14	11:45-14:45	3	08:41/16:06	6/SW	1	None.	7	>2km	None	None.
				5/SW	2	None.	7	>2km	None	None.
				6/SW	1	None.	7	>2km	None	None.
27/01/14	12:30-15:30	3	08:18/16:41	5/S	4	None.	4	>2km	None	None.
				6/S	7	Light rain.	4	>2km	None	None.
				6/S	8	Light rain.	4	500m-2km	None	None.
07/02/14	08:30-11:30	3	07:56/17:05	4/W	8	Light rain.	4	500m-2km	None	None.
				4/W	6	Light sleet.	4	>2km	None	None.
				3/W	2	None.	4	>2km	None	Farmer checking sheep.

Date	Survey period	Duration (hours)	Sunset/sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
07/02/14	12:00-15:00	3	07:56/17:05	5/SW	4	None.	4	>2km	None	None.
				5/SW	5	None.	4	>2km	None	None.
				5/SW	5	None.	4	>2km	None	None.
02/03/14	08:30-11:30	3	07:03/17:54	2/SE	4	None.	4	>2km	None	None.
				6/S	7	None.	4	>2km	None	None.
				6/S	8	None.	4	>2km	None	None.
02/03/14	12:00-15:00	3	07:03/17:54	6/S	8	Light rain.	5	>2km	None	None.
				5/SE	8	Moderate rain.	5	500m-2km	None	None.
				5/SE	8	Moderate rain.	5	500m-2km	None	None.
Total		42 hours								
VP5										
12/09/13	13:30-16:30	3	06:42/19:42	6/SE	8	None.	9	50-500m	None	None.
				6/SE	8	None.	9	50-500m	None	None.
				5/SE	8	Moderate rain.	9	500m-2km	None	None.
24/09/13	12:50-15:50	3	07:04/19:11	2/SE	8	None.	15	>2km	None	None.
				2-3/SE	8	None.	11	500m-2km	None	None.
				2/SE	8	None.	11	>2km	None	None.
02/10/13	15:01-18:01	3	07:20/18:50	5-6/SE	8	Light drizzle.	12	>2km	None	None.
				6/SE	8	None.	11	>2km	None	None.
				4-5/SE	8	Drizzle.	11	>2km	None	None.

Date	Survey period	Duration (hours)	Sunset/sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
11/10/13	14:45-17:45	3	07:38/18:29	2-3/NE	8	None.	11	>2km	None	None.
				2-3/NE	8	None.	11	>2km	None	None.
				2-3/NE	8	None.	10	>2km	None	None.
25/11/13	12:20-15:20	3	08:09/15:57	1/W	7	None	4	>2km	None	None.
				2/W	8	None	2	>2km	None	None.
				2/W	8	None	1	>2km	None	None.
27/11/13	08:15-11:15	3	08:13/15:55	2/W	8	None	8	500m-2km	None	None
				2-3/W	8	None	8	500m-2km	None	None
				2-3/W	8	None	8	500m-2km	None	None
04/12/13	11:35-14:35	3	08.25/15.49	5/SW	3	None.	4	>2km	None	None.
				4/SW	2	None.	4	>2km	None	None.
				4/SW	2	None.	4	>2km	None	None.
09/01/14	08:30-11:30	3	08:40/16:07	5/SW	8	None.	4	500m-2km	None	None.
				5/SW	7	None.	4	500m-2km	None	None.
				4/SW	7	None.	4	>2km	None	None.

Date	Survey period	Duration (hours)	Sunset/sunrise time (where applicable)	Wind force (Beaufort scale) and direction	Cloud Cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Snow cover (depth and percentage coverage across site)	Notes (e.g. disturbance events)
09/01/14	12:00-15:00	3	08:40/16:08	5/SW	8	None.	4	500m-2km	None	None.
				6/SW	6	Light rain.	4	500m-2km	None	None.
				6/W	7	Light rain.	4	500m-2km	None	None.
27/01/14	08:45-11:45	3	08:18/16:41	5/SW	8	None.	3	>2km	70% 1cm	None.
				6/SW	6	Light rain.	3	>2km	70% 1cm	None.
				6/SW	7	Light rain.	3	>2km	70% 1cm	None.
13/02/14	08:40-11:40	3	07:43/17:18	8/SW	6	None.	1	>2km	100% 15cm	None.
				7/SW	7	None.	1	>2km	100% 15cm	None.
				7/SW	8	None.	1	>2km	100% 15cm	None.
13/02/14	12:10-15:10	3	07:43/17:18	6/SW	8	None.	1	>2km	100% 15cm	None.
				6/SW	8	Light rain showers.	1	500m-2km	100% 15cm	None.
				6/SW	8	Moderate rain showers.	1	500m-2km	100% 15cm	None.
04/03/14	08:30-11:30	3	06:58/17:58	6/SW	6	None.	2	>2km	None	None
				6/SW	7	None.	2	>2km	None	None
				6/SW	7	None.	3	>2km	None	Walkers on Enoch Hill
04/03/14	12:00-15:00	3	06:58/17:58	7/SW	6	None.	3	>2km	None	None
				7/SW	6	None.	3	>2km	None	None
				7/SW	7	None.	3	>2km	None	None.
Total		42 hours								

Winter Transect Survey

Table B2 Dates, Times and Weather Conditions During Winter Transect Surveys

Visit number	Date	Survey period	Sunrise / Sunset time	Wind force (Beaufort scale) and direction	Cloud cover (eighths)	Precipitation (rain/snow/hail, heavy/moderate/light, showers)	Temperature (Degrees Celsius)	Visibility (<100m, 100-500m, 500m-2km, >2km)	Notes
1	24/09/2013	11:13-17:50	07:05	W F3	8/8	Light rain	12c	>2km	
2	03/10/2013	12:30-15:52	07:23	SE F5-6	7/8	None	14c	>2km	
3	25/11/2013	10:45-16:10	08:09	No wind	7/8	None	2c	>2km	
4	17/01/2014	08:00-14:30	08:32	SE F1	7/8	None	6c	>2km	
5	28/01/2014	09:00-15:30	08:15/16:44	NE F3	7/8	Light rain	5c	>2km	
6	16/02/2014	08:00-15:00	07:36/17:24	SW F4	3/8	None	3c	>2km	80% snow cover, depth 20cms.
7	03/03/2014	08:30-15:30	07:00/17:56	W F3	4/8	None	7c	>2km	

Appendix C

Survey Results

Vantage Point Survey

Table C1 Target Species Flight Data

Flight reference number	VP Number	Date	Time	No. of birds	Flight time at 0-30m	Flight time at 30-150m	Flight time at >150m	Notes
Pink-footed Goose								
EH_046_A	4	08/01/2014	08:49	10	6			
EH_046_B	4	08/01/2014	08:49	10		156		
Black Grouse								
EH_062	1	01/03/2014	08:10	4	7			07:50-08:10 two males lekking/fighting and two females feeding nearby (10-15m away).
Hen Harrier								
EH_032	1	24/09/2013	11:58	1	63			Male. Landed.
EH_034	1	24/09/2013	12:28	1	31			Male. Lost from view.
EH_037	1	02/10/2013	16:53	1	45			Female.
EH_040	2	11/10/2013	16:45	1	372			Male.
EH_050	5	09/01/2014	14:09	1	72			Male. Lost from view.

Flight reference number	VP Number	Date	Time	No. of birds	Flight time at 0-30m	Flight time at 30-150m	Flight time at >150m	Notes
Merlin								
EH_027_A	4	10/09/2013	15:51	1	8			Female.
EH_027_B	4	10/09/2013	15:51	1		6		Same bird as EH_027_A. Mobbing Raven.
EH_027_C	4	10/09/2013	15:51	1	24			Same bird as EH_027_A/B
EH_033_A	1	24/09/2013	11:58	1	22			Mobbed Hen Harrier.
EH_033_B	1	24/09/2013	11:58	1		15		Flew towards forestry.
EH_035	4	02/10/2013	13:45	1	18			Mobbing Buzzard.
EH_039	2	11/10/2013	12:52	1	3			Male. Hunting Golden Plover.
Golden Plover								
EH_028	5	12/09/2013	13:35	22	13			
EH_029	5	12/09/2013	14:22	2	6			
EH_030	3	13/09/2013	08:08	18		14		
EH_031	3	13/09/2013	08:08	18	3			Lost over brow of hill.
EH_036	5	02/10/2013	15:04	1	7			
EH_038_A	2	11/10/2013	12:52	4	10			
EH_038_B	2	11/10/2013	12:52	4		35		
EH_038_C	2	11/10/2013	12:52	4	5			Lost from sight.
EH_041	3	14/11/2013	11:29	19	8			
EH_042	3	26/11/2013	09:13	2	5			
EH_043	5	27/11/2013	09:51	7	4			

Flight reference number	VP Number	Date	Time	No. of birds	Flight time at 0-30m	Flight time at 30-150m	Flight time at >150m	Notes
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EH_048	5	09/01/2014	08:33	3	3			
EH_049	5	09/01/2014	09:55	8	5			
EH_051	5	09/01/2014	14:30	1	3			
EH_052	2	11/01/2014	13:02	5	5			
EH_053	3	20/01/2014	09:35	1	3			
EH_054	5	27/01/2014	09:30	1	4			Lost from sight.
EH_055	5	27/01/2014	11:15	8	2			Lost from sight.
EH_056	4	07/02/2014	10:35	2	4			Lost from sight.
EH_057	2	19/02/2014	10:10	2	4			Lost from view.
EH_058	2	19/02/2014	10:22	10	3			Lost from view.
EH_059	2	19/02/2014	13:05	110		600		Spent 1/3 of flight time at CRH of a 30 minute flight. Marked as a polygon on the map.
EH_061	3	27/02/2014	10:13	35	4			
EH_063	1	01/03/2014	08:25	2	6			Lost from view.
EH_064	3	23/03/2014	11:03	220		360		
EH_065	2	24/03/2014	10:05	1	6			Lost from view.
EH_066	2	24/03/2014	11:35	200	1500			Flock active in area between 11:35 and 12:00. Marked as a polygon on the map.

Winter Transect Survey

Table C2 Details of Target and Secondary Species Encountered During Winter Transect Survey Results

Date	Species	Count	Location	Activity	Notes
Black Grouse					
24/09/2013	BK	1	Blood Moss	Flying	Male. Flew from forestry to Blood Moss.
28/01/2014	BK	2	Blood Moss	Lekking/Flying	Two males lekking between 10:00-10:30 then one bird flew off toward Knockburnie Burn and the other toward Knockburnie Glen.
03/03/2014	BK	3	Blood Moss	Loafing	Males.
03/03/2014	BK	4	Blood Moss	Flying	Three males and one female.
Hen Harrier					
16/02/2014	HH	1	Blood Moss/Peat Hill	Hunting	Female, lost from sight.
03/03/2014	HH	1	Benty Cowan	Flying	Female, lost from sight.
Buzzard					
03/03/2014	BZ	1	Blarene Hill	Flying	Soaring.
17/01/2014	BZ	1	Trough Burn	Flying	
28/01/2014	BZ	1	Knockburnie Burn	Flying	
28/01/2014	BZ	4	Benty Cowan	Flying	
Kestrel					
24/09/2013	K.	1	Over VP4	Flying	Mobbed by five Raven. Female.
24/09/2013	K.	1	Connelburn Rigg	Flying	Male. Flew West.
25/11/2014	K.	1	Blarene Hill	Hunting	
17/01/2014	K.	1	Near Dalleagles	Flying	

Date	Species	Count	Location	Activity	Notes
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17/01/2014	K.	1	Marshallmark	Perched	
28/01/2014	K.	1	Peat Hill	Hunting	
28/01/2014	K.	1	High Chang	Hunting	
16/02/2014	K.	1	Peat Hill	Hunting	
Golden Plover					
24/09/2013	GP	2	Barbey's Hill	Loafing	Flushed
24/09/2013	GP	1	High Chang	Flying	
03/10/2013	GP	16	Barbey's Hill	Loafing	Flushed
03/10/2013	GP	1	Enoch Hill	Flying	
03/10/2013	GP	1	Benty Cowan	Loafing	Flushed
03/10/2013	GP	16	Benty Cowan	Flying	
03/10/2013	GP	1	Benty Cowan	Loafing	Flushed
03/10/2013	GP	19	High Chang	Loafing	
03/10/2013	GP	1	High Chang	Loafing	Flushed
03/10/2013	GP	1	High Chang	Loafing	Flushed
25/11/2013	GP	1	Benty Cowan	Loafing	Flushed
17/01/2014	GP	1	Benty Cowan	Flying	
17/01/2014	GP	1	High Chang	Flying	
17/01/2014	GP	6	Barbey's Hill	Flying	
16/02/2014	GP	9	Polga Burn to High Chang Hill	Flying	Lost from sight.
03/03/2014	GP	3	High Chang	Loafing	

Date	Species	Count	Location	Activity	Notes
Snipe					
24/09/2014	SN	1	NY 55658 07719	Loafing	Flushed.
24/09/2014	SN	1	Chang Hill	Loafing	Flushed.
24/09/2014	SN	1	Connelburn Rigg	Loafing	Flushed.
03/10/2014	SN	1	Rigg Hill	Loafing	Flushed.
17/01/2014	SN	1	Benty Cowan	Flying	
17/01/2014	SN	1	Benty Cowan	Flying	
28/01/2014	SN	1	Blood Moss	Flying	Flushed.
28/01/2014	SN	4	Blood Moss	Flying	Flushed.
03/03/2014	SN	1	Littlechang Burn	Flying	Flushed.
03/03/2014	SN	1	Benty Cowan	Flying	Flushed.
03/03/2014	SN	1	Chang Hill	Flying	Flushed.
Woodcock					
17/01/2014	WK	1	High Chang Hill	Flying	
Raven					
24/09/2014	RN	5	Over VP4	Flying	Mobbing female Kestrel.
03/10/2014	RN	2	Knockburnie Burn	Flying	
03/10/2014	RN	4	Rigg Hill	Flying	
25/11/2014	RN	9	Blarene Burn	Foraging	
28/01/2014	RN	1	Polmathurn Bridge	Flying	
28/01/2014	RN	2	Polga Burn	Flying	Displaying.
16/02/2014	RN	2	Chang Hill	Flying	

Incidental Records

Table C3 Incidental Records

Date	Time	Species	Count	Location	Activity	Notes
Pink-footed Goose						
11/10/2013	10:40	PG	48	Barbey's Hill	Flying	
Black Grouse						
13/09/2013	13:00	BK	1	Blood Moss	Flying	Flew from forest to Blood Moss.
16/12/2013	08:57	BK	3	E of Blood Moss	Lekking	Males.
22/01/2014	09:30	BK	1	Blood Moss	Loafing	Male.
06/02/2014	08:30-09:25	BK	2	E of Blood Moss	Lekking	Males.
11/03/2014	11:30	BK	1	NW of Peat Hill	Flushed	Male.
11/03/2014	14:00	BK	1	High Chang	Flushed	Male.
11/03/2014	16:30	BK	3	NW of Peat Hill	Flushed	Three males.
12/03/2014	Morning	BK	2	Blood Moss	Flushed	Two females.
Dotterel						
02/10/2013	14:57	DO	1	Benty Cowan	Loafing	Flushed.
Golden Plover						
11/09/2013	12:19	GP	1	VP2	Flying	Heard not seen.
11/09/2013	17:53	GP	2	Barbey's Hill	Loafing	Flushed.
12/09/2013	09:50	GP	1	Benty Cowan	Loafing	Flushed.
12/09/2013	09:50	ID	1	Benty Cowan	Loafing	American Golden Plover.
13/09/2013	12:35	GP	11	Barbey's Hill	Loafing	Flushed.
02/10/2013	14:57	GP	28	Benty Cowan	Loafing	Flushed.
02/10/2013	11:15	GP	55	Barbey's Hill	Loafing	Flushed.
11/10/2013	10:50	GP	5	High Chang	Flying	
11/10/2013	12:06	GP	1	Enoch Hill	Flying	
25/11/2013	13:18	GP	1	Benty Cowan	Flying	Heard not seen.
04/12/2013	12:12	GP	1	Benty Cowan	Flying	Heard not seen.
Dunlin						
12/09/2013	16:50	DN	1	Benty Cowan	Flying	Flew over calling.

Appendix 12.F

Confidential Information

Supplied to SNH, RSPB, EAC & Scottish Government only

Appendix 12.G

Collision Risk Modelling



Enoch Hill Wind Farm: Appendix 12.G

Collision Risk Analysis

1.1 Introduction

Bird flight activity over the Proposed Development was assessed during vantage point watches. Vantage Point (VP) surveys undertaken across two breeding and three non-breeding seasons confirmed that target species flight activity over the Proposed Development is relatively limited. Collision risk analysis (CRA) has therefore been limited to golden plover given the presence of relatively small groups of birds during the winter period that were recorded in flight within the area proposed for turbines.

Of the three non-breeding seasons during which VP surveys were undertaken at Enoch Hill, golden plover activity appeared to be at its greatest during winter 2013/14 in terms of peak flock size and the cumulative amount of flight time. Collision risk has therefore been modelled using golden plover flight data for winter 2013/14 only, as this represents a worst case scenario.

1.2 CRA Background

Flight lines of target species recorded during VP surveys can be digitised into a GIS package to determine if any regularly used flight paths or areas of 'core' flight activity (around a nest site for example) are present and, where necessary, to allow a development to be designed to avoid these.

Data obtained during VP surveys can also be used to determine the theoretical collision risk for target species by incorporation into a model, such as that developed by W. Band (Band *et al.*, 2007) and herein referred to as the Band model. The Band model uses a two-stage approach, whereby the number of birds or flights passing through the air space swept by the rotors is determined at Stage 1 and the probability of a bird strike occurring is calculated at Stage 2. The product of Stage 1 and Stage 2 gives a theoretical annual collision mortality rate on the assumption that birds make no attempt to avoid colliding with turbines.

The Band model involves making a number of assumptions, for example that a turbine blade has width and pitch but no thickness and that a bird's flight will be unaffected by a near miss, despite the slipstream around a turbine blade. The amount of time that a species may be active within the site in a year is also required for the model and must therefore be estimated.

Because the Band model assumes that no action is taken by a bird to avoid collision, it is recognised that the collision risk figures derived are purely theoretical and represent worst case estimates. In the general absence of empirically derived avoidance estimates for individual species, the actual value of the results of the modelling for impact assessment is limited, although further assumptions about likely levels of active avoidance on the part of birds are generally made in order to draw conclusions (empirical evidence to date suggests that avoidance rates are well in excess of 95% e.g. Fernley, Lowther & Whitfield, 2006, Scottish Natural Heritage (SNH) 2010b). As a result of these considerations, outputs from CRA must be interpreted with care.

CRA, and particularly the Band model favoured by SNH, has been the subject of academic debate and comment regarding its relevance and usefulness (e.g. Chamberlain *et al.*, 2005 & 2006, Madders & Whitfield 2006, Drewitt & Langston 2006, Fernley, Lowther & Whitfield 2006), the conclusion of which being that CRA results must be interpreted with care as noted above. The main influence on the final result of CRA is the avoidance rate that is applied to the model; and without accurate avoidance rates, the model becomes relatively meaningless no matter how mathematically robust it is.

For a number of years SNH recommended a highly precautionary approach, using a value of 95% as an avoidance rate (Band *et al.*, 2007). However, empirical evidence has accrued which suggests that avoidance rates for most species/groups are well in excess of 95% and precautionary rates can be increased to 98-99% or higher in most cases. This has been acknowledged by SNH and the species-specific avoidance rate of 98% recommended by them (SNH 2010b) has been applied for the purposes of this assessment.



1.3 Methods

Definition of Terms

The definition of the terms used in this assessment are as follows:

- ▶ **Collision Risk Area:** This is determined as the boundary around the extremities of the outermost turbines, including blade length and incorporating the proposed micro-siting allowance of 50m;
- ▶ **Collision Risk Height:** Only flight data at collision risk height is used in the Band model; and in this case the worst-case rotor swept heights are between 24m and 130m on the basis of the largest rotor diameter being considered (106m) on a 77m hub height to meet the maximum tip height criteria of 130m). During surveys, observed flights of target species were assigned to one of a series of height bands, generally 0-30m, 30-130m (or 30-150m) and >130m (or >150m). For the purposes of CRA, all flights at heights of 30-150m and 20% of flight time within band 0-30m (i.e. on the basis of the 6m 'risk airspace' between 24m and 30m being 20% of the 0-30m height band) have been included;
- ▶ **View-Shed:** The survey area associated with each VP, calculated on the basis of a 180° arc and a 2km-radius applied around each VP location. The area of visibility within each view-shed at collision-risk height is calculated using Zone of Theoretical Visibility software (in this case ReSoft Windfarm Release 4.2.1.7);
- ▶ **Collision Risk Volume:** Defined as the volume of the collision risk height airspace over the collision risk area;
- ▶ **The Rotor-Swept Volume:** Defined as the volume of air that would actually be swept by all of the rotors in the wind farm. For an individual rotor this is determined by the area swept (πr^2) multiplied by the depth of the rotor blades from front to back.

Selection of Flights

CRA for golden plover has been carried out using the cumulative survey data from VPs 2, 3 and 5 during winter 2013/14. The entire turbine envelope lies within these three view-sheds and the main activity area for golden plover¹ (Enoch Hill, High Chang Hill, Barbey's Hill and Benty Cowan Hill) lies within these. The mean flock size across the 2013/14 winter season was of 26 individuals (a total of 26 flocks comprising 710 individuals in total, with the peak flock size of 220 birds in March).

Table 1.1 details those flights that meet the criteria detailed above and which have therefore been included in the CRA. It should be noted that the amount of time at collision risk height has been derived as a product of flight duration and the number of individuals in the flock. Furthermore, given the apparent random nature of golden plover flights, all of those observed within each view-shed at collision-risk height have been included in the CRA, including flights out-with the collision-risk area. As such, the results of the CRA are likely to over-estimate the theoretical collision risk of golden plover.

Table 1.1 Golden Plover (GP) Flights from Winter 2013/14 included in the CRA

Unique Identification (UID) Code	Time (secs) at collision risk within viewshed (30-130m)	Time (secs) at collision risk within viewshed (24m-30m)
Vantage Point 2		
EH_038_A	N/A	8
EH_038_B	140	N/A
EH_038_C	N/A	4

¹ Only two flights, each of two individuals, was recorded from VP1 and from VP4.



Unique Identification (UID) Code	Time (secs) at collision risk within viewshed (30-130m)	Time (secs) at collision risk within viewshed (24m-30m)
EH_052	N/A	5
EH_057	N/A	1.6
EH_058	N/A	6
EH_059	66,000	N/A
EH_065	N/A	1.2
EH_066	N/A	60,000
Vantage Point 3		
EH_030	202	N/A
EH_031	N/A	10.8
EH_041	N/A	30.4
EH_042	N/A	2
EH_053	N/A	0.6
EH_061	N/A	28
EH_064	63,360	N/A
Vantage Point 5		
EH_028	N/A	57.2
EH_029	N/A	2.4
EH_036	N/A	1.4
EH_043	N/A	5.6
EH_048	N/A	1.8
EH_049	N/A	8
EH_051	N/A	0.6
EH_054	N/A	0.8
EH055	N/A	3.2
Total	129,702	60,179

Selection of Parameters used in CRA

A series of parameters are required to allow CRA to be undertaken. These are primarily biometrics of the bird species in question, for example wingspan and flight speed, and turbine specifications, for example rotor diameter and rotational speed. There is scope for a degree of variation in the input parameters for a given species and the final choice of turbine will only be known following a competitive tendering process and will depend on the technology available at the time of construction. Furthermore, there is scope for a degree of variation even where the final choice of turbine has been made as some parameters have a range, for example rotational period, but only a single value can be used in the model.

In order to carry out CRA, it has been assumed that the largest blade currently being considered will be used as this maximises the risk area, with median values being used where parameters have a range. It has also



been assumed that turbines will be non-operational for 15% of the time (e.g. during periods where wind speed is too low or too high to operate, or during maintenance).

In respect of bird biometric data, this has been obtained from the British Trust for Ornithology (BTO) website², while information on average flight speed has been obtained from Alerstam *et al.*, 2007. As previously noted, the default golden plover avoidance rate of 98% as recommended by SNH has been applied.

Turbine data and golden plover biometric data used in the CRA are presented in **Table 1.2**.

Table 1.2 CRA assumed Parameters

Parameter	Specification
Number of turbines	19
Number of blades	3
Max Chord (m)	4
Pitch (°)	6
Maximum height to blade tip (m)	130
Approximate Hub Height (m)	77
Approximate rotor diameter (m)	106
Revolution period (sec)	4.6
GP wing span (m)	0.72
GP body length (m)	0.28
GP flight speed (m/sec)	13.7

1.4 Results

The detailed workings of the CRA are provided in Appendix 1.A. A theoretical annual collision rate of **4.4** golden plover was predicted based upon the season with the greatest level of flight activity (winter 2013/14) during the five seasons that Enoch Hill was surveyed (2011-2014).

² <http://www.bto.org/about-birds/birdfacts>. Accessed on 30 June 2015.



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Appendix 1.A

Golden Plover CRA



Stage 1

1	Survey area visible (ha)	1626	
	Proportion of time between 24-130m (t) (obs time/survey time) 0.418743386	Survey time (Mins) 7560	Bird obs time@24-130m (Mins) 3165.7
2	Flight activity per ha (F) $F = t/\text{Survey area visible}$ 0.00025753		
	Flight risk area (ha)	301	
3	Proportion of time at 24-130m $F \times \text{flight risk area}$ 0.077516457	Hub height (m) 77	Blade diameter (m) 106
		Maximum rotor height 130	Minimum rotor height 24
4	Proportion of time in turbine area $((\text{top of rotor}-\text{bottom of rotor})/(130-24)) \times F$ 0.077516457		
		days likely present 212	hours active 10
5	Bird occupancy period in windfarm n (hrs) (days present*hrs active per day)* prop time in turbines 164.3348891		
6	Flight risk volume V_w (m ²) (windfarm area*rotor diameter) 319060000		
		Number of turbines 19	πR^2 8828.285714
7	Combined volume swept by rotors V_r (m ³) 382441.3371	Blade Depth (m) 2	Bird Length (m) 0.28
8	Occupancy of rotor swept area b (bird seconds) (n*(V_r/V_w)) 709.1281796	n(secs) (used in step 8) 591605.6007	
		flight speed (m/s) 13.7	
9	Time to fly through and clear rotors time (rotor depth+bird length)/flight speed(m/s) 0.166423358		
10	Number of transits through rotors per year (b/time) 4260.9895		
		Stage 2 (collision probability) 0.052	
	Annual theoretical collision rate assuming no avoidance (Number of transits x stage 2 collision probability) 221.8		

Annual theoretical collision rate assuming 98% avoidance:

CALCULATION OF COLLISION RISK FOR BIRD PASSING THROUGH ROTOR AREA - Golden Plover

K: [1D or 3D] (0 or 1)		Calculation of alpha and p(collision) as a function of radius										
NoBlades	3						Upwind:			Downwind:		
MaxChord	4	m	r/R	c/C	α	collide	contribution		collide	contribution		
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
BirdLength	0.28	m	0.025	0.575	7.57	23.01	1.00	0.00125	22.52	1.00	0.00125	
Wingspan	0.72	m	0.075	0.575	2.52	7.83	0.37	0.00280	7.35	0.35	0.00262	
F: Flapping (0) or gliding (+1)	0		0.125	0.702	1.51	5.61	0.27	0.00334	5.02	0.24	0.00299	
			0.175	0.860	1.08	4.84	0.23	0.00403	4.12	0.20	0.00343	
Bird speed	13.7	m/sec	0.225	0.994	0.84	4.35	0.21	0.00466	3.52	0.17	0.00377	
RotorDiam	106	m	0.275	0.947	0.69	3.48	0.17	0.00456	2.69	0.13	0.00352	
RotationPeriod	4.60	sec	0.325	0.899	0.58	2.88	0.14	0.00445	2.13	0.10	0.00329	
			0.375	0.851	0.50	2.43	0.12	0.00433	1.72	0.08	0.00306	
			0.425	0.804	0.45	2.08	0.10	0.00421	1.41	0.07	0.00285	
			0.475	0.756	0.40	1.80	0.09	0.00407	1.17	0.06	0.00264	
			0.525	0.708	0.36	1.59	0.08	0.00398	1.00	0.05	0.00250	
			0.575	0.660	0.33	1.42	0.07	0.00389	0.87	0.04	0.00238	
			0.625	0.613	0.30	1.27	0.06	0.00379	0.76	0.04	0.00227	
			0.675	0.565	0.28	1.15	0.05	0.00368	0.67	0.03	0.00217	
			0.725	0.517	0.26	1.03	0.05	0.00357	0.60	0.03	0.00207	
			0.775	0.470	0.24	0.93	0.04	0.00344	0.54	0.03	0.00199	
Bird aspect ratio: β	0.39		0.825	0.422	0.23	0.84	0.04	0.00330	0.49	0.02	0.00192	
			0.875	0.374	0.22	0.76	0.04	0.00316	0.45	0.02	0.00186	
			0.925	0.327	0.20	0.68	0.03	0.00300	0.41	0.02	0.00180	
			0.975	0.279	0.19	0.61	0.03	0.00284	0.38	0.02	0.00176	

Overall p(collision) =	Upwind	7.2%	Downwind	5.0%
	Average	6.1%		
	inc shut-down	5.2%	(turbines assumed inoperative 15% of time)	

Unique Identification (UID) Code	Time (secs) at collision risk (30-130m)	Time (secs) at collision risk 24m-30m)	
Vantage Point 2			
EH_038_A		8	
EH_038_B	140		
EH_038_C		4	
EH_052		5	
EH_057		1.6	60025.8
EH_058		6	
EH_059	66,000		
EH_065		1.2	
EH_066		60,000	
Vantage Point 3			
EH_030	202		
EH_031		10.8	
EH_041		30.4	71.8
EH_042		2	
EH_053		0.6	
EH_061		28	
EH_064	63,360		
Vantage Point 5			
EH_028		57.2	
EH_029		2.4	
EH_036		1.4	
EH_043		5.6	
EH_048		1.8	
EH_049		8	81
EH_051		0.6	
EH_054		0.8	
EH055		3.2	60178.6
Total	129,702		189,881

mins 3164.7