HIGHLEE HILL WIND FARM

Environmental Statement 2016

Volume 4 – Technical Appendices

Technical Appendix 2.1 – Schedule of Standard Mitigation

Introduction

2.1 This technical appendix details the mitigations the RES implement as a matter of course on all of their wind farms. This mitigation is based on experience gained from the construction and operation of wind farms throughout the world.

2.2 The following RES documents will be implemented throughout construction:

- RES Standard Environmental Requirements of Contractors;
- RES Water Quality Monitoring Procedure; and
- RES Procedure in the Event of a Contaminant Spill.

Best Practise

Planning & Environmental Legislation

- The Town and Country Planning (Scotland) Act 1997 (as amended).
- The Water Environment (Controlled Activities) (Scotland) Regulations 2005 (as amended) (CAR Regulations).

SEPA Pollution Prevention Guidelines

- PPG01 General guide to the prevention of pollution.
- PPG02 Above ground oil storage tanks.
- PPG04 Treatment and disposal of sewage where no foul sewer is available.
- PPG05 Works and maintenance in or near water.
- PPG06 Working at construction and demolition sites.
- PPG07 Refuelling facilities.
- PPG08 Safe storage and disposal of used oils.
- PPG18 Managing fire water and major spillages.
- PPG13 Vehicle washing and cleaning.
- PPG21 Pollution incident response planning.
- SEPA Special Requirements for Civil Engineering Contracts for the Prevention of Pollution.

British Standards Institute

- Code of Practice for Earth Works, BS6031:2009.
- Code of practice for noise and vibration control on construction and open sites. Noise, BS5228-1: 2009.

CIRIA Publications

- Control of Water Pollution from Construction Sites – Guide to Good Practice (SP156).
- Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (C532).
- Control of Water Pollution from Linear Construction Projects – Technical Guidance (C648).
- Control of Water Pollution from Linear Construction Projects – Site Guide (C649).
- Environmental Good Practice – Site Guide (C650).
- The SUDS Manual (C697).
- Site Handbook for the Construction of SUDS (C698).

General Construction Mitigation

Dust

2.3 Dust management will be carried in accordance with industry best practice measures to ensure that any local sensitive receptors are not affected by nuisance levels of dust from the works. The following methods of dust suppression may be implemented during the construction phase of the wind farm as required:

- site tracks to be damped down using bowser or other suitable system;
- road sweeper to be used to remove loose material from highways during construction;
- cleaning vehicles including wheel washing facilities;
- soil erosion control measures;
- speed limits to be put in place to ensure low vehicle speeds;
- all vehicle loads to be covered;
- damping of dry excavations and cutting activities which generate dust; and
- programming of works to minimise the time that soils are exposed.

Lighting

2.4 All lighting rigs will be downward facing and lights will be switched off during daylight hours.

Waste Management

2.5 RES shall ensure waste is minimised on the construction site by reducing, re-using and recycling waste. A Site Waste Management Plan (SWMP) will be created prior to construction which identifies all waste streams and responsibilities.

2.6 The SWMP will be periodically reviewed and amended as required. All waste disposal records will be retained and copies provided, where necessary.

Cultural Heritage

2.7 If deemed necessary, a Written Scheme of Works will be prepared prior to commencement of works and agreed with the Planning Authority.

2.8 Where required, cultural heritage assets would be entirely fenced off or visibly marked out to prevent accidental damage occurring to the remains during construction activities in the vicinity.

2.9 Where necessary, supervision of by archaeological clerk of works and toolbox talks discussing site specific archaeological sensitivities will be provided to all site personnel.

Ornithology

Vegetation Clearance

2.10 There is no forest felling proposed as part of the current proposal. If any felling were to be deemed necessary, prior to any tree felling on the site, the area in question would be searched by a suitably qualified and experienced ecologist/ornithologist for any breeding birds. Should any active nests be located, the area will be marked out, with an exclusion zone of 5 m radius for all non-Schedule 1 species. Should any breeding Schedule 1 species be found on site, an exclusion zone will be agreed with SNH, but would be based upon the disturbance distances provided in SNH guidance.

2.11 No activity should be undertaken within exclusion zones until the nest is no longer in use. A Schedule 1 licence may be required to check upon any Schedule 1 nests located on the site.

2.12 For other vegetation clearance (for example bush/shrub or ground vegetation removal) vegetation removal should occur where possible within the period September – March (inclusive), outside the bird breeding season. Should vegetation removal be required outside this period then the area should be searched prior to removal by a suitably qualified and experienced ecologist/ornithologist. Any nests found would be suitably protected.

Terrestrial Ecology

General

2.13 An Ecological Management Plan (EMP) will be agreed with The Highland Council.

2.14 The EMP will detail measures required to protect ecology at the proposed wind farm site, including pre-construction surveys and vegetation management.

2.15 All water crossings will allow the free passage of mammals.

Ecological Clerk of Works

2.16 An Ecological Clerk of Works (ECoW) will be appointed to conduct pre-construction protected species surveys and regular monitoring during construction.

2.17 The ECoW will provide Toolbox talks to highlight site specific ecological sensitivities to all site personnel.

2.18 Written guidelines will be issued for use by all construction contractors containing the protocol and contact details for calling upon retained professional support in the event that protected species are found.

Vegetation Clearance

2.19 As per the ornithological vegetation clearance.

Traffic & Transport

2.20 A Traffic Management Plan will be agreed with The Highland Council prior to the commencement of construction.

Geology, Hydrology & Hydrogeology

2.21 Any incident that may impact water quality will be dealt with in accordance with the RES Emergency Procedure in the Event of a Contaminated Spill.

2.22 Detailed measures to address surface water management will be addressed in the SuDS Design.

2.23 Water quality monitoring will be undertaken on discharge waters prior to, during the construction phase to assess and manage the performance of the SuDS system, making adjustments as necessary to ensure that site drainage does not impact on local watercourses.

Drainage Design Principles

SuDS

2.24 A SuDS design will be agreed with SEPA prior to the commencement of construction and will be implemented as agreed.

2.25 The use of swales, check dams and settlement ponds in series will provide a surface water management train that will mitigate any adverse impact on the hydrology of the Site and surrounding areas during the construction phase of the project.

2.26 Flow rates from tracks will be reduced through use of attenuating check dams "at source", with pass-forward flow rate reduced by filtration and temporary detention. Suitable SuDS infrastructure will be retained for the operational phase of the project.

2.27 A SuDS design will be implemented to:

- ensure that the impact to existing hydrological patterns including watercourse morphology, overland flow routes and channels, private water abstraction points / catchments and flood characteristics is minimised;

- address site specific constraints such as Groundwater Dependant Terrestrial Ecosystems (GWDTEs), protection of downstream SAC sites and private water supply abstraction points;
- avoid transporting rainfall runoff in long linear drainage swales by providing regular channel "breakouts", whereby water is encouraged to flow overland, thus maintaining existing natural hydrological patterns;
- reducing surface water flow rates and volumes by providing stone filtration check-dams, whereby the flow velocity and rate of discharge is reduced;
- providing settlement ponds at turbine hard standing areas, where runoff from additional impermeable areas is attenuated prior to discharged to the natural environment;
- provide up-slope cut off drains in excavated areas to separate "clean" surface water from "dirty" runoff over construction areas; and
- ensure that all swales, crossings and other hydraulic features will be engineered to ensure that dimensions etc. are suitable to convey predicted flows and so prevent build-up of surface water and/or flooding.

2.28 A SuDS design will reduce the sediment/silt loads in construction and post construction runoff by providing a "treatment train" of pollutant removal to all surface water runoff, nominally by:

- ensuring that drainage swales are designed to convey flows at a low velocity by using a flat bottomed swale profile;
- encouraging vegetation growth in the base of all linear drainage to provide additional sediment removal from flows;
- providing settlement and filtration features in all linear drainage swales (stone check dams, filtration dams) to reduce flow velocity and encourage settlement of silts;
- installing temporary silt fencing to provide extra protection to waterways / environmentally sensitive areas during the construction phase;
- providing settlement ponds at turbine hard standing areas to manage both sediment generated both during and post construction;
- ensuring that the final discharge points of the SuDS treatment train are located on stable, undisturbed, vegetated ground, allowing flow entrained sediment to drop out of flows. Provide silt fencing at outlet if required; and
- prevent discharge of construction runoff directly to existing watercourses or natural drainage channels. All discharges are to be via a SuDS feature to improve water quality prior to final discharge to the environment.

Water Crossings

2.29 The hydraulic requirements of all watercourse crossings will be considered and using the following guidance the watercourse crossings will be appropriately sized:

- Flood Estimation Handbook (Statistical Analysis) and Flood Studies Report (FSR) where appropriate used to determine the design flow;
- CIRIA Culvert design and operation guide (C689); and
- Scottish Executive (2002) River Crossings and Migratory Fish: Design Guidance (where appropriate).

2.30 Additional factors considered in the design and orientation of watercourse crossings includes:

- use of clear span crossings in order to avoid disruption to the stream bed where stream bed width is >2 m;
- embedment of closed culverts to allow a natural bed substrate to form;
- crossing direction to generally be perpendicular with access road direction, therefore minimising the length of stream affected;
- consideration of the passage of out-of-bank flood flows;
- provision of mammal (e.g. otter/water vole) passage through the crossing structure in all flow conditions; and
- consideration of any factors or recommendations arising out of a pre-construction habitat survey of the watercourse channel at the crossing location.

2.31 These water crossings will be subject to CAR authorisation from SEPA. Good practice in relation to water crossings involves the following aspects:

- the appropriate crossing type will be identified from SEPA's best practice guidance and will take into account any ecological and hydrological constraints; and
- crossings will be sized and designed to minimise effect upon flood risk (sized to accommodate the 1 in 200 year flow.

General Construction Phase Controls

2.32 The following procedures apply to the general construction activities either within watercourses or in the vicinity of watercourses.

- ensure roads are built to the layout design;
- avoid construction near streams in wet weather whenever possible;
- avoid using acidic, metal or sulphide-rich spoil for road construction;
- layout design to ensure roadside drains do not discharge directly into watercourses, but rather through a buffer area of adequate width;
- keep cement and raw concrete out of watercourses;
- avoid placing spoil heaps within buffer zones; and
- run-off from excavations will not be pumped directly to watercourses. Where dewatering of excavations is required, water shall be pumped to the head of a treatment train (swale, filtration checkdams and detention pond) in order to remove suspended silts prior to re-entry to the natural drainage system.

2.33 It is noted that SuDS treatment techniques will be utilised to reduce silt load from runoff prior to the discharge of flows over the open vegetated areas.

Ground Water Dependent Terrestrial Ecosystem Mitigation

2.34 The following procedures apply to the general construction activities when working in catchments contributing to an area recognized as a GWDTE:

- in areas where construction work is in proximity to high dependency GWDTE a buffer zone will be fenced off during construction;
- all construction runoff will be directed through the proposed SuDS system prior to dispersal over open vegetated areas;
- all refuelling will be undertaken at designated refuelling points. There will be no refuelling within catchments contributing to GWDTE;
- dewatering of excavations will be minimized in the vicinity of GWDTEs;
- discharge of dewatering operations will be via suitable SuDS infrastructure; and
- surface and subsurface drainage will be provided to maintain continuity of groundwater contributions to GWDTEs.

Concrete Washout

2.35 Concrete will not be allowed to enter watercourses under any circumstances, and drainage from excavations in which concrete is being poured will not be discharged directly into existing watercourses without appropriate treatment and consent of the SEPA. Delivery trucks, tools and equipment will be cleaned at designated washout areas located conveniently and within a controlled area of the site.

2.36 The washout area will be lined to prevent infiltration of high alkaline content flow, and will be covered to minimise the ingress of rainwater to the containment area.

2.37 No concrete washout areas will be located within high dependency GWDTE buffer zones.

Spoil Management

2.38 Excavated spoil (peat and subsoils) are to be stored adjacent to proposed access track alignments. Areas of stored spoil will not be permitted:

- within previously denoted watercourse buffer zones;
- to obstruct the flow of overland surface water; and
- within the high dependency GWDTE buffer zone.

2.39 There will be no ponding of surface water on top of spoil. Spoil will be graded to ensure that all direct precipitation will run directly off the surface.

2.40 Temporary silt fencing will be installed downslope of spoil as required.

2.41 Where areas of spoil storage other than sidecasting are proposed, formal drainage will be designed on a bespoke basis as part of the SUDS design to allow controlled dewatering and prevent washout of suspended solids to the receiving water environment.

2.42 As a principle, preventing the release of any pollution/sediment is preferable to dealing with the consequences of any release this are included within the ToSM. There are several general measures which cover all effects assessed within this chapter:

- prior to construction, specific drainage plans will be produced for each section of the site. These will take into account any existing local drainage which may not be mapped and incorporate any specific mitigation measures identified during the assessment. Full SUDs solutions in line with CIRIA guidance will be implemented which will attenuate peak flows and reduce sedimentation;
- a plan for dealing with pollution/sedimentation/flood risk incidents will be developed prior to construction and this will be adhered to should any incident occur, reducing the effect as far as practicable. This will be included in the final ToSM;
- in particular, this plan will contain details on the location of spill kits, will identify site '*hotspots*' where pollution may be more likely to originate from (such as locations with stored material or areas susceptible to erosion), provide details to site personnel on how to identify the source of any spill and state procedures to be adopted in the case of a spill event;
- a wet weather protocol will be developed. This will detail the procedures to be adopted by all staff during periods of heavy rainfall. Roles will be assigned to different engineering, construction and supervising personnel, and the inspection and maintenance regimes of sediment and runoff control measures will be adopted during these periods; and
- in extreme cases, the above protocol will dictate that work on site may have to be temporarily suspended until weather or ground conditions allow.

Pollution Risk

2.43 Good practice measures in relation to pollution prevention will include the following:

- drip trays will be placed under vehicles which could potentially leak fuel or oils;
- areas will be designated for washout of vehicles which are a minimum distance of 50m from a watercourse or drain;
- the washout water will also be stored in the washout area before being treated and disposed of;
- potentially contaminated runoff will not enter a watercourse without treatment. Oil interceptors will be considered in the detailed design prior to construction, if there are areas of hardstanding which may be particularly vulnerable to pooling of surface water runoff and will have a high likelihood of contamination from vehicles;
- water will be prevented as far as possible, from entering excavations such as borrow pits through the use of measures such as cut off drains around the working area (this also applies as a good practice measure for dealing with erosion and sedimentation); and
- procedures will be adhered to for storage of fuels and other potentially contaminating materials in line with the Water Environment (Oil Storage) (Scotland) Regulations 2006, to minimise the potential for accidental spillage.

Erosion and Sedimentation

2.44 Good practice in relation to the management of erosion and sedimentation will include the following:

- all stored materials will be located outwith a 50 m buffer around watercourses;
- stockpiled material will be appropriately covered;

- water will be prevented, as far as possible, from entering excavations such as borrow pits through the use of appropriate cut-off drainage;
- where the above is not possible, water that enters the borrow pit will pass through settlement lagoons (or other appropriate methods for silt removal) to remove silt prior to discharge into the surrounding drainage system;
- the amount of ground exposed, and time period during which it is exposed, will be kept to a minimum. If the material is stockpiled on a slope, silt fences will be used to minimise sediment transport. More than one set of interception measures may be required and the appropriate number of measures will be determined by the Ecological Clerk of Works (ECoW) to be employed during construction.
- where possible, works involving excavation and subsequent exposure of unvegetated ground will be minimised during periods of intense rainfall. This will be managed through the implementation of a wet weather protocol;
- drainage systems and associated measures to minimise sedimentation into natural watercourses such as silt traps will be robustly designed. The final CDMS will include measures such as check dams, settling ponds and silt traps to limit flows and prevent contamination of watercourses; and
- silt traps, single size aggregate, geotextiles or (if required) straw bales will be used to filter any coarse material and prevent increased levels of sediment. Further to this, activities involving the movement or use of fine sediment will avoid periods of heavy rainfall where possible. These measures also ensure that the risk of erosion and sedimentation from the limited forest felling required is minimised. The implementation of specific measures will require detailed design within the final CDMS.

Fluvial Flood Risk and Man-Made Drainage

2.45 Good practice in relation to the management of surface water runoff rates and volumes and potential for localised flood risk will include the following:

- drainage systems will be designed to ensure that the risk of blockage arising from sediment, pollutants or foreign materials is minimised through design and maintenance;
- appropriate drainage will attenuate runoff rates and reduce runoff volumes to ensure a minimal effect upon flood risk;
- Sustainable Drainage Systems (SUDs) will be adopted for managing surface water drainage and water quality alongside areas of hardstanding and any SUDs design will be appropriate for the infiltration rates of the site and will be developed during the detailed design phase. The implementation of SUDs will help control runoff rates, erosion and sedimentation;
- where necessary, check dams will be used within cable trenches to prevent trenches developing into preferential flow pathways; and
- as per good practice for pollution and sediment management, prior to construction, specific drainage plans will be developed for each area of the site and construction personnel made familiar with the implementation of these.

2.46 Further site specific information on ground conditions, drainage design and maintenance will be finalised during the detailed design and construction phases.

Water Abstraction

2.47 Water will be required during the construction, operation and decommissioning phases. It is planned that brown water will be used along with boreholes. During operation there may also be limited requirement for onsite abstraction for toilet facilities/hand washing. As such, abstraction volumes are anticipated to be low. Good practice follows the General Binding Rules (GBRs) of the Controlled Activities Regulations and incorporates the following aspects:

- water use will be planned so as to minimise abstraction volumes;
- water will be re-used where possible; and
- abstraction volumes will be recorded.

The appropriate level of CAR authorisation would be sought based on the predicted water volumes required during each phase of the development.

Peat Management

2.48 The use and reuse of peat on wind farm sites is a key consideration from a carbon payback, ecological and hydrological perspective. A Draft Peat Management Plan (PMP) has been produced and follows the Scottish Renewables/SEPA guidance. The draft PMP is included as Appendix 8.2.

2.49 The draft PMP expands upon the information obtained as part of the EIA survey work and includes the following information:

- an overview of peat condition on site;
- the activities that will require peat excavation along with associated volumes;
- the classification of this peat and its suitability for re-use;
- identification or restoration and reinstatement options including the volumes of peat required and the likely source; and
- details on the handling and storage of excavated peat.

2.50 Good practice with regards to peat management will involve the following aspects:

- peat excavation has been minimised through the development of a layout design which avoids (in most instances) areas of deep peat and will be minimised further at the detailed design stage through the micro-siting of individual development components where possible;
- construction work will seek to minimise the amount of peat excavated at any one time, thereby reducing the potential for excavated material to lose structural integrity through drying;
- where stockpiling of excavated peat is required, the stockpiled amounts will be as large as possible (with due regard to safety and risk of peat slide) to reduce the chance of the peat drying out;

- where stockpiling of excavated peat is required, peat turfs will be used to protect peat from erosion. Peat turfs will be excavated intact, in units as large as practical to reduce the chance of them drying out;
- the surface layer of peat and vegetation (acrotelm) will be stripped separately from the catotelmic peat;
- acrotelmic material will be stored separately from catotelmic material;
- to minimise handling and transportation of peat, acrotelmic and catotelmic will be replaced, as far as is reasonably practicable, in the location from which it was removed;
- in borrow pits, wet, structurally poor peat will be placed at the bottom of any restoration profile, followed by more fibrous peat and then turf material from the source borrow pit will be placed on top;
- if necessary, excavated peat will be sprayed to prevent it drying out;
- excavated peat will be used onsite for appropriate activities such as: dressing road verges and restoring borrow pits, cable trenches and areas of temporary hardstanding. The draft PMP provides outline calculations of excavated peat, along with estimates of volumes for re-use; and
- restoration activities will be overseen by the Ecological Clerk of Works to ensure methods are properly adhered to;
- the draft PMP shows that the proposed volumes of excavated peat can be re-used on site in a sensitive and appropriate manner.

2.51 There are several general measures which cover all effects assessed within this chapter:

- prior to construction, specific drainage plans will be produced for each section of the site. These will take into account any existing local drainage which may not be mapped and incorporate any specific mitigation measures identified during the assessment. Full SUDs solutions in line with CIRIA guidance will be implemented which will attenuate peak flows and reduce sedimentation;
- a plan for dealing with pollution/sedimentation/flood risk incidents will be developed prior to construction and this will be adhered to should any incident occur, reducing the effect as far as practicable. This will be included in the final ToSM;
- in particular, this plan will contain details on the location of spill kits, will identify site '*hotspots*' where pollution may be more likely to originate from (such as locations with stored material or areas susceptible to erosion), provide details to site personnel on how to identify the source of any spill and state procedures to be adopted in the case of a spill event;
- a wet weather protocol will be developed. This will detail the procedures to be adopted by all staff during periods of heavy rainfall. Roles will be assigned to different engineering, construction and supervising personnel, and the inspection and maintenance regimes of sediment and runoff control measures will be adopted during these periods; and
- in extreme cases, the above protocol will dictate that work on site may have to be temporarily suspended until weather or ground conditions allow.

Noise

2.52 Where available the quietest plant and machinery will be employed and maintained in good working order with appropriate silencers, mufflers or acoustic covers fitted where applicable.

2.53 Stationary noise sources will be sited as far away as possible from sensitive developments and, if necessary, shielded by acoustic barriers.

TECHNICAL APPENDIX 2.2 – HOMES EQUIVALENT FIGURES

To calculate the number of households whose annual electricity demand would equal the output of the Development, the following equation has been used:

$$\textbf{Number of Households} = \frac{\textbf{installed capacity (kW) x load factor}^{1}\textbf{x annual number of hours}}{\textbf{average household electricity usage}^{2}}$$

Where,

- The installed capacity of the Development is nominally 44.85 MW (13 x 3.45 MW turbines);
- The capacity factor, or 'load factor' of 0.3222 (i.e. 32.22%) is a site specific constant that takes into account the fluctuating nature of the wind, and various loss mechanisms (e.g. wakes and electrical transmission);
- 8,760 is the number of hours in a year; and
- 4,115 kWh is the annual average household electricity usage per year in Great Britain

Therefore,

$$\textbf{Homes supplied} = \frac{\textbf{44,850kW x 0.3222 x 8,760 hr}}{\textbf{4,115 kWh/home}} \textbf{=30,762 homes}$$

Household estimates for The Scottish Borders for the year 2014 were 53,157[3] and therefore the percentage of households served using 13 x 3.45MW turbines = (30,762/53,157)x100 = 57.9% of homes in the Scottish Borders.

[1] Measured site specific capacity factor
[2] Based available figures from DECC statistics on household consumption 2014: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/449134/ECUK_Chapter_3_-_Domestic_factsheet.pdf
[3] National Records of Scotland – Scottish Borders Factsheet: http://www.nrscotland.gov.uk/files/statistics/council-area-data-sheets/scottish-borders-factsheet.pdf

Technical Appendix 4.1: Glossary

Aesthetic Aspects: The key aspects of the landscape which contribute to its appearance (previously composition), such as:

- scale
- enclosure
- diversity
- texture
- form
- line
- contour
- balance
- movement
- pattern.

Analysis (Landscape): The process of breaking the landscape down into its component parts to understand how it is made up.

Analysis (Visual): The process of identifying the nature of visibility in an area, which is determined through topographic analysis.

Assessment (Landscape): An umbrella term for description, classification and analysis of landscape.

Baseline: The landscape and visual character of the study area as it exists at the commencement of the assessment process – i.e. prior to the development proposal under consideration.

Biodiversity: The concept of variety in all species of plants and animals.

Classification: A process of sorting the landscape into different types using selected criteria, but without attaching relative values to the different types of landscape.

Constraints map: Map showing the location of important resources and receptors that may form constraints to development.

Countryside: The rural environment and its associated communities (including the coast).

Cultural and social factors: The elements of the landscape which are the result of human activity, e.g.:

- Land use management
- Character of settlements and buildings
- Pattern and type of fields and enclosures
- Rights of way /footpaths
- Artistic/literary associations

Cumulative Effects: Effects arising from the additional changes to the landscape or visual character caused by a development when seen in conjunction with other developments (associated with it or separate to it).

Digital Terrain Model (DTM): Computer generated 3 dimensional model based on aerial survey of ground surface (e.g. Ordnance Survey *Profile data*). Often utilised as a basis for visibility modelling over large areas.

Digital Surface Model (DSM): Computer generated 3 dimensional model based on aerial survey of ground surface, tree canopies, built structures etc.). Often utilised as a basis for visibility modelling where the effects of intervening structure and/or vegetation need to be incorporated.

Diversity: Where a variety of qualities or characteristics occur.

Effect: The result of an impact on a landscape or visual receptor.

Element: A component part of the landscape (e.g. roads, hedgerows, woods)

Enhancement: Landscape or visual improvement through restoration, reconstruction or creation.

Environmental Fit: The relationship of a development to identified environmental opportunities and constraints in its setting.

Field Pattern: The pattern of hedges and walls that define fields in farmed landscapes.

Geographic Information System: Computerised data base of geographical information that can easily be updated and manipulated.

Horizontal Angle Subtended: The angle measured in degrees from the left most visible part to the right most visible part of any development.

Key characteristics: The elements of the landscape and/or their inter relationship which form the defining components of the landscape

Impact: The change arising for a landscape or visual receptor as a result of some form of alteration to the baseline.

Indirect Impacts: Impacts on the environment, which are not a direct result of the development but are often produced away from it or as a result of a complex pathway. Sometimes referred to as secondary impacts.

Landcover: Combination of land use and vegetation that covers the land surface.

Landform: See Topography.

Landscape: Human perception of the land conditioned by knowledge and identity with a place.

Landscape Capacity: An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors. The degree to which a particular landscape character type or area is capable of is able to accommodate change without unacceptable adverse effects on its character. Capacity is likely to vary according to the type and nature of the changes being proposed. The capacity of the landscape is derived from a combination of Landscape Character Sensitivity, Visual Sensitivity and Landscape Value.

Landscape Character: The distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place in different areas of the landscape.

Landscape Character Type: A landscape type will have broadly similar patterns of geology, landform, soils, vegetation land use, settlement and field pattern discernible in maps and field survey records.

Landscape Fabric: Physical elements of the landscape or development site.

Landscape Factor: A circumstance or influence contributing to the impression of the landscape (e.g. scale, enclosure, elevation).

Landscape Feature: A prominent eye-catching element or landmark (e.g. church spire, wooded hilltop).

Landscape Impact: The change in the elements, characteristics, qualities and overall character of the landscape as a result of development.

Landscape Effect: The consequence of change in the elements, characteristics, qualities and overall character of the landscape as a result of development. These effects can be positive, neutral or negative.

Landscape Evaluation: The process of attaching value (non-monetary) to a particular landscape, usually by the application of previously agreed criteria, including consultation and third party documents, for a particular purpose (for example, designation or in the context of an assessment).

Landscape Quality (or Condition): Based on judgments about the physical state of the landscape and about its intactness. Also relates to the state of repair of individual features and elements which make up character in any one place.

Landscape Resource: The combination of elements that contribute to landscape context, character and value.

Landscape Sensitivity (to a specific type of change): The extent to which a landscape can accept change of a particular type and scale and is assessed in relation to the following:

- Existing land use;
- Pattern and scale of the landscape, including simplicity/complexity;
- Landscape quality or condition including presence of any detracting features;
- The nature of views – visual enclosure/openness of views, scale of views;
- Value placed on the landscape – which may be expressed through designation; and
- Scope of mitigation, which will be in character with the existing landscape.

- **Magnitude of landscape change:** A measure of the amount of change to the landscape that would occur as a result of proposed development, generally based on the **scale** or degree of change to the landscape resource, the **nature** of the effect and its **duration**. This is based on a combination of largely quantifiable parameters, such as the distance to the proposed development, visible extent, degree of contrast with context, extent to which the development would be visible, and the duration of an impact.
- **Magnitude of visual change:** A measure of the amount of change to the visual context that would occur as a result of a proposed development. This is generally based on the scale of change to the view with respect to the loss or addition of features in the view and changes in its composition, including the proportion of the view that would be occupied by the proposed development; the degree of contrast or integration of any new features of changes in the landscape with the existing or remaining landscape elements and characteristics in terms of form, scale, mass, line, height, colour and texture; duration and nature of the change, whether temporary or permanent, transient or persistent, etc.; the angle of view in relation to the main activity of the receptor(s); distance of the viewpoint from the proposed development; and extent of the area over which the changes would be visible.

Methodology: The specific approach and techniques used for a given study.

Mitigation Measures: Measures including any process, activity or design process to avoid, reduce, remedy or compensate for adverse landscape and visual impacts of a development. Mitigation can also apply to the amelioration of existing adverse effects associated with existing developments/features in the landscape.

Natural Factors: The natural elements of the landscape which contribute to its character, e.g.

- Geology;
- Soils;
- Landform; and
- River and drainage pattern.

Perception (of Landscape): The psychology of seeing and possibly attaching value or meaning to the landscape.

Perceptual Aspect: Elements of the landscape which evoke a response to the senses, such as;

- Wildness ;
- Remoteness;
- Sense of security; and
- Tranquillity.

Receptor: Physical landscape resource, special interest or individual or group experiencing view liable to change as a result of the proposed development.

Receptor Location: Location occupied by identified receptors.

Residual Effects: Effect of development after mitigation proposals are taken into account.

Scoping: The process of identifying likely significant effects of a development on the environment – which may be carried out in a formal or informal way.

Significant Effect: An effect which is considered by the assessor to be "significant" in terms of the Environmental Impact Assessment Regulations which require the identification of significant effects.

Visual Amenity: Particular composition of landscape elements that contribute to a view, or views.

Visibility Analysis: The process of identifying theoretical (based on digital modelling) and/or actual predicted areas from where any given development may be seen.

Visual Effect: The consequence of change in the appearance of the landscape as a result of development, which may be positive or negative.

Visual Impact: The change in the appearance of the landscape and nature of views which may be adverse or beneficial.

Viewshed: The extent of potential visibility to or from a specific area or feature.

Viewpoint Sensitivity The extent to which a view would be altered by change of a particular type and scale, assessed in relation to the following:

- Location and land use (receptor activity) at the viewpoint or context of the view;
- Landscape character and quality at the viewpoint;
- Landscape character and quality of the intervening landscape;
- Importance of the view (which may be determined with respect to its popularity or number of affected people, its appearance in guidebooks, on tourist maps and the facilities provided for its enjoyment and references to it in literature and/or art.

Visualisation: Computer generated simulation or photomontage or other technique to illustrate how the proposed development would appear.

Zone of Theoretical Visibility (ZTV) The area predicted to have views of a proposed development on the basis of a digital terrain model or digital surface model, which may/may not take account of landcover features.

Zone of Visual Influence or Viewshed: The area within which a proposed development will be visible.

Technical Appendix 4.2: Landscape Character Type Descriptions

Of the LCTs considered at the outset of the LVIA process only eleven have been carried forward for detailed assessment as fourteen of the original list fall outwith the viewshed of the proposed Development, and a further twenty eight were omitted following detailed consideration of the limited extent of the proposed Development's visibility, the LCTs distance from the proposed development and consequent low likelihood of significant effects.

The LCTs/NCAs which are outside viewshed for the proposed Development according to the ZTV (Figure 4.2a), and would therefore not have visibility of the proposed development include:

- Pastoral Upland Fringe Valley (Bowmont Water and Kale Water) (BDR26);
- Wooded Upland Fringe Valley (Jed Water) (BDR28);
- Wooded Upland Fringe Valley (Slitrig Water) (BDR28);
- Pastoral Upland valley (Gala Water) (BDR23);
- Upland Valley with Pastoral Floor (Upper Yarrow and Upper Ettrick) (BDR22);
- Upland Valley with Woodland (Middle Tweed and Lower Ettrick/Yarrow) (BDR25);
- Southern Uplands (DGW22) Tarras;
- Upland Glens (Ewes) (DGW11);
- Narrow Wooded River Valleys (Eskdale)(DGW5);
- Foothills With Forest (Eskdale, Oer and Tinnisburn) (DGW21);
- Foothills (Annandale) (DGW20);
- Upland Fringe (Liddesdale) (DGW17);
- Intimate Pastoral Valleys (Pastoral Eskdale) (DGW6); and
- Flow Plateau (Annandale) (DGW16).

On the basis that these LCTs would be subject to no effect as result of the proposed Development they have been omitted from the LVIA.

The LCTs that fall within the theoretical viewshed of the proposed Development, but are not considered further are listed in Table TA4.2A, overleaf along with the justification for their omission.

The assessment of potential residual effects on the eleven LCTs included is summarised in Technical appendix 4.3.

Table TA 4.2A: Landscape Character Types Omitted from the LVIA

LCTs and NCAs	Nearest part of LCT to the proposed Development and Direction from the Highlee Hill Wind Farm[1]	Justification for Omission
Border Moor and Forest NCA	2.3 km to the south east/east of the site	The NCA comprises around one quarter of the study area, partially overlapping with the NNP. The ZTV indicates visibility would be confined to a small number of distant summits.
Cheviots NCA	14.4 km to the east of the site	The ZTV indicates visibility would be confined to a small number of distant summits, including The Cheviot. A review of the findings of the assessment of Viewpoint 22 in TA4.6 indicates that such distant locations would not be subject to significant effects.
Lower Kale of Lowland valley with Farmland (LCT BDR29)	6 km to the NE	Theoretical visibility is largely confined to the Bowmont Forest area where predicted visibility would be substantially constrained by vegetation and any views that are possible would be distant. Consequently, no significant effects are anticipated within this unit of BDR29.
Lower Tweed of Lowland valley with Farmland (LCT BDR29)	15.1 km to the N beyond the Lower Teviot	Sparse, sporadic and distant theoretical visibility occurs on the highest elevations in this broad, shallow, flat bottomed valley. Such visibility would be concentrated on the transitional edge of the LCT with the Grassland with Hills LCT (including the lower slopes of the Eildon Hills) and Lowland Margin with Hills LCT (including the lower slopes of Sweethope Hill). Field reconnaissance suggests that actual visibility would be substantially restricted and highly unlikely, therefore, to constitute a significant effect on this unit of BDR29.
Midgard of Grassland with Rock Outcrops (LCT BDR10)	6.2 km to the NW	Sporadic theoretical visibility occurs on a small number of low summits (between of 240 m and 300 m AOD) and mainly comprise blade tips. However, the intervening forested higher hills of the Southern Uplands would reduce this visibility further, with the consequence that it is considered highly unlikely that significant effects on the character of this LCT unit would be experienced.
Allan Water of Grassland with Rock Outcrops (LCT BDR10)	8.6 km to the NW	Sporadic visibility on a few low summits (between of 250 m to 260 m AOD) and mainly blade tip visibility is shown on the slopes. However, the intervening forested higher hills of the Southern Uplands would reduce this visibility further, with the consequence that it is considered highly unlikely that significant effects on the character of this LCT unit would be experienced.
Chisholme of Grassland with Rock Outcrops (LCT BDR10)	13.7 km to the NW	Sporadic visibility occurs on a few low summits (between of 280 to 310 m AOD) and mainly blade tip visibility is shown on the slopes. However, the intervening forested higher hills of the Southern Uplands would reduce this visibility further, with the consequence that it is considered highly unlikely that significant effects on the character of this LCT unit would be experienced.
Upland Valley with Pastoral Floor (Liddel Water) (LCT BDR22)	8.2 km to the SW	The ZTV indicates that only blade tips would be visible and would be seen at distances of over. Consequently, it is considered highly unlikely that significant effects on the character of this LCT would occur.
Upper Teviot of Pastoral Upland Fringe Valley (LCT BDR26)	10 km to the NW	Limited theoretical visibility is indicated in the ZTVs. Given the limited extent of theoretical visibility, the prevalence of structural vegetation, and the distance of potential receptor locations from the proposed Development, no significant effects are anticipated within this LCT unit.
Borthwick Water of Pastoral Upland Fringe Valley (LCT BDR26)	11.5 km to the NW	Scarce visibility occurs on the higher side of Borthwick Water valley, where the LCU transfers to Grassland with Rock Outcrops LCT. As in the Upper Teviot unit of this LCT, the limited extent of theoretical visibility, the prevalence of structural vegetation, and the distance of potential receptor locations from the proposed Development, no significant effects are anticipated within this LCT unit.
Minto Hills of Rolling Farmland (LCT BDR8)	11.6 km to the NW	Visibility would be constrained by a combination of topography and vegetation, the clearest views being provided from the summit of Minto Hills. Viewpoint 25 is representative of such a view and suggests that no significant effect

[1] Distances do not represent the nearest location with potential visibility of the proposed Development.

Table TA 4.2A: Landscape Character Types Omitted from the LVIA		
LCTs and NCAs	**Nearest part of LCT to the proposed Development and Direction from the Highlee Hill Wind Farm**[1]	**Justification for Omission**
		on the character of this LCT unit would be experienced.
Lempdaw of Rolling Farmland (LCT BDR8)	22.2 km to the NE	Visibility is indicated on low south west facing landforms (between 200 m to 280 m AOD). However, given the low elevation in this LCT, relative to those of intervening higher to the south-west, the prevalence of forestry, and the distance between potential receptor locations and the proposed Development, no significant effects are anticipated within this LCT unit.
Westruther Platform of Rolling Farmland (LCT BDR8)	30 km to the N	Sporadic visibility is indicated within this LCT unit. However, given the low elevation in this LCT, relative to intervening higher landforms to the south-west, the prevalence of forestry, and the distance between potential receptor locations and the proposed Development, no significant effects are anticipated within this LCT unit.
Ale Water of Wooded Upland Fringe Valley (LCT BDR28)	14 km to the N	Theoretical visibility would be limited to a small number of locations on the northern side of Ale Water valley, where the LCU transfers to Grassland with Hills LCT. **G**iven the low elevation **and enclosed nature of this** LCT, relative to those of **intervening higher to the south**, the prevalence of **woodland and structural vegetation**, and the distance between potential receptor locations and the proposed Development, no significant effects are anticipated within this LCT unit.
Dun Knowe Group of Southern Uplands Type with Scattered Forest (LCT BDR4)	15.2 km to the NW	The ZTV indicates sporadic, distant and elevated visibility on summits and south east facing slopes of hills (between 310 m and 470 m AOD). Intervening forested landforms and the distance at which the proposed development would be seen limits potential visibility and means that significant effects on this LCT unit would be highly unlikely.
Broadlaw Group of Southern Uplands Type with Scattered Forest (LCT BDR4)	25 km to the NW	The ZTVs indicate views would be provided from large scale exposed hills, above Jarrow and Ettrick Water. However, given the limited proportion of the LCT unit affected and its distance from the proposed Development, significant effects are not anticipated within this unit.
Craik LCA of the Southern Upland Type with Forest Covered LCT (LCT BDR5)	18.6 km to the W	Whilst the ZTV indicates visibility on summits and west/south east facing forested slopes of hills within Craik Forest, the distance at which the proposed Development may theoretically be seen, coupled with the large scale and extensive forest cover in this LCT means that significant effects are highly unlikely.
Maxwellheugh of Rolling Lowland Margin (LCT BDR16)	20 km to the NE	Views of the proposed Development would be rare within this LCT. Given the constrained visibility coupled with the distance at which the proposed Development would be seen, no significant effects are anticipated within this LCT.
North and West Langholm of Southern Uplands (LCT DGW22)	20.5 km to the SW	The ZTV shows only blade tip visibility on three summits within this LCT, the proposed Development appearing as between 1 and 3 blade tip. However, given the distance at which they would be seen, and the limited incidence of viewshed inn this LCT, no significant effects are anticipated in this landscape.
Black Hill/Hume Crags of Lowland Margin with Hills (LCT BDR18)	22.5 km to the N	Within these smooth rolling farmlands theoretical visibility is constrained to south facing landforms including Fans Hill, Brotherstone Hill, Sweethope Hill. However, given the limited extent of the proposed Development viewshed, the prevalence of structural vegetation, including shelter belts and the distance at which the proposed Development would be viewed, no significant effects are anticipated in this LCT.
Tweed/Gala/Ettrick Confluence of Upland Fringe Valley with Settlements (LCT BDR27)	22.8 km to the NW	In this densely settled Tweed valley, visibility occurs only on the south east facing slopes of low hills, to the north east of Melrose, next to the B6360. Given the limited extent of the propose Developments viewshed and its distance from the proposed Development, no significant effects are anticipated on the character of this landscape.
Lower Merse of Lowland with Drumlins (LCT BDR15)	24 km to the NE	The southern part of the LCT lies within the Study Area, where sporadic visibility occurs on strongly directional landform pattern of parallel elongated ridges (around 100 m AOD) and hollows. Given the often low elevations of this LCT, the screening effect of intervening elevated topography and vegetation, no significant effects are anticipated within this LCT.
Eskdalemuir of Southern Uplands with Forest (LCT DGW23)	24.8 km to the SW	Visibility is only indicated on a few summits within the Eskdalemuir Forest. Given the limited extent of the potential visibility and the distance of such receptor locations from the proposed Development, no significant effects are

Table TA 4.2A: Landscape Character Types Omitted from the LVIA		
LCTs and NCAs	**Nearest part of LCT to the proposed Development and Direction from the Highlee Hill Wind Farm**[1]	**Justification for Omission**
		anticipated within this LCT.
Undulating Grassland (LCT BDR12) - West Gala and East Gala	25.5 km to the NW	Theoretical visibility would be scarce within this LCT, and where it does occur, receptors would be located at a considerable distance from the proposed development. Consequently, no significant effects are anticipated in this LCT.
Pastoral Upland Fringe Valley (LCT BDR26) - Lower Leader	25.7 km to the N	The ZTV occurs sporadically on the higher sides of this pastoral wooded valley. Glen the limited extent of potential visibility and the distant location of potential receptor locations, relative to the proposed Development no significant effects are anticipated in this LCT.
Lowland Margin Platform (LCT BDR17) - Gordon Platform	30.5 km to the NE	Little visibility occurs within this gently sloping landscape due to the low elevations relative to the intervening higher topography, to the south-west. Given the limited extents of theoretical visibility and the distance of potential receptor locations from the proposed Development, no significant effects are anticipated in this LCT.
Plateau Grassland (LCT BDR2) - Lauder Common	32 km to the NW	The south eastern part of the large scale rolling plateau landscape lies within the Study Area. The ZTV indicates distant visibility on the landform of Sell Moor (423 m AOD), to the north east of the adjacent Longpark Wind Farm. On the basis of the distance of this LCT form the proposed Development site, no significant effects are anticipated in this LCT.
Dissected Plateau Moorland (LCT BDR1) - Moorfoot Plateau	35 km to the NW	The south eastern part of the LCT lies within the Study Area. The ZTV indicates elevated distant visibility on summits of between 450 m and 650 m AOD. Longpark Wind Farm is located 2.2 km to the east of the LCT. Langhope Rig Wind Farm appears 17 km to the south east of the LCT. On the basis of the distance of this LCT form the proposed Development site, no significant effects are anticipated in this LCT.

Table TA 4.2B: Summary Landscape Character Types Assessed					
LCT	**Name**	**Nearest part of LCT to the proposed Development and Direction from the Highlee Hill Wind Farm**[2]	**Key Characteristics**	**Value and Susceptibility**	**Sensitivity to the Type of Development Proposed**
BDR5	Southern Upland Type with Forest Covered - Wauchope/ Newcastleton	Contains the proposed Development	▪ A distinctive variant of the Southern Uplands landscape type dominated by forest cover. ▪ Large scale rolling landform; ▪ Dominant coniferous forest cover characterised by Sitka spruce plantations with occasional areas of pine and larch; ▪ Simple, uniform character; and ▪ Visual horizons in this landscape type are mainly confined by trees. Where longer views can be gained visual orientation is often difficult due to the uniformity of much of the forest cover. Wauchope/Newcastleton has a strong and direct links with character of Kielder Forest immediately to the south of Cheviots ridge. The Wauchope/Newcastleton Unit is sparsely populated with few settled areas or public roads.	The north eastern corner of the LCU is within the SLA of the Cheviot Foothills. The LCT unit is considered to be of medium to low value due to its substantially modified condition, low rarity, and non-designated status. The landscape contains a number of characteristic elements that are held in common with the type of development proposed. There is some scope for mitigating landscape and visual impacts of associated with wind farm development (e.g. existing forest infrastructure may be utilised and the retention of forest cover would enable the screening of wind farm infrastructure and ancillary elements from external viewpoints). The Southern Uplands Forest Covered is considered to have a medium to low susceptibility to wind farm development due to the large scale of the landscape, the extensive forestry plantations present, which are perceived as man-made modifications to the landscape. The sensitivity of this LCT is considered to be medium to low, having regard to its medium to low susceptibility and medium to low value. The large scale of the Southern Uplands Forest Covered landscape does not apply across the entire LCT. The valleys of Black Burn and Hyndlee Burn are considered to have a medium to high susceptibility to wind farm development due to their enclosed character, with more diverse landscape elements, shorter views and smaller scale landscape. The sensitivity of this part of the Wauchope/Newcastleton Unit is considered to be high as assessed on VIEWPOINT 2, which represents views of the Black Burn valley.	Generally medium to low, but increasing to high in the valleys of Black Burn and Hyndlee Burn
BDR11	Grassland with Hills - Bonchester/Dunion	The northern section of the application site is situated within this unit.	A diverse upland fringe landscape characterised by prominent discrete hills rising above surrounding grasslands. This landscape most closely encompasses the essence of the Borders heartland. ▪ Typically steep, cone or dome-shaped hills, frequently of volcanic or igneous rock; ▪ Diverse surrounding landform types, ranging from smooth undulations to strongly elongated ridges and hollows; ▪ Land cover dominated by permanent pasture; ▪ Locally frequent woodland cover; ▪ Low to medium settlement density; ▪ Rich in visual contrasts, with individual hills as dominant focal points of views.	Bonchester/Dunion Grassland with Hills: The LCU lies almost entirely within the SLA of Teviot Valleys. Value is high due to the strong landform identity of Southdean Hill and Bonchester Hill which are recognized by overlapping designation. Visual diversity and contrast of enclosure and expansive views (scale diversity) gives a medium to high landscape character susceptibility to wind farm development.	Medium to high
	Grassland with Hills - Rubers Law	2.2km NW		Rubers Law Grassland with Hills Designations: The northern half of the LCU is within the SLA of Teviot Valleys. Value is high due to the strong landform identity of Rubers Law (iconic landmark) which is recognized by overlapping designation. Visual diversity and contrast of enclosure and expansive views (scale diversity) gives a medium to high landscape character susceptibility to wind farm development.	Medium to high
	Grassland with Hills - Eildon Hills	18km NW		Eildon Hills Grassland with Hills Designations: The north eastern corner of the LCT lies within the NSA of Eildon/Leaderfoot	High

[2] Distances do not represent the nearest location with potential visibility of the proposed Development.

Table TA 4.2B: Summary Landscape Character Types Assessed

LCT	Name	Nearest part of LCT to the proposed Development and Direction from the Highlee Hill Wind Farm[2]	Key Characteristics	Value and Susceptibility	Sensitivity to the Type of Development Proposed
				and its north western edge occurs within the SLA of the Tweed, Ettrick and Yarrow Confluences. Value is high due to the strong landform identity of Eildon Hills (iconic landmark) which is recognized by overlapping designations (SLA and NSA). Visual diversity and contrast of enclosure and expansive views (scale diversity) gives a medium to high landscape character susceptibility to wind farm development.	
BDR28	Wooded Upland Fringe Valley - Rule Water	230m NW	A deeply-incised river valley with a well-wooded appearance. ▪ Small scale, intimate, enclosed character; ▪ Deeply-incised river channels with frequent cliffs and steep slopes; ▪ Heavily wooded valley floors and lower valley sides; ▪ Contrasting open rolling slopes at higher levels above rivers.	The northern half of the LCU is within the SLA of Teviot Valleys. Value is high due to its distinctive dramatic form and designated status. The LCU is considered to have a high susceptibility to wind farm development due to its complexity; intimate scale and open distant views on valley sides.	High
BDR7	Cheviot Foothills - Falla Group	900m NE	An upland landscape of strongly rolling grass covered hills with occasional rock outcrops. ▪ Discrete dome and cone-shaped hills and ridges, with occasional rock outcrops on steeper slopes and bill tops; ▪ Uplands dominating the skyline in the south and east; ▪ Grassland cover dominant, but with locally significant coniferous forestry; ▪ Settlement includes small villages in the lower reaches of valleys.	The north western corner of this landscape is within the SLA of Teviot Valleys and its south eastern edge extends within the SLA of the Cheviot Foothills. Value is medium to high, due to its partial designation, and wide visual influence, forming attractive backdrop from adjoining upland and Upland Fringe landscapes. The landscape is considered to have a medium susceptibility to wind farm development due to the large scale of the landscape with a simple, open character.	Medium
BDR4	Southern Uplands Type with Scattered Forest - Cauldcleuch Head Group	1 km W	An upland landscape characterised by large-scale, rolling, heather and grassland covered hills. ▪ Large-scale rolling landform with higher dome or cone-shaped summits; ▪ Significant areas of peatland and heather moorland; ▪ Mosaic of grassland, bracken and rushes on lower ground; ▪ Extensive coniferous plantations prominent in views adjacent landscape sub-type at Craik and Wauchope Forests; ▪ Locally-prominent scattered large coniferous plantations.	This landscape is not subject to formal designation. Value is medium partly due to remoteness. The LCU is considered to have a medium to low susceptibility to wind farm development due to the large scale of the landscape and extensive forestry plantations demonstrating substantial modification of the landscape and restricting views out from parts of the LCT.	Medium

Table TA 4.2B: Summary Landscape Character Types Assessed					
LCT	**Name**	**Nearest part of LCT to the proposed Development and Direction from the Highlee Hill Wind Farm**[2]	**Key Characteristics**	**Value and Susceptibility**	**Sensitivity to the Type of Development Proposed**
BDR8	Rolling Farmland - Oxnam	6 km NE	An undulating upland fringe landscape of large-scale fields, with mixed arable and pastoral land use. ▪ Undulating relief, becoming more pronounced at higher elevations; ▪ Large-scale field pattern, enclosed by hedgerows, with scattered coniferous woods; ▪ Mix of arable, ley pasture and permanent grazing land; ▪ Moderately densely settled, with frequent farmsteads and small villages.	A small section of the eastern side of the Jed Water to the south of Jedburgh lies within the SLA of Teviot Valleys. Value is considered medium due to the general absence of designation and its agriculturally productive condition. The LCT is considered to have a medium to high susceptibility dependent upon the proximity of settlement and the scale of the landscape and elevation.	Medium to High
BDR29	Lowland valley with Farmland - Lower Teviot	7.9 km NW	A broad lowland valley type which merges downstream with the drumlin country of the Merse. ▪ Broad, shallow, flat bottomed valleys with gently sloping/undulating sides; ▪ Neat pattern of medium to large sized arable and pasture fields divided by hedgerows with some mature broadleaf tree lines; ▪ Bluffs and terraces cut by rivers; ▪ Occasional prominent volcanic hills, knolls and rock outcrops; ▪ Broadleaf woodland common on strips on river bluffs and in side valleys, small blocks, shelterbelts and policy woodlands on lower slopes and valley floor; ▪ Scattered small towns, stone built farmsteads, villages, and mansion houses along well developed road network.	Part of the LCT is situated within the SLA of Teviot Valleys. Value is medium to high due to the recreational use of Scotland Great Trails (such as Borders Abbeys Way and St Cuthbert's Way) extending through the valley and Minto Hill as SB 'Iconic Viewpoint'. The LCT is considered to have a high susceptibility to wind farm development due to its intimate scale and open distant views on valley sides.	High
BDR6	Cheviot Uplands - Cocklaw Group	10.2 km E	Rugged upland landscape characterised by grass covered hills dissected by steep sided valleys with frequent rock outcrops and scree slopes. ▪ Distinctive dome and cone shaped hills and spurs with rugged peaks, frequent rock outcrops and scree; ▪ Scattered small coniferous plantations; ▪ Land cover dominated by coarse grassland, interspersed with scattered patches of bracken, gorse and rushes; ▪ No major roads or settlements; and ▪ Steep-sided glacial meltwater channels.	The LCU lies entirely within the SLA of Cheviot Foothills. Value is medium to high due to the recreational use and designated status. The LCU is considered to have a medium to high susceptibility, the greatest susceptibility relating to the landscapes distinctive dramatic topography and sense of enclosure within valleys and enclosed locations, whilst some reduced susceptibility occurs in the large scale elevated and open parts of the landscape.	Medium to High

Table TA 4.2B: Summary Landscape Character Types Assessed

LCT	Name	Nearest part of LCT to the proposed Development and Direction from the Highlee Hill Wind Farm[2]	Key Characteristics	Value and Susceptibility	Sensitivity to the Type of Development Proposed
BDR10	Grassland with Rock Outcrops - Whitehaugh	12 km NW	A strongly undulating upland fringe landscape characterised by angular pasture covered hills with rugged knolls and rock outcrops. ▪ Distinctive irregular strongly undulating and angular landform; ▪ Frequent knolls, ridges and rock outcrops; ▪ Land cover characterised by permanent pastures with patches of gorse and rushes and scattered small woodlands; ▪ Farmsteads and dwellings dispersed along minor road network; ▪ Small lochans and mires in depressions; and ▪ Drystone dykes common.	The LCT is not covered by any landscape designations. Value is medium, largely related to recreational uses such as LDR routes and the A7 tourist route. The LCT is considered to have a medium to high susceptibility the range reflective of the variability of elevations, and consequently, enclosure and perceived scale and incidence of scattered settlement compared with the larger population centre of Hawick.	Medium to High

Technical Appendix 4.3: Residual Effects on Landscape Character

Table 4.3: Residual effects on Landscape Character

LCT Ref	LCT Name	Distance and Direction to Nearest Turbine	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
BDR5	Southern Upland Type with Forest Covered - Wauchope/ Newcastleton	Within which the site lies	Medium to low	The visibility of the proposed Development within the Wauchope/Newcastleton Unit of the Southern Uplands Forest Covered LCT is largely confined to locations within 4.5 km of the proposed Development. The areas affected are concentrated within the northern forested part of the Wauchope/Newcastleton Unit, on the surrounding hills (including Charlie's Knowe, Green law, Lamb Rig, Green Law, Haidlee Flow, Brackie Law, Wardmoor Hill, Wolfelee Hill) which enclose the proposed Development on three sides. Viewpoints 2, 3, 6, 15, 19, 20 and 21 are representative of this LCT and were utilised to verify potential effects on the character of this landscape. The magnitude of change attributable to the proposed Development varies between None in locations with no visibility of the proposed turbines, to substantial within the application site, within the enclosed landscape adjoining the A6088, and at elevated summits such as Wolfelee Hill, Southdean Fort and Carters Fell. Consequently the residual effect on this LCT would range from None to **Major/moderate**.	The turbines of the operational wind farms of Langhope Rig and Longpark appear in elevated distant views and are difficult to discern above the skyline in views to the north west of the proposed Development. There would be limited cumulative visibility of the proposed Development with the existing wind farms due to the intervening distances and topography. The cumulative magnitude of change would vary between None in locations with no cumulative visibility, including forested areas and locations within the enclosed landscape adjoining the A6088, but increasing to Slight in the majority of other locations, primarily due to the relative distance and lesser prominence of the majority of existing/consented wind farms. In this context the cumulative effects on the Wauchope/Newcastleton Unit of the Southern Uplands Forest Covered LCT, would range from None to Moderate.	The proposed Birneyknowe Wind Farm, 8.8 km to the north west of the proposed Development, would appear in elevated views from Viewpoint 15 and Viewpoint 19, in conjunction with the proposed Highlee Hill Wind Farm and in the opposite direction of the Highlee Hill turbines, respectively. The proposed Longpark Extension Wind Farm would be difficult to discern in long distance views and therefore is regarded as not having any interaction with the proposed Development. Localised substantial change and **Major/moderate** effect would be experienced at elevated locations such as Southdean Fort, and Carters Fell/ Knox Knowe, but the majority of the LCT would be subject to slight change and moderate cumulative effects.	The introduction of the Wauchope/Newcastleton scheme would introduce a particularly large scale and expansive wind farm development to this LCT, one which has a considerable viewshed, and which would provide a more immediate cumulative context for the proposed Development. As a consequence, moderate to substantial cumulative change would be experienced from a larger number of locations, with **Major/moderate** effects experienced in location within the A6088 corridor, elevated locations at Southdean Fort. It should be noted, however, that this is dependent upon how the proposed Development and the Wauchope/Newcastleton schemes relate in views. For example, in views from Knox Knowe, the presence of the Wauchope/Newcastleton scheme would diminish the prominence/conspicuousness of the proposed Development.
BDR11	Grassland with Hills - Bonchester/ Dunion	The northern section of the site lies	Medium to high	The site's northern section extends within the Bonchester/Dunion unit of the Grassland with Hills LCT, although the proposed turbines are located 3 km to the south of the southern boundary of the LCT. The ZTV (Figure 4.2a) extends over the south/south east facing slopes of Doorpool Hill, Bonchester Hill, Faw Hill and Black Law. Visibility occurs throughout the unit, from 3 km at Chesters village to 11 km on the summit of Black Law. Viewpoints 1, 4, 5, 8, 11, 18 and 23 are located within this LCT. The magnitude of change would vary	The turbines of the operational wind farms of Langhope Rig and Longpark appear in elevated distant views and are difficult to discern. There would be limited cumulative visibility of the proposed Development with other existing wind farms due to the intervening distances and topography. No existing/consented wind farms are currently visible from viewpoints around Chesters On this basis, the magnitude of change ranges from None in locations with no cumulative visibility, but increasing to Slight or Moderate in the majority of other	The proposed Birneyknowe Wind Farm, 8.8 km to the north west of the proposed Development, would appear in elevated views from Viewpoint 8, in conjunction with the proposed Highlee Hill Wind Farm and from Viewpoint 5, the proposed Birneyknowe Wind Farm would be seen at a closer distance than the proposed Development. The other proposed Wind Farms (Windy Edge and Longpark Wind Farm Extension) would be difficult to discern in long distance views (also	The introduction of the proposed Wauchope/Newcastleton scheme would introduce a particularly large scale and expansive wind farm development close to this LCT, one which has a considerable viewshed, and which would provide a more immediate cumulative context for the proposed Development. As a consequence, **Major/moderate** to **Major** effects experienced in location within the A6088 corridor, and at Chesters and Chesters Brae. However, viewed from Bonchester Hill, the proposed Development

Table 4.3: Residual effects on Landscape Character							
LCT Ref	**LCT Name**	**Distance and Direction to Nearest Turbine**	**Sensitivity**	**Residual Effect**	**Residual Cumulative Effect: Existing/Consented Wind Farm Scenario**	**Cumulative Effect Existing, Consented and Proposed Wind Farms**	**Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario**
				between None in locations with no views of the proposed Development, to substantial in the vicinity of Chesters, at Bonchester Hill and Chesters Brae. Elsewhere, the majority of the LCT would be subject to Slight or Negligible change. Consequently, residual effects on this LCT would range from None to **Major**, the greatest effects being experienced in the vicinity of Chesters. Elsewhere, the majority of the LCT would be subject to moderate or moderate/minor effects.	locations, primarily due to the relative distance and lesser prominence of the majority of existing/consented wind farms. However, cumulative change at Bonchester Hill would be substantial. Consequently, residual cumulative effects would range from none to Moderate, with localised **Major /moderate** effects at Bonchester Hill.	being well screened) and therefore are not regarded as having any interaction with the proposed Development. The magnitude of change attributable to the proposed Development with the operational/consented wind farms and the proposed Birneyknowe Wind Farm would be Moderate on the Bonchester/Dunion unit of the Grassland with Hills LCT. However localised **Major/moderate** effects would be experienced at Bonchester Hill and in locations at Chesters (notably Chesters Brae).	would overlap with and merge with the scoping scheme, the scale of which would dominate views from this elevated viewpoint in comparison and as a result the proposed Development would represent a Moderate cumulative effect.
	Grassland with Hills - Rubers Law	2.2 km NW	Medium to high	The ZTV (Figure 4.2a) extends over the south/south east facing slopes of Rubers Law and along the western side of Rule Water valley. Viewpoint 12 and 17 are located in this landscape. The magnitude of change experienced within this landscape would range from None (in locations situated in the viewshaddow on the northern side of Rubers law) to Moderate at Rubers Law. This equates to a residual effect on landscape character ranging from None to Major/moderate.	The turbines of the operational wind farms of Langhope Rig and Longpark appear in elevated distant views as small verticals within the landscape, to the north west of the proposed Development. There would be limited simultaneous visibility of the proposed Development with the existing wind farms due to the intervening distances and topography. The magnitude of change attributable to the proposed Development with the operational/consented wind farms would generally be None or Slight, but with localised Moderate change experienced at the summit of Rubers Law itself. This equates to a general Moderate/minor effect with a Moderate effect identified at Rubers Law.	The proposed Birneyknowe Wind Farm, which would be located within the south western corner of this landscape, 8.8 km to the north west of the proposed Development, and would be seen at a closer distance than the proposed Development. The magnitude of change attributable to the proposed Development with the operational/consented wind farms and the proposed Birneyknowe Wind Farm would range from None to Moderate, with localised substantial change experienced at the summit of Rubers Law, due to the increased cumulative context provided by Birneyknowe. Consequently, residual cumulative effects would generally be Moderate or Moderate/minor, but with localised **Major/moderate** effects experienced at the summit of Rubers Law.	The introduction of the Wauchope/Newcastleton scheme would introduce a particularly large scale and expansive wind farm development relatively close to this LCT, and one which has a considerable viewshed and which would provide a more immediate cumulative context for the proposed Development. However, the proposed Development would generally be seen as overlapping with and consequently less prominent than the scoping scheme, thereby causing a reduction in the cumulative effect attributable to the proposed Development.
	Grassland with Hills - Eildon Hills	18 km NW	High	Sporadic and distant visibility occurs on the highest elevations (including Eildon Hills (422 m AOD and Cauldshiels Hill) on an otherwise more intimate landscape of hollows and minor valleys. The elevated view from the Eildon Hills is represented by Viewpoint 16, and indicates	Intervisibility between the proposed Development and existing/consented wind farms is predicted at the summit and elevated south facing slopes of Eildon Hills. The magnitude of cumulative change attributable to the proposed Development in conjunction with existing/consented wind	The introduction of the proposed Birneyknowe turbines would add little to the cumulative context when viewed from this LCT. The magnitude of change attributable to the proposed Development with the operational/consented wind farms	In the event of the proposed Wauchope/Newcastleton scoping scheme be progressed in its current form the proposed Development would overlap with this far larger and more expansive development, thereby reducing the prominence of

Table 4.3: Residual effects on Landscape Character

LCT Ref	LCT Name	Distance and Direction to Nearest Turbine	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
				that the proposed Development would form a small component within an overall expansive and complex view. Due to the limited vertical and horizontal extent of the view that would be occupied by the proposed Development, coupled with its back-clothing by the Cheviots and Southern uplands, to the south, the magnitude of change is considered as Slight. Lower lying locations would be subject to Negligible change. However, the increased visibility provided from elevated summits and south facing flanks of the Eildon Hills would result in slight change due to distance and the relatively limited proportion of the expansive views obtained from such positions. In this context residual effects would range from Moderate/minor to Moderate.	farms in the study area would be Slight and the residual cumulative effect would be Moderate.	and the proposed Birneyknowe Wind Farm would therefore remain Slight, equating to a Moderate cumulative effect.	the proposed Development. This, in turn, would result in a reduction in the cumulative magnitude of change arising from the propose Development with the consequence that the residual cumulative effect would be Moderate/minor.
BDR28	Wooded Upland Fringe Valley - Rule Water	3 km NW	High	Visibility is indicated on the elevated sides of Rule Water valley, and the lower eastern flanks of Rubers Law. It is predicted that overall visibility of the proposed development is limited within this deeply-incised and heavily treed valley, with intermittent glimpses of the propos turbines visible only. Given the limited extent of visibility and the large proportion of this LCT that would be unaffected, the magnitude of change is considered to be Slight and the residual effect Moderate.	Due to the incised nature of this landscape, intervisibility with existing and proposed wind farms which are situated distantly from this LCT, the cumulative magnitude of change would be Negligible, equating to a Minor effect.	Whilst Birneyknowe Wind Farm would theoretically be visible it would be subject to the same interruption by landform and tree cover as the proposed Development. However, where it is visible Birneyknowe would be closer and more prominent. In this context the magnitude of cumulative change would generally be Negligible to Slight, equating to a Moderate/minor to Moderate cumulative effect.	Given the limited visibility of the proposed Development and other wind farms, including the Wauchope/Newcastleton scheme, the anticipated magnitude of cumulative effects attributable to the proposed Development would be Slight, equating to a Moderate cumulative effect.
BDR7	Cheviot Foothills - Falla Group	900 m NE	Medium	The ZTV indicates close proximity but sporadic visibility on low hills, mostly within forested areas. Viewpoint 14 is illustrative of the restricted nature of views of the proposed Development, constituting a Slight magnitude of change. It is predicted that the magnitude would rise to Substantial on the minor road above the Jed Water valley, on the approach to Chesters Brae. Consequently, residual effects on this LCT would range from None to Moderate/minor, with localised **Major/moderate** effects on the approach to	In the context of the distant existing/consented wind farms the magnitude of cumulative change attributable to the proposed Development would generally be slight, equating to a Moderate/minor cumulative effect, but increasing to **Major/moderate** in the vicinity of Chesters Brae.	The Birneyknowe Wind Farm would be seen at a longer distance and therefore less prominent than the proposed Development, but would provide a new cumulative context with the result that the magnitude of change attributable to the proposed Development increase to Moderate but remain at **Major/moderate** in the vicinity of Chesters Brae.	The inclusion of the Wauchope/Newcastleton scheme would substantially increase the cumulative context. In which case the cumulative magnitude of change attributable to the proposed Development would be Moderate and **Major/moderate** in the vicinity of Chesters Brae.

Table 4.3: Residual effects on Landscape Character

LCT Ref	LCT Name	Distance and Direction to Nearest Turbine	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
				Chesters Brae.			
BDR4	Southern Uplands Type with Scattered Forest - Cauldcleuch Head Group	1 km W	Medium	The ZTV indicates sporadic and elevated visibility on a small number of summits to the north and south of Slitrig Water, several with forest covering. The proposed Development would be screened from the majority of this LCT unit by intervening topography. Viewpoint 10 is located at the summit of Pike Fell, which is one of the closest parts of this LCT unit to the proposed Development. The magnitude of change would range from none across a large proportion of this LCT to Moderate to the north and south of Slitrig Water due to the relatively limited extent of the LCT subject to views of the proposed Development, the distance at which the proposed Development would be seen, and its partially obscured and backclothed position. Consequently, for much of this LCT there would be no residual effect, but where the proposed Development is visible, it would constitute a Moderate residual effect.	The operational Langhope Rig Wind Farm is visible against the skyline, 18.4 km to the north west within the Dun Knowe Group unit of the Southern Uplands Type with Scattered Forest. It is considered that the magnitude of change on the scale of the landscape unit attributable to the proposed Development with the operational/consented wind farms would be Slight, equating to a Moderate/minor cumulative effect.	The closest section of this LCT to the Proposed Wind Farm and one which offers some of the greatest cumulative intervisibility is that represented by Viewpoint 10. According to Viewpoint 10 Birneyknowe Wind Farm would appear at a closer distance and on a larger scale than the proposed Development and in the same direction as the existing Lammermuir Hills based developments (i.e. in the opposite direction to the proposed Development). In this context the magnitude of change experienced in this landscape unit attributable to the proposed Development with the operational/consented wind farms would range from none to Moderate, equating to residual cumulative effects varying between none and Moderate.	The Wauchope/Newcastleton scoping scheme would introduce a prominent and expansive wind farm, which the proposed Development would appear to extend laterally. In the context of the Langhope, Birneyknowe and Wauchope/Newcastleton scheme, the proposed Development would constitute a Moderate addition, reflecting a Moderate cumulative effect.
BDR8	Rolling Farmland - Oxnam	6 km NE	Medium	The ZTV indicates visibility would be concentrated on higher elevations within this rolling farmland landscape, on the eastern side of Jed Water valley. From where the proposed Development would be seen distantly and would be largely backclothed by topography visibility Viewpoint 9 illustrates the limited proportion of the expansive view obtainable from this LCT that would be affected with the consequence that the magnitude of change would be Moderate, equating to a Moderate residual effect.	Due to the distance at which existing/consented wind farms and the proposed Development would be visible, the separation of cumulative developments and the proposed Development in different directions in views, and the limited proportion of the LCT subject to cumulative visibility, the magnitude of cumulative change attributable to the proposed Development would be Moderate and the residual effect would similarly be Moderate.	The residual effect attributable to the proposed Development is considered to remain Moderate as the proposed Birneyknowe Wind Farm would be seen at comparatively long distance and would be less prominent than the proposed Development.	Whilst the introduction of the proposed Wauchope/Newcastleton scheme would establish a large scale expansive wind farm to the south of the proposed Development, the proposed Development would retain a degree of prominence and consequently, would continue to pose a Moderate cumulative effect.

Table 4.3: Residual effects on Landscape Character

LCT Ref	LCT Name	Distance and Direction to Nearest Turbine	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
BDR29	Lowland valley with Farmland - Lower Teviot	7.9 km NW	High	Visibility mainly occurs on the highest elevations (Minto Hills and Peniel Heugh) above this broad, shallow, flat bottomed wooded valley. The proposed Development would be screened from the majority of this LCT unit by intervening topography. Viewpoint 25 is indicative of the potential visibility of the proposed Development. In views from this location the proposed Development would affect a relatively small proportion of the expansive views available from this elevated position and would be backclothed. As a consequence the magnitude of change would be Slight, equating to a Moderate residual effect.	The magnitude of change attributable to the proposed Development when considered in respect of the proposed Development with the operational/consented wind farms would be Negligible on the Lower Teviot unit of the Lowland valley with Farmland LCT. This is largely due to the limited extent of intervisibility with cumulative schemes and their considerable distance from this LCT.	In the context of the existing/consented wind farms and proposed Birneyknowe Wind Farm, which would be seen at a closer distance and on a larger scale than proposed Development, the magnitude of change would remain Slight, and the residual cumulative effect would be Moderate.	In the event of the proposed Wauchope/Newcastleton scheme being implemented, the proposed Development would continue to result in only Moderate cumulative effects, as demonstrated in respect of Viewpoint 25.
BDR6	Cheviot Uplands - Cocklaw Group	10.2 km E	Medium	The ZTV indicates sporadic visibility on summits and to the south west facing slopes of hills, with five SB Iconic viewpoints appearing within the ZTV on the Pennine Way on the boundary of the LCT and NNP. The representative Viewpoint 7 indicates that the proposed Development would occupy a limited vertical and horizontal proportion of the expansive views locations in this LCT and that it would generally be backclothed by the Southern Uplands. Consequently, the magnitude of change would be Moderate, reducing to Slight on the Pennine Way by Cairn Hill, Cheviots (Ref. Viewpoint 22).	Due to the distance the simultaneous visibility of the proposed Development with the existing wind farms (including Langhope Rig, Green Rig) is imperceptible.	It is considered that the magnitude of change on the scale of the landscape unit attributable to the proposed Development with the operational/consented wind farms would be slight on the Cocklaw Group unit of the Cheviot Uplands LCT, equating to a discernible alteration to baseline conditions. According to the assessment of representative Viewpoint 7 and Viewpoint 22, the additional magnitude of change attributable to the proposed Development is considered to remain Moderate and Slight, respectively, as the proposed Birneyknowe Wind Farm would be seen simultaneously and at a longer distance, and therefore less prominent, than the proposed Development. This equates to residual cumulative effects of between Moderate and Moderate/minor.	In the context of the existing/consented and proposed wind farms, and the Wauchope/Newcastleton scoping proposals, the proposed Development would continue to represent development a Moderate and Moderate/minor cumulative effect.

Table 4.3: Residual effects on Landscape Character

LCT Ref	LCT Name	Distance and Direction to Nearest Turbine	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
BDR10	Grassland with Rock Outcrops - Whitehaugh	12 km NW	Medium	Sporadic visibility is indicated on some low summits (between of 260 m to 320 m AOD) within undulating pasture covered hills. Viewpoint 24 is located in this landscape and demonstrates the limited vertical and horizontal proportion of expansive views available from locations that it would occupy, as well its backclothed position. Consequently, the magnitude of change would be Slight, and the residual effects would be Moderate/minor.	Although the Langhope Rig turbines appear approximately 8 km to the north west of the landscape unit, the predicted intervisibility with the proposed Development would be limited to a small number of elevated locations. The magnitude of cumulative change attributable to the proposed Development when considered in conjunction with operational/consented wind farms would range from Negligible to Slight and the residual effect would range from Moderate/minor to Minor.	The proposed Birneyknowe scheme, whilst providing a more obvious cumulative context to the proposed Development, would be seen at a closer distance and on a large scale than the proposed Development. consequently, the magnitude of cumulative change attributable to the proposed Development when considered in conjunction with operational/consented wind farms would range from Negligible to Slight and the residual effect would range from Moderate/minor to Minor	The introduction of the Wauchope/Newcastleton scheme would increase the prominence of wind energy development in views to the south-east. The proposed Development would overlap with this scoping scheme, with the consequence that its prominence would be slightly reduced. In this context the magnitude of cumulative change attributable to the proposed Development would be Negligible, and residual cumulative effects would be Minor.

Technical Appendix 4.4: Residual effects on Designated & Classified Landscapes

Designation/ Classification	Key Characteristics & Special Qualities	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
Landscape Designations						
Eildon and Leaderfoot NSA	The Scottish Borders Local Landscape Designation Review Revised Report (June 2012)[1] cites the special qualities of the Eildon and Leaderfoot NSA, which are defined in the SNH Commissioned Report No.374 'The special qualities of the NSAs'[2]. ▪ Great landscape diversity within a compact area; ▪ The distinctive triad of the Eildon Hills; ▪ Spectacular views from the hill summits; ▪ A strongly united landscape pattern of lively rhythm and colour; ▪ A richly wooded scene of great variety; ▪ The Tweed, an iconic river of international renown; ▪ A rich array of historic buildings, structures and estate; ▪ The hub of Border settlement; ▪ A harmonious and varied prospect from unequalled viewpoints; ▪ Inspiration for the arts, literature and painting; ▪ Border country ballads and battles; ▪ The historic crossings of Leaderfoot; ▪ Scott's View; and ▪ The Wallace Statue.	High	Long distance views of the proposed Development would be provided from the summits and southern slopes of the Eildon Hills The view from the Eildon Hills is represented by VP16. The proposed Development would be seen distantly and would form a small component within an expansive and panoramic view. The proposed Development would also be backclothed in views from this designated area, further reducing its prominence in the view to Slight, equating to a Moderate residual effect. The proposed Development is not located within this designated area and so would not affect it physically. It would also not significantly adversely affect or undermine the diversity of the Eildon Hills landscape or the spectacular, harmonious and varied nature of views from the Hills.	Cumulative visibility of the proposed Development and existing/consented wind farms would be confined to elevated summits only. The majority of cumulative schemes visible from the Eildon Hills summits are located on the Lammermuir Hills, to the north of the Hills, in the opposite direction to the proposed Development, and are therefore of limited prominence. On this basis and the relative distance and limited prominence of the proposed Development, and its backclothed position, the cumulative change wrought in the designated area would be Slight, equating to a Moderate cumulative effect.	The introduction of the proposed Birneyknowe development, would increase the perceived cumulative context of the proposed Development, but would not result in an increased cumulative effect.	The introduction of the Wauchope/Newcastleton scoping scheme would establish a development of considerable size to the south of the proposed Development, thereby reducing the prominence of the proposed Development and the corresponding cumulative effect to Moderate/minor.
Northumberland National Park	The special qualities of National Parks relate to: ▪ landscape and views; ▪ geology and geography; ▪ biodiversity and rare species; and ▪ archaeology and history. The rural communities who live and work within the Parks now - and the history of the people who've lived there in the past - are also part of what makes these areas special. It is the combination of these special qualities that led to these areas being designated to be protected as National	High.	Limited visibility is predicted within the NNP, potential views being confined to a small number of elevated summits, including The Cheviot (815 m AOD). Viewpoint 22 is located close to the border of the NNP and indicative of views from elevated locations in the NNP. Given the limited geographical extent of the proposed Development's viewshed, the	Cumulative visibility would largely be confined to a small number of elevated summits within the NNP. Where visible, operational and consented wind farms, such as those on the Lammermuir Hills, would be difficult to discern due to their distance from key receptor locations in the NNP. Moreover, they are located to the north-west of the NNP,	The introduction of the proposed Birneyknowe Wind Farm, whilst introducing a cumulative context closer to the proposed Development would be seen distantly and also backclothed. On this basis it would pose an insufficient addition to substantively alter the findings of the cumulative assessment in respect of existing/consented wind farms.	The introduction of the proposed Wauchope/Newcastleton scheme would add a substantial number of turbines arranged in three clusters to the south, south-west and west of the proposed Development. The difference between the design of the proposed Development and the

[1] Land Use Consultants (June 2012), Local landscape Designation Review, Revised Report, Scottish Borders Council

2 Scottish Natural Heritage (2010), The special qualities of the National Scenic Areas, SNH Commissioned Report No.374

Designation/ Classification	Key Characteristics & Special Qualities	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
	Parks. The special qualities for the NNP are summarised as follows:[3] ▪ A diverse landscape; ▪ An ancient landscape; ▪ The presence of a World Heritage site; ▪ deep roots of communities in the Park; ▪ Ancient hill forts and 'pure' rivers The Cheviot Hills; ▪ spiritual refreshment offered to visitors; ▪ The valleys of the North Tyne and Redesdale were once home of the Border Reivers; ▪ Biodiversity and ecological richness; ▪ Extensive areas of the National Park designated for their international importance for nature conservation; and ▪ A geologically important landscape.		distance at which the proposed Development would be seen, its backclothed position and the limited proportion of the expansive views from this designation that it would occupy, the magnitude of change would generally be None, increasing to Slight in the vicinity of the Cheviot, representing residual effects that range from None to Moderate. The proposed Development is not considered to reduce the diversity of this designated landscape, and would not detract from its constituent elements, many of which are physical in nature.	whilst the proposed Development would be seen to the south-west. Given the limited geographical extent of cumulative visibility, the relative distance of the proposed Development and existing/consented wind farms and relative proportion of what are expansive panoramic views likely to be affected The magnitude of cumulative change attributable to the proposed Development, when considered in conjunction with the existing/consented developments, the magnitude of cumulative change would range from none to Slight, equating to residual cumulative effects of between None and Moderate. Seen in the context of existing/consented wind farms, the proposed Development would not reduce the diversity of this designated landscape, and would not detract from its constituent elements, many of which are physical in nature.	The overall additional magnitude of change attributable to the proposed Development with the operational/consented wind farms and the proposed Birneyknowe Wind Farm would remain negligible when considered on the scale of the Northumberland National Park Consequently, in the context of existing, consented and proposed wind farms, the magnitude of cumulative change would range from none to Slight, equating to residual cumulative effects of between None and Moderate. The proposed Development, seen in this cumulative context, would not reduce the diversity of this designated landscape, and would not detract from its constituent elements, many of which are physical in nature.	Wauchope /Newcastleton scheme would be emphasised by the proximity of the two schemes. The magnitude of cumulative change attributable to the proposed Development with the operational/consented, proposed and scoping schemes would remain None to Slight and the residual effects None and Moderate. The proposed Development, in this expended cumulative context, would not reduce the diversity of this designated landscape, and would not detract from its constituent elements, many of which are physical in nature.
Teviot Valleys SLA	The SLA is ls located between Hawick and Jedburgh. The SLA's boundaries are formed by ridges which contain the valleys, and by the village of Chesters and the A6088 to the south. This area covers a series of distinctive Borders valleys and hills, and has been defined to draw together a number of landmark features with their pastoral and woodland settings. Visually prominent hills include Minto Crags, Peniel Heugh, Dunion Hill, Minto Hills and Rubers Law, each of which has a strong relationship with adjacent valleys and the wider landscape. The three valleys each have their own distinctive character and scale. Minto Crags are a dramatic feature contrasting strongly with the gentle farmed valley Teviot below. Long views along the Teviot valley are terminated by the monument on Peniel Heugh. The setting of Fatlips Castle is a reminder of a historic past, when the landscape was dominated by	Medium to High.	Principle views of the proposed Development would occur on elevated slopes and summits at Bonchester Hill, Black Law, Rubers, and elevated locations to the north and west of Chesters. However, views from locations within the Teviot valley would be restricted by the intervening topography and vegetation. Viewpoints 5, 8, 12, 17, 18, and 23 are located within this designated area. Three of these representative viewpoints (Viewpoints 5, 12 and 23) would be subject to substantial change, equating to a	Seen in conjunction with existing/consented wind farms, which are primarily located at a considerable distance to the north and north-west of this SLA, the proposed Development is, with the exception of Bonchester Hill, considered to represent a Slight to Moderate cumulative addition and a Moderate/Minor to Moderate cumulative effect on this designated area.	The proposed Birneyknowe Wind Farm would introduce a more conspicuous cumulative context and one which is located closer to the proposed Development. The other proposed Wind Farms (Windy Edge and Longpark Wind Farm Extension) would be difficult to discern in long distance views (also being well screened) and therefore are not regarded as having any interaction with the proposed Development. The overall magnitude of change attributable to the	The introduction of the Wauchope/Newcastleton scoping scheme would represent a considerable increase in the influence of wind farm developments in the borrowed prospect from this designated area. The proposed Development would overlap with the Wauchope/Newcastleton scheme, but would remain relatively prominent and would contrast with the scale and form of the scoping scheme, but would not constitute a significant

[3] http://www.nationalparks.gov.uk/learningabout/whatisanationalpark/specialqualities/special_qualities_nb

Designation/ Classification	Key Characteristics & Special Qualities	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
	wealthy landowning and military classes, and is associated with extensive designed landscapes. The smooth, rounded grassy Minto Hills contrast with the rugged, wooded Minto Crags. Rubers Law has a distinctive craggy summit, dissected and rocky. Bonchester Hill is almost a reduced version of the same, while Dunion Hill is a landmark above Jedburgh. The Jed valley is important as a key gateway into the Borders along the A68, including the sense of sudden arrival at Jedburgh after the scenic drive through the wooded valley. Rocky cliff features of red sandstone along the Jed are particularly attractive against spring green of trees. The Rule Water is smaller in scale than the Jed valley, and is densely wooded with beech trees along the road. It is an intimate, picturesque valley with traditional stone buildings and bridges, and intriguing gateways into estates. There is evidence of management which suggests a well-established and valued landscape. The SLA's comprises the following LCTs: ▪ Lowland Valley with Farmland (Medium sensitivity); ▪ Grassland with Rock Outcrops (Medium sensitivity); ▪ Grassland with Hills (Medium to high sensitivity); ▪ Wooded Upland Fringe Valley (Medium to high sensitivity, but outwith the ZTV for the proposed Development); and ▪ Cheviot Foothills (Medium sensitivity).		**Major/moderate** residual effect, indicating potentially significant effects at Bonchester Hill, Rubers Law, and on land north of Chesters. However, elsewhere no significant effects are anticipated due to the constrained nature of views of the proposed Development. On this basis, significant effects on the SLA would be localised. The proposed Development would not affect views of the visually prominent hills (including Bonchester Hill, Rubers Law) from/within the valleys of Teviot, Jed Water and Rule Water Valley with which the identified hills have a strong relationship, as stated by the Designation Statement of the Teviot Valleys SLA[4]. It is therefore considered that the proposed Development would have moderate and not significant impact upon this designated area overall.		proposed Development with the operational/consented wind farms and the proposed Birneyknowe Wind Farm would generally range from Slight to moderate on the Teviot Valleys SLA.	cumulative effect in this context.
Cheviot Foothills SLA	The Cheviot Foothills extend 3.5 km to the east/north east of the site and abut with the Northumberland National Park western boundary. The Cheviot uplands are distinct from typical Borders hills, being of different form with more frequent rocky outcrops. The area has a very remote and untouched character, especially when experienced at the summits. The rocky outcrops enliven the green grass moorland expanse of some hills. Layers of hills give visual depth to views into and within the area. The surrounding valleys have a quieter, unintimidating drama. Flat valley floors without tree cover allow open views to the hills. Carter Bar is a key access point into the Borders, and into Scotland. The Cheviots are a well-used recreational resource, contiguous with the Northumberland National Park, and including sections of the Pennine Way and St Cuthbert's Way. The SLA's comprises the following LCTs:	High	Views of the proposed Development would be sporadic and largely confined to elevated locations on west and south-west facing slopes of Cheviot Uplands and Foothills, at the eastern side of this designated landscape. The remainder of the designation being screened by a combination of topography and/or structural vegetation including forest cover, shelter belts and woodlands. Viewpoints 7 and 22 are situated in some of the principle areas of visibility within this designated landscape, adjoining the NNP at Black Law and Cairn Hill. The assessment in respect of these viewpoints concludes that the	The other operational wind farms (including Langhope Rig, Green Rig) would be difficult to discern in long distance views and therefore are regarded as providing only a limited cumulative context. On this basis, and given the limited proportion of the designated area affected, the magnitude of cumulative change attributable to the proposed Development would be slight, and the residual cumulative effect would range from Moderate to Moderate/minor. The proposed Development would not constitute a significant cumulative effect on	The proposed Birneyknowe Wind Farm would interposed between the Langhope Rig Wind Farm and the proposed Development creating a clear emergent pattern of development, as well as introducing a more conspicuous cumulative context and one which is located closer to the proposed Development. In this context the proposed a Moderate to Moderate/minor cumulative effect, the greatest effect occurring at Black Law. However, as the majority of the designated area would be unaffected, the overall cumulative effect would be	The proposed Wauchope/Newcastleton scoping scheme would introduce a large number of turbines organised In three distinct clusters, to views from elevated locations in the eastern half of this designated area, and provide a more immediate cumulative context close by the proposed Development. Notwithstanding this, the proposed Development would be evidently different from the scoping scheme. Consequently, it would constitute a Moderate to Moderate/minor effect in

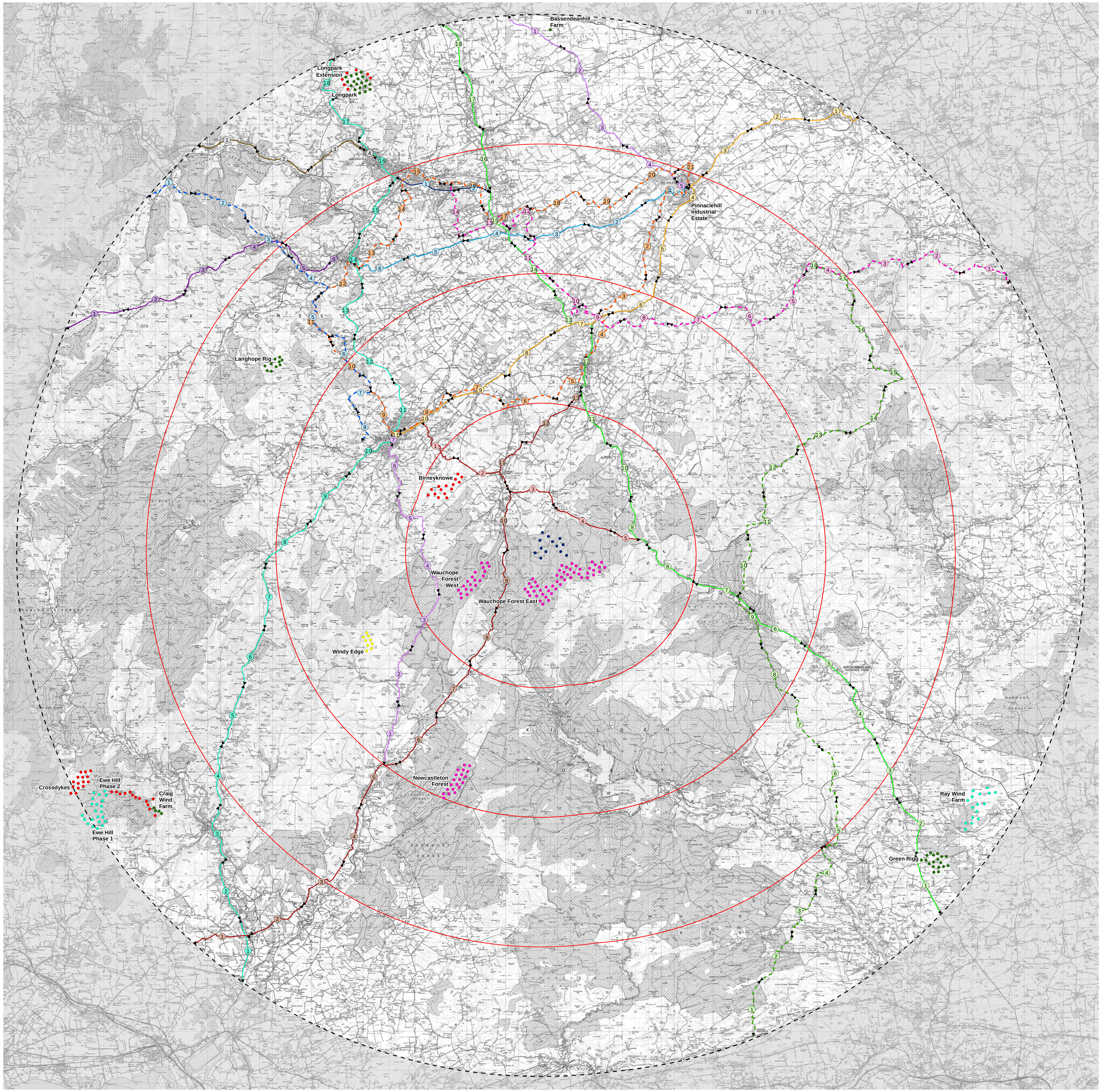
[4] Scottish Borders Council, August 2012, Supplementary Planning Guidance, Local Landscape Designations

Designation/ Classification	Key Characteristics & Special Qualities	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
	▪ Cheviot Uplands (Medium sensitivity) ▪ Pastoral Upland Fringe Valley (Medium to high sensitivity) ▪ Southern uplands Forest Covered (Medium to low sensitivity) ▪ Cheviot Foothills (Medium sensitivity)		proposed Development would result in Moderate to Slight change, and Moderate to Moderate/minor residual effects, respectively. However, the majority of the designated area would be subject to no residual effects. The proposed Development would not undermine the key characteristics, scale or remote/untouched character of this landscape.	the remote and undeveloped character of this landscape or undermine its relationship to the NNP.	Slight.	locations affected within this designated area. However, the majority of this designated area would be subject to no cumulative effect.
Tweed Lowlands SLA	This area is focused on the meandering alignment of the River Tweed as it flows through the lowland between Newtown St Boswells and Kelso. The SLA is bounded by higher ground to north and south of the river. This area includes the less dramatic but still distinctive landscape of the lower Tweed. It is a recognisable Borders landscape of rolling mixed farmland, well-wooded and mature, with attractive vistas and visual diversity. In views from the A699 it forms the foreground to the view of the Eildon Hills. The area is of importance to recreation and tourism, containing numerous opportunities for enjoying the landscape, including some key attractions such as Smailholm Tower, Floors Castle and the Borders Abbeys Way/St Cuthbert's Way. The SLA's comprises the following LCTs: ▪ Lowland Valley with Farmland (Medium sensitivity) ▪ Lowland Margin with Hills (Medium to high sensitivity) ▪ Lowland with Drumlins (Medium to high sensitivity)	High	The majority of the SLA would be subject to no views of the proposed Development, including Mertoun GDLs and Borders Abbey Way. Visibility would be sporadic and concentrated along the northern side of River Tweed, on contour levels of between 207 m AOD and 60 m AOD. An analysis of the ZTVs, and field reconnaissance indicates that much of the potential visibility would be interrupted by a combination of topography and structural vegetation, and where visibility is possible, the proposed Development would appear as a small number of turbine rotors and blade tip seen distantly on a treed skyline to the south. Given the restricted nature of visibility and distance the SLA is from the proposed Development, the magnitude of change associated with the proposed Development would range from None to Slight, equating to no residual effect to localised Moderate effects.	As in many of the other designated landscapes, the operational and consented wind farms would be difficult to discern in long distance views to the north and north-west (in the opposite direction to the proposed Development), and would therefore provide a limited cumulative context. Given the limited proportion of this designated area subject to cumulative impacts and the distance of potential receptors from the proposed Development, the cumulative magnitude of change would range from None to Slight, equating to non effect to localised Moderate effects. The proposed Development would not significantly alter the key characteristics of this landscape.	Intervisibility between the proposed wind farms, including Birneyknowe and the proposed Development would be highly constrained from this designated area. On the basis of the limited proportion of this designated area subject to cumulative impacts and the distance of potential receptors from the proposed Development, the cumulative magnitude of change would range from None to Slight, equating to non effect to localised Moderate effects.	Whilst the Wauchope/Newcastleton scoping scheme would theoretically add considerably to the cumulative context of the proposed Development, it would be screened across much of this designated area by topography and structural vegetation. Where the proposed Development is seem in conjunction with Wauchope/Newcastleton the two schemes would overlap. However, the proposed Development would be differentiated somewhat due to the size of its turbines. However, in the context of the limited proportion of this SLA with cumulative views and the distance of potential receptors form the proposed Development, the residual cumulative effects attributable to the proposed Development would range from None to localised Moderate effects.
Tweed, Ettrick and Yarrow Confluence SLA	The area has a strong sense of place, and contains representative Border features, albeit that each valley retains its own character. The enclosing uplands and upland fringes offer contrast and an attractive wider setting, and enable views across the valleys, the descending approach to Selkirk along the A699 being particularly scenic. A series of	High	The majority of the SLA lies outside the viewshed of the proposed Development Distant sporadic visibility is indicated on the south east facing slopes of the Southern	The other operational wind farms would be difficult to discern in long distance views and therefore are regarded as having no discernible cumulative interplay with the	Visibility of the proposed wind farms, including Birneyknowe would be substantially restricted and in the small number of locations where it would be seen would be more	Visibility of the Wauchope/Newcastleton scheme would be substantially restricted and in the small number of locations where it would be

Designation/ Classification	**Key Characteristics & Special Qualities**	**Sensitivity**	**Residual Effect**	**Residual Cumulative Effect: Existing/Consented Wind Farm Scenario**	**Cumulative Effect Existing, Consented and Proposed Wind Farms**	**Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario**
	estate landscapes give visual diversity to these valleys, including Abbotsford, Sunderland and Bowhill. The SLA's comprises the following LCTs: ▪ Upland Valley with Woodland (Medium to high sensitivity); ▪ Southern Upland with Scattered Forest (Medium sensitivity); ▪ Upland Fringe Valley with Settlements (Medium to high sensitivity); and ▪ Undulating Grassland (Medium to high sensitivity) ▪ Grassland with Hills (Medium to high).		Upland with Scattered Forest (including SUW, Old Drove Road and Borders Abbey Way). An analysis of the ZTVs, and field reconnaissance indicate that much of the potential visibility would be interrupted by a combination of topography and structural vegetation, and where visibility is possible, the proposed Development would appear as a small number of turbine rotors and blade tip seen distantly on a treed skyline to the south-east. Given the restricted nature of visibility and distance the SLA is from the proposed Development, the magnitude of change associated with the proposed Development would range from None to Negligible, equating to no residual effect to localised Moderate/minor effects.	proposed Development. Consequently there would be Negligible or no change and Moderate/minor to no residual cumulative effect. The proposed Development is therefore not considered to pose any threat to the integrity of this designated area or any of its constituents.	prominent than the proposed Development. The magnitude of change attributable to the proposed Development within the context of the existing/consented and proposed wind farm developments would range from None to Negligible, and the residual cumulative effects would range from None to Moderate/minor. Consequently, no significant effect on the special qualities of this designation is anticipated.	seen would be more prominent than the proposed Development. The magnitude of change attributable to the proposed Development within the context of the existing/consented, proposed and scoping status turbines would range from None to Negligible, and the residual cumulative effects would range from None to Moderate/minor. Consequently, no significant effect on the special qualities of this designation is anticipated in this context.
Gardens and Designed Landscapes						
Monteviot GDL	Set in the SLA of the Teviot Valley, 11.9 km to the north east of the proposed Development site and 4 km to the North of Jedburgh, Monteviot is a large designed landscape characterised by its extensive park and woodlands around the river and the prominent hill landform of Peniel Heugh, which rises steeply to the north. Monteviot House itself, together with the main gardens, occupies a higher shelf of land above the river, a good vantage point for long landscape views south over the fertile valley terrain towards the Cheviots. Covering a sizable area along the River Teviot, the parkland and policy woodland canopy contribute to the quality of the surrounding landscape by virtue of their extent. Scenically prominent by virtue of the extent of the designed landscape and the landmark Waterloo monument on Peniel Heugh, Monteviot also has a strong amenity focus through its seasonally open gardens, walkers' trails and countryside visitor centre at Harestanes, the former Home Farm.	High	The proposed Development would be screened from the majority of this GDL due to its enclosed and low lying position relative to surrounding topography. However, views of all thirteen turbines would be provided from the open summit and south facing slope of Peniel Heugh, and the Waterloo Monument. However, the proposed Development would be seen at a distance of over 19 km to the south, would be largely backclothed and would occupy a relatively limited proportion of the expansive view provided from this location. On the basis of this analysis the magnitude of change resulting from the proposed Development would range from None to Slight and the residual effect would generally be None, but with localised Moderate effects	Cumulative visibility is constrained to the elevated summit and Waterloo Monument on Peniel Heugh. Whilst the majority of existing, consented wind farms are visible to the north of this part of the GDL, they are seen at a considerable distance, and in the opposite direction to the proposed Development, and provide a limited cumulative context. The operational Langhope Rig and Longpark, however, are visible at distances of around 20 km to the west and north-west of this GDL, respectively. Given the limited proportion of this GDL subject to cumulative views, the distance of the GDL from each wind farm, the distance/separation between wind farms, the magnitude of cumulative change at this GDL	The incorporation of the proposed Birneyknowe scheme would provide a more prominent and immediate cumulative context for the proposed Development, but would not increase the cumulative effect from that of the existing/consented scenario.	The incorporation of the Wauchope/Newcastleton scheme would introduce a large number of turbines arranged in a series of clusters to the view towards the proposed Development, with the consequence that there would be a reduction in the prominence of the proposed Development when seen amidst the Wauchope/Newcastleton array.

Designation/ Classification	Key Characteristics & Special Qualities	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
			experienced at Peniel Heugh, and the Waterloo Monument. The proposed development would not significant alter or degrade the character and special qualities of this GDL.	would range from None to Slight, and the residual cumulative effect would likewise vary from None to Moderate. In this context, the integrity of the GDL would not be compromised.		
Bemersyde GDL	Bemersyde Estate lies 22.6 km to the north of the application site, above the River Tweed, 2 km upstream from Newtown St Boswells, 90 m to the north of Dryburgh Abbey GDL. Topographically, the region is characterised by the strongly meandering course of the river, moderately rolling landform and prominent conical and dome-shaped hills. Bemersyde occupies a relatively prominent location on top of the river side (160m AOD), the canopy of the woods and top of the tower can be seen from Scott's View. Similarly, from the upper storeys of Bemersyde House, views extend across Lauderdale, the Tweed Valley and as far south as the more distant Cheviot Hills. At ground level, shelterbelts enclose most of the park and garden areas, and protect them from prevailing south-westerly winds. The scenic qualities of the region as a whole have been recognised through the designation of the Eildon and Leaderfoot National Scenic Area.	As the GDLs are identified in the Inventory with notes of the specific qualities attributabl e to each inventory property, they are considered to be highly sensitive landscape receptors to the proposed developme nt.	Whilst the ZTVs indicate potential visibility of the proposed Development from this GDL field reconnaissance suggest that it would be screened by a combination of topography and the extensive woodland cover in the estate. Consequently, there would be no effect on this designed landscape.	None.	None.	None.
Floors Castle GDL	The Floors Castle GDL lies 23.5 km to the north east of the site within the SLA of the Tweed lowlands, immediately west of the town of Kelso, occupying a prominent site overlooking the River Tweed near its confluence with the Teviot. From the castle, open views stretch southwards across a broad sweep of parkland and the rolling green lowlands of the Tweed valley. The ruins of Kelso abbey, Roxburgh castle and a more distant castellated folly punctuate the middle distance, while beyond, the peaks of the Cheviot hills are visible on a clear day.	High	Whilst theoretical visibility is indicated across much of this GDL, field reconnaissance suggests that it would be substantially restricted by the extensive woodland on its southern side, thereby restricting views to a small number of elevated open locations at the northern end of the estate from where the proposed Development would appear distantly to the south-west and appear as a small number of blade tips on the skyline beyond the treed horizon in the middle ground.	The distance and separation of existing and consented wind farms means that there would be no discernible cumulative context perceived from the interior of his GDL and consequently, no cumulative effect attributable to the proposed Development.	Whilst the proposed Birneyknowe Wind Farm would theoretically be visible in conjunction with the proposed Development from a small number of elevated locations within the northern part of this GDL it would be seen distantly to the south-west and would not be directly intervisible with the proposed Development. Consequently, the cumulative magnitude of change attributable to the proposed Development with the operational/consented and	Whilst the Wauchope/Newcastleton scheme would theoretically be visible from this GDL, it would, like the proposed Development, be barely visible from the interior of the estate. As a consequence intervisibility with the proposed Development would be highly restricted and the magnitude of cumulative change would be Negligible and the residual cumulative effect Minor.

Designation/ Classification	Key Characteristics & Special Qualities	Sensitivity	Residual Effect	Residual Cumulative Effect: Existing/Consented Wind Farm Scenario	Cumulative Effect Existing, Consented and Proposed Wind Farms	Cumulative Effect Existing/Consented, Proposed and Scoping Wind Farm Scenario
			Given the limited proportion of this GDL affected by views, its distance from proposed Development and the restricted nature of the views of the proposed Development, the magnitude of change within this GDL would be Negligible, equating to a Moderate/minor effect. The proposed Development would not alter the character or special qualities of this designed landscape.		proposed wind farms would be Negligible and the residual cumulative effect would be Minor.	



DRAFT

HIGHLEE HILL
WIND FARM

FIGURE AP1

ROUTE ANALYSIS

Key

- Proposed Turbines
- 40km Buffer from Outer Turbine
- 10km Radii from Proposed Turbines

Cumulative Turbines

- Operational
- Under Construction
- Consented
- Application
- At Appeal
- Refused – Pending Appeal
- Scoping

Routes

- A6088
- A6089
- A6091
- A68
- A698
- A699
- A7
- A708
- A72
- B6357
- B6399
- Pennine Way
- Borders Abbeys Way
- Cross Borders Drove Road
- St Cuthbert's Way
- Segment Number

LAYOUT DWG	XXXXXDXXXX-XX	T-LAYOUT NO.	PSCOhhi041

DRAWING NUMBER
AP1

SCALE - 1:150,000 @ A1

ENVIRONMENTAL STATEMENT
2016

Appendix 4.6 Viewpoint Assessment

Introduction

This Technical Appendix (TA) sets out the findings of the detailed viewpoint assessment, carried out as part of the LVIA for the proposed Development. The findings of the Viewpoint Assessment are used to inform the overall assessment of effects of the LVIA, and were initially utilised in the design of mitigation measures discussed in Chapter 3, and in Table 4.8a and Table 4.8b of the LVIA.

The viewpoints were selected to reflect a range of locations at different distances and directions, and elevations from the proposed Development site. The selected viewpoints were intended to represent the experience that receptors would experience at recognised vantage points, within landscape character types and landscape designations, settlements, important transportation and recreational routes, as well as Iconic Viewpoints. The viewpoints have been utilised in the development of the design strategy and in the assessment of landscape and visual effects arising from the proposed Development.

The viewpoints were agreed with Scottish Borders Council (SBC) and Scottish Natural Heritage (SNH), along with the cumulative context to be considered in the LVIA in April, 2016, and are shown on Figures 4.4 and 4.6, respectively.

An assessment of the potential effects on both landscape character and visual amenity arising from the proposed Development at each of the agreed viewpoints has been carried out in line with Guidelines for Landscape and Visual Impact Assessment, Third Edition[1] (GLVIA 3). The existing and predicted views from each of these viewpoints have been described and analysed in order to identify the magnitude of change and the residual effects on landscape character and visual amenity.

Visualisations for each of the viewpoints are illustrated in Figures 4.8 – 4.33d of Volume 3 of the ES. These images have been created in accordance with current SNH guidance and contain details of the location, elevation, bearing and distance of the proposed Development from the nearest proposed Development turbine. It should be noted that bearings of views may vary according to whether the view is centred on the site centre (as in the case of the montaged images) or whether the site is offset to take account of cumulative developments (i.e. in cumulative wireline images).

The visualisations reflect the visibility of the proposed Development at the time of the cessation of construction works at the site. Necessarily, the baseline context of the landscape in which the proposed Development would be established has also been reflected, including planned felling and restocking of the Wauchope Forest by the Forestry Commission. However, there is some potential for variations in the timing of forest operations, and so where the presence or absence of forestry has an important influence on the visibility of the proposed Development, this is commented upon.

The assessment of cumulative effects of the proposed Development considers cumulative effects in respect of operational and/or consented wind farms, as well as proposed wind farm developments. At the request of SBC, the Wauchope/Newcastleton scoping scheme has also been included, despite the uncertain nature of this development's design and prospects. It has therefore been included for reference only and should not be given any weight.

[1] Landscape Institute and Institute of Environmental Management and Assessment (2013) Guidance for Landscape and Visual Impact Assessment – Third Edition

Viewpoint 1: A6088, Chesters (Ref. Figures 4.8a – 4.8e)

Viewpoint	A6088, Chesters
Grid ref	362390 610466
Eye level	205 m AOD
Distance to nearest turbine	3 km
Bearing	179º south
Location	The viewpoint is located next to the A6088, on the southern edge of Chesters village.
Sensitivity of Landscape Character at Viewpoint (Bonchester/Dunion of Grassland with Hills LCT)	The viewpoint is located in an upland fringe landscape of medium scale, with smooth, rounded terrain, where pasture dominates the land cover but where shelter belts and occasional larger coniferous plantations are prominent. Although the landscape at this viewpoint is not covered by any designations, it is valued by the inhabitants of Chesters village as part of their amenity and therefore its value is considered to be High. Due to the viewpoint's location on the transitional edge from the Grassland Hills to the Southern Uplands Forest Covered landscape, its medium scale its susceptibility to wind farm development is considered to also be High. On this basis, the sensitivity of the landscape and this viewpoint is considered to be High.
Sensitivity of Visual Receptor	Residents of Chesters village: High Road users: Medium
Existing View	The view towards the site comprises an open panorama across the low lying, essentially flat terrain associated with the confluence of White Burn with Jed Water. The foreground is comprised of medium scale agricultural fields bisected by woodland occurring in small scattered shelterbelts and coniferous plantation blocks. The ground rises towards the north east facing slopes of Highlee Hill, which forms the short distant skyline. The outline of the distant prominent ridge of the Cheviot Hills appears above the east falling slope of Highlee Hill, on the left hand side of the view, forming an even skyline with the forested summit of Highlee Hill. Views to the north, away from the proposed Development site comprise the village of Chesters and the landform of Doorpool Hill which bounds the view in this direction.
Predicted View:	Six of the proposed turbines which are on the north facing slope of Green Law, on the eastern part of the site, would be visible and would occupy a backclothed position against the prominent elongated ridge of the Cheviot Hills, therefore only their blades would appear above the skyline. The remaining turbines (on the east facing slope of Wardmoor Hill), on the western part of the site would appear on the skyline. All turbines would have their lower columns screened by intervening landform and therefore would not appear in their entire height. rotor movement would be clearly visible at this distance.
Magnitude of Change/Impact:	The proposed Development's turbines would appear as new elements within the landscape, occupying 31 degree horizontal subtended angle of the view. The alignment of turbines follows the underlying landform and most of their lower towers would be partially screened by the intervening topography and/or retained forestry. Due to the distance the magnitude of change is considered as Substantial.

Effect on Landscape Character	Major
Effect on Visual Amenity	Major - Major/moderate
Cumulative Visibility	None of the existing, consented wind farms would be visible from this location. However, the proposed Birneyknowe Wind Farm would occupy 13 degree subtended angle of the view at a distance of 6.9 km to the west, between the landforms of Wolfelee Hill and distinctive landform of Bonchester Hill. The proposed Development would be partially screened by the northern slope of Wolfelee Hill.
Cumulative Magnitude of Change	None - Existing/ Consented Wind farm Scenario Medium. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	None - Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	None - Existing/ Consented Wind farm Scenario **Major - Major/moderate -** Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative Effect with Scoping Scheme Incorporated	The proposed Wauchope East Wind Farm would be backclothed by the topography of Carter Fell and seen at a distance of 5.6 km and close to the south of the proposed Development. Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by the proposed Development, but would be more distant. Moreover, the proposed Development would contrast with the scale of the Wauchope turbines and would appear closer. Consequently, the cumulative effect attributable to the proposed Development, when viewed in conjunction with existing, consented, proposed and scoping scenarios would be **Major/Moderate** in respect of landscape character and **Major/moderate -** Moderate in respect of visual amenity.

Viewpoint 2: A6088, Southdean (Ref. Figures 4.9a to 4.9h)

Viewpoint	A6088, Southdean
Grid ref	363248 609113
Eye level	200 m AOD
Distance to nearest turbine	2.1 km
Bearing:	195º south west
Location:	The viewpoint is located next to the A6088 on the bottom slope of Southdean Hill, on the side of Black Burn valley, adjacent to the Southdean property.
Sensitivity of Landscape Character **(Southern Uplands Forest Covered LCT)**	The landscape in view, whilst located within the large scale Southern Uplands Forest Covered LCT, is not typical of it. In contrast to the extensive forested uplands of this LCT, the landscape in the vicinity of the viewpoint is a farmed river valley with a pattern of medium scale pastoral fields with interspersed plantations and shelter belts on sloping ground which rises towards the elevated valley side that forms a forested horizon in the background of the view. Although the landscape in the view is not covered by any designations, it is valued by residents of Southdean hamlet as part of their visual amenity and therefore its value is considered to be Medium. The scale and enclosed nature of the landscape in the vicinity of this viewpoint, coupled with the limited opportunities for mitigation of the type of development proposed, the susceptibility of the landscape is considered to be High. Sensitivity: High
Sensitivity of Visual Receptor	Residents of Southdean: High Road users: Medium
Existing View	The view towards the site comprises a broad view across the valley interior towards Jed Water, the course of which is indicated by the riparian woodland in the middle ground. The ground falls towards the river, before rising again towards the north east facing slope of Highlee Hill. The forestry plantations on top of the landform occupy a large proportion of the skyline. Due to the viewpoint location on the bottom slope of Southdean Hill, the view is channelled through the Jed Water valley north west south east direction.
Predicted View	The proposed Development would primarily appear as a series of blade tips crossing the skyline above an intervening forest canopy on the skyline of this view. However, the upper columns and rotors of turbines 5 and 6 would be evident, and whilst prominent, would not dominate or undermine the scale of the landscape in the foreground or middle ground.
Magnitude of Change/Impact	The turbines appear as new elements within the landscape, occupying 51 degree subtended angle of the view. Due to the riverside vegetation in close proximity view, and the screening provided by the landform, the proposed turbines do not appear as dominant elements in relation to the underlying landform and vegetation. Blade movement would be clearly visible at this distance and would be likely to attract the eye towards the turbines rising above the landform. Due to the distance the magnitude of change is considered as Substantial.
Effect on Landscape Character	**Major**
Effect on Visual Amenity	**Major/moderate - Major**
Cumulative Visibility	No views of existing/consented wind farms are provided from this location. The blade tip of the proposed Birneyknowe Wind Farm would be screened by the intervening building at distance of 8 km to the west. No other proposed development would, be visible from this location.
Cumulative Magnitude of Change	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative Effect with Scoping Scheme Incorporated	The proposed Wauchope East Wind Farm would appear above the landform of Highlee Hill and on the backdrop of the Cheviot Hills at a distance of 4.1 km to the south west, beyond the proposed Development. The proposed Wauchope East Wind Farm would occupy 39 degree subtended angle of the view. The cumulative effect of the proposed Development when viewed in conjunction with existing, consented, proposed and scoping scenarios would be **Major/Moderate** in respect of landscape character and **Major/moderate -** Moderate in respect of visual amenity.

Viewpoint 3: Fort northeast of Southdean Ref Figures 4.10a to 4.10h)

Viewpoint	Fort northeast of Southdean
Grid ref	363490 609389
Eye level	305 m AOD
Distance to nearest turbine	2.4 km
Bearing	199º south
Location	The viewpoint is located on the summit of Southdean Hill (300 m AOD), next to an Iron Age hill fort, to the south east of the village of Chesters.
Sensitivity of Landscape Character **(Wauchope/Newcastleton unit of Southern Uplands Forest Covered LCT)**	In the view is the Southern Uplands Forest Covered landscape, which is a large scale rolling landform dominated by forest cover. Due to the absence of designations and the influence of commercial forestry the landscape is considered as having a medium to low value. Due to the scale and its simple uniform character the susceptibility of this landscape to wind farm development is considered to be medium to low. Sensitivity: Medium
Sensitivity of Visual Receptors	Walkers: High
Existing View	The viewpoint on top of the summit provides 360 degree panoramic long range views over the surrounding landscape. The view towards the site comprises an elevated perspective, the ground in the foreground falling steeply toward Black Burn valley where medium scale pasture and arable fields predominate and are bounded by dykes and hedgerows. The A6088 can be seen extending through the valley south-eastward towards Carter Bar. Farm houses and farm buildings are present within the fields. In the middle ground coniferous forestry is a dominant aspect of the landscape. Visual movement is drawn upwards to the prominent ridge of the Cheviot Hills, which forms the distant skyline and horizon above Wauchope Forest.
Predicted View	All thirteen of the proposed Development turbines would be visible from this viewpoint and would form prominent new large scale elements and a cohesive array in in what is a large scale undulating forested landscape in the middle ground of this view Whilst the majority of turbine columns would be backclothed by the elevated topography of the Southern uplands, many of the turbines' blades and a small number of rotors would overtop the skyline.
Magnitude of Change/Impact	The turbines would occupy 46 horizontal degrees of the view. The alignment of evenly distributed turbines reflects the gently sloping form of the underlying landform. Due to the proposed retention of forest cover at the proposed Development site and the essentially simple nature of the development, the majority of existing landscape pattern would be retained intact. Blade movement would be clearly visible at this distance. Given the proximity of this viewpoint to the proposed Development and the proportion of the view affected, the magnitude of change is therefore considered as Substantial.
Effect on Landscape Character	**Major/moderate**

Effect on Visual Amenity	Major
Cumulative Visibility	The operational turbines of Langhope Rig are difficult to discern against the skyline at a distance of 24.5 km to the west, occupying 3.3 degree subtended angle of the view. The operating Longpark Wind Farm turbines are imperceptible above the skyline 35.6 km to the north west, (occupying 2.4 degree subtended angle of the view), as well as the indicated blades of Dun Law 1&2 and Toddleburn at a distance of beyond 47 km The proposed Birneyknowe Wind Farm would appear at a distance of 8.2 km to the west, occupying 14 degree subtended angle of the view. The proposed Longpark Wind Farm Extension would be difficult to discern above the skyline 36.4 km to the north west.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Substantial - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate - Existing/ Consented Wind farm Scenario **Major** - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farms	As in previous viewpoints, the Wauchope East Wind Farm would be backclothed by the elongated landform of Carter Fell and would be seen at a distance of around 4.3 km to the south-west, beyond the proposed Development. Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by the proposed Development. Several Wauchope West Wind Farm turbines would appear above the landform, 7.3 km to the south east. The proposed Development would remain a prominent contributor to the cumulative context, extending wind farm development closer to this receptor location. In the context of this and the likely differentiation between the proposed Development and the Wauchope/Newcastelton scheme, the proposed Development is considered to represent a **Major/moderate** effect.

Viewpoint 4: A6088, Western Approach Chesters (Ref. Figures 4.11a to 4.11e)

Viewpoint	A6088, Western Approach Chesters
Grid ref	361689 610622
Eye level	203 m AOD
Distance to nearest turbine	3.14 km
Bearing	170º south east
Location	The viewpoint is located next to the A6088, on the western edge/approach to Chesters village.
Sensitivity of Landscape Character (Bonchester/Dunion of Grassland with Hills LCT)	This is an upland fringe landscape with a medium scale and smooth, rounded terrain. Pastures dominate the land cover and woodland cover varies in extent, with occasional larger coniferous plantations. Although the landscape in the view is not covered by any designations, it is evaluated by the inhabitants of Chesters village as part of their visual amenity and therefore its value is considered to be medium to high. Due to the viewpoint's location on the transitional edge from the Grassland Hills to the Southern Uplands Forest Covered landscape, the landscape in the view does not present diversity of the Grassland with Hills, nor does it have the large scale of the Southern Uplands Forest Covered landscape. Due to its medium scale the landscape character susceptibility to wind farm development is considered to be medium. Sensitivity: Medium
Sensitivity of Visual Receptors	Residents of Chesters village: High Road users: Medium
Existing View	The view towards the proposed development site comprises an open panorama across the low lying, essentially flat terrain associated with the confluence of White Burn with Jed Water. The foreground is comprised of large open fields bisected by coniferous plantation blocks. The ground rises towards the north/north east facing slopes of Highlee Hill and Wolfelee Hill, which form the smooth short distant skyline. The silhouetted outline of the distant prominent ridge of the Cheviot Hills appears above the eastern slope of Highlee Hill, on the left hand side of the view, forming an even skyline with the forested summit of Highlee Hill. Views to the rear comprise the village of Chesters and the landform of Doorpool Hill which rises to the north of Chesters and also restricts visibility beyond.
Predicted View	Whilst all thirteen of the proposed Development turbines would theoretically be visible intervening topography and vegetation would serve to reduce the visibility, perceived scale and prominence of the proposed turbines. The proposed Development would appear as a relatively cohesive array set back from the prominent edge of the uplands, but with some clustering of turbines 10, 11 and 13 at the eastern end of the proposed Development site.
Magnitude of Change/Impact	The proposed Development would occupy 30 horizontal degrees of the view and would represent a prominent new element on the skyline of this view. However, because of the partially screened position they occupy and their clear association the larger scale and simple landscape of the uplands they constitute a new feature rather than the defining element in the view and in the landscape context as experienced from this location. Due to the proximity of this viewpoint to the proposed Development, the prominent skyline position of the turbines and the proportion of the view they affect, the magnitude of change is considered as Substantial.
Effect on Landscape Character	**Major/moderate**
Effect on Visual Amenity	**Major** in respect of residential receptors and **Major/moderate** in respect of road users.
Predicted Cumulative view	No wind farms are currently visible from this viewpoint, and there is no potential visibility of consented but currently unbuilt wind farms. The blade tips of the proposed Birneyknowe Wind Farm would be screened by the intervening landform and vegetation at a distance of 6.18 km to the west.
Cumulative Magnitude of Change	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm	The proposed Wauchope East Wind Farm would be backclothed by the topography of Carter Fell and would be seen at a distance of 5.9 km to the south, beyond the proposed Development. Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. In this context, the proposed Development would, nonetheless, represent a prominent contributor to the cumulative context, extending wind farm development closer to this receptor location. In the context of this and the likely differentiation between the proposed Development and the Wauchope/Newcastelton scheme, the proposed Development is considered to represent a **Major/moderate** effect on the character at this viewpoint and a **Major** – **Major/moderate** effect in respect of visual amenity.

Viewpoint 5: Bonchester Hill (Ref. Figures 4.12a to 4.12h)

Viewpoint	Bonchester Hill
Grid ref	359496 611717
Eye level	325 m AOD
Distance to nearest turbine	4.8 km
Bearing	152º south east
Location	The viewpoint is located on the summit of Bonchester Hill (323AOD), next to an Iron Age hill fort, to the east of the village of Bonchester Bridge.
Sensitivity of Landscape Character (Bonchester/Dunion of Grassland with Hills LCT)	In the view is a diverse upland fringe landscape with an intimate valley and nearby hills providing some contrast between enclosure and expansive views towards the Cheviot Hills. Due to its location within the Teviot Valleys SLA and being part of the well known walk of 'Bonchester Bridge and Hill', the landscape is considered to having a medium to high value. Having visual diversity, open character with expansive views gives a medium to high landscape character susceptibility to wind farm development on this elevated location. Sensitivity: Medium to High
Sensitivity of Visual Receptors	Walkers: High
Existing View	The viewpoint on top of the summit provides 360 degree panoramic and long range views over the surrounding landscape. The view towards the site comprises steeply graded foreground that falls away into the incised landscape of the A6088 corridor and adjoining farmland of the Fodderlee Burn. The north east extending shoulder of Wolfelee Hill (393 m AOD) forms the short distant skyline, with the eye being drawn upwards to the prominent elongated ridge of the Cheviot Hills, which forms the distant skyline (approximately 10 km to the south east). The undulating landform on the middle ground comprises a patchwork of medium scale pasture and arable fields, bound by tree belts, forestry blocks and hedgerows.
Predicted View	The proposed turbines appear on top of the north east extending shoulders of Highlee Hill. The turbines are all but entirely backclothed by the prominent elongated ridge of the Cheviot Hills, the blade tips of three turbines just overtopping the horizon. The bases of the turbines would not be visible due to the screening effect of intervening topography and forest cover. The turbines would be seen in the context of a large scale upland landscape and large scale forest plantations, and set against a backdrop of the forested slopes of the Southern Uplands to the south. The proposed development would be set back from the smaller scale and more undulating topography of the farmlands that adjoin the A6088 and the settlements of Chesters and Southdean.
Magnitude of Change/Impact:	The turbines would occupy a 22 degree subtended angle of the view. In the context of the large scale view and upland landscapes the proposed development would, whilst introducing new large scale vertical elements and movement to an essentially still landscape, result in little reduction or loss of the existing landscape pattern or scale, and would not interrupt the undulating form of the southern Uplands. Notwithstanding this, the elevated nature of this viewpoint, coupled with its relative proximity to the proposed development and subsequent prominence of the proposed Development means that the magnitude of change is considered as Substantial.
Effect on Landscape Character	**Major/Moderate**
Effect on Visual Amenity	**Major**
Predicted Cumulative view	The operational Langhope Rig Wind Farm is difficult to discern at a distance of 19.9 km to the north west on the backdrop of the distant hills. Due to the distance the operational Bassendeanhill Farm turbine, 34.7 km to the north east, is imperceptible, as are Dun Law 1&2, Crystal Rig, Aikengall, Fallago Rig and Black Hill Wind Farms, all beyond 45 km distance. The proposed Birneyknowe Wind Farm would appear against the skyline at a distance of 3.9 km to the west. Three blades of Windy Edge would be discernible above the skyline, in between the landforms of Wyndburgh (507 m AOD) Hill and Greatmoor Hill (599 m AOD), 14.13 km to the south west.
Cumulative Magnitude of Change	Substantial - **Existing/ Consented Wind farm Scenario** Substantial Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	**Major/moderate -** Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	**Major -** Existing/ Consented Wind farm Scenario **Major** - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with Scoping Scheme Incorporated	The proposed Wauchope East Wind Farm would be seen at a distance of around 7.8 km to the south of this viewpoint and would be backclothed by topography. The proposed Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by the proposed Development. Both schemes would be seen in close proximity and overlapping in the middle ground, with the consequence that the prominence of the proposed Development would be reduced and the residual cumulative effect on landscape character attributable to the proposed Development would be Moderate, whilst there would be **Major/moderate** effects on visual amenity at this viewpoint.

Viewpoint 6: B6357 Vantage Point (Ref. Figures 4.13a to 4.13j)

Viewpoint	B6357 Vantage Point
Grid ref	359168 603536
Eye level	362 m AOD
Distance to nearest turbine	3.2 km
Bearing	48.6º north east
Location	The viewpoint is located within Wauchope Forest on the north eastern shoulder of Dog Knowe Note o' the Gate (376m AOD), at a Forestry Commission picnic area, adjacent to the car park off the B6357.
Sensitivity of Landscape Character **(Wauchope/Newcastleton Southern Uplands Forest Covered LCT)**	In the view is a typical Southern Uplands Forest Covered landscape, with large scale and dominant coniferous forest cover. Due to some recreational use the value of the landscape receptor is considered to be medium. Due to the scale and its simple uniform character the susceptibility of this landscape to wind farm development is considered to be medium. Sensitivity: Medium
Sensitivity of Visual receptor	Walkers: High
Existing View	The view towards the site comprises a long distance panorama across the Wauchope Forest. The landform falls gently towards the incised valley of Swire Sike, which merges with the forestry. The peaks of The Cheviot (815m AOD), The Schil (601m AOD) and The Curr (564m AOD) are distinguishable above Wauchope Forest, on the distant skyline, at a distance of more than 35 km. The smooth ridge of the Cheviot Hills forms the short distance skyline to the east, above this forested plateau (on the right/eastern side of the view).
Predicted View	All thirteen of the proposed turbines (columns and rotors) would be visible at a distance of around 3 km from this viewpoint. The turbines would form a cohesive array, albeit with some stacking evident in respect of turbines 1 and 9. The proposed development would be located in an extensive area of gently undulating coniferous forestry. The proposed Development would be partially backclothed but would overtop the skyline formed by the Cheviot Hills and would introduce movement to a part of the view that is currently still.
Magnitude of Change/Impact	The turbines appear as large scale vertical elements within the landscape, occupying 32 degree subtended angle of the view, but are considered to reflect the large scale of their landscape and visual context. Whilst the proposed Development would maintain views towards the distant hills that form the backdrop to this view and represent a substantial new element of the view, they are not considered to dominate this vantage point.
Effect on Landscape Character	**Major/moderate**
Effect on Visual Amenity	**Major**
Cumulative Visibility	No wind farms are currently visible from this viewpoint, and there is no potential visibility of consented but currently unbuilt wind farms. The operational Fallago Rig Wind Farm, 54.5 km to the north west, is screened by the intervening vegetation.

Cumulative Magnitude of Change	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	None - Existing/ Consented Wind farm Scenario None - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with the proposed Scoping Scheme Incorporated	The proposed Wauchope East Wind Farm would be seen at a distance of 1.4 km to the east, and would appear adjacent to the proposed Development. Wauchope East Wind Farm would appear closer and occupy almost twice the angle (51 degree) of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by the proposed Development. However, as the proposed Development would represent a clear and prominent lateral extension of the influence of wind energy development in views from this location, it is considered to represent a **Major/moderate** cumulative effect in this context for both landscape character and visual amenity.

Viewpoint 7: Pennine Way, Black Halls (Ref. Figures 4.14a to 4.14e)

Viewpoint	Pennine Way, Black Halls
Grid ref:	378833 610654
Eye level	446m AOD
Distance to nearest turbine	15.9 km
Bearing	255º west
Location	The viewpoint is located on the western edge of the Cheviot Hills on the west facing slope of Black Halls, on the Pennine Way (National Trail), adjacent to the Roman road route of Dere Street. The viewpoint also lies next to the western boundary of the Northumberland National Park and within Cheviot Foothills SLA.
Sensitivity of Landscape Character (Cocklaw Group of Cheviot Uplands LCT)	In the view is the landscape of the Cheviot Uplands, which is characterised by coarse grass covered hills, distinctive dome/cone shaped hills and scattered coniferous plantations. Due to its recreational use for walking, and by being designated as Cheviot Foothills SLA, the value of the landscape receptor is considered to be medium to high. Due to its distinctive topography, its large scale and its remote quality, the susceptibility of the landscape to wind farm development is considered to be medium to low. The higher ground is open and exposed in character, which allows long-range, unobstructed views of the adjacent hills and upland fringe landscape types. Sensitivity: Medium
Sensitivity of Visual receptor	Walkers: High
Existing View	The view towards the site is framed by the adjacent slopes of Gaisty Law to the right, and by Greystone Brae to the left of the panorama. The view extends across the remote Cheviot Uplands in the foreground towards the distant horizon which is formed by the smoothly rolling Southern Uplands. The higher ground plateau on the middle ground is partially covered by Leithope Forest and is interspersed with several cone-shaped peaks, which are distinctive characteristics of the Cheviot Foothills SLA. Beyond Leithope Forest the ground drops towards the low hills of Wauchope Forest. The skyline is defined by the intervening topography, from close proximity to the infinite horizon. On the left side of the view the skyline is formed by the smooth landform of Hungry Law (501 m AOD) and the north eastern edge of Carter Fell (579 m AOD) rising above Leithope Forest. The higher hills of the Southern Uplands form the skyline above Wauchope Forest. The landform of Wolfelee Hill is visible at a distance of 19.2 km, and Bellings Hill at a distance of 14.6 km, next to the cone-shaped peaks. The landmass of Rubers Law is distinguishable above the slope of Gaisty Law, 21km to the north west, on the right side of the view.
Predicted View	All thirteen of the proposed Development's turbines would be visible from this location, but would be seen distantly and in the context of a large scale gently undulating upland of moorland and forestry. The proposed Development would be seen as a single array backclothed by topography. The lower columns of the proposed Development turbines would be partially screened by intervening forestry and Leithope Forest.
Magnitude of	The turbines would occupy an 8 degree subtended angle of the view.

Change/Impact	Due to the distance and the minor vertical, as well as horizontal, scale occupied by the proposed turbines in relation to the topography and forestry cover, combined with backclothing, the magnitude of change is considered as Moderate.
Effect on Landscape Character	Moderate
Effect on Visual Amenity	**Major/moderate**
Cumulative Visibility	The operational Langhope Rig Wind Farm would be difficult to discern at a distance of 38.45 km (partially screened by the landform of Rubers Law), as well as the blade tip of the operational Longpark, 43.4 km to the north west. Birneyknowe Wind Farm would appear above the cone-shaped peaks at a distance of 23.24 km, on the backdrop of the distant terrain, occupying 26.2 degree of subtended angle of the view. The distances between the proposed Development and Birneyknowe Wind Farm ensure they would appear as individual developments. The blade tip of the proposed Longpark, would be imperceptible at a distance of 44 km to the north west.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Moderate. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate/minor - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate - Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farms: Figure 4.14c	The proposed Wauchope East Wind Farm, as shown on the wirelines, would appear above the lower slope of Catcleuch Shin at a distance of 13.5 km. Wauchope West Wind Farm would appear above the distant ridge of Southern Uplands, which rises beyond Wauchope Forest. Mainly the blades of the proposed Wauchope West Wind Farm would be visible above, in the context of proposed Development, and would be seen at a distance of around 22 km. As both of the proposed wind farms would appear at a longer distance and beyond the proposed Highlee Hill Wind Farm turbines, the additional magnitude of change attributable to the proposed Development is considered to be Moderate in respect of landscape character but **Major/moderate** in respect of visual amenity.

Viewpoint 8: Borders Abbey Way, Black Law (Ref. Figures 4.15a to 4.15g)

Viewpoint	Borders Abbey Way, Black Law
Grid ref	361955 618202
Eye level	341 m AOD
Distance to nearest turbine	10.7 km
Bearing	178º south
Location	The viewpoint is located on the summit of Black Law (338 m AOD), to the east of the village of Betrule and to the south west of Jedburgh, in between Rule Water and Jed Water. The landform lies within the Teviot SLA and it is crossed by the Borders Abbey Way.
Sensitivity of Landscape Character (Bonchester/Dunion of Grassland with Hills LCT)	This is a diverse upland fringe landscape with open character of the hills and upper pastures contrasting with pockets of more intimate scale landscape in valleys. Pastures dominate the land cover and woodland cover varies in extent, with occasional larger coniferous plantations. Due to its location in the middle of the Teviot Valleys SLA, on a well-used recreational route, the landscape is considered as having a medium to high value. Having visual diversity, open character with expansive views gives a medium landscape character susceptibility to wind farm development on this elevated location. Sensitivity: Medium
Sensitivity of Visual Receptor	Walkers: High
Existing View	The viewpoint on top of the summit provides 360 degree elevated long distance views over the surrounding landscape. The summit plateau accommodates several telecommunication masts. The view towards the site comprises an elevated panorama across a rough grassland. To the right, the shoulder of Black Law, Watch Knowe (292 m AOD), extends to the south west, as indicated by the dyke on its summit, forming a type of moorland plateau at this location. Black Law is drained by several burns, which flow to Jew Water to the east. Stripes of riparian vegetation are visible on a slope of Black Law and on the grassland below. (The extent of Jed Water valley is distinguishable within the landscape on the left side of the view.) The partially forested landform of Faw Hill (331 m AOD) rises in the middle ground. The distant skyline beyond is formed by the prominent ridge of the Cheviot Hills.
Predicted View	All thirteen of the proposed Development's turbines would be visible from this open elevated viewpoint. The proposed turbines appear above the western shoulder of Faw Hill, at a distance of 10.7 km. The turbines would be almost entirely backclothed by the Cheviot Hills, only a few blade tips and the rotor with blades would overtop the skyline.
Magnitude of Change/Impact	The turbines would occupy an 11.6 degree horizontal angle of this expansive view. Due to the distance and the small vertical and horizontal proportion of view affected and the scale of the proposed turbines in relation to the landscape of the magnitude of change is considered as Moderate.
Effect on Landscape Character	Moderate
Effect on Visual Amenity	**Major/moderate**
Cumulative Visibility	The operational Langhope Rig Wind Farm is difficult to discern at a distance of 20.4 km to the west on the backdrop of the distant terrain. Due to the distance the single turbine of the operational Bassendeanhill Farm, 28.10 km to the north is difficult to distinguish within the landscape. The operational turbines of Longpark Wind Farm are hardly perceivable against the skyline at a distance of 27 km to the north west, next to the Eildon Hills, as are the wind farms on the Lammermuirs: Toddleburn, Dun Law 1&2, Crystal Rig, Aikengall, Fallago Rig and Black Hill Wind Farms, all beyond 40 km distance. Three blades of the proposed turbines of Windy Edge would be difficult to discern within the landscape at a distance of 20.85 km to the south west. The proposed Birneyknowe Wind Farm would appear next to Bonchester Hill, 9 km to the south west. The proposed turbines of Longpark Wind Farm Extension would be perceivable as part of operational Longpark Wind Farm at a distance of 27 km to the north west, next to the Eildon Hills.
Cumulative Magnitude of Change	Moderate - Existing/ Consented Wind farm Scenario Moderate. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario Moderate. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	**Major/moderate** - Existing/ Consented Wind farm Scenario **Major/moderate**. Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farms: Figure 4.15c	The proposed Wauchope East Wind Farm would appear on the backdrop of the elongated landform of Carter Fell at a distance of 13.3 km to the south, beyond the proposed Highlee Hill Wind Farm. Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. Wauchope West Wind Farm would appear next to the landform of Wolfelee Hill, above Bonchester Hill, at a distance of 13.8 km. The additional magnitude of change attributable to the proposed Development is considered to be reduced to Slight and the resultant cumulative effect would be Moderate/minor in respect of landscape character and Moderate in respect of visual receptors.

Viewpoint 9: Minor Road & Footpath, Townfoot Hill (Ref. Figures 4.16a to 4.16e)

Viewpoint	**Minor Road & Footpath, Townfoot Hill**
Grid ref	373391 618939
Eye level	290 m AOD
Distance to nearest turbine	15.7 km
Bearing	220º south west
Location	The viewpoint is located next to the minor road, on top of Townfoot Hill (288 m AOD). The road extends between Oxnam and Hownam and forms part of the Heritage Path, recognized as Dere Street Old Roman Road.
Sensitivity of Landscape Character **(Oxnam of Rolling Farmland LCT)**	This is an undulating upland fringe landscape of large scale field pattern, and scattered coniferous plantations. The higher ground of this landscape, at the viewpoint location, has an open character with distant views of the uplands. The landscape in the view is not covered by any designations, however, due to some recreational use of Dere Street Old Roman Road the value of the landscape receptor is considered to be medium. Due to the scale and dominant forestry cover the susceptibility of this landscape to wind farm development is considered to be medium. Sensitivity: Medium
Sensitivity of Visual receptor	Walkers: High
Existing view	The view towards the site comprises a long distance panorama across the rolling undulations of a patchwork of medium and large sized arable fields, bisected by coniferous plantations, towards the Southern Uplands which form the skyline. The west falling slope of Townfoot Hill forms the immediate skyline to the south, above which the outline of the prominent ridge of the Cheviot Hills forms the distant skyline. The grass covered higher slope and forested lower slope of Townfoot Hill extend over the foreground. This immediate landform partially shields views towards the proposed Development and also of the surrounding landscape. In this viewpoint, views open to the west and south west where the distinctive shape of Rubers Law (424 m AOD) rises at a distance of 16 km (on the right side of the view).
Predicted view	All thirteen of the proposed development's turbines would be visible from this open elevated position. The proposed Development would appear as a single array on the lower hills of Wauchope Forest, and would be backclothed by the elevated form of the Southern Uplands beyond (including Wyndburgh Hill (507 m AOD), Fanna Hill (514 m AOD), Lamblair Hill (498 m AOD), Greatmoor Hill (599 m AOD)).
Magnitude of Change/Impact	The turbines would occupy 9.4 horizontal degrees of the view. Due to the distance and the proportion of the view it would affect, the proposed Development would result in Moderate change to the baseline view.
Effect on Landscape Character	Moderate
Effect on Visual Amenity	Moderate **- Major/moderate**
Cumulative Visibility	The operational wind farms of Langhope Rig and Longpark are difficult to discern within the landscape at a distance of 31.7 km to the west and 33.7 km to the north west respectively. Due to the distance the wind farms on the Lammermuirs, such as Toddleburn and Dun Law 1&2 are difficult to discern on the skyline, as they are located beyond 44 km distance. The proposed Birneyknowe Wind Farm (partially screened by the intervening topography) would appear at a distance of 19.16 km to the west, occupying 26.2 degree of subtended angle of the view. The distances between the proposed Development and Birneyknowe Wind Farm ensure that they would appear simultaneously as individual developments. The turbines of the proposed Longpark Wind Farm Extension, as shown on the wireline, would be difficult to discern on the skyline at a distance of 34.22 km to the north west.
Cumulative Magnitude of Change	Moderate - Existing/ Consented Wind farm Scenario Moderate. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	**Major/moderate-** Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with Scoping Scheme Incorporated	The proposed Wauchope East Wind Farm would appear immediately adjacent to the proposed Development at a distance of 15.4 km, occupying 14.2 degree of subtended angle of the view. Part of the Wauchope East Wind Farm would be backclothed by the landmass of Carter Fell. The proposed Wauchope West Wind Farm would appear above the skyline, above Belling Hill, at a distance of 21 km. The additional magnitude of change attributable to the proposed Development is considered to remain Moderate and the residual cumulative effect, taking account of the proposed Scoping scheme would be Moderate in respect of landscape character and **Major/moderate** in respect of walkers.

Viewpoint10: Pike Fell (Ref. Figures 4.17a to 4.17h)

Viewpoint	**Pike Fell**
Grid ref	353484 606364
Eye level	398 m AOD
Distance to nearest turbine	7.8 km
Bearing	89.5º east
Location	The viewpoint is located on top of Pike Fell (400 m AOD), 7.6 km to the south east of Hawick, east of the B6399. Pike Fell forms part of the south north orientated hill range which extends between Lang Burn and Lurgies Burn.
Sensitivity of Landscape Character **(Claudcleuch Head Group of Southern Uplands with Scattered Forest LCT)**	This is a typical large scale uplands plateau, as shown by the pronounced rolling nature of the terrain and with locally prominent large coniferous plantations. Although the landscape is not covered by any designations the variety of contiguous landscape such as upland fringe and valley types adds visual diversity and therefore it is considered as having a medium value. Due to the large scale and extensive coniferous plantations prominent in views of the adjacent landscape of Wauchope Forest, the susceptibility of this landscape to wind farm development is considered to be medium. Sensitivity: Medium
Sensitivity of Visual Receptor	Walkers: High
Existing view	The viewpoint on top of the summit that provides 360 degree long range panoramic views over the surrounding landscape. The view towards the site comprises an elevated panorama across rough grassland, which falls steeply in the direction of Lurgies Burn. The elongated ridges of north east south west orientated forested hills (including Templehall Hill (342 m AOD), Wyndburgh Hill (502 m AOD)) extend on the middle ground. The prominent elongated ridge of the Cheviot Hills forms the skyline above the forested hills, at a distance of approximately 13 km to the south east. To the north (on the left side of the view) the eastern side of Rule Water valley emerges from Wauchope Forest, as indicated by the landform of Wolfelee Hill, on the north western edge of Wauchope Forest. Beyond Wolfelee Hill, the distinctive form of The Cheviot is evident in the distance.
Predicted View	All thirteen of the proposed Development's turbines would e visible from this location. However the columns of the turbines are largely restricted by intervening elongated forested ridge (including Templehall Hill (342 m AOD). All turbines are backclothed by the topography of the Cheviot Hills.
Magnitude of Change/Impact	The turbines would occupy a 7.6 horizontal angle in this expansive view and would be seen distantly and would be partially obscured. Consequently, the magnitude of change wrought at this viewpoint would be Moderate.
Effect on Landscape Character	Moderate
Effect on Visual Amenity	**Major/moderate**
Cumulative Visibility	The operational Langhope Rig Wind Farm is visible against the skyline, 18.4 km to the north west. The operational Longpark Wind Farm at a distance of 35.5 km to the north is difficult to discern above the skyline, as well as the single turbine of Bassendeanhill Farm, at a distance beyond 40 km. Due to the distance the wind farms on the Lammermuirs, such as Toddleburn, Dun Law 1&2, Fallago Rig, Crystal Rig 1&2, Aikengall and Black Hill, are imperceptible on the skyline, as they are located beyond 47 km distance. The proposed Birneyknowe Wind Farm would appear above the close proximity ridgeline, which extends to the north (including summits of Berryfell Hill (393 m AOD) and Peat law (343 m AOD)), at a distance of 3.8 km, on the backdrop of the distant terrain, occupying 26.2 degree of subtended angle of the view. The turbines of the proposed Longpark Wind Farm Extension, as shown on the wireline, would be difficult to discern above the skyline at a distance of 36 km to the north.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate - Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with Scoping Scheme Incorporated	The proposed Wauchope East Wind Farm would appear on the backdrop of the elongated landform of Carter Fell and to the south (right) of the proposed Development at a distance of 7.7 km. The proposed Wauchope East Wind Farm would occupy more than twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by the proposed Development. The proposed Wauchope West Wind Farm would appear next to the Wauchope East Wind Farm on the forested ridge of Fanna hill (514 m AOD) at a distance of 3.4 km to the south east. According to Figure 4.17d, mainly blades and some rotors with blades of the proposed Newcastleton Forest would appear 17 km to the south. The proposed Development would extend the impacts associated with the proposed Wauchope/Newcastelton scheme and represent a Moderate residual cumulative effect on landscape character and a **Major/moderate** effect on visual amenity at this viewpoint.

Viewpoint 11: Footpath and Minor Local Road, Chesters Brae (Ref. Figures 4.18a to 4.18f)

Viewpoint Name	Footpath and Minor Local Road, Chesters Brae
Grid ref	363285 610786
Eye level	257 m AOD
Distance to nearest turbine	3.6 km
Bearing	190º south west
Location	The viewpoint is located next to the minor road, on the eastern edge/approach to Chesters village.
Sensitivity of Landscape Character (Bonchester/Dunion of Grassland with Hills LCT)	This is a transitional landscape from upland fringe with an intimate river valley and distinctive cone-shaped hill to the smooth, rounded terrain of the Southern Uplands. Pastures dominate the land cover and woodland cover varies in extent. Although the landscape in the view is outside the Teviot Valleys SLA, it is evaluated as having a medium value due to the strong landform identity of Southdean Hill as the focal point in the view. The landscape is evaluated by the inhabitants of Chesters village as part of their visual amenity. Having visual diversity and contrast of enclosure and expansive views (scale diversity) gives a medium to high landscape character susceptibility to wind farm development. Sensitivity: Medium
Sensitivity of Visual receptor:	Residents of Chesters village: High Road users: Medium to High
Existing View	The view towards the site comprises an open panorama with the foreground steeply descending towards Jed Water valley, the low lying, essentially flat terrain associated with the confluence of White Burn with Jed Water. The valley landscape is comprised of large green fields divided by a network of hedgerows. The ground rises from the valley towards the north/north east facing slopes of Highlee Hill, which form the smooth short distant skyline. The prominent ridge of the Cheviot Hills (indicated by the straight slope of Carlin Tooth in this view) forms the distant skyline above Highlee Hill. The distinctive landform of Southdean Hill comprises a focal point above the valley on the left side of the view, on the backdrop of the landmass of the Cheviot Hills. Views to the rear comprise the village of Chesters and the south west slope of Belling Hill which rises to the north east of Chesters, and also restricts visibility beyond.
Predicted view	All thirteen of the proposed Development's turbines would be visible (upper columns and rotors) from this elevated viewpoint. The proposed development would appear as a cohesive single array at the end of the valley, within the extensive forested landscape of Wauchope forest and in the context of the Southern upland moorland landscapes in the distance.
Magnitude of Change/Impact	The proposed turbines would occupy a total of 30 horizontal degrees of the view. Given the relative proximity of this viewpoint to the proposed Development and the proportion of the view it would occupy, the magnitude of change at this viewpoint would be Substantial.
Effect on Landscape Character	**Major/moderate**
Effect on Visual Amenity	**Major/Moderate - Major**
Cumulative Visibility	None
Cumulative Magnitude of Change with operational/consented /proposed wind farms	None
Cumulative Effects on Landscape Character	None
Cumulative Effect on Visual Amenity	None
Predicted Cumulative view with scoping wind farms: Figure 4.18c	The Wauchope East Wind Farm would appear on the backdrop of the elongated landform of Carter Fell at a distance of 5.8 km to the south, beyond the proposed Highlee Hill Wind Farm. The proposed Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. Several Wauchope West Wind Farm turbines would appear above the landform of Wolfelee Hill, at a distance of 8 km. The additional magnitude of change attributable to the proposed Development, when seen in conjunction with the scoping scheme would be **Major/moderate** in respect of the landscape character at this viewpoint and **Major** to **Major/moderate** in respect of visual amenity.

Viewpoint 12: Rubers Law (Ref. Figures 4.19a to 4.19g

Viewpoint Name	Rubers Law
Grid ref	358037 615560
Eye level	422 m AOD
Distance to nearest turbine	8.9 km
Bearing	155º south east
Location	The viewpoint is located on the summit of Rubers Law (424 m AOD), a prominent conical hill with a conspicuously rugged and isolated peak in the Scottish Borders area, 3.6 km to the north west of Bonchester Bridge. Rubers Law is the site of a hill fort and Roman Signal Station. It stands between the River Teviot and Rule Water and its northern slope provides glamping and camping[2] options. There are a number of possible routes to its summit for walkers.
Sensitivity of Landscape Character (Rubers Law of Grassland with Hills LCT)	This is a diverse upland fringe landscape with open character of the hills and upper pastures contrasting with pockets of more intimate scale landscape in valleys. Pastures dominate the land cover and woodland cover varies in extent, with occasional larger coniferous plantations. Rubers Law is identified as a Scenic Viewpoint in the Scottish Borders Council Wind Energy SPG. Rubers Law stands within the Teviot Valleys SLA. Based on that, and due to its recreational use, this landscape is considered to have high value. Having diversity in scales due to diverse surrounding landform types, ranging from smooth undulations to strongly elongated ridges and hollows, the landscape in views gives a medium landscape character susceptibility to wind farm development. Sensitivity: Medium to High.
Sensitivity of Visual receptor	Walkers: High
Existing View	This elevated viewpoint provides 360 degree panoramic and long range views across the surrounding landscapes of the area. The view towards the site comprises an elevated panorama over the Rule Water valley, across an undulating patchwork terrain of medium scale pasture and arable fields, bound by tree belts, forestry blocks and hedgerows. The distinctive landform of Bonchester Hill (328 m AOD) appears on the other side of the Rule Water valley on the backdrop of the smooth landforms of Wolfelee Hill (393 m AOD) and Highlee Hill. The prominent elongated ridge of the Cheviot Hills forms the skyline at a distance of 15 km. To the south west the skyline is formed by the higher hills of the Southern Uplands.
Predicted View	All thirteen of the proposed Development's turbines would be visible from this perspective but would be backclothed by the Cheviot Hills.
Magnitude of Change/Impact	The turbines would occupy 14.4 horizontal degree angle of the view. Given the proportion of the view the magnitude of change is considered as Substantial.
Effect on Landscape Character	**Major/moderate**
Effect on Visual Amenity	**Major**
Cumulative Visibility	The operational Langhope Rig Wind Farm is difficult to distinguish within the landscape at a distance of 17.1 km to the north west, in the opposite direction to the proposed Development. The operational Longpark Wind Farm is difficult to perceive on the skyline at a distance of 27.8 km to the north west. Due to the distance the operational Bassendeanhill Farm turbine, 31 km to the north, is imperceptible, as are Toddleburn, Dun Law 1&2, Crystal Rig, Aikengall, Fallago Rig and Black Hill Wind Farms, all beyond 40 km distance.
Cumulative Magnitude of Change	Moderate - Existing/ Consented Wind farm Scenario Substantial. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario **Major/moderate -** Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	**Major / moderate -** Existing/ Consented Wind farm Scenario **Major -** Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with Scoping Scheme Incorporated	The proposed Wauchope East Wind Farm would be seen at a distance of 11.9 km to the south of this viewpoint, beyond the proposed Development. Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. In this context, the prominence of the proposed Development would be slightly reduced from the existing/consented and proposed wind farm context, and would constitute a Moderate cumulative effect in relation to landscape character at this viewpoint and **Major/moderate** in terms of visual amenity.

[2] http://www.ruberslaw.co.uk/

Viewpoint 13: Five Stanes (Ref. Figures 4.20a to 4.20e)

Viewpoint	Five Stanes
Grid ref	375269 616861
Eye level	303 m AOD
Distance to nearest turbine	15.8 km
Bearing	231º south west
Location	The viewpoint is located on the plateau of Five Stanes, on the Heritage Path, recognized as Dere Street Old Roman Road.
Sensitivity of Landscape Character **(Falla Group of Cheviot Foothills LCT)**	This is a large scale upland landscape of rolling grass covered hills with a simple and open character. Although the landscape in the view is not covered by any designations, due to some recreational use of Dere Street Old Roman Road the value of the landscape receptor is considered to be medium. Due to the scale and its simple and open character the susceptibility of this landscape to wind farm development is considered to be medium. Sensitivity: Medium
Sensitivity of Visual Receptor	Walkers: High
Existing View	The location on the plateau of Five Stanes provides a 360 degree view of varying distances of the nearby hills to the infinite horizon. The view towards the site comprises an open panorama, across the rough grassland covered south west falling slope of Five Stanes (291 m AOD) towards Oxnam Water valley. The view extends across the higher ground plateau and the smooth summits of the Cheviot Foothills on the middle ground towards the ridge of the higher hills of the Southern Uplands, which rise beyond Wauchope Forest at a distance of 13 km. These higher hills extend beyond Wauchope Forest (including Wyndburgh Hill (507 m AOD), Fanna Hill (514 m AOD), Lamblair Hill (498 m AOD). The elongated ridge of Carter Fell (579 m AOD) forms the skyline to the south, on the left side of the view. To the west the view extends towards the infinite horizon, which is formed by the Southern Uplands of Moorfoot and the Lammermuirs. The landmass of Rubers Law rises above the skyline at a distance of 17.3 km to the west (on the right side of the view).
Predicted View	The proposed turbines would appear as small verticals above the smooth landform of the Cheviot Foothills (Mervins Law (255 m AOD) and Belling Hill (354 m AOD)), on the backcloth of the higher hills of the Southern Uplands, at a distance of 15.8 km to the south west. The wind farm would appear as a single cohesive cluster of turbines with stacking of turbines 2 & 4 evident in this angle of the view. The turbines would appear in a backclothed position, only five blades appearing above the skyline. Turbine 13 appears slightly separated from the main cluster, its rotor with blades above the skyline. The bottom towers of turbines are screened by the intervening landform and forestry block on top of Mervins Law.
Magnitude of Change/Impact	The turbines appear as new elements within the landscape, occupying 9.4 degree subtended angle of the view. Blade movement would be barely perceptible at this distance. Due to the distance and the minor vertical, as well as horizontal, scale occupied by the proposed turbines in relation to the topography and forestry cover, combined

	with backclothing, the magnitude of change is considered as moderate to slight.
Effect on Landscape Character	Moderate/minor
Effect on Visual Amenity	Moderate
Cumulative Visibility	The blade tips of the operational Langhope Rig Wind Farm are difficult to discern within the landscape at a distance of 33.8 km to the north west. The rotors with blades of the proposed Birneyknowe Wind Farm would appear above the skyline, at a distance of 20.3 km to the south west and would be seen simultaneously with the proposed Highlee Hill Wind Farm. The blade tip of the proposed Longpark Wind Farm Extension would be imperceptible above the skyline at a distance of 37 km to the north west.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Moderate. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate/minor - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate - Existing/ Consented Wind farm Scenario **Major/moderate -** Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with the Scoping scheme Incorporated	The proposed Wauchope East Wind Farm would appear next to Highlee Hill Wind Farm at a distance of 14.7 km. The proposed Wauchope West Wind Farm would appear beyond the proposed Highlee Hill Wind Farm, at a distance of 21.2 km. In this context, the prominence of the proposed Development would be slightly reduced from the existing/consented and proposed wind farm context, and would constitute a Moderate cumulative effect on the landscape character of the viewpoint. However, residual cumulative effects on visual amenity would be **Major/moderate**.

Viewpoint 14: Oxnam to Camptown Road (Ref. Figures 4.21a to 4.21e)

Viewpoint	Oxnam to Camptown Road
Grid ref	369355 614165
Eye level	207 m AOD
Distance to nearest turbine	9.4 km
Bearing	222º south west
Location	The viewpoint is located next to the minor road, 1.4 km to the north east of Camptown. The road extends between Oxnam and Camptown, on the eastern edge of Dolphinston Moor.
Sensitivity of Landscape Character (Falla Group of Cheviot Foothills LCT)	The viewpoint is located on the transitional edge between Rolling Farmland and Cheviot Foothills landscape, where the upland fringe landscape is characterised by an undulating landscape of large scale fields, with mixed pastoral and arable land use with occasional coniferous plantations. Due to the absence of designations (the minor road is not recognised as a tourism route) and prevailing agricultural land use, the landscape is considered as having a medium value. Due to its medium scale, with intermediate horizon formed by the western side of Jed Water valley allowing views of moderate range, the susceptibility of the landscape to wind farm development is considered to be medium. Sensitivity: Medium
Sensitivity of Visual Receptor	Road users: Medium
Existing View	The view towards the site comprises medium scaled views across small to medium scaled pastoral fields on Dolphinstone Moor, lined by dykes and traversed by the minor road. The south west extending slope of Dod Hill (297 m AOD) forms the short distance skyline to the south (on the left side of the view). The grounds fall smoothly towards Jed Water to the west. The discrete dome shaped hills (including the forested landform of Belling Hill (354 m AOD) and Mervins law (255 m AOD)) which form the western side of Jed Water valley, concurrently form the smooth distant skyline at a distance of 5.6 km. The landform of Dolphinston Moor restricts distant views to the north west and north. Views to the north east, east, south east and south are restricted by the landform of Dod Hill. Due to the enclosure which is formed by the adjoining hills, the only available long distant views are to the south west, towards the western higher side of Jed Water valley.
Predicted View	Whilst theoretical visibility of up to eleven of the proposed Development's turbines would be provided from this location, a comparison of the wireline images and the baseline photo and the photomontage indicates that only two turbines would be evident (turbines 5 and 6) and one of these would appear as a blade tip on the horizon. The other turbines would be entirely screened by intervening topography and vegetation. The proposed Development's turbines would be seen at a distance of over 9 km to the south west.
Magnitude of Change/Impact	Given the distance at which the proposed development would be viewed and its substantially screened position the magnitude of change would be Slight.

Effect on Landscape Character	Moderate/minor
Effect on Visual Amenity	Moderate/minor
Cumulative Visibility	The blade tips of the operational Langhope Rig Wind Farm are imperceptible within the landscape at a distance of 28.4 km to the north west. Three blade tips of Birneyknowe Wind Farm would be distinguishable (as rotating) above the skyline at a distance of 14 km to the west.
Cumulative Magnitude of Change	Negligible - Existing/ Consented Wind farm Scenario Slight. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Minor - Existing/ Consented Wind farm Scenario Moderate/minor - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Minor - Existing/ Consented Wind farm Scenario Moderate/minor - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm	The rotors with blades of the proposed Wauchope East Wind Farm would appear above the nearby landform at a distance of 9.4 km. The blades of the proposed Wauchope West Wind Farm would appear above Mervins Law, at a distance of 14.8 km. The additional magnitude of change attributable to the proposed Development is considered to be Moderate as it would be seen closer to this viewpoint, and would constitute a clear discernible cumulative element and a Moderate/minor residual cumulative effect seen in the context of the scoping scheme.

Viewpoint 15: Wolfelee Hill (Ref. Figures 4.22a to 4.22h)

Viewpoint	Wolfelee Hill
Grid ref	359720 608480
Eye level	393 m AOD
Distance to nearest turbine	2.3 km
Bearing	130º north east
Location	The viewpoint is located on top of Wolfelee Hill (393 m AOD), to the south west of Chesters village, next to the B6357. Although the OS map shows a path along the eastern slope of the hill, in reality no such path presently exists. The Wolfelee Hill is at the north western corner of Wauchope Forest, part of the higher ridge which forms the steep eastern side of Rule Water valley.
Sensitivity of Landscape Character (Southern Uplands Forest Covered LCT)	In the view is a typical Southern Uplands Forest Covered landscape, with large scale, simple character with dominant coniferous forest cover. Due to some recreational use the value of the landscape receptor is considered to be medium. Due to the scale and its simple uniform character the susceptibility of this landscape to wind farm development is considered to be medium to low. Sensitivity: Medium
Sensitivity of Visual Receptor	Walkers: High
Existing View	The viewpoint on top of the summit provides 360 degree panoramic and long range views across the surrounding landscape. The view towards the site comprises a foreground and middle ground of rough grassland crossed by the woodland belt on the eastern slope of Wolfelee Hill. Wauchope Forest extends over the middle ground. The prominent elongated ridge of the Cheviot Hills forms the skyline above Wauchope Forest, at a distance of approximately 9 km to the south east.
Predicted View	All thirteen of the proposed development's turbines (columns and rotors) would be visible from this location. The proposed turbines appear on the lower hills of Wauchope Forest as a single array. The proposed Development would be all but entirely backclothed by the prominent ridge of the Cheviot Hills, with the blade tips of three turbines just breaking the horizon (turbines 2,4 and 5). The lower towers of the proposed turbines (on the western part of the site) would be screened by the intervening woodland belt and topography (on the eastern part of the site).
Magnitude of Change/Impact:	Given the proximity of this viewpoint to the proposed development and its consequent prominence and the proportion of the view it would affect, the magnitude of change would be Substantial.
Effect on Landscape Character	**Major/moderate**
Effect on Visual Amenity	**Major**
Cumulative Visibility	The operational turbines of Langhope Rig appear against the skyline 21.7 km and Longpark Wind Farm is difficult to discern above the skyline at a distance of 35 km to the north west. The single turbine of Bassendeanhill would be difficult to discern within the landscape, beyond 28 km to the north. Due to the distance the wind farms on the Lammermuirs, such as Toddleburn, Dun Law 1&2, Fallago Rig, Crystal Rig 1&2, Aikengall and Black Hill, are imperceptible on the skyline, as they are located beyond 47 km distance. The proposed Birneyknowe Wind Farm would be seen on the backdrop of terrain at a distance of 5.1 km to the west, occupying 4.4 degree subtended angle of the view. Three blades of the proposed Windy Edge Wind Farm would appear above the lower slope of Wyndburgh Hill at a distance of 11.9 km. The turbines of the proposed Longpark Wind Farm Extension, as shown on the wireline, would be difficult to discern above the skyline at a distance of 35.6 km to the north west.
Cumulative Magnitude of Change	Moderate - Existing/ Consented Wind farm Scenario Moderate. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	**Major/moderate** - Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm	The proposed Wauchope East Wind Farm would appear on the backdrop of the elongated landform of the Cheviot Hills at a distance of 4.8 km to the north east, beyond the proposed Highlee Hill Wind Farm. Wauchope East Wind Farm would occupy 12.4 degree subtended angle of the view. The proposed Wauchope West Wind Farm would appear against the skyline, at a distance of 3.9 km to the south west. The additional magnitude of change attributable to the proposed Development is considered to be Moderate in respect of landscape character, and **Major/moderate** in respect of visual amenity.

Viewpoint 16: Eildon Hills Vantage Point (Ref. Figures 4.23a to 4.23g)

Viewpoint	Eildon Hills Vantage Point
Grid ref	354826 632297
Eye level	403 m AOD
Distance to nearest turbine	25.8 km
Bearing	163.6º south east
Location	The viewpoint is located on the middle peak of the Eildon Hills, a triple peaked hill to the south of Melrose. The best known landmark in the Borders region, the Eildon Hills stand within the Eildon and Leaderfoot NSA. The viewpoint lies close to St Cuthbert's Way (Long Distance Route), which crosses the saddle between the summits.
Sensitivity of Landscape Character (Eildon Hills Grassland with Hills LCT)	This is a diverse upland fringe landscape with a variety of landscape character areas merged together in the view (including River Teviot valley). Due to the elevation the experience is that of a large scale and smooth, rounded terrain. Pastures dominate the land cover, and woodland cover varies in extent. Eildon Hill is located within the NSA and is identified as a Scenic Viewpoint in the Scottish Borders Council Wind Energy SPG. Based on this, and due to its recreational use, this landscape is considered to have high value. The rolling wooded landscape with distinctive landforms, ranging from smooth undulations to strongly elongated ridges and hollows, gives a medium to high landscape character susceptibility to wind farm development. Sensitivity: High
Sensitivity of Visual Receptor	Walkers: High
Existing View	The viewpoint on top of the summit provides 360 degree panoramic and long range views over the surrounding landscape. The view towards the site comprises an expansive view across a relatively flat agricultural landscape of medium to large scale pasture and arable fields bounded by tree belts, hedgerows and occasional small belts of forestry. The elongated ridge of the Cheviot Hills and Southern Uplands form the distant horizon at an approximate distance of 32 km. The distinctive shape of Rubers Law rises above the smoothly undulating terrain at a distance of 17 km. Additionally, the adjacent landform of Minto Hills and the more distant Cheviot Hills form prominent features in this expansive open panorama.
Predicted View	All thirteen of the proposed development's turbines would be visible from this elevated location. The proposed turbines appear as a cohesive and balanced array, would be seen distantly and below the skyline and would be separated from, and lower than, the distinctive landform of Rubers Law.
Magnitude of Change/Impact	The proposed Development would form a small component within an overall expansive view, where it would not become a new visual focus.
Effect on Landscape Character	Moderate
Effect on Visual Amenity	Moderate
Cumulative Visibility	Two blades of Ewe Hill are imperceptible due to the 52.1 km distance. The operational turbines of Langhope Rig appear against the skyline 17.4 km to the south west. The operating Longpark Wind Farm turbines are seen above the skyline 11.3 km to the north west. The wind farms on the Lammermuirs, such as Toddleburn, Dun Law 1&2, Fallago Rig, and Black Hill, are discernible on the skyline, at distances of between 23 km to 30 km. Crystal Rig 1&2 and Aikengall Wind Farms are difficult to discern as they are located beyond 35 km distance. Single turbine of Bassendeanhill appears as a small vertical within the landscape, 15.9 km to the north east. The proposed Birneyknowe Wind Farm would be seen in combined visibility with the proposed Highlee Hill turbines on the other side of Rubes Law. The turbines would appear on the backdrop of the distant terrain, 20.3 km to the south, and occupy 7.2 degree of subtended angle of the view. The proposed Crossdykes Wind Farm blade would not be visible at the distance of 51.4 km to the south west. The proposed Longpark Wind Farm Extension would be seen above the skyline 12.1 km to the north/north west.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Slight. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm	The proposed Wauchope East Wind Farm would be backclothed by the elevated topography of the Cheviot Hills, and would be seen at a distance of over 28 km to the south east, beyond the proposed Highlee Hill Wind Farm. Wauchope East Wind Farm would occupy more than twice the angle (12.5 degree) of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. Wauchope West Wind Farm would appear against the skyline, at a distance of 27.3 km to the west of Rubers Law. The additional magnitude of change attributable to the proposed Development is considered to be reduced to Slight and the residual cumulative effect in respect of landscape character and visual amenity would be Moderate/minor.

Viewpoint 17: A6088 Approach to Bonchester Bridge (Ref. Figures 4.24a to 4.24g)

Viewpoint	A6088 Approach to Bonchester Bridge
Grid ref	355990 612663
Eye level	251 m AOD
Distance to nearest turbine	7.8 km
Bearing	145º south east
Location	The viewpoint is located next to the A6088, 2.6 km to the west of Bonchester Bridge and 4.8 km to the south east of Hawick. It is the south western edge of the Teviot Valley SLA.
Sensitivity of Landscape Character (Rubers Law of Grassland with Hills LCT)	This is a large scale upland fringe landscape characterised by discrete hills rising above surrounding pasture. Pastures dominate the land cover, while woodland cover varies in extent. The experience of the view towards the proposed site is dominated by the topographical containment provided by the simpler landscape of the Southern Uplands with Forest Cover. Although the viewpoint is located next to the Teviot Valley SLA, the landscape in the view is not covered by designations and therefore the landscape is considered as having a medium value. The open character of these upper pastures, providing expansive views, gives a medium landscape character susceptibility to wind farm development. Sensitivity: Medium
Sensitivity of Visual receptor	Road users: Medium
Existing View	The viewpoint is located on an expansive gently rolling plateau of coarse grassland and rough pasture, in large units divided by fences. This high pasture provides almost 360 degree long distance views of the surrounding landscape. The view towards the site comprises an open panorama across large fields shown with the landform of Wolfelee Hill in direct view on the backdrop of the prominent elongated ridge of the Cheviot Hills, which forms the distant skyline. Bonchester Hill is visible to the east (on the left side of the view).
Predicted view:	Ten of the proposed Development turbines would be visible from this location, including three rotors and seven blade tips, the remainder of turbines being screened by the intervening topography of Wolfelee Hill and coniferous forest.
Magnitude of Change/Impact:	The turbines would occupy a total of a 14.5 degree horizontal angle of the view. Given the restricted visibility of the proposed development and its backclothed position in the view, the magnitude of change would be Moderate.
Effect on Landscape Character	Moderate
Effect on Visual Amenity	Moderate
Cumulative Visibility	The operational turbines of Langhope Rig Wind Farm appear as small verticals against/above the skyline at a distance of 16.4 km to the north west (in the opposite direction to the proposed Development). The operational Longpark Wind Farm is discernible on the skyline at a distance of 29.9 km, next to the Eildon Hills. The operational single turbine of Bassendeanhill Farm 34 km to the north is screened by the intervening forestry. Due to the distance the wind farms on the Lammermuirs (including Toddleburn, Dun Law 1&2, Fallago Rig, Crystal Rig, Aikengall, and Black Hill Wind Farms), all beyond 40 km distance, are imperceptible within the landscape. The proposed Birneyknowe Wind Farm would appear in the close proximity view, 950 m to the south west. The proposed turbines of Longpark Wind Farm Extension would be hardly perceivable on the skyline at a distance of 30.5 km to the north west, next to the Eildon Hills.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Moderate. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate/minor - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate/Minor- Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm	The proposed Wauchope East Wind Farm would appear on the backdrop of the elongated landform of Carter Fell at a distance of 10.1 km to the south east, beyond the proposed Highlee Hill Wind Farm. Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. Wauchope West Wind Farm would appear against the skyline, at a distance of 7.6 km (on the left side of the view). The additional magnitude of change attributable to the proposed Development is considered to be reduced to slight, constituting a Moderate/minor residual effect in respect of landscape character and a residual effect ranging between Moderate/minor in respect of road users and Moderate for tourists utilising the A6088.

Viewpoint 18: Minor Road by Cummings Hill, south of Jedburgh (Ref. Figures 4.25a to 4.25g)

Viewpoint	Minor Road by Cummings Hill, south of Jedburgh
Grid ref	363704 613216
Eye level	417 m AOD
Distance to nearest turbine	6 km
Bearing	187º south
Location	The viewpoint is located next to the minor road which extends to the north of Chesters and provides a link to the A68, 3 km to the south of Jedburgh. The viewpoint is located 3 km to the north west of Chesters on the south east facing slope of Faw Hill (331 m AOD). The viewpoint lies within the Teviot Valleys SLA.
Sensitivity of Landscape Character **(Bonchester/Dunion of Grassland with Hills LCT)**	The viewpoint is located on the transitional edge between Grassland with Hills and Cheviot Foothills landscape, where the character of the upland fringe landscape is characterised by the strongly rolling grass covered hills with occasional coniferous plantations. Due to its location in the middle of the Teviot Valleys SLA, the landscape is considered as having medium value. The simple landform and forestry block in the view give a medium landscape character susceptibility to wind farm development. Sensitivity: Medium
Sensitivity of Visual Receptors	Road users: Medium
Existing View	The view towards the site comprises an enclosed road view with the west facing slope of Cummings Hill (302 m AOD) forming the immediate horizon across the view to the south. The forested summit of Doorpool Hill (270 m AOD) rises on the close proximity skyline to the south west, on the right side of the view. Views to the north/north west are restricted by the landform of Faw Hill (331 m AOD), the only available long distant views being to the east/north east, towards the Cheviot Hills.
Predicted View	The majority of the proposed development would be screened from this position by intervening topography. However, the blade tip of three of the proposed turbines would appear on the skyline above the west facing slope of Cummings Hill (302 m AOD), at a distance of 6 km to the south.
Magnitude of Change/Impact	Given the substantially restricted nature of the proposed Development's visibility and consequent limited proportion of this view it would affect the magnitude of change would be slight.
Effect on Landscape Character	Moderate/minor
Effect on Visual Amenity	Moderate/minor
Cumulative Visibility	No wind farms are currently visible from this viewpoint, and there is no potential visibility of consented but currently unbuilt wind farms within the study area. In the view to the north the Black Hill Wind Farm is screened at a distance of 42.9 km by the intervening topography and vegetation. The proposed Windy Edge turbines, at a distance of 18 km, would be screened by the intervening vegetation. The proposed Birneyknowe Wind Farm would appear on the skyline, next to the summit of Bonchester Hill, at a distance of 8.2 km to the south west and would be screened by the intervening dykes in this view.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Slight - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate/minor - Existing/ Consented Wind farm Scenario Moderate/minor - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate/minor - Existing/ Consented Wind farm Scenario Moderate/minor - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm.	Several turbines of the proposed Wauchope West Wind Farm would appear above the skyline next to the forested summit of Doorpool Hill, at a distance of 10.1 km. Seen in this context, the proposed Development would constitute a Slight cumulative change and Moderate/minor cumulative effect.

Viewpoint 19: Footpath at Knox Knowe (Ref. Figures 4.26a to 4.26f)

Viewpoint	Footpath at Knox Knowe
Grid ref	365486 602807
Eye level	491 m AOD
Distance to nearest turbine	3.4 km
Bearing	320º north west
Location	The viewpoint is located on top of Knox Knowe, close to the cairn (502 m AOD), which is in the middle of the elongated ridge of Carter Fell, rising on the south eastern edge of Wauchope Forest.
Sensitivity of Landscape Character **(Southern Uplands Forest Covered LCT)**	The viewpoint is located on the boundary of the Southern Uplands Forest Covered landscape and Border Moor and Forest landscape types. The landscape in the view towards the site is across Southern Uplands Forest Covered landscape, which has a large scale, simple character with dominant coniferous forest cover. In the view, diversity is added to this simple upland landscape by the features of distant upland fringe and valley (Rule Water Valley). Due to the diversity and scenic qualities provided by some of the iconic Scottish Borders summits on the skyline, and also due to its recreational use, the value of the landscape receptor is considered to be medium. Due to the large scale landscape with extensive commercial forestry and infinite horizon the susceptibility of this landscape to wind farm development is considered to be medium. Sensitivity: Medium
Sensitivity of Visual Receptor	Walkers: High
Existing View	The view towards the site comprises an elevated panorama across moorland in the foreground, and over Wauchope Forest and Rule Water valley on the middle ground towards a distant horizon which is formed by the smoothly rolling Southern Uplands of Lammermuir Hills. The landforms of Wolfelee Hill (393 m AOD), Bonchester Hill (323 m AOD), Faw Hill (331 m AOD) and Belling Hill (354 m AOD) form the medium distance skyline on the backdrop of the distant Southern Uplands. The iconic twin peak of the Eildon Hills is seen between Bonchester Hill and Faw Hill at a distance of 31.4 km to the north. Although the viewpoint is located on a high plateau, the nearby higher summit of Knox Knowe Crain (502 m AOD) to the south west and adjoining plateaux of Carter Fell (579 m AOD) limit views to the south and east within the Cheviot Hills. Open views are therefore available over lower hills to the north west.
Predicted view: **Figure 4.29a/b**	All thirteen of the proposed development's turbines would be visible from this elevated position. The turbines would appear on the lower hills of Wauchope Forest, at a close distance to the north west falling slope of Knox Knowe Cairn, and would be backclothed by topography. The eastern turbines of the proposed Development would appear on the backdrop of Bonchester Hill. The lower parts of four turbines on the western part of the site would be partially screened by the north east extending slope of the nearby hill of Scrathy Holes (521 m AOD). Turbines 9 & 12 and turbines 10 & 11 would overlap in this view.
Magnitude of Change/Impact	The turbines would occupy a 27.2 degree subtended angle of the view. Given the proximity of this viewpoint to the proposed development and the proportion of the view that the proposed Development would affect, the magnitude of change would be Substantial.
Effect on Landscape Character	**Major/moderate**
Effect on Visual Amenity	**Major**
Cumulative Visibility	The operating Langhope Rig turbines appear to the south west of Wolfelee Hill at a distance of 13.2 km, as small verticals on the backdrop of the terrain. The turbines of the operational Longpark Wind Farm are difficult to discern above the skyline at a distance of 42.4 km. Single turbine of Bassendeanhill Farm is difficult to distinguish beyond 30 km distance within the landscape. Due to the distance the wind farms on the Lammermuirs, such as Toddleburn, Dun Law 1&2, Fallago Rig, Crystal Rig 1&2, Aikengall and Black Hill, are imperceptible on the skyline, as they are located beyond 52 km distance. The proposed Birneyknowe Wind Farm turbines would appear in front of the operational Langhope Rig Wind Farm, on the backdrop of terrain at a distance of 13.2 km, occupying 10.4 degree subtended angle of the view. The turbines would be seen in conjunction with the proposed Development, which extends in the foreground. The turbines of the proposed Longpark Wind Farm Extension, as shown on the wireline, would be difficult to discern above the skyline at a distance of 43.2 km.
Cumulative Magnitude of Change	Moderate - Existing/ Consented Wind farm Scenario Substantial - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario **Major/moderate** - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	**Major/moderate** - Existing/ Consented Wind farm Scenario **Major** - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm	The proposed Wauchope East Wind Farm would appear in a close distance of 1.2 km above the north west falling slope of Knox Knowe Cairn, in front of the proposed Highlee Hill Wind Farm. The proposed Wauchope East Wind Farm would occupy an almost four times wider angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. In this context the proposed Developments prominence would reduce and the level of effect would reduce to Moderate in respect of landscape character and **Major/moderate** in relation to visual amenity of walkers.

Viewpoint 20: A6088 North-West of Carter Bar (Ref. Figures 4.27a to 4.27g)

Viewpoint	A6088 North-west of Carter Bar
Grid ref	367572 607372
Eye level	331 m AOD
Distance to nearest turbine	4.2 km
Bearing	260º west/south west
Location	The viewpoint is located next to the A6088, which extends through the north eastern section of Wauchope Forest, and links with the A68 (close to Carter Bar) 2.6 km to the south east.
Sensitivity of Landscape Character (Cocklaw Group of Cheviot Uplands LCT)	In the view is a typical Southern Uplands Forest Covered landscape, with a large scale, simple character with dominant coniferous forest cover. Due to the absence of designations (the A6088 is not recognised as a tourism route) and prevailing land use of commercial forestry, the landscape is considered as having a medium value. Due to the scale and its simple uniform character the susceptibility of this landscape to wind farm development is considered to be medium to low. Sensitivity: Medium to low
Sensitivity of Visual Receptor	Road users: Medium
Existing View	The view towards the site comprises an open panorama across rough pasture divided by dykes in the foreground, with Wauchope Forest extending over the middle ground of the view. The higher hills of the Southern Uplands (including Wyndburgh Hill (507 m AOD), Fanna Hill (514 m AOD) form the skyline at a distance of 12.7 km beyond Wauchope Forest. The landform of Wolfelee Hill appears against the short distance skyline, indicating the north western corner of Wauchope Forest (at a distance of 7.7 km). The south western edge of the prominent elongated ridge of the Cheviot Hills, indicated by the straight slope of Carlin Tooth (551 m AOD), rises above Wauchope Forest and forms the skyline (approximately 6.5 km), to the south west, on the left side of the view. To the north west the view extends towards the infinite horizon which is formed by the smoothly rolling Southern Uplands of the Lammermuirs. The distinctive landform of Bonchester Hill rises on the backdrop of the distant hills above Wauchope Forest. The viewpoint is located on the lower west falling slope of Green law (374 m AOD), and therefore views to the south/south east/east and north east are limited to close proximity by this landform. Views to the north/north west are restricted by the nearby Crink Law (301 m AOD).
Predicted View	All thirteen of the proposed development's turbines would be visible from this position. The proposed turbines would appear on the lower hills of Wauchope Forest on the backdrop of the higher ridge of the Southern Uplands, 4.2 km to the south west of the viewpoint. The proposed Development would appear as a single cohesive cluster of turbines.
Magnitude of Change/Impact	The turbines would occupy a 27.4 degree horizontal angle of the view. Given the proximity of the viewpoint to the proposed Development and the proportion of the view affected the magnitude of change would be Substantial.
Effect on Landscape Character	**Major/moderate**
Effect on Visual Amenity	**Major/moderate**
Predicted Cumulative Visibility	The operational Langhope Rig Wind Farm is distinguishable against the skyline, as seen beyond the landform of Bonchester Hill, 29.7 km to the north west. The operational Longpark Wind Farm, at a distance of 39 km to the north west, would be screened by the forestry block, as would the single turbine of Bassendeanhill Farm and all of the wind farms on the Lammermuirs as shown on the wireline. The proposed Birneyknowe Wind Farm would appear between Wolfelee Hill and Bonchester Hill, at a distance of 12.5 km, on the backdrop of the distant terrain, occupying 9.7 degree of subtended angle of the view. The distances between the proposed Development and Birneyknowe Wind Farm ensure that they would appear simultaneously as individual developments. The turbines of the proposed Longpark Wind Farm Extension, as shown on the wireline, would be difficult to discern above the skyline at a distance of 39.7 km.
Cumulative Magnitude of Change	Moderate - Existing/ Consented Wind farm Scenario Substantial - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate **-** Existing/ Consented Wind farm Scenario **Major/moderate -** Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	**Moderate - -** Existing/ Consented Wind farm Scenario **Major/Moderate-** Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm	The proposed Wauchope East Wind Farm would appear above the skyline next to the proposed Highlee Hill Wind Farm at a distance of 2.5 km. The proposed Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. The proposed Wauchope West Wind Farm would appear behind Highlee Wind Farm, above the distant landform of the Southern Uplands, beyond Wauchope Forest, at a distance 10.1 km to the south west. The proposed Development would represent a notable increase in the proportion of the view affected by wind farm developments, its relative proximity compared to the scoping scheme resulting in a **Major/moderate** residual cumulative effect on landscape character at the viewpoint and a **Major/moderate** effect on road users

Viewpoint 21: Carter Bar (Eastern Vantage Point) (Ref. Figures 4.28a to 4.28c)

Viewpoint	Carter Bar (Eastern vantage point)
Grid ref	369796 606861
Eye level	417 m AOD
Distance to nearest Turbine	6.2 km
Bearing	267º west
Location	The viewpoint is located in the car park, next to the A68, which is a popular scenic tourist route. The location is named Carter Bar, a point on the England–Scotland border, where the A68 road crosses the border and forms a pass located at the top of Redesdale in the Cheviot Hills at an elevation of 417 metres.
Sensitivity of Landscape Character (Southern Uplands Forest Cover LCT)	At the Carter Bar viewpoint the landscape change from Cheviot Hills to the lower hills of Southern Uplands/Cheviot Foothills and it is recognized as a border crossing and stopping place. The viewpoint is also located on the boundary of the NNP and Cheviot Hills SLA. Based on the above the landscape is considered to have high value. Due to its transitional elevated location and the variety of landscapes merging in the open view to the north west towards the infinite horizon, the susceptibility of this landscape to wind farm development is considered to be medium to high. The topographical containment in the view towards the site reduces its susceptibility to wind farm development to medium. Sensitivity: Medium to high
Sensitivity of Visual Receptors	Visitors: High
Existing View	The view towards the site comprises panorama across the roadside boundary walls and embankments and designed viewing platform. The north falling slope of Catcleuch Shin (544 m AOD) forms the immediate skyline across half of the panorama, shielding views to the outside. At the Carter Bar viewpoint the Cheviot Hills transform into the lower hills of the Southern Uplands, with views open to the north west/north and north east across the Scottish Borders. On the right side of the panorama the view extends to the distant hills of the Southern Uplands. The landform of Rubers Law (424 m AOD) at a distance of 14.6 km and Bonchester Hill (323 m AOD) at a distance of 11.4 km, are distinguishable against the skyline.
Predicted View	Whilst there is theoretical visibility of up to four turbines from this vantage point, field reconnaissance suggests that these turbines would be entirely screened by intervening vegetation. In the event of this vegetation being felled the turbines would be revealed.
Magnitude of Change/Impact	On the basis of the analysis of predicted visibility within the existing baseline context the proposed Development would result in no perceptible change. In the event of intervening forestry being felled, the relatively restricted visibility of the proposed Development and its context within a large scale landscape and visual context would be Slight.
Effect on Landscape Character	None in the current baseline context, but increasing to Moderate/minor in the event of the intervening forestry being felled.
Effect on Visual Amenity	None in the current baseline context, but increasing to Moderate in the event of the intervening forestry being felled.
Cumulative Visibility	The operational Langhope Rig Wind Farm is distinguishable against the skyline as seen above the landform of Bonchester Hill, 31.3 km to the north west. The operational Longpark Wind Farm at a distance of 40.8 km to the north is difficult to discern above the skyline, next to the Eildon Hills, as well as the single turbine of Bassendeanhill Farm. Due to the distance the wind farms on the Lammermuirs, such as Toddleburn, Dun Law 1&2, Fallago Rig, Crystal Rig 1&2, Aikengall and Black Hill, are imperceptible on the skyline, as they are located beyond 48 km distance. The proposed Birneyknowe Wind Farm would appear at a distance of 15 km, on the backdrop of the terrain, occupying approximately 10 degree of subtended angle of the view. The turbines of the proposed Longpark Wind Farm Extension, as shown on the wireline, would be imperceptible on the skyline at a distance of 41.5 km.
Cumulative Magnitude of Change	Currently, the effectively screened position of the proposed Development mean that there would be no cumulative change. However, in the event of intervening forestry being felled and the proposed Development revealed, the magnitude of cumulative in respect of existing/consented turbines would be Slight. This would remain the case in the event of the proposed wind farms in the study being incorporated.
Cumulative Effects on Landscape Character	Currently None, but potentially Moderate/minor if intervening forestry is felled.
Cumulative Effect on Visual Amenity	Currently None, but potentially Moderate if intervening forestry is felled.
Predicted Cumulative view with Scoping Wind Farm	Currently None, but potentially Moderate/minor if intervening forestry is felled.

Viewpoint 22: Pennine Way by Cairn Hill, Cheviots (Ref. Figures 4.29a to 4.29g)

Viewpoint	**Pennine Way by Cairn Hill, Cheviots**
Grid ref	389405 619267
Eye level	732 m AOD
Distance to nearest turbine	28.9 km
Bearing	244º south west
Location	The viewpoint is located on the south western shoulder of The Cheviot, to the west of the summit of Cairns (743 m AOD), on the Pennine Way (National Trail), adjacent to the western boundary of the Northumberland National Park, within Cheviot Foothills SLA.
Sensitivity of Landscape Character **(Cocklaw Group of Cheviot Uplands LCT)**	In the view is the landscape of the Cheviot Uplands, which is characterised by coarse grass covered hills dissected by steep sided valleys with frequent rocky outcrops and scree slopes. Due to its recreational use for walking, and by its designation as Cheviot Foothills SLA, the value of the landscape receptor is considered to be medium to high. Due to its distinctive topography, its large scale and its remote quality, the susceptibility of the landscape to wind farm development is considered to be High. The higher ground is open and exposed in character, which allows long-range, unobstructed views of the adjacent hills and upland fringe landscape types. Sensitivity: High
Sensitivity of Visual Receptor	Walkers: High
Existing View	The view towards the site is open and panoramic. The foreground and middle ground contain the open moorland grassland and steeply graded form of the Cheviot Hills, beyond which the Southern Uplands form a distant horizon.
Predicted View	All thirteen of the proposed Development's turbines would be provided from this distant elevated position. The proposed turbines would appear as small scale feature within this expansive view and would be backclothed by topography.
Magnitude of Change/Impact	The turbines appear as distant elements within the landscape, occupying a 5 degree subtended angle of the view. Due to the distance and the limited proportion of the expansive views available that the proposed Development would occupy, the magnitude of change would be Slight.
Effect on Landscape Character	Moderate
Effect on Visual Amenity	Moderate
Cumulative Visibility	The operational Langhope Rig Wind Farm at a distance of 47.7 km is barely perceptible. Due to the distance the blades of the consented Ewe Hill Wind Farm (on the skyline, above the proposed Highlee Hill turbines), at a distance of 69 km, would be imperceptible. The operational Longpark Wind Farm is difficult to discern at a distance 46.6 km to the north west, as well as are the single turbine of Bassendeanhill Farm. Due to the distance the wind farms on the Lammermuirs, such as Toddleburn, Dun Law 1&2, Fallago Rig, Crystal Rig 1&2, Aikengall and Black Hill are imperceptible on the skyline, as they are located beyond 40 km distance. Also the operational Green Rig Wind Farm and the consented Ray Wind Farm, 36.6 km and 32.2 km to the south east respectively, are/would be barely perceivable. The proposed Birneyknowe Wind Farm would be discernible simultaneously with the proposed Highlee Wind Farm at a distance of 34.6 km, on the backdrop of the distant terrain, occupying 2.7 degree of subtended angle of the view. The distances between the proposed Development and Birneyknowe Wind Farm ensure they would appear as individual developments. The blades of the proposed Windy Edge Wind Farm would be difficult to discern against the skyline at a distance of 42.8 km, beyond the proposed Highlee Hill turbines. The blade tips of Loganhead Wind Farm at a distance of 66 km would be imperceptible. The turbines of the proposed Longpark Wind Farm Extension Wind Farm would be difficult to discern at a distance of 47 km, on the backdrop of the distant terrain to the north west.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Slight - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind farm	The proposed Wauchope East Wind Farm would appear at a distance of 27 km, extending the horizontal subtended angle occupied by turbines by 3.8 degrees, next to the proposed Highlee Hill Wind Farm. Together the Wauchope East Wind Farm and the proposed Highlee Hill Wind Farm would occupy 9 degree subtended angle of the view. The proposed Wauchope West Wind Farm would appear beyond the proposed Highlee Hill Wind Farm, at a distance of 34.8 km. The blades of the proposed Newcastleton Forest Wind Farm would be imperceptible on the skyline at a distance of 44.8 km to the south west. The additional magnitude of change attributable to the proposed Development is considered to remain slight and the residual cumulative effect would be Moderate.

Viewpoint 23: Northern Approach to Chesters (Ref. Figures 4.230a to 4.30g)

Viewpoint	Northern Approach to Chesters
Grid ref	362429 611706
Eye level	259 m AOD
Distance to nearest turbine	4.3 km
Bearing	180º south
Location	The viewpoint is located on the minor road which links the A6088 in the centre of Chesters village with the B6357 at Wester Fodderlee, 4 km to the north west of Chesters. The road extends across the eastern part of the landform of Doorpool Hill (270 m AOD), which lies within the Teviot SLA.
Sensitivity of Landscape Character **(Bonchester/Dunion of Grassland with Hills LCT)**	This is a transitional landscape from upland fringe with an intimate river valley and distinctive cone-shaped hill to the smooth, rounded terrain of the Southern Uplands. Pastures dominate the land cover and woodland cover varies in extent. The value of this landscape receptor is considered to be medium to high due to its scenic qualities (strong landform identity of Southdean Hill) and its location within the Teviot Valleys SLA. Having visual diversity and contrast of enclosure and expansive views (scale diversity) gives a medium to high landscape character susceptibility to wind farm development. Sensitivity: Medium
Sensitivity of Visual Receptors	Road users: Medium
Existing View	The view towards the site open and expansive. The view comprises a steeply graded foreground consisting of the road and adjoining pasture which falls towards Jed Water valley. Beyond the valley, the ground rises towards the north east facing slopes of forested summit of Highlee Hill, forming the short distance skyline alongside the distinctive landform of Southdean Hill, on the left hand side of the view. Above the south facing slope of Doorpool Hill the summit of Wolfelee Hill forms the skyline on the right side of the view. The eye is drawn to the elongated prominent ridge of the Cheviot Hills, which forms an even and distant skyline above Wauchope Forest/Highlee Hill, at a distance of approximately 10 km. The external views from this location are restricted by the undulations of Doorpool Hill, the only open views available are to the south.
Predicted View	All thirteen of the proposed turbines would be visible from this elevated position. The turbines would be seen on an intervening ridge between the viewer and the Cheviot Hills beyond. The proposed Development would appear as a single array situated in an area of extensive coniferous forestry adjoining an incised farmed valley.
Magnitude of Change/Impact	The proposed turbines appear as new elements within the landscape, occupying a 24 degree horizontal angle of the view. Given the proximity of this viewpoint to the proposed Development and the proportion of the view the proposed Development would affect, the magnitude of change would be Substantial.
Effect on Landscape Character	**Major/moderate**

Effect on Visual Amenity	**Major/moderate**
Cumulative Visibility	Due to the intervening topography the operational Longpark Wind Farm is imperceptible on the skyline at a distance of 33 km to the north west, as are the blade tips of Toddleburn. Two blade tips of Windy Edge would be screened by the intervening vegetation 16.1 km to the south west. The proposed Longpark Wind Farm Extension would be imperceptible against the skyline at a distance of 33.8 km to the north west.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Slight - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate/minor - Existing/ Consented Wind farm Scenario Moderate/minor- Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate/minor - Existing/ Consented Wind farm Scenario Moderate/minor - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with Scoping Wind Farm	The proposed Wauchope East Wind Farm would appear on the backdrop of the elongated landform of Carter Fell at a distance of 6.8 km to the south, beyond the proposed Highlee Hill Wind Farm. The proposed Wauchope East Wind Farm would occupy almost twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. Several rotors with blades of the proposed Wauchope West Wind Farm would appear above Wolfelee Hill, at a distance of 18.1 km. The increased prominence of the cumulative context provided by the scoping scheme would provide a more obvious and immediate cumulative context within which the proposed Development, whilst overlapping with the scoping scheme, would be prominent due to its larger size and closer proximity. Consequently the residual cumulative effect when the proposed Wauchope/Newcastelton scheme is incorporated would be Moderate.

Viewpoint24: Drinkstone Hill (Ref. Figures 4.31a to 4.31g)

Viewpoint	Drinkstone Hill
Grid ref	348326 618619
Eye level	318 m AOD
Distance to nearest turbine	17.5 km
Bearing	130.8º south east
Location	The viewpoint is located on the summit of Drinkstone Hill (318 m AOD), 3 km to the north west of Hawick. The Cross Borders Drove Road crosses the southern and Borders Abbeys Way on the eastern slope of Drinkstone Hill.
Sensitivity of Landscape Character (Whitehaugh of Grassland with Rock Outcrops LCT)	This is a strongly undulating upland fringe landscape around Hawick on the fringes of the Middle Teviot valley. Due to its recreational use, this landscape is considered to have medium value. Having an open and exposed character on higher ground, (where the viewpoint is located) with distant and panoramic views to the Southern Uplands and surrounding valleys The landscape gives a medium landscape character susceptibility to wind farm development. Sensitivity: Medium
Sensitivity of Visual Receptor	Walkers: High
Existing View	The viewpoint provides 360 degree and long range views over the surrounding landscape, with some screening provided by the nearby woodland blocks. The view towards the site comprises an elevated panorama over the River Teviot valley, across an undulating patchwork terrain of medium scale pasture and arable fields, bound by tree belts, forestry block s and hedgerows. The distinctive landform of Rubers Law Hill (424 m AOD) appears on the left side of the view. The elongated ridge of Carter Fell (Cheviot Hills) forms the skyline at a distance of 23 km. As a viewpoint was requested from the summit, the woodland block screens part of the panorama.
Predicted View	All thirteen of the proposed turbines would be visible from this elevated position. However, the turbines would be backclothed by topography and the lower columns of all of the turbines would be screened by intervening topography, leading in a reduction in the perceived scale of the turbines.
Magnitude of Change/Impact	Given the partially screened position, backclothed and distant position of the proposed Development, and consequent limited visibility an d prominence, the magnitude of change would be Slight.
Effect on Landscape Character	Moderate/minor
Effect on Visual Amenity	Moderate
Cumulative Visibility	The operational Langhope Rig Wind Farm is visible at a distance of 6.9 km to the west and Longpark Wind Farm is discernible on the skyline at a distance of 22.8 km to the north. The wind farms on the Lammermuir Hills (including Dun Law 1&2, Fallago Rig, Aikengall and Black Hill Wind Farms), all beyond 40 km distance, are screened by the intervening forestry at this location. The proposed Birneyknowe Wind Farm would appear at a distance of 9.3 km, to the west of Wolfelee Hill, partially in front of the proposed Development. The proposed Longpark Wind Farm Extension at a distance of 23.2 km to the north, would be screened by the intervening forestry at this location.
Cumulative Magnitude of Change	Slight- Existing/ Consented Wind farm Scenario Slight. Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate/minor- Existing/ Consented Wind farm Scenario Moderate/minor - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with Scoping scheme Incorporated	The proposed Wauchope East Wind Farm would introduce a large number of turbines to the background of this view, set against the backdrop of the elongated landform of Carter Fell. These turbines would be seen at a distance of over 19 km and would occupy almost three times the horizontal extent of the view that the proposed Development would. The proposed Development would entirely overlap with the Wauchope scheme, thereby reducing the prominence of the proposed Development turbines and resulting in moderate/minor residual cumulative effect.

Viewpoint 25: Minto Hills (Ref. Figures 4.32a to 4.32g)

Viewpoint	Minto Hills
Grid ref	355977 620653
Eye level	275 m AOD
Distance to nearest Turbine	14.4 km
Bearing	155.58º south east
Location	The viewpoint is located on the summit of Minto Hills (318 m AOD), 5.8 km to the north east of Hawick.
Sensitivity of Landscape Character (Lowland Valley with Farmland LCT)	This is a broad shallow flat bottomed valley with gently sloping sides, covered by medium to large sized arable and pasture fields divided by hedgerows with mature broadleaf woodland, shelterbelts on lower slopes and valley floor. The Lower Teviot is open in character with distant views gained along the valley to the surrounding upland fringe farmlands and the hills. Minto Hills is identified as a Scenic Viewpoint in the Scottish Borders Council Wind Energy SPG. Minto Hills stands within the Teviot Valleys SLA. Based on that, and due to its recreational use, this landscape is considered to have high value. Having diversity in scale due to diverse surrounding landform types with the Rubers Law (iconic landmark) prominent in views to surrounding landscape, the landscape in views gives a medium to high landscape character susceptibility to wind farm development. Sensitivity: High
Sensitivity of Visual Receptors	Walkers: High
Existing View	The viewpoint provides 360 degree long range views. The view towards the site comprises a panorama over the River Teviot valley, across an undulating patchwork terrain of medium scale pasture and arable fields, bound by tree belts, forestry block s and hedgerows. The settlement of Denholm lies on the bottom of the River Teviot valley. The distinctive form of Rubers Law (424 m AOD) rises in direct view above the River Teviot valley, its rugged summit forming a skyline feature. The elongated ridge of Carter Fell (Cheviot Hills) forms the smooth distant skyline.
Predicted View	Whilst four of the proposed Development's turbines would theoretically be visible, only three would be discernible due to the screening effect of intervening vegetation. The rotors of turbines 10, 11 and 13 would be visible beyond the north east facing lower slope of Rubers Law, but would be seen distantly and would be backclothed by topography. The scale of the turbines relative to Rubers Law, and their backclothed position would help to avoid detracting from or compromising the hills scale.
Magnitude of Change/Impact	Given the relative distance of this viewpoint from the proposed Development, the substantially screened and backclothed position of the proposed Development in the view, the magnitude of change would be Slight.
Effect on Landscape Character	Moderate
Effect on Visual Amenity	Moderate
Cumulative Visibility	The operational Langhope Rig Wind Farm is visible at a distance of 14.2 km to the west and Longpark Wind Farm is discernible on the skyline at a distance of 22.3 km to the north. Due to the distance the operational Bassendeanhill Farm turbine, 26.4 km to the north, is imperceptible, as are the wind farms on the Lammermuirs, including Toddleburn, Dun Law 1&2, Crystal Rig, Aikengall, Fallago Rig and Black Hill Wind Farms, all beyond 43 km distance. The proposed Birneyknowe Wind Farm would appear at a distance of 8.7 km, to the west of Rubers Law, The turbines would appear on the backdrop of the distant terrain, and occupy X degree of horizontal subtended angle of the view. The proposed Longpark Wind Farm Extension at a distance of 22.9 km to the north, would be discernible.
Cumulative Magnitude of Change	Slight - Existing/ Consented Wind farm Scenario Moderate - Slight/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	Moderate - Existing/ Consented Wind farm Scenario Moderate - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with scoping wind Farm	The proposed Wauchope East Wind Farm would appear on the both sides of the landform of Rubers Law, at a distance of 17.3 km. The turbines would appear behind, and amongst, the proposed Highlee Hill Wind Farm. Wauchope West Wind Farm would appear to the west of the Rubers Law, at a distance of 13.1 km. Whilst the prominence of the propose Development's turbines would be marginally reduced, it would still represent a Moderate effect.

Viewpoint 26: A7 Approach to Hawick (Ref. Figures 4.33a to 4.33e)

Viewpoint	A7 approach to Hawick
Grid ref	351073 616776
Eye level	181 m AOD
Distance to nearest turbine	14.2 km
Bearing	132.3º south east
Location	The viewpoint is located next to the A7, on the north eastern approach to Hawick.
Sensitivity of Landscape Character (Upper Teviot Pastoral Upland Fringe Valley LCT	This is a medium scale pastoral valley enclosed by upland fringe pastures. Views are of moderate range, with intermediate horizons formed by woodland strips or by the contours of side-valleys. Although the landscape in the view is outside the Teviot Valleys SLA, it is evaluated as having a medium value due to the strong landform identity of Rubers Law. The landscape is evaluated by the inhabitants of Hawick as part of their visual amenity. Having visual diversity gives a medium to high landscape character susceptibility to wind farm development. Sensitivity: Medium
Sensitivity of Visual Receptor	Residents of Hawick village - High Road users: Medium to High
Existing View	The view towards the site comprises an open expansive and long range view in which the foreground descends towards the River Teviot valley. The valley landscape is comprised of arable and green fields divided by a network of hedgerows and treebelts. The housing developments appear on the backdrop of the valley side. The ground rises from the valley towards the north west facing slopes of Orchard Hill (206 m AOD) and the landform which accommodates the Cavers House and Parkland. Both landforms form the smooth, woodland covered short distance skyline. The prominent landform of Rubers Law comprises a focal point above the valley on the left side of the view. Views to the rear are comprised of the Homebase store building and the north eastern slope of Gala Law (221 m AOD) which rises to the north of Hawick, and also restricts visibility beyond.
Predicted View	According to the wireline view three blades, three blade tips and one rotor with blades would appear above the intervening landform. Four blade tips would appear on the skyline.
Magnitude of Change/Impact	Given the distance and limited visibility of the proposed Development in transient road view the magnitude of change is considered as Negligible.
Effect on Landscape Character	Minor
Effect on Visual Amenity	Minor
Cumulative Visibility	No wind farms are currently visible from this viewpoint, and there is no potential visibility of consented but currently unbuilt wind farms. The proposed Birneyknowe Wind Farm would appear on top/above the landform of Orchard Hill, on the skyline at a distance of 6.4 km to the south east, occupying 30 horizontal degrees subtended of the view and would represent a considerably more prominent development than the proposed development.
Cumulative Magnitude of Change	None - Existing/ Consented Wind farm Scenario Negligible Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effects on Landscape Character	None - Existing/ Consented Wind farm Scenario Minor - Existing/ Consented and Proposed Wind farm Scenario
Cumulative Effect on Visual Amenity	None - Existing/ Consented Wind farm Scenario Minor - Existing/ Consented and Proposed Wind farm Scenario
Predicted Cumulative view with Scoping Wind Farm	The blades of the proposed Wauchope East Wind Farm would appear above the intervening landform at a distance of 16.3 km to the south east, beyond/amongst the blades of the proposed Highlee Hill Wind Farm. The proposed Wauchope East Wind Farm would occupy twice the angle of horizontal extent of turbines in the view in comparison with the subtended angle of view occupied by Highlee Hill Wind Farm. Several Wauchope West Wind Farm turbines would appear above the landform of Orchard Hill, at a distance of 13.1 km. The additional magnitude of change attributable to the proposed Development is considered to be Negligible, equating to a Minor cumulative effect.

Technical Appendix 4.7: Residential Visual Amenity Study

Introduction

Residential visual amenity is a subset of residential amenity, which can also include aspects such as noise, dust, vibration, light and shadow flicker or traffic. Consequently, it is necessary to consider visual amenity as part of a broader series of environmental conditions at properties. The following study should therefore be read in conjunction with Chapters 9 and 11 of the ES.

The scope of this Residential Visual Amenity Assessment (RVAS) includes those residential properties that are situated within 3 km of the outermost turbines of the proposed Development and which are predicted to have potential views of the proposed Development.

In order to establish a list of the relevant properties for inclusion in the study, Census data (OS Address Point Data) and 1:25,000 mapping data was utilised and verified by field survey. Any properties not shown to be liable to potential views of the proposed Development in the ZTVs in Volume III of the ES, have been omitted.

A total 15 properties were identified within the 3 km study area as having potential views of the proposed Development. These properties are listed in Table TA4.7b, below, and their location identified on Figure AP2.

In the course of preparing this study each of the residential properties was surveyed from adjacent public roads and public rights of way. No visits within the property curtilages were undertaken. Notwithstanding this, the findings of the study are considered to provide adequate basis for determining potential effects on visual amenity of the properties affected.

Planning Context

The planning system does not provide any specific protection to private views and in general the outlook from each individual property is a matter of private interest and not a public one, which is the primary concern of the planning system. However, where a development may result in impacts on the outlook of a property being overwhelming or oppressive so as to affect residents to the extent to make everyday living conditions unsatisfactory, this can be a material consideration in determination of the planning application.

There is no formal or statutory guidance available as to how to assess the visual component of living conditions. However, the following study is based on tried and tested methodology and relies upon professional judgement. This is consistent with the approach advocated by the Reporter in the Baillie decision

"Any assessment of acceptability in these circumstances relies on judgement rather than measurement[1]."

This judgement should not take account of the range of potential personal attitudes towards wind farms.

The matter of judgement of potential impacts on living conditions has been considered at several public inquiries to determine whether the potential impacts upon the visual amenity of residential properties is so unsatisfactory that the development in question should be refused planning permission in the public interest. A number of these decisions have been reviewed as part of this study.

Inspector Woolcock in the Langham Appeal Decision of September 2011[2] stated that:

"The planning system controls development in the public interest, and not in the private interest. The preservation of open views is a private interest, which the planning regime is not intended to protect. But public and private interests may overlap. The issue is whether the number, size, layout and proximity of wind turbines would have such an overwhelming and oppressive visual impact on a dwelling and its amenity space that they would result in unsatisfactory living conditions, and so unacceptably affect amenities and the use of land and buildings which ought to be protected in the public interest".[3]

Inspector Lavender in his Appeal Decision in respect of Enifer Downs[4] (2009) (Appeal Ref: APP/X22201/A/08/2071880) stated that:

"when turbines are present in such number, size and proximity that they represent an unpleasantly overwhelming and unavoidable presence in the main views from a house or garden, there is every likelihood that the property concerned would be come to be widely regarded as an unattractive and thus unsatisfactory (but not necessarily uninhabitable) place in which to live. It is not in the public interest to create such living conditions where they did not exist before.[5]"

In the Carland Cross Appeal Decision of 19th January 2010 (Inspector Lavender), there were 209 properties within 3 km of the proposed turbines. 23 were identified as likely to experience *"high*

[1] Paragraph 8.21, Erection of wind farm at Bardnaheigh Farm, Westfield, by Thurso (Baillie). Case reference IEC/3/105/3, 17th August 2009 (SPR76).

[2] Land between Anderby, Anderby Creek, Chapel St Leonards and Langham. Appeal Decision APP/D2510/A/10/2130539, September 2011

[3] Paragraph 63 Land between Anderby, Anderby Creek, Chapel St Leonards and Langham. Appeal Decision APP/D2510/A/10/2130539. 29th September 2011 (SPR77).

[4] North Dover (Enifer Downs) Public Inquiry, PINS Appeal Reference APP/X2220/A/08/2071880. Decision Letter, dated 16 March 2009 ('Lavender Test')

[5] Paragraph 66 Land west of Enifer Downs Farm and east of Archers Court Road and Little Pineham Farm, Langdon, Appeal decision APP/X2220/A/08/2071880. 28th April 2009 (SPR78).

significance of visual impact" which in each case the Council judged to be as *"overwhelmingly adverse."* However, the Inspector stated that:

"..those who face the prospect of living close to a wind farm may attach very different value judgements to their visual impact than the wider public, who stand to benefit from the energy produced without seeing the turbines from their homes. In impact, the former is primarily a private interest whereas the latter is a public one and, in the case of the former, few householders are able to exercise control over development by others that may do no more than impinge into the outlook from their property. The planning system is designed to protect the public rather than private interests, but both interests may coincide where, for example, visual intrusion is of such magnitude as to render a property an unattractive place in which to live. This is because it is not in the public interest to create such living conditions where they did not exist before. Thus I do not consider that simply being able to see a turbine or turbines from a particular window or part of the garden of a house is sufficient reason to find the visual impact unacceptable (even though a particular occupier might find it objectionable)."[6]

This has become known as the 'Lavender test'[7], although is clearly still one of subjective judgement rather than objective measurement. This was recognised in a Secretary of State case of 6th July 2011 in respect of Burnthouse Farm, where Inspector Kingaby stated (para 229) that:

"The methodology for assessing the visual impact on residential occupiers was considered fully at the Inquiry. I accept that the approach used by Inspectors in the Enifer Downs, Poplar Lane and Carland Cross Appeals and elsewhere should not be regarded as a mechanistic 'test' and has no status in terms of being part of a statutory documentation or planning policy and guidance. However, it seems to me that a logical, transparent and objective approach to assessing visual impact should be adopted."

In the same decision (paragraph 232), Inspector Kingaby noted that serious harm to living conditions which might lead to a recommendation for planning permission to be refused in the public interest, is a more stringent requirement than the identification of a significant adverse impact:

"I consider that when assessing the effect on visual outlook, it is helpful to pose the question 'would the proposal affect the outlook of these residents to such an extent i.e. be so unpleasant, overwhelming and oppressive that this would become an unattractive place to live?"[8]

More recently, in respect of Fauch Hill and Harburnhead Wind Farms, Reporters Messers Dent and Jackman in their Report (2014[9]) stated that they considered that:

[6] Paragraph 23, Carland Cross Appeal Decision (APP/D0840/A/09/2103026) 19th January 2010 (SPR82).

[7] North Dover (Enifer Downs) Public Inquiry, PINS Appeal Reference APP/X2220/A/08/2071880. Decision Letter, dated 16 March 2009 ('Lavender Test')

[8] Paragraph 232 Land North of Burnthouse Farm, Appeal Decision APP/D0515/A/2123739. 6th July 2011 (SPR79).

[9] Report to the Scottish Ministers, Fauch Hill Wind Farm and Harburnhead Wind Farm, Directorate for Planning and Environmental Appeals, January 2014

"a significant change to a local resident's outlook from their property does not mean a wind farm proposal is necessarily unacceptable. Significant changes are likely to be inevitable for the closest properties. We agree that a 'higher' test is relevant."

They conclude that they *"agree with the conclusions from pervious decisions that this means a wind farm would have to be overbearing or dominant."*

The Planning Inspectorate for England and Wales defines the term 'overbearing ' as: 'A term used to describe the impact of a development or building on its surroundings, particularly a neighbouring property, in terms of its scale, massing and general dominating effect'. This definition is also considered appropriate to use in the Scottish context.

The following study therefore, does not define a simple level of visual effect, but refers to the degree to which this would affect the living conditions at the property itself and the wider public interest. It is therefore important to emphasise that a residential receptor anticipated to experience a significant visual impact in EIA terms, would not necessarily be subject to 'overbearing', 'overpowering', 'oppressive' or 'unpleasantly overwhelming and unavoidable effects and may therefore not represent an unacceptable effect on residential amenity of properties or the undermining of public interest.

Methodology

Method of Assessment

There is no specific published guidance available on the method for conducting an assessment of impacts on residential visual amenity in the locality of a wind farm or any other form of proposed development. Paragraph 6.17 of The Landscape Institute Guidelines for Landscape and Visual Impact Assessment states that:

"Effects of development on private property are frequently dealt with mainly through residential amenity assessments. These are separate from LVIA although visual effects assessment may sometimes be carried out as part of a residential amenity assessment, in which case this supplements and forms part of the normal LVIA for a project. Some of the principles set out here for dealing with visual effects may help in such assessments but there are specific requirements in residential amenity assessment."

The Landscape Institute does not define the specific requirements for residential amenity assessment. The LVIA methodology described in the Chapter 4: Landscape and Visual Impact Assessment, underpins the approach taken to the RVAS. The assessment and conclusions of this Technical Appendix are therefore based on professional judgment, underpinned by the findings of desk study, field survey and the visual information (including, OS maps and aerial photography).

For the purposes of this study the following process has been adopted:

- Desktop study and identification of addresses;
- Field survey and verification;

- Assessment of potential for significant visual effects to occur at each property; and
- Evaluation of Effects on Living Conditions.

Study Area

Current Scottish Planning Policy (SPP) includes a recommendation that local planning authorities (LPAs) in their development of spatial frameworks for wind energy developments include community separation distance for consideration of visual impact extending to 2 km from the edge of cities, towns and villages for Group 2 areas.

"A separation distance of up to 2 km between areas of search and the edge of cities, towns and villages is recommended to guide developments to the most appropriate sites and to reduce visual impact, but decisions on individual developments should take into account specific local circumstances and geography."

The study has been undertaken within a 3 km radius study area from the outermost turbines of the proposed Development (plus a 50m buffer around each to take account of potential turbine micro-siting). Whilst a review of Inspectors' reports following Public Inquiries indicates that unacceptable effects on residential visual amenity are most likely to arise at distances of less than 1 km (usually around 750 m - 8OO m), as there are no properties within 1 km of the site and owing to the size of the proposed Development's turbines an expanded 3 km study area radius has been used as a precautionary measure.

Baseline Visual Amenity

For the purposes of this study, the visual amenity experienced at a property is made up of a combination of the type, nature, extent and quality of views that may be available from the property and its domestic curtilage (e.g. gardens and access drives).

In considering baseline visual amenity, the following has been examined:

- the landscape context of the property and its domestic curtilage in terms of landform, land cover and pattern and the presence of visual foci, both natural and man-made and their distance from the viewer;
- the nature and extent of the available existing views (including main/primary views) from the property and its garden, including the proximity and relationship of the property to surrounding landform, landcover and visual foci; and
- views experienced when approaching or departing from the property via its driveway and / or access track, if applicable.

Field Survey

The study area was visited in October 2015 and the predicted views from each of the properties assessed from the nearest publicly accessible location with reference to draft wireline images. The field surveys considered potential screening by local variations in topography, tree cover and buildings within the landscape.

Significance of Visual Effects

In line with the methodology in the LVIA in Chapter 4 of the ES, the determination of whether significant visual effects would occur at properties is based on a comparison of receptor sensitivity and the magnitude of potential change predicted. For the purposes of this study the sensitivity of residential receptors is assumed to be high.

Judgements as to the level of significance of the impact are described as **Major, Major/Moderate, Moderate,** Minor, Minor/None. **Major** and **Major/Moderate** considered significant in EIA terms. The process for these judgements is outlined in the methodology for the Landscape and Visual Impact Assessment (Chapter 4). Table TA4.7a summarises the levels of significance of visual impacts in relation to impacts upon visual amenity of residential properties adopted for this study.

Table TA4.7a: Residual Visual impact.	
Major	The proposed Development would result in substantial change to a large proportion of the views from the property, including external circulatory and recreational spaces. The proposed Development would form a prominent or even dominant feature in views and would constitute a considerable or fundamental change to views and the visual amenity at the property. Such impacts may also relate to potentially significant cumulative effects, including potential encirclement or enclosure of the property by wind energy developments.
Moderate	The proposed Development would affect a large number of key views from the property, including external circulatory and recreational spaces and would form a prominent element. Such impacts may also relate to potentially significant cumulative effects.
Minor	The proposed Development would affect views of secondary importance from a property (e.g. oblique or restricted views, or views from utilitarian areas in the property.), and/or would be of limited prominence or influence on the overall visual amenity of the property. The proposed Development would constitute a minor cumulative element Such impacts may also relate to additional cumulative effects.
Negligible	Minimal visibility, the proposed Development is substantially screened from views from the property and represents a barely discernible change to views from the property.
No Effect	Despite theoretical visibility indicated in the ZTV no views of the proposed Development would be provided.

Evaluation of Effects on Living Conditions

It is important to reiterate that the threshold for an unacceptable effect on residential amenity is not the same as the threshold for a significant effect determined through the LVIA as part of the EIA process.

Having identified the potential for significant visual effects at properties it is necessary to identify where such effects are considered to result in a likelihood that the property concerned would be come to be widely regarded as an unattractive and thus unsatisfactory (but not necessarily uninhabitable) place in which to live.

Assessment

As noted previously, 15 properties were identified within 3 km of the proposed development, as potentially having a view of the proposed Development turbines. The location of these properties is identified on Figure AP2 and they are listed and assessed in Table TA4.7b, below which records the following data:

- Allocated property reference ID;
- Name of property;
- Distance from the nearest proposed Development turbine;
- Direction from the proposed Development;
- Description of property;
- Existing Views towards the proposed Development from the property;
- Potential views of the proposed Development and assessment of potential visual effect; and
- Assessment of effect on living conditions at each property.

It is acknowledged that current forest cover will change over time, and where the loss of tree cover may affect the prominence of the proposed Development and the potential for overbearing effects this is commented upon.

Findings

Of the fifteen residential properties within 3 km of the proposed Development turbines with potential views of the proposed Development eleven were assessed to be subject to potentially significant visual effects in EIA terms. However, none were considered to represent an unacceptable effect on the amenity of the properties concerned (i.e. would not result in overwhelming, overbearing or unavoidable effects) due to a combination of the distance at which the proposed Development turbines would be seen, their partially screened position, and set back from prominent skylines overlooking properties. The turbines would clearly relate to the interior of the large scale uplands, rather than the enclosed, smaller scale landscape of the valley farmland landscape in which the properties are located. On this basis the proposed Development is not considered to represent an unacceptable impact on residential amenity.

Table TA4.7b: Effects on residential visual amenity within 3 km of the proposed Development.

Ref ID	Name of property	Distance from the nearest turbine	Direction to proposed Development	Description of property	Existing Views towards the proposed Development	Potential views of the proposed development and assessment of potential visual effect	Predicted Effect
9 & 10	Lustruther Farm	1.8 km	South	Property 9 and 10 are part of the Lustruther farm complex and comprise a detached house and separate Bed and Breakfast. These properties are oriented towards a minor road farm access linking to a service road and the A6088 carriageway between Southdean and Chesters. The properties are located at around 214 m AOD enclosed to the north-west by substantial farm outbuildings, but with living space and gardens evident to the north-east and south of the properties. The perimeter of the property curtilage is marked by remnant hedgerow trees. The main of these dwellings is oriented to the east and south-east, across Jed Water Valley. The elevated edge of the Southern Uplands Forest Covered landscape encloses the landscape to the south of these properties, whilst the distinctive conical form of the Southdean Hill forms a prominent landmark and focal point to the east.	Unverified potential filtered views towards the proposed Development from the southern aspect of these properties.	The proposed Development would be seen on the skyline, but would be partially screened by intervening topography and forestry at Weasels Hill and south of Peden's Cleuch.	**Major** and significant in EIA terms, but not overbearing or overwhelming in respect of the living conditions at these properties. This is due to the distance and partially screened position and consequent separation of the proposed Development from these properties. This finding would not be materially altered in the event of forest cover at the site being felled.
16	Whiteburn, Southdean	2.4 km	South	A bungalow, abutting the western side of the A6088, 700m to the south of Chesters. The main reception and leisure spaces, including a conservatory, are located on the western side of the house and adjoined by small expanses of lawn. The southern, western and eastern aspects of the curtilage are open, providing prospect across the adjoining farmland.	Views to the south, towards the proposed Development are partially restricted by intervening vegetation and farm buildings.	Oblique views (40 degree horizontal angle) and restricted views from windows in the southern end of the house would be provided, from where the proposed Development would be seen on the skyline, but would be partially screened by intervening topography and forestry at Weasels Hill and south of Peden's Cleuch.	**Major** and significant in EIA terms, but not overbearing or overwhelming in respect of the living conditions at these properties. This is due to the distance and partially screened position and consequent separation of the proposed Development from these properties.
16	Manse	2.5 km	South	A two storey house is accessed via farm track from the A6088, 870m to the south of Chesters. The property is extensively tree clad, but filtered views out are provided. Therefore views outside are limited and filtered.	To the south an extending mature tree belt merges with the dense riparian vegetation of Jed Water, which flows 50m to the south of the house.	Oblique and filtered views of the proposed Development above the landform of Highlee Hill are predicted from the west and south east facing first floor windows of the property and from some external ground floor locations. The proposed Development would be seen on the skyline, but would be partially screened by intervening topography and forestry at Weasels Hill and south of Peden's Cleuch.	**Major/moderate** and significant in EIA terms, but not overbearing or overwhelming in respect of the living conditions at these properties. This is due to the distance and partially screened position and consequent separation of the proposed Development from these properties. These finding would not be materially altered in the event of forest cover at the site being felled.
27	Southdean Cottage	2 km	South	This cottage comprises a short terrace of two storey dwellings with dormer windows, 1.0km to the south of Chesters. The dwellings are located on the floor of Jed Water Valley, with the riverside open space extending to the north west of the house. The south east and north east	Views towards the proposed Development are foreshortened by a steeply graded bank in the foreground.	Whilst the ZTV indicates potential visibility, of the blade tips of up to three of the proposed Development turbines, field reconnaissance suggests that such visibility would be reduced by topography and vegetation. There	Initially significant in EIA terms, but not overbearing or overwhelming in respect of the living conditions at these properties. This is due to the distance and partially screened position and consequent separation

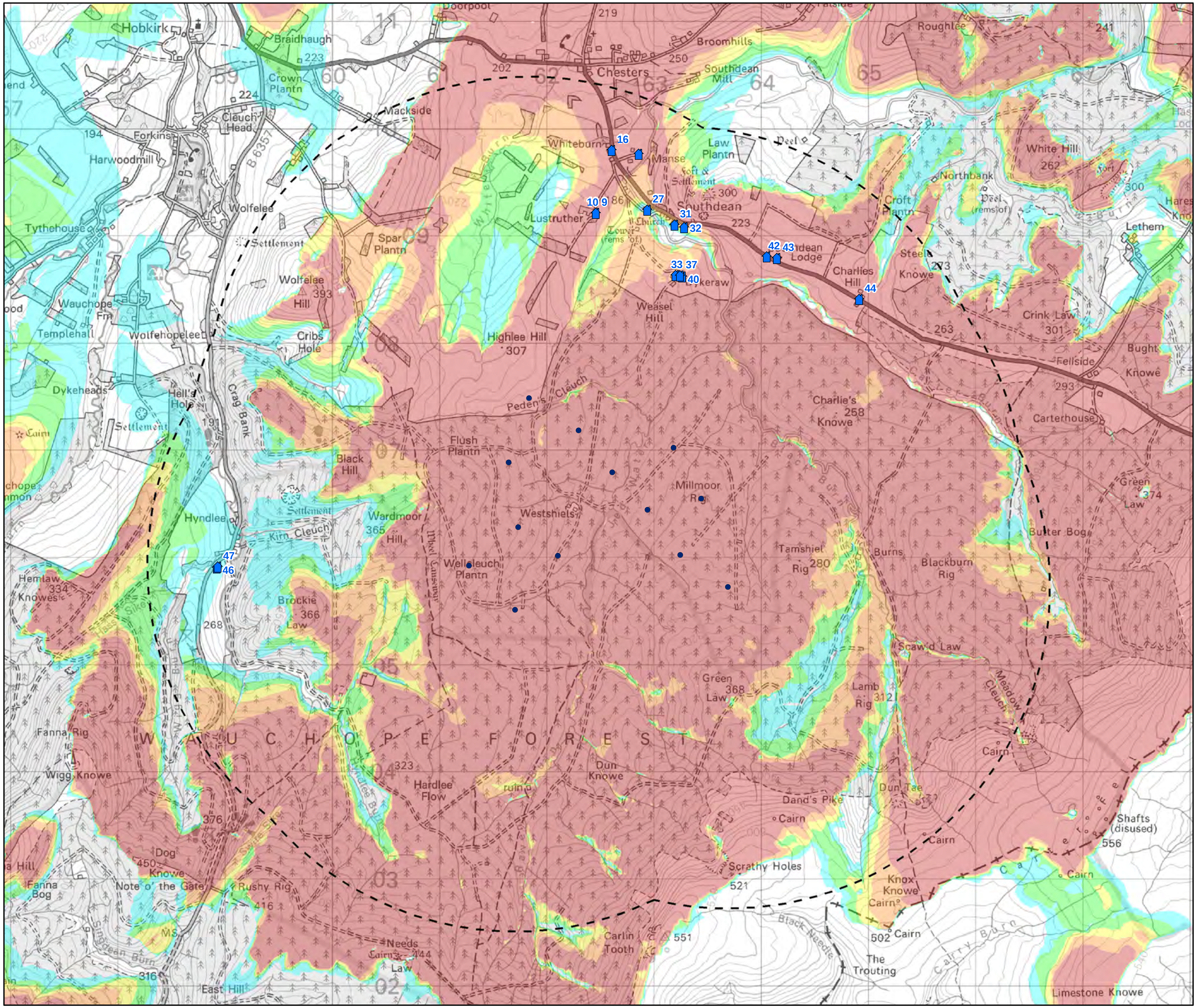
Table TA4.7b: Effects on residential visual amenity within 3 km of the proposed Development.

Ref ID	Name of property	Distance from the nearest turbine	Direction to proposed Development	Description of property	Existing Views towards the proposed Development	Potential views of the proposed development and assessment of potential visual effect	Predicted Effect
				facing open space areas are hard surfaced. Due to its enclosed location on the bottom of the river valley, views are drawn through the valley north west south east direction. Views from the south west facing elevation are contained by the landform in the immediate vicinity. Views to the north east are impeded by the south west facing slope of Southdean Hill. Views from the north west facing conservatory look across the elongated open space, which is connected to the property.		is also evidence of tree/shrub planting on the intervening slopes to the south of these dwellings which, during the life of the proposed Development would gradually reduce visibility further.	of the proposed Development from these properties. Moreover, once existing tree/shrub planting has established this would reduce to non significant EIA effects.
31	Southdean House	2.0 km	South/ South west	This two storey detached property is located within the incised landscape of Jed Water, south of the A6088 carriageway, 1.5 km to the south east of Chesters. Lawned open spaces extend to the west and east of the house, whilst key views from a conservatory is facing to the south/south east and provides open views of the alignment of Jed Water, which is marked by riparian vegetation. Views are channelled along the alignment of the river valley and the prominent elevated valley sides that enclose it.	The generally open aspect to the south of this property provides a high degree of visibility towards the proposed Development, the elevated edge of the Southern Uplands bounding views from this property.	The blade of up to four turbines would be seen on the skyline amidst the forestry south of Weasel Hill. In the event of the existing forestry at the site being felled there would be greater visibility and prominence of the proposed Development, but it would remain partially screened by intervening topography.	**Major/moderate** and significant in EIA terms, but not overbearing or overwhelming in respect of the living conditions at these properties. This is due to the distance and partially screened position and consequent perceived separation of the proposed Development from these properties. This finding would not be materially altered in the event of forest cover at the site being felled.
32	Merry Oaks Southdean	2.1 km	South/ South west	Cottage is located next to the A6088, 1.7 km to the south east of Chesters, on the bottom of Jed Water valley. To the north the house is facing the road embankment in an immediate view, its south/south west facing aspect is more opened, where the pasture fields extend beyond its perimeters. Views to the north/north east are enclosed by the landform of Southdean Hill. Views to the east and south east are limited by the tree belt associated with Jed Water.	The south/south west facing aspect is more open, with views across the pasture land. The landform of Weasel Hill forms the short distance skyline to the south /south west.	Views of the upper columns and rotors of up to nine of the turbines would be provided from the south facing elevation and rear garden of the property, the turbines visible above the landform of Weasel Hill. The turbines would also be seen from the access road when approaching the house.	**Major/moderate** and significant in EIA terms, but not overbearing or overwhelming in respect of the living conditions at these properties. This is due to the distance and partially screened position and consequent reduced prominence and perceived separation of the proposed Development from these properties. This finding would not be materially altered in the event of forest cover at the site being felled.

Table TA4.7b: Effects on residential visual amenity within 3 km of the proposed Development.							
Ref ID	**Name of property**	**Distance from the nearest turbine**	**Direction to proposed Development**	**Description of property**	**Existing Views towards the proposed Development**	**Potential views of the proposed development and assessment of potential visual effect**	**Predicted Effect**
33, 37 and 40	Dykeraw Farm Cottage) Dykeraw Farm The Steading Dykeraw Farm	1.7 km	South/ South west	These three properties (comprising Dykeraw Farm, Dykeraw Farm Cottage and Dykeraw Farm - The Steading) are located on the side of the A6088 carriageway, 2 km to the south of Chesters. The properties are situated on an elevated location on the north east facing slope of Weasel Hill, above Jed Water valley. Farm buildings are located to the south west of the properties. Due to their elevated location the main views are orientated across Jed Water valley to the north east.	Views to the south/south west are contained by the rising slope of Weasel Hill. A coniferous plantation forms the skyline at a distance of around 170 m. Recent felling to the south of these properties has provided some increased intervisibility towards the proposed Development, but the majority of intervening forest cover remains.	Four turbines would be seen above the forest to the south and several blades would appear above the forestry to the south west. Views are predicted mainly from the open space around the houses. There are several mature trees within the properties' perimeters and therefore views of the development would be filtered or partially screened. The turbines would be seen from the access road when approaching the house. Whilst, any forest felling at the site may result in increased visibility the prominence of the proposed Development is unlikely to be greatly increased.	**Major/moderate** and significant in EIA terms, but not overbearing or overwhelming in respect of the living conditions at these properties. This is due to the distance and partially screened position and consequent reduced prominence and perceived separation of the proposed Development from these properties. This finding would not be materially altered in the event of forest cover at the site being felled. This finding would not be materially altered in the event of forest cover at the site being felled.
42	Southdean Lodge Bothy	2.2 km	South west	This two storey detached dwelling is located immediately to the south of the A6088 carriageway, 2.4 km to the south east of Chesters, on the eastern side of Jed Water valley. The dwelling is extended to the south/south west (with added conservatory and balcony) with designed amenity space. The property is recently renovated and has an open aspect in all directions.	Views south, towards the proposed Development site are provided from southern aspect of this property and much of its curtilage.	The entire proposed development would be seen in direct open panoramic views (approximately 55 degree of horizontal angle) above the forestry to the south west. Whilst, any forest felling at the site may result in increased visibility the prominence of the proposed Development is unlikely to be greatly increased.	Major/moderate and significant in EIA terms, but not overbearing or overwhelming in respect of the living conditions at these properties. This is due to the distance and partially screened position and consequent perceived separation of the proposed Development from these properties. This finding would not be materially altered in the event of forest cover at the site being felled.
43	Southdean Lodge	2.0 km	South west	This two storey detached dwelling is located immediately to the north of the A6088 carriageway, 2.4 km to the south east of Chesters. It is surrounded by mature trees and enclosed by a 1.5 m high hedgerow on its southern boundary.	Views towards the proposed Development from the ground floor of this property are substantially constrained by an intervening hedgerow. However, views towards the proposed development are provided from an upper floor window in the southern façade, whilst oblique views are provided from the upper floor window in the western façade.	Whilst views of the proposed Development would be negligible from the ground floor level of the property, the proposed Development would be clearly visible on the skyline from the upper floor of the property. The proposed Development would occupy a large proportion of the view, but would be set within the large scale forested landscape of forested slopes of the uplands.	Moderate effect in EIA terms, overall. Visual effects being confined to upper floor rooms only. On this basis the effects are not considered to be overbearing or overwhelming in respect of the living conditions at these properties due to the properties distance from the proposed Development and restriction of visibility to the upper floor south facing rooms in the house.

Table TA4.7b: Effects on residential visual amenity within 3 km of the proposed Development.

Ref ID	Name of property	Distance from the nearest turbine	Direction to proposed Development	Description of property	Existing Views towards the proposed Development	Potential views of the proposed development and assessment of potential visual effect	Predicted Effect
44	Charlies Hill Southdean	2.0 km	South west	Two storey detached cottage north of the A6088 carriageway, 3.3 km to the south east of Chesters. The property is enclosed to the south east and west by a dense coniferous hedge to a height of around 2 m. The main reception/recreational spaces at the property are located at the rear of the house and include a north facing conservatory and garden.	Views south from the ground floor of the dwelling are screened by a dense coniferous hedgerow along the curtilage boundary in this aspect. Whilst views from the south facing upstairs windows, they are filtered through a mature coniferous tree belt on the southern side of the A6088.	Restricted views of the proposed development would be provided from the upper floor south facing windows.	Moderate/minor effects in EIA terms The effects are not considered to be overbearing or overwhelming in respect of the living conditions at these properties due to the properties distance from the proposed Development turbines, and the restricted nature of views.
46 & 47	Brockielaw Hyndlee & Brockielaw Hyndlee Cottage	2.2 km	East/ North east	Semi-detached single storey dwelling located on the eastern side of the B6357 carriageway, on the north east extending shoulder of Fanna Rig, on the western side of the Hyndlee burn valley. These dwellings are located in an enclosed landscape with a short distance views bounded by the forested slopes of Brockie Law to the east, and the forested ridge that encloses the western side of the Hyndlee valley.	Views towards the proposed Development, whilst indicated in the ZTVs, are foreshortened by intervening topography and forest cover.	No views of the proposed Development are anticipated from these dwellings.	None.



HIGHLEE HILL WIND FARM

FIGURE AP2

TOPOGRAPHY

Key

- Proposed Turbines
- 3km Buffer from Outer Turbine
- Dwelling with Predicted Visibility Within 3km

Number of Turbines Visible at Blade Tip Level (150m and 176m)

- 1 - 3
- 4 - 6
- 7 - 9
- 10 - 12
- 13

1. The ZTV analysis does not take into account the screening effect of vegetation, buildings and other surface features
2. Predicted visibility based on a viewer eye height 2m above ground
3. Visibility calculated using Ordnance Survey Terrain 5 DTM on a 5m Grid
4. Effect of earth curvature and light refraction is included

LAYOUT DWG XXXXXDXXXX-XX	T-LAYOUT NO. PSCOhhi039

DRAWING NUMBER AP2

SCALE - 1:35,000 @ A3

ENVIRONMENTAL STATEMENT 2016

Technical Appendix 4.8: Borrow Pit Search Area Assessment

A series of five Borrow Pit Search Areas (BPSAs) has been identified, the location of which are indicated in Figure 2.1. The BPSAs were identified initially in locations identified as potentially suitable for winning stone for use in the construction of site access tracks and hardstandings associated with crane pads, laydown areas and compounds. However, at the time of the LVIA no detailed site investigations had been made to determine the precise quality or suitability of stone at each of the BPSAs and no detailed extraction footprint, working scheme or restoration proposals had been devised. Consequently, it is not possible to provide a detailed assessment of this element of the proposed Development. The focus of the following high-level assessment is to compare the BPSAs and to identify which of the BPSAs would have potential to cause significant landscape or visual effects. A number of previously considered BPSAs have already been omitted on the advice of environmental and technical considerations. Those remaining have been compared with reference to

- The extant Forestry Management Plan (Figure 1.4); and
- The Site layout, including infrastructure, as illustrated and described in Chapter 2 of the ES;

A number of assumptions have been made in respect of likely extraction and restoration proposals for any borrow pits at the site, including:

- the potential for the sympathetic design of any excavation profiles to avoid excessively deep voids or excessive scarring of the landscape;
- restoration of borrow pits as early as possible after the construction phase of the proposed Development to a low level with some exposed faces retained, but with roll-over slopes incorporated to reduce the extents of any exposed rock faces and to avoid the formation of anomalous edges on skylines;
- Restored pits would be replanted with suitable forest species, thereby reinstating forest production at each pit at the earliest practicable time.

Three basic scenarios have also been considered:

- The extraction of stone at a number of relatively small borrow pits throughout the application site to avoid the formation of large extraction voids;
- The use of a small number of larger borrow pits to concentrate disturbance to one or two specific locations; and
- The use of existing borrow pit that were formed to provide stone for the existing forest tracks on the site.

The table overleaf contains an assessment of the predicted effects of both the excavation and restoration of the BLSAs. From this assessment it is apparent that BPSAs B, D and E are the least problematic in landscape and visual terms and would represent the most local options to the main site access tracks, thereby avoiding lengthy haulage on site. In contrast, the existing borrow pits, whilst already disturbed, would be the most visible and would necessitate lengthy haulage of materials at the site. On the basis of the preceding analysis BPSAs B, D and E are considered to be preferable.

In terms of whether a single large borrow pit is excavated or whether several smaller excavations are utilised, it is considered advantageous to consider the development of B,D and E in order to avoid the necessity of a deep or expansive excavation and to provide materials as close to construction sites within the application site as possible.

Borrow Pit Search Area Ref.	Location (Grid Ref)	Description	Potential effects on Landscape Fabric and/or Landscape Character	Potential Visibility and Visual Effects	Cumulative Visibility	Potential Mitigation
B	361797 606833	Location on the north east facing forested slope of Wardmoor Hill (365m AOD) at an elevation of between 257m to 263m AOD and lies immediately adjacent to the main site access track allowing simple access.	No significant effects anticipated during either the excavation or restoration phases of the proposed Development. Any land clearance, alteration to landcover and topography would be associated with localised temporary loss of forest cover, formation of a temporary extraction void and final low level restoration with a modest exposed rock face. The restoration would be dominated by coniferous forest species in keeping with the adjacent landscape.	This BPSA would theoretically be visible from elevated locations to the north-east including Viewpoint 3 at Southdean Hill (2.6 km from the application site) and VP11_Chesters Brae. However, it is situated within an area defined in the current Forest Plan as a 'thinning area adjacent to a retained area of mature forestry,' that would effectively screen this BPSA. Consequently, visual effects would be minor to none and non-significant.	No discernible intervisibility with other BPSAs	Retention of adjoining areas of forest, careful control of extent of working areas, rapid restoration, including re-establishment of forest cover.
D	361110 605865	Location on the south east facing forested slope of Wardmoor Hill (365m AOD) at an elevation of between 309m and 318m AOD.	No significant effects anticipated during either the excavation or restoration phases of the proposed Development. Any land clearance, alteration to landcover and topography would be associated with localised temporary loss of forest cover, formation of a temporary extraction void and final low level restoration with a modest exposed rock face. The restoration would be dominated by coniferous forest species in keeping with the adjacent landscape.	Theoretical views are predicted from the north east - VP3_Southdean Hill (4.2 km to the NE). However, the BPSA lies within a 'thinning area' and would be largely screened behind retained forestry. Consequently, visual effects would be minor to none and non-significant.	No intervisibility with other BPSAs due to the screening effect of intervening forestry	Retention of adjoining areas of forest, careful control of extent of working areas, rapid restoration, including re-establishment of forest cover.
E	362018 606044	Location on the east extending bottom slope of the forested Wardmoor Hill, at an elevation of between 240m and 250m AOD and lies immediately adjacent to the main site access track allowing simple access.	No significant effects anticipated during either the excavation or restoration phases of the proposed Development. Any land clearance, alteration to landcover and topography would be associated with localised temporary loss of forest cover, formation of a temporary extraction void and final low level restoration with a modest exposed rock face. The restoration would be dominated by coniferous forest species in keeping with the adjacent landscape.	Theoretical views are predicted from the north east - VP3_Southdean Hill (4.2 km to the NE). However, this BPSA is situated within a 'no felling' zone, and would therefore be screened behind retained forestry. Consequently, visual effects would be minor to none and non-significant.	No intervisibility with other BPSAs due to the screening effect of intervening forestry	Retention of adjoining areas of forest, careful control of extent of working areas, rapid restoration, including re-establishment of forest cover.
Existing Site_1	359610 607568	Location on the steep north east facing forested slope of Wolfelee Hill (340m AOD), at an elevation of between 287m and 291m AOD and lies immediately adjacent to the existing access track allowing simple access.	This BPSA is located at an existing excavation. Consequently, there would be no significant effect on landscape fabric or character unless the pit was substantially extended.	Potential views into the site from the south facing slope of Wolfelee Hill (not from the summit) 900 m from the sit. As the BPSA is situated within the Phase 4 felling area (due for clearance in2018-22 – i.e. around the time of the construction of the proposed Development) views of this pit would be provided from the summit of Wolfelee Hill. This BPSA would also necessitate extended haulage of stone across the application site due to its location towards the westernmost end of the site. On this basis potential visual effects would be moderate/minor and non-significant.	In views from Wolfelee Hill simultaneous visibility with the neighbouring existing borrow pit (BPSA_2).	Retention of adjoining areas of forest or delay to their felling, careful control of extent of working areas, rapid restoration, including re-establishment of forest cover.
Existing	360423	Enclosed location at the head of	This BPSA is located at an existing	Potential views into the site from the south	In views from Wolfelee Hill	Retention of adjoining areas of

Site_2	607281	depression in between Wolfehopelee Hill and Wolfelee Hill, at an elevation of 320m AOD and lies immediately adjacent to the existing access track allowing simple access.	excavation. Consequently, there would be no significant effect on landscape fabric or character unless the pit was substantially extended.	facing slope of Wolfelee Hill (2.9 km to the north). Theoretically the views from the minor road, which extends along the western side of Wigg Burn to the north west of the site, could be possible. However, this BPSA lies within a 'no felling' zone, and would be screened behind retained forestry. Consequently there would be no significant visual effects associated with this BPSA.	simultaneous visibility with the neighbouring existing borrow pit (BPSA_1).	forest or delay to their felling, careful control of extent of working areas, rapid restoration, including re-establishment of forest cover.

MacArthur Green

Technical Appendix 5.1

Highlee Hill Wind Farm

Extended Phase 1 Habitat Survey

Prepared by: Andrew Rattey Date: 17th March 2014
Reviewed by: Rafe Dewar

Tel: 0141 221 6873
Web: www.macarthurgreen.com
Email: rafe.dewar@macarthurgreen.com
Address: 95 South Woodside Road, Glasgow, G20 6NT | Glasgow | G20 6NT

MacArthur Green

Contents

1. EXECUTIVE SUMMARY

MacArthur Green was commissioned by RES Ltd (RES) to complete an Extended Phase 1 Habitat Survey at the proposed Highlee Wind Farm (referred to as the "proposed wind farm site").

Surveying of a preliminary layout of the site was conducted on 25-26th April 2011, and following change to proposed wind farm layout, a subsequent survey was conducted in July 2013 to cover this additional area.

Results from both surveys showed that the site and survey area can be generally split into two sections comprising the extensive areas of conifer forestry plantation (A1.2.2) and clear felled (A4.2) areas in the south and eastern ends of the survey area, and the grassland dominated fields in the north. Additional habitats recorded within the open gaps and rides within the conifer plantation consist of predominantly un-improved neutral grassland (B2.1) and marshy grassland (B5), while wet modified bog (E1.7) and blanket bog (E1.6.1) was also recorded in isolated patches along several rides. The open habitat north of the conifer plantation is largely dominated by marshy grassland with improved grassland (B4) also a prominent feature of the open fields in the very northern edge of the survey area. The remaining grassland habitat across this area is comprised of two large patches of blanket bog, occasional patches of unimproved neutral and acid grassland (B1.2), and rare patches of semi-improved acid grassland (B1.2). The remaining habitat recorded across the survey area is generally limited to several isolated patches of broadleaved plantation (A1.1.2), continuous scrub (A2.1), and swamp (F1).

Three main watercourses were recorded within the survey area; the Jed Water, Peden's Cleuch, and the Fell Burn. Additional minor watercourses include the Black Burn, the Westershiels Burn, the Cleuch Burn and the White Burn.

Signs of any protected species were noted throughout the surveys. Otter presence was confirmed within the survey area, along with locally abundant amphibians (most notably palmate newt). Squirrels were also found to be present within the survey area, although it was not possible to determine whether signs found were from red or grey squirrels. Suitable habitats/features were also identified which would suggest the potential presence of great crested newts, bats, reptiles, and water voles, although no evidence of these species was recorded.

2. INTRODUCTION

MacArthur Green was commissioned by RES Ltd (RES) to undertake an Extended Phase 1 Habitat Survey (Ex. P1) at the proposed Highlee Wind Farm which lies adjacent to Highlee Hill near the village of Chesters, in the Scottish Borders (hereafter referred to as the "proposed wind farm site" - Figure 5.1).

The aim of the Ex. P1 was to detail those habitats present within the survey area together with any other features of ecological interest for which further survey work may be required in order to fully inform the ecological impact assessment of the proposed wind farm.

Surveying of a preliminary layout of the site was conducted on 25-26th April 2011, and following change to proposed wind farm layout, a subsequent survey was conducted in July 2013 to cover this additional area. Figure 5.1 shows the combined survey areas.

3. SITE AND SURVEY AREA

The survey area is where Ex. P1 surveys were carried out in 2011 and 2013 and covers all proposed wind farm infrastructure plus a suitable buffer, within the site. The site is situated on gently sloping and undulating upland and upland margin land 14 km SSW of Jedburgh and 14 km south-east of Hawick (approximate centre at Ordnance Survey grid reference NT 625 075). From its southern edge the site extends northwards over an extensive area of the Dykeraw forestry plantation. From here the site extends further north across the summit and slopes of Highlee Hill. The western edge of the site is bordered by plantation forestry and is close to the Cragbank Wood Nature Reserve which is protected under the designated Cragbank and Wolfehopelee Site of Special Scientific Interest (SSSI) and is part of Borders Woods Special Area of Conservation (SAC). The eastern site boundary is delineated by the Jed Water and a tributary of this named Black Burn (part of the River Tweed SAC).

4. METHODOLOGY

Field surveys were completed in accordance with standard Ex. P1 guidelines (JNCC, 2010) and involved surveyors completing a walkover of the survey area and recording the habitats present onto a 1:10,000 map. Linear and point features (such as fence lines and single trees) were also mapped. Ex. P1 is a standard technique for classifying and mapping British habitats, with the aim of providing an inventory of those areas of greatest ecological importance. Certain areas of habitat consist of complex mosaics with other distinct habitats. These mosaics could not be clearly assigned to a single Phase 1 category and, for the purposes of the current study, have instead been assigned to four distinct mosaic units within the survey area (shown on Figure 5.1).

In addition to the recording of habitats, all other features of ecological interest, especially those pertaining to the presence or likely presence of protected species were also noted via the inclusion of 'Target Notes' (TNs). Each TN includes a brief description of the feature together with a grid reference – additional information such as a diagram and/or photograph is also appropriate depending on the feature.

Higher plant identification and nomenclature follow Stace (2010).

5. SURVEY CONSTRAINTS

Surveys were carried out during a suitable time of year and in suitable weather conditions, with all vegetation in leaf and identifiable to species level. All areas of the survey area were accessible.

6. SURVEY RESULTS

The following habitats were recorded (in order of greatest coverage) during surveys in 2011 and 2013. A full botanical species list can be found within Appendix 4.

6.1 Habitats

Coniferous Plantation (A1.2.2)

Coniferous plantation is the dominant habitat type within the survey area and consists mainly of Sitka spruce *Picea sitchensis* and Norway spruce *Picea abies*, although European larch *Larix deciduas* is also present in places. No significant understorey exists in this habitat. There are small patches of broadleaved and mixed woodland found in certain locations alongside, and within, the rides running through the forestry plantation. Species in these small sections include common hawthorn *Crataegus monogyna*, European alder *Alnus glutinosa*, and goat willow *Salix caprea*.

Recently-felled Coniferous woodland (A4.2)

Recently-felled plantation is the next most abundant habitat within the survey area. While the majority of the habitat is typically species poor consisting mostly of dead conifer material, certain areas have a distinctly richer species composition with varying abundances of neutral grassland species including soft rush *Juncus effusus*, and tufted hair grass *Deschampsia cespitosa*. In addition, isolated broadleaved trees (mainly beech *Fagus sylvatica*) have been retained in certain areas along with patches of gorse *Ulex eropaeus*-dominated scrub (TN 14).

Marshy Grassland (B5)

Marshy grassland is the dominant habitat across the open ground along the summit and slopes of Highlee Hill in the central and northern end of the survey area. The habitat displays a distinct variation in species composition across its extent resulting in three distinct habitat variants recorded during the surveys. The first and most abundant habitat variant consists of a general dominance of rush species including soft rush and sharp-flowered rush *Juncus acutiflorus,* alongside frequent Yorkshire fog *Holcus lanatus*, tufted hair-grass, purple moorgrass *Molinia caerulea*, crested dog's-tail *Cynosurus cristatus*, sweet vernal grass *Anthoxanthum odoratum*, and common bent *Agrostis capillaris*. Additional vascular constants include marsh thistle *Cirsium palustre* and common sorrel *Rumex acetosa*, while herb associates include marsh marigold *Caltha palustris,* marsh cinquefoil *Potentilla palustris*, and marsh lousewort *Pedicularis palustris*. Certain areas of marshy grassland are characterised by an almost exclusive dominance of rush species with few other associates.

Another habitat variant consists of an almost exclusive dominance of purple moorgrass alongside occasional patches of tormentil *Potentilla erecta*, velvet bent *Agrostis canina*, soft rush, and star sedge *Carex echinata.* Additional vascular species restricted to rare patches include common heather *Calluna vulgaris*, hare's-tail cottongrass *Eriophorum vaginatum,* and cross-leaved heather *Erica tetralix*. The associated basal layer consists of a general dominance of *Sphagnum* mosses including *S. fallax* and *S. capillofolium*, and common hair-cap moss *Polytrichum commune*. Certain areas of this habitat variant are distinguished by drier conditions and the emergence of additional grass species including sweet vernal grass, Yorkshire fog, wavy hair-grass *Deschampsia flexuosa*, and mat grass *Nardus stricta*.

The final habitat variant consists of an almost exclusive dominance of meadowsweet *Filipendula ulmaria* alongside other marshy grassland associates including soft rush, sharp-flowered rush, and tufted hair-grass.

Neutral Grassland – Unimproved (B2.1)

Neutral grassland is moderately abundant across the survey area and forms the dominant habitat along the various forestry rides and sections of roadside verge throughout the Dykeraw plantation. Elsewhere the habitat is a prominent feature of the bankside vegetation along many of the watercourses, while it was also recorded in several large patches across the slopes and summit of Highlee Hill. The species composition of the habitat varies considerably across the survey area resulting in three distinct habitat variants. The first and most abundant habitat variant consists of a general dominance of tall tussocks of either soft rush or tufted hairgrass, with crested dog's tail grass, Yorkshire fog, and common bent also present to varying extents. The associated herb layer is species poor and is dominated by a mixture of creeping buttercup *Ranunculus repens* and white clover *Trifolium repens*. This habitat variant is the dominant grassland habitat within areas of clear fell and forestry ride within the Dykeraw plantation, but was also recorded in several isolated patches across the summit and slopes of Highlee Hill.

The second most abundant habitat variant consists of a tall grass sward dominated by false oat-grass *Arrhenatherum elatius,* with additional vascular associates consisting of Yorkshire fog, tufted hair-grass, and common bent. Although largely uniform in its vegetative composition, certain areas of this habitat variant are distinguished by a noticeable increase in species richness with additional species recorded including meadow sweet, Yorkshire fog, creeping soft grass *Holcus mollis*, greater bird's-foot trefoil *Lotus pedunculatus*, and creeping buttercup.

The final habitat variant is a short to medium height grassland consisting of abundant crested dog's-tail grass alongside frequent common bent, sweet vernal grass, Yorkshire fog, and mat grass. Additional vascular associates present to varying extents include tormentil, common daisy *Bellis perennis*, and common mouse-ear *Cerastium fontanum*. Certain areas of this habitat variant are distinguished by a much taller sward and emergence of additional species such as lesser knapweed *Centaurea nigra*, glaucous sedge *Carex flacca*, and meadow vetchling *Lathyrus pratensis*.

Across most of its extent the habitat is in a moderate condition with only moderate signs of grazing and disturbance. However the habitat recorded within the open areas across Highlee Hill has been subject to high levels of grazing, as evident in a much shorter sward height.

Improved Grassland (B4)

Improved grassland is absent across the majority of the survey area but is locally abundant across the open fields in the very northern end and also forms several small patches across the northern slopes of Highlee Hill. The habitat consists of a species-poor mixture of abundant perennial rye grass *Lolium perenne*, alongside varying amounts of crested dog's-tail and common bent. Certain areas of this habitat are distinguished by an almost exclusive dominance of perennial rye grass with few associates. The associated herb layer consists of scattered creeping buttercup and white clover.

This habitat is agriculturally improved and subject to high levels of grazing.

Acid Grassland – Semi-improved (B1.2)

Semi-improved acid grassland is restricted to a series of patches of varying size across the summit and slopes of Highlee Hill in the northern end of the survey area. Here the habitat also forms the dominant bankside vegetation along the White Burn and another small tributary. Elsewhere the community was recorded along sections of forestry ride and clear fell where it forms close associations with areas of neutral grassland and marshy grassland. The habitat consists of a mixture of common grasses including common bent, sheep's fescue *Festuca ovina,* and wavy hair-grass, over a herb layer comprised of dominant heath bedstraw *Galium saxatile.* Large areas of this habitat are distinguished by the emergence of more neutral grassland species such as Yorkshire fog and crested dog's-tail amongst the more typical acidic associates. The emergence of these neutral species reflects localised nutrient enrichment; most likely caused by droppings from local livestock.

The habitat as a whole is subject the varying levels of grazing pressure; this disturbance is most pronounced across the open ground around Highlee Hill.

Acid Grassland – Unimproved (B1.1)

Unimproved acid grassland is restricted to a series of large patches across the lower northern slopes of Highlee Hill in the northern end of the survey area. The habitat displays a considerable degree of variation in species richness, resulting in several distinct habitat variants recorded across the survey area. The majority of this variation stems from the varying dominance of several grass species including mat grass, heath rush *Juncus squarrosus*, and common bent. The remaining vegetation is largely uniform across most of the habitat and is comprised of a mixture of grasses including sheep's fescue, alongside frequent tormentil, heath bedstraw, heath woodrush *Luzula multiflora*, and common sorrel. The associated basal layer consists of a patchy carpet of step moss *Hylocomium splendens* and *Pleurozium schreberi*.

Wet Modified Bog (E1.7)

Wet modified bog is restricted to several sections of forestry ride in the south-eastern end of the survey area and was also recorded in one small patch in the eastern edge of the survey area. The species composition of the habitat varies little across its extent, consisting of a dominance of either hare's-tail cottongrass or purple moorgrass, alongside typical mire associates including wavy hair-grass, cross-leaved heath, and tormentil. Common heather was also recorded in isolated patches. The associated basal layer consists of a patchy carpet of *Sphagnum capillifolium, S. cuspidatum, S. palustre,* and common hair-cap moss.

Blanket Bog (E1.6.1)

Blanket bog is restricted to two large patches across the summit and slopes of Highlee Hill and several small sections of forestry ride in the south-eastern end of the survey area. There is a marked degree of variation in species richness across this habitat which is reflected in the varying abundances of the dominant vascular species. Hare's-tail cottongrass is a regular throughout the habitat but separate distinct areas are distinguished by local abundances of either deer grass *Trichophorum germanicum,* or common heather. Furthermore, certain areas of this habitat are characterised by an almost exclusive dominance of hare's-tail cottongrass. Additional vascular associates present to varying extents include purple moorgrass, common sedge *Carex nigra*, common cottongrass *Eriophorum angustifolium,* and bilberry *Vaccinium myrtillus*. The composition of the basal layer varies throughout but is mostly comprised of a mixture of *Sphagnum* mosses including *S. capillifolium* and *S. palustre*, and non-*Sphagnum* mosses including *Hypnum jutlanticum,* step moss, *Rhytidiadelphus loreus*, and common hair-cap moss. *Sphagnum papillosum* was also recorded at several isolated locations.

Flush and Spring: acid/neutral (E2.1)

Acid flush habitat is rare across the survey area, being restricted to several linear flushes within an area of blanket bog across the summit and slopes of Highlee Hill (TN 19). These features were not large enough to be mapped so are not included in the results figure (Figure 1) but are referenced within the target notes. The habitat has a consistent vegetative character consisting of a dominance of either soft rush or sharp-flowered rush, alongside varying amounts of purple moorgrass, sweet vernal grass, and wavy hair-grass. The associated basal layer consists of a mixture of *Sphagnum palustre*, *S. fallax*, and common hair-cap moss.

Wet heath (D2)

Wet heath is restricted to several small patches across the northern slopes of Highlee Hill. The habitat shows little variation in species composition across most of its extent, consisting of short swards of common heather alongside frequent cross-leaved heath, bilberry, tormentil, deer grass, purple moorgrass, and heath rush. Additional vascular associates present to varying extents include wavy hair-grass, sheep's fescue, mat grass, sweet vernal grass, common sedge, and common cottongrass. The basal layer is dominated largely by non-*Sphagnum* mosses including *H. jutlandicum, H. splendens,* and *P. schreberi* while *Sphagnum capillifolium* was also recorded in places. Certain areas of this habitat are distinguished by a short heather sward (5-10cm) alongside abundant heath rush. This particular habitat variant was found on areas of damp peaty soil in a few places in the open ground across the north-western end of the survey area.

Wet heath/acidic grassland mosaic (D6)

This habitat is restricted to a single patch across the southern slopes of Highlee Hill. The habitat consists of an overall dominance of heath rush alongside frequent patches of common heather. Additional species present to varying extents include bilberry, wavy hair-grass, and purple moorgrass. The basal layer is comprised of mixtures of *Sphagnum capillifolium* and step moss.

Other tall herb & Fern: Tall Ruderal (C3.1)

This habitat is very common within the Dykeraw forestry plantation but is mainly restricted to areas of recently felled plantation where, although abundant in places, it forms the sub-dominant habitat. As a result the habitat is not included in the results figure (figure 1). The habitat consists of tall swards of rosebay willowherb *Chamerion angustifolium*, alongside several other vascular associates including tufted hair-grass and Yorkshire fog. The habitat was also recorded in one solitary patch in the northern end of the plantation. Here the habitat consists of a dominance of creeping thistle *Cirsium arvense* alongside other species including common nettle *Urtica dioica*.

Swamp (F1)

This habitat is rare across the survey area but forms a large patch near the Southdean property, in the very northern edge of the survey area. Elsewhere the habitat was recorded in several patches of varying size along a section of the Jed Water in the centre of the survey area. These particular patches were too small to accurately map and so are not included in the results figure (Figure 1). The species composition of this habitat varies considerably across the survey area resulting in several distinct habitat variants. The first and the most botanically rich variant consists of a general dominace of greater tussock-sedge *Carex paniculata*, alongside frequent wild angelica *Angelica sylvestris,* soft rush, and tall fescue *Festuca arundinacea*. The remaining habitat variants are largely distinguished by their respective dominant species; these include lesser pond sedge *Carex acutiformis*, floating sweet grass *Glyceria fluitans*, and reed canary grass *Phalaris arundinacea*. The remaining associated vegetation in these habitat variants is comprised of species typical of the surrounding habitats.

Broadleaved Woodland – plantation (A1.1.2)

The habitat forms four separate patches of varying size within the Dykeraw forestry plantation, in the southern end of the survey area. Tree species recorded include grey willow *Salix cinerea*, birch *Betula* spp., alder*,* rowan *Sorbus aucuparia*, willow *Salix* spp., sycamore *Acer pseudoplatanus*, and beech. Each of the individual patches recorded across the survey area has a unique assemblage of the above tree species which results in each patch having a distinct species composition.

Continuous Scrub (A2.1)

Continuous scrub was recorded in several isolated patches within the open ground across the summit and slopes of Highlee Hill, in the northern section of the survey area. The habitat consists of a dense layer of gorse with few associates.

Semi-natural Broadleaved Woodland (A1.1.1)

This habitat is restricted to a single small patch along the banks of the Peden's Cleuch Burn within the Dykeraw forestry planatation. This patch was too small to map accurately and so is not included in the results figure (Figure 1). Here the habitat is associated with areas of continuous scrub and grassland habitats. The habitat has a canopy comprised of alder and ash *Fraxinus excelsior*, with a ground layer consisting of a mixture of grasses including tufted hair-grass and Yorkshire fog, and additional vascular associates including meadowsweet, water avens *Geum rivale,* and common sorrel. The associated herb layer consists of creeping buttercup and bugle *Ajuga reptans*.

Scattered Bracken (C1.1)

This habitat was recorded only once during the survey, in association with an area of neutral grassland and tall ruderals along a narrow section of forestry ride in the southern end of the survey area. The habitat is species-poor and consists of an almost exclusive dominance of bracken *Pteridium aquilinum*, alongside vegetative associates of the neighbouring habitats.

Dry dwarf shrub heath (D1.1)

Dry dwarf shrub heath is limited to one very small area on the eastern edge of the survey area (TN 29), adjacent to the Black Burn. It must be noted that this area of habitat was too small to map accurately and is therefore not shown on Figure 1. Common heather is dominant here, with varying levels of bilberry.

Running Water (G2)

There are four main burns within the survey area, the most prominent being the Jed Water running through the eastern section of the survey area (TNs 5 and 37). This watercourse intersects and drains the vast majority of the survey area and is around 5 m wide, with a depth up to 0.5 m. The burn lies over a substrate dominated by cobbles and boulders with bank vegetation consisting primarily of common grass species (e.g. Yorkshire fog and sweet vernal grass), meadowsweet, lesser celandine *Ranunculus ficaria*, rosebay willowherb, wild strawberry *Fragaria vesca*, and goat willow. Several scattered hawthorn trees were also recorded on the banks of the burn at one location. A section of the Jed Water lies within the River Tweed SAC, along the eastern edge of the survey area.

The Jed Water is fed by the Peden's Cleuch (TN 27) from the north-west. The burn is approximately 1m wide and 0.25m deep and is a typical lowland burn with a substrate of bedrock, cobbles, and gravel. The banks of the burn are around 0.5 m high with vegetation consisting of soft rush, meadowsweet and wood anemone *Anenome nemorosa*.

The Fell Burn is located near the eastern border of the survey area (TN 41) and feeds the Black Burn (which in turn feeds the Jed Water further north). The Fell Burn is small, averaging a width of around 1m and a depth of less than 0.5m. The substrate of the burn consists of cobbles and sand. The burn also has high banks that are dominated by soft rush and common grass species.

The White Burn is located in the very north-western end of the survey area and feeds into the Jed Water approximately 2km north of the survey area (TN 2). The White Burn is a moderate sized watercourse with a width of 1.5-2 m and depth of up to 0.5 m, a slow flow over a substrate of stone/silt, and vegetated banks.

Additional watercourses that feed into the Jed Water include the Black Burn (TN 23) that feeds it from the east, and the Westershiels Burn (TN 36) that feeds it from the west. The Black Burn is similar in dimensions to the Jed Water being approximately 1m wide and 0.25 m deep, while the Westershiels Burn is small, being approximately 0.5m wide and <0.5 m deep. The banks of both burns consist primarily of soft rush and common grasses. A section of the Black Burn lies within the River Tweed SAC, along the eastern edge of the survey area.

Additional minor watercourses discovered within the survey area are detailed within Target Notes 6-7, 9-11, 16, 18, 26, 28-29, and 34.

A system of drainage networks exist across the entire area of clear-fell and forestry. The largest of these drains exist alongside the forestry tracks. Drainage channels were also recorded across sections of the open ground around Highlee Hill (TNs 12 and 13). These drains eventually feed into many of the burns located around the survey area. Where mid-channel/bankside vegetation exists, it is largely dominated by soft rush.

Marginal Vegetation (F2.1)

Marginal vegetation is present along the majority of the watercourses within the survey area, extending out from the channel for a distance of up to 10m. Soft rush and common grasses are heavily dominant along the majority of the smaller burns noted in the survey. Marginal vegetation along the Jed Water is varied and includes large areas of meadowsweet, and tormentil. Additional species include wild strawberry, ladies mantle *Alchemilla vulgaris*, lesser celandine, germander speedwell *Polygala serpyllifolia*, and wood speedwell *Veronica montana.*

Standing Water (Oligotrophic) (G1.4)

There are several small bodies of standing water present across the survey area, the largest of which is located in the south section of the survey area, in a large disused quarry (TN 39). This body of water is approximately 40 X 20m in size and has no aquatic vegetation. There are three smaller ponds located nearby in the same quarry (TN 39). These features have a general size of around 5 X 5m and are permanent due to the aquatic vegetation present including pondweed *Potamogeton* spp. and reed mace *Typha latifolia.*

Another standing body of water is located in the northern section of the survey area in an area of clearfell (TN 22). This water body is 5 X 5 m in size and is a permanent feature since there is a moderate abundance of aquatic plant species including pondweed and duck weed *Lemna minor*. Three other small (5 X 5m) water bodies surround this feature. These are also permanent features due to their aquatic vegetation. Palmate newts *Lessotriton helveticus* were discovered at this location.

Approximately 400 m north east from this location is a medium sized (around 10 X 10 m, 1 m deep) body of standing water (TN 17). This is a permanent feature and shares similar vegetation to that of the pond in TN 15 with the addition of horsetail *Equisetum* spp.

A small body of water exists (5 X 10 m; <1 m deep) in the central area of the survey area (TN 32). This is a permanent feature having aquatic vegetation including pond weed and soft rush on the banks.

Another small pond is located in the southern area of the survey area (TN 35). This is a small (3 X 10 m, 1 m deep), permanent feature with aquatic vegetation including pondweed. Marginal vegetation includes soft rush, a horsetail species, a dock plant species *Rumex* spp., and goat willow.

Four other small bodies of standing water that each contain palmate newts are described in Target Notes 42, 31, 38, and 20. Three of these (TNs 31, 38, and 20) are small pools (1 X 1 m; <0.5 m deep). One pool resides in a small drain (TN 31), the other consists of a square watering hole near the Jed Water (TN 20), and the last lies within a water channel near the Jed Water (TN 38). The other pond is very small (0.5 X 0.5 m; 0.5 m deep) and consists of an old settlement lagoon alongside a section of track in the southern area of the survey area (TN 42). This is a permanent feature with aquatic vegetation and palmate newts.

Finally, one small (<5 m X 5 m) ephemeral pool exists beside an area of scrub in the centre of the survey area (TN 33). This pool has little aquatic vegetation. However, there was an abundance of tadpoles recorded at this location.

Quarry (I.2.1)

Two disused quarries are present within the survey area. The larger of the two is located on the western edge of the Dykeraw forestry plantation in the southern end of the survey area (TN 9). At the entrance to this quarry is a patch of scrub and scattered broadleaved trees consisting mainly of pioneer species (goat willow, gorse, cuckoo flower *Cardamine pratensis* and soft rush). This habitat was identified as having good potential for reptiles. This quarry also contains three ponds as described above and in TN 39.

The smaller of the two quarries lies within the open fields across the summit of Highlee Hill and is approximately 0.15 ha in size. Surrounding vegetation consists of extensive marshy grassland.

Built up areas (J3)

This category was assigned to any buildings, associated gardens, and areas of forestry track or road recorded within the survey area.

Arable (J1.1)

Arable land is restricted to a single large open field in the very northern end of the survey area.

6.2 Faunal Interest

Faunal interest was recorded through the identification of signs of animal presence e.g. sightings, tracks, droppings etc., together with potentially suitable habitats. In each case, this interest was target noted, with a grid reference and photograph taken as appropriate.

The following points were noted during the Ex.P1:

Badger

No evidence of badger *Meles meles* was confirmed from the survey area. The Dykeraw forestry plantation has a predominantly peat-based soil which is generally sub-optimal for badger setts. However, the forest rides may offer potential commuting routes and both rides and areas of clear-fell could offer moderate foraging potential. The ground across Highlee Hill is more suitable for badgers with a predominantly mineral based soil and a mixture of open and forested patches offering suitable foraging opportunities.

Bats

No evidence of bat presence was confirmed within the survey area during the surveys; however, a number of potentially suitable bat roosting habitats were identified. Suitable bat roost habitat recorded includes a series of metal barns (TN 3) and a separate corrugated shed (TN 4), both located within the open fields in the very northern end of the survey area. Elsewhere, scattered mature broadleaved trees (mainly beech) offer similar bat roost potential (TNs 1, 8, and 14), while a series of broadleaved trees near the Westshiels ruin (TN 40) offer moderate bat roost potential.

It is likely that bat species will use the survey area for foraging, given the habitat mosaic presence (i.e. numerous edge features created by the felled/clearfelled habitats).

Red Squirrel

Squirrel-bitten cones were identified at several locations across the conifer plantation within the survey area (TNs 15 and 43). Although there is a lack of Scots pine within the plantation there is an abundance of Norway and Sitka spruce which may provide a suitable food source for red squirrels *Sciurus vulgaris*. Sitka spruce is generally unsuitable for red squirrel as the species has a ‘low’ carrying capacity, between 0.00 and 0.11 squirrels per hectare (Gurnell *et al,* 2009) and has an unpredictable coning cycle and low average seed energy value compared to other tree species. Furthermore, the trees shed their cones in the first 4 months after maturing in September restricting red squirrel food supply (Gurnell *et al*., 2009; Poulsom *et al*., 2005). However, the mixture of Sitka spruce and Norway spruce could provide a more reliable coning cycle which may help support a population of squirrels. It is generally very difficult to distinguish between grey squirrel *Sciurus carolinensis* and red squirrels in the field, with additional survey work and analysis being required to do so.

Otter

Signs of otter *Lutra lutra* were recorded during the Ex. P1 at several locations along the Jed Water (TNs 21, 24 and 37). Along with the Peden's Cleuch and Black Burn, the Jed Water is considered suitable to support a foraging population, given the food supply (salmonids) observed (TN 37). Additional watercourses that were assessed to be suitable for foraging and commuting otters include the White Burn and the Cleuch Burn (TNs 2, 6, and 11).

Water Vole

No water vole *Arvicola amphibious* evidence was recorded within the survey area, although areas of limited suitable habitat were identified within the survey area along several of the recorded burns (TNs 2, 5-6, 10-11, 28, and 29), and a vegetated drainage ditch (TN 13), in the open northern end of the survey area. These areas are suitable due to the abundant food source (rushes) together with a moderately suitable burrowing substrate. However, these burns are subject to high levels of disturbance both from farming activity and trampling from cattle, which renders them generally unsuitable for the species.

The remaining watercourses, including all of those within the forestry, were generally unsuitable for water vole due to a combination of sub-optimal channel characteristics (some are too wide while others are too narrow), unsuitable bank characteristics (banks are very steep in places, and often with a stone-based substrate), and a general lack of aquatic vegetation in many places.

Amphibians

Palmate newts were recorded in several of the ponds discovered during the field survey (TNs 20, 22, 31, and 42) and it was considered possible that both smooth newt and great crested newt *Triturus cristatus* are present here also given the nature of the habitat (i.e. a well-developed pond network within suitable terrestrial habitat). Evidence of further amphibian species (most likely common frog *Rana temporaria* and toad *Bufo bufo*) was observed through the recording of tadpoles in most of the ponds within the survey area.

Great crested newt

A great crested newt Habitat Suitability Index (HSI) analysis was conducted following identification of potentially suitable habitat within the survey area. This analysis resulted in an average HSI score of 0.7 across four particular ponds. Within the Amphibian and Reptile Group for the United Kingdom (ARG UK[1]) guidance, a score of 0.7 indicates good suitability for great crested newts. The rest of the ponds analysed fell under the categories of average and below average for suitability. The results from the full HSI analysis can be found within Appendix 3.

Reptiles

Two areas of suitable habitat for reptiles were identified during the field survey, with the largest being the dry heath that borders the Black Burn in the eastern section of the survey area (TN 30). This habitat has an abundance of heather, offering suitable shelter and foraging ground for reptiles. The other area of suitable habitat lies at the entrance to the large quarry described in TN 39 where a mosaic of open rock and pioneer vegetation has created a suitable foraging/shelter resource for reptiles. In addition, it is likely that the reptiles have/will spread into the clear-felled areas, with similar levels of cover/foraging habitat present in places here.

Birds

Although covered under a separate ornithological report, the following notable incidental bird records were made during this survey:

- Cuckoo
- Crossbill sp.

[1] * *ARG UK Advice Note 5: Great Crested Newt Habitat Suitability Index — 1*

7. SUMMARY

In general, the habitats within the survey area are of varying ecological value with the conifer forestry and associated areas of clearfelled plantation being of generally low ecological value. The conifer plantation is broken up by strips of marginal vegetation along the numerous burns that intersect the survey area while there are also sparse pockets of semi-improved and unimproved grassland, and patches of wet modified bog and dry heath in places. Other notable features across this general area are the abundance of small bodies of standing water and swamp, the disused quarry, and locally frequent mature broadleaved trees.

The open ground across the summit and slopes of Highlee Hill is of relatively higher ecological value due to the extensive areas of species-rich marshy grassland and patches of blanket bog. Additional habitats recorded across this general area include semi-improved and un-improved acid and neutral grassland, as well as several pockets of improved grassland. At the northern edge of the survey area the ground is generally dominated by improved grassland which is of low ecological value. However, a large stand of swamp vegetation was also recorded near the Southdean property in this area and is of higher ecological value.

The watercourses within the survey area would appear to offer suitable foraging and migration routes for otters, in particular the Jed Water, Peden's Cleuch, and Black Burn, with several otter signs discovered along the Jed Water. The White Burn and the Cleuch Burn were also assessed to offer suitable foraging and commuting habitat.

Although no evidence of water vole presence within the survey area was recorded, a number of moderately suitable areas (mainly vegetated drainage ditches) were identified where there was an abundant food resource (rushes) together with a reasonably suitable substrate for burrowing.

A number of potentially suitable bat roost habitats were identified during the surveys. These include
a series of metal barns and corrugated shed in the northern part of the survey area, as well as a number of scattered mature broadleaved trees (mainly beech) in certain locations including the Westshiels ruin. It is likely that bat species will use the survey area for foraging, given the habitat mosaic presence (i.e. numerous edge features created by the felled/clearfelled habitats).

Signs of squirrel presence were noted at two separate locations in forestry within the survey area. The forested areas of the survey area were assessed as being of moderate ecological value affording a suitable food source and commuting routes. As detailed previously, it is generally not possible to distinguish between red and grey squirrels in the field.

The ponds within the survey area were seen to support a healthy newt population, with numerous palmate newts observed. It is likely that smooth newts will also be present, whilst the great crested newt HSI identified a habitat suitable for supporting great crested newts, although no evidence was recorded.

Suitable habitat for reptiles was identified within the survey area and it is likely that some species are present here.

The open habitat across Highlee Hill appears to be suitable for badgers, with a predominantly mineral based soil and mixture of open and forested patches offering foraging opportunities. Furthermore areas of scrub and woodland in this area will provide cover where necessary. Although the majority of the forestry and clear-fell habitats within the Dykeraw forestry plantation appear unsuitable for badgers, the forest rides may provide commuting routes and both the rides and areas of clear fell may offer some limited foraging potential.

8. REFERENCES

Amphibian and Reptile Groups of the United Kingdom, 2010. *ARG UK Advice Note 5: Great Crested Newt Habitat Suitability Index – 1.* ARG.

Joint Nature Conservancy Council, 1990. *Handbook for phase 1 habitat survey – a technique for environmental audit*. Revised reprint 2003. JNCC

Rose, F. (1981). *A Wild Flower Key, for the British Isles and North West Europe*. Revised reprint 2006. Warne, London.

Stace, C., 1995. *New Flora of the British Isles* (2nd Edition), Cambridge University Press.

APPENDIX 1 – TARGET NOTES

Target note No.	Grid reference	Description	Photo
1	NT 62520 09880	Scots Pine dominated woodland with hawthorn *Crataegus monogyna* and understorey of cock's foot grass *Dactylis glomerata,* nettles, tufted hair-grass *Deschampsia cespitosa*, and ferns. Some bat potential.	1
2	NT 62642 09856	White Burn watercourse, 1.5-2m wide, slow flow rate at time of survey, stone/silt substrate, vegetation on either bank, up to 0.5m deep. Some good habitat potential for water vole and otter.	
3	NT 62630 09720	Two metal barns used for storing feed and bales of hay. Features were assessed as having low bat roost potential.	2a-b
4	NT 62700 09700	Grazed field with *D. glomerata*, spear thistle *Cirsium vulgare*, white clover *Trifolium repens*, wavy hair-grass *Deschampsia flexuosa*, low sward height. Hawthorn bushes along SW boundary. Also has corrugated shed within the field which looks unused - possible bat roost potential.	
5	NT 62800 09620	River known as the Jed Water runs along field boundary, 3-4m wide, fast flowing, grassy vegetation either side with hawthorn trees, sandy/stony substrate. Potential for water vole and otter.	
6	NT 62750 09375	Watercourse known as the Cleuch Burn running along field boudaries with stony substrate with heavy vegetation including nettles, cow parsley *Anthriscus sylvestris* and marsh thistle *Cirsium palustre*. Potential for Water Vole and Otter.	4
7	NT 62508 09351	Watercourse between field boundaries, overgrown vegetation with cow parsley, tufted hair-grass, nettles, hawthorn bushes and mixed broadleaved trees. Watercourse dried up at time of survey.	
8	NT 62400 09150	Mixed trees including Scots pine *Pinus sylvestris*, Douglas fir *Pseudotsuga menziesii* and beech *Fagus sylvatica* next to farmhouse. Potential for bat activity.	3
9	NT 61514 09047	Watercourse with slow waterflow. Overgrown vegetation including soft rush *Juncus effusus*, tufted hair-grass and meadowsweet *Filipendula ulmaria*.	
10	NT 61279 08963	Watercourse 0.25m to 0.3m wide although at times the embankments almost enclose over the top of the watercourse. Constant flow rate. Combination of soil/clay/stoney substrate. Marshy vegetation with soft rush, Yorkshire fog *Holcus lanatus* and meadowsweet. Potential for water vole.	
11	NT 62460 08820	Watercourse known as Cleuch Burn continues through gorge with slow flow rate, heavy vegetation either side, burn up to 0.5m in width with stony substrate, potential for otter and water vole.	
12	NT 62370 08791	Drainage channel through woodland, overgrown and dried out in places with rushy/grassland vegetation.	
13	NT 62177 08735	Drainage ditch with potential for water vole.	
14	NT 62670 08500	Series of mature beech trees. Minimal bat potential. Advised to be retained.	
15	NT 62556 08424	Old squirrel predated cones.	
16	NT 61114 08355	Watercourse with static pools of water with heavy vegetation growth, particularly rush species. Low probability of protected species.	5
17	NT 62460 08184	Standing body of water (15X15m; max depth - 2m). Permanent feature. Vegetation similar to that found at TN 22.	6
18	NT 62128 08113	Watercourse overgrown with static water. Some protected species potential.	
19	NT 61920 08040	Grazed field with sharp-flowered rush *Juncus acutiflorus* and some soft rush and patches of purple moorgrass *Molinia caerulea*. Evidence of neutral flushes with the abundance of rush spp. but with low moss cover.	
20	NT 63633 07947	Square watering hole (1X1m). Abundance of palmate newts.	
21	NT 63551 07917	Otter slide on bank of Jed water.	7
22	NT 62168 07887	Four ponds in small area (3 small and 1 large). Size varies between 5 X 5m for small and 10 X 25m for the Largest pond. Aquatic vegetation present includes pondweed and duck weed *Lemnaceae lemnaminor*. Marginal vegetation includes soft rush, cuckoo flower *Cardamine pratensis*, meadow buttercup *Ranunculus acris*, and reed mace *Thypha* spp. Abundance of invertebrates. Palmate newts present.	18a-b
23	NT 63738 07847	The Black burn. Small burn (<1m wide; <0.5m deep) with high banks. Substrate consists of cobbles and sand. Fairly swift flow. Bank vegetation dominated by soft rush and common grasses. Burn feeds into the Jed water.	
24	NT 63329 07817	Otter prints on sandbar along Jed water.	8
25	NT 61280 07780	Corridor of heavily grazed ground running between two water courses. Combination of dry dwarf shrub heath and dry modified bog with hare's-tail cottongrass *Eriophorum vaginatum*, common heather *Calluna vulgaris*, bell heather *Erica cinerea*, and bilberry *Vaccinium myrtillus*.	
26	NT 61790 07580	Watercourse with static water. Up to 0.3m width. Overgrown vegetation including abundant sharp-flowered rush.	
27	NT 62045 07434	Peden's Cleuch Burn (1m wide; 50cm high banks; 25cm deep). Typical lowland burn. Substrate consists of beckrock, cobbles and gravel. Banks of soft rush, meadow sweet, nettles, and wood anenome *Anenome nemorosa*. Decent potential for Otter. Fish (Parr) present on river. Banks of bedrock or clay material sub-optimal for Water vole.	9
28	NT 61750 07350	Watercourse between 0.3 to 0.5m in width, with steady flow rate, stone substrate, and embankments with abundant soft rush. Moderate probability of protected species being present.	

Target note No.	Grid reference	Description	Photo
29	NT 61396 07339	Watercourse up to 0.3m in width, overgrown with abundant marshy vegetation including sharp-flowered rush and tufted hair-grass. Potential for water vole.	
30	NT 64246 07023	Nice area of dry heath. Suitable area for reptiles.	
31	NT 63462 07049	Small pool (1X1m; <0.5m deep) sitting in section of small drain. Marginal vegetation - soft rush. Tadpoles and palmate newts present.	10
32	NT 60925 06973	Small body of water (5X10m; <1m deep). Permanent feature. Aquatic vegetation includes pond weed *Potamogeten* spp*.* Marginal vegetation dominated by soft rush. Moderate ecological interest.	11
33	NT 60869 06869	Small area of Scrub with species including common gorse *Ulex europaeus*, conifers and goat willow. Adjacent area of wetland with small ephemeral pool (<5m wide, 5m long). Little aquatic vegetation present. Abundance of invertebrates and tadpoles. Marginal vegetation includes soft rush.	
34	NT 62053 06711	Small minor burn running under track with small flow. Moderate ecological interest. Width is 0.5m and depth is 0.15m. Banks of soft rush. Potential for water voles low.	
35	NT 61503 06630	Small pond (3X10m; 1-2m deep). Permanent feature. Aquatic vegetation includes pondweed. Marginal vegetation consists of soft rush, horestail grass species *equisetum sp*., a dock Plant species *rumex sp.* and goat willow *Salix caprea*.	12
36	NT 62322 06534	Westshields burn. Small in size, approximately 0.5m wide and <0.5m deep. The banks consist primarily of soft rush and common grasses.	
37	NT 62629 06532	The Jed water (5m wide; <0.5m deep). Substrate consists of cobbles/boulders, with sandy/muddy banks. Burn has a variable flow and depth. Bank vegetation includes common grasses, meadow sweet, lesser celandine *Ranunculus ficaria*, rosebay willowherb *Chamerion angustifolium*, dock plant *Rumex* spp., wild strawberry *Fragaria vesca* and goat willow. Otter spraints found on Jed water. In addition *Salmo* spp parr spotted along burn.	13
38	NT 62601 06500	L shaped channel of water near Jed water. Mostly infilled with reed mace, common grasses and soft rush. One area of clear water present (1 X 1m; 1-2m deep). Aquatic vegetation present includes pond weed. Newts present.	14
39	NT 60940 06484	Old disused quarry. Suitable habitat for reptiles. Abundance of pioneer sp. including goat willow, gorse, Norway spruce, cuckoo flower, and soft rush. Series of 3 ponds in disused quarry. Permanent features. Two ponds of high ecological value with average size of 5-10 X 5-10m. Aquatic vegetation - old pondweed and reed mace. Newts present in one pond. Third pond consists of a large pool of water (50 X 50m) and has minimal ecological value.	15a-c
40	NT 62249 06478	Westshields. Old ruin of house. Fairly high bat roost potential in building and surrounding mature broadleaved trees. Mature broadleaved trees consist of beech, sycamore *Acer pseudoplatanus* and scattered silver birch *Betula pendulans.* There is a stand of mature birch trees nearby with moderate bat roost potential. Advised to retain.	16a-b
41	NT 63835 06136	The Fell burn. Small burn (1m wide; <0.5m deep) with high banks. Subsrate consists of cobbles and sand. Fairly swift flow. Bank vegetation includes soft rush and common grasses. Several drains from clear fell area feed into this burn.	17
42	NT 61168 05773	Old settlement lagoon that has developed into a young pond (0.5 X 0.5m; 0.5m deep). Permanent feature (aquatic vegetation and a supply of water from nearby drain). Abundance of invertebrates and palmate newts.	6
43	NT 61145 05528	Squirrel predated cones.	5

APPENDIX 2 – SITE PHOTOGRAPHS

Photo ref 1) Area of Scot's pine dominated woodland with hawthorn tree that was assed to have bat potential (TN 1).

Photo ref 2a) Metal barn which was assessed as having low bat roost potential (TN 3).

Photo ref 2b) Metal barn which was assessed as having low bat roost potential (TN 3)

Photo ref 3) Series of mixed broadleaved trees assessed as having bat roost potential (TN 8)

Photo ref 4) Section of the Cleuch Burn (TN 6)

Photo ref 5) Section of un-named watercourse (TN 16)

Photo ref 6) Small permanent body of standing water. Abundant aquatic vegetation (TN 17)

Photo ref: 7) Otter slide on bank of Jed Water (TN 21)

Photo ref 8) Fresh otter prints on sandbank along Jed Water (TN 24)

Photo ref 9) The Peden's Cleuch Burn. Typical lowland burn with moderate otter potential (TN 27)

Photo ref 10) Small pool sitting in section of small drain. Tadpoles and palmate newts present (TN 31)

Photo ref 11) Small body of water. Permanent feature with aquatic vegetation (TN 32)

Photo ref 12) Small permanent pool in middle of site. Abundant aquatic vegetation present (TN 35)

Photo ref 13) Section of the Jed Water (TN 37)

Photo ref 14) Small pool in a channel of water adjacent to the Jed Water. Abundant aquatic vegetation and newts present (TN 38)

Photo ref 15a) Large disused quarry. Several small bodies of water and suitable reptile habitat, with abundant pioneer plant species (TN 39)

Photo ref 15b) Small pool No. 2 in disused quarry (TN 39)

Photo ref 15c) Large body of water in disused quarry. No aquatic vegetation (TN 39)

Photo ref 16a) Westshiels ruin. Potential for bat roost in building with mature broadleaved trees adjacent. (TN 40)

Photo ref 16b) Stand of mature beech trees near Westshiels ruin. Moderate bat roost potential (TN 40)

Photo ref 17) Section of the Fell Burn (TN 41)

Photo ref: 18a) One of several small pools recorded in an area of clear fell. Moderate aquatic vegetation; palmate newts present (TN 22)

Photo ref: 18b) Larger pool. Abundant aquatic vegetation (TN 22)

APPENDIX 3 – GREAT CRESTED NEWT HABITAT SUITABILITY INDEX

Pond N	Grid Reference	Map location	Pond area	Permanence	Water quality	% shaded	Water fowl	Fish	No. nearby ponds	terrestrial habitat	% pond surface veg	HSI score	Pond suitability
1	NT 62460 08184	0.5	0.4	1	0.67	1	1	1	0.65	1	1	0.78	Good
2	NT 62168 07887	0.5	0.05	1	0.67	1	1	1	0.65	1	0.8	0.62	Average
3	NT 62168 07887	0.5	0.05	1	0.67	1	1	1	0.65	1	0.4	0.58	Below average
4	NT 62168 07887	0.5	0.05	1	0.67	1	1	1	0.65	1	0.35	0.57	Below average
5	NT 62168 07887	0.5	0.45	0.9	0.67	1	1	1	0.65	1	0.9	0.776	Good
6	NT 60925 06973	0.5	0.1	1	0.67	1	1	1	0.825	1	1	0.698	Good
7	NT 60524 07331	0.5	0.05	0.5	0.33	1	1	1	0.825	0.67	0.3	0.48	Poor
8	NT 60940 06484	0.5	0.1	1	0.67	1	1	1	1	1	1	0.71	Good
9	NT 60940 06484	0.5	0.1	0.5	0.67	1	1	1	1	1	0.6	0.63	Average

APPENDIX 4 – BOTANICAL SPECIES LIST

Common name	Latin
Beech	*Fagus slyvatica*
Bell heather	*Erica cinerea*
Bilberry	*Vaccinium myrtillus*
Birch	*Betula spp.*
Bird's foot trefoil	*Lotus pedunculatus*
Bog moss	*Sphagnum capillifolium*
Bog moss	*Sphagnum palustre*
Bog moss	*Sphagnum cuspidatum*
Bog moss	*Sphagnum papillosum*
Bracken	*Pteridium aquilinum*
Bugle	*Ajuga reptans*
Cock's-foot grass	*Dactylis glomerata*
Common bent	*Agrostis capillaris*
Common cottongrass	*Eriophorum angustifolium*
Common daisy	*Bellis perennis*
Common hair-cap moss	*Polytrichum commune*
Common heather	*Calluna vulgaris*
Common mouse-ear	*Cerastium fontanum*
Common nettle	*Urtica dioica*
Common sorrel	*Rumex acetosa*
Cow parsley	*Anthriscus sylvestris*
Creeping buttercup	*Ranunculus repens*
Creeping soft grass	*Holcus mollis*
Creeping thistle	*Cirsium arvense*
Crested dog's-tail	*Cynosurus cristatus*
Cross-leaved heath	*Erica tetralix*
Cuckoo flower	*Cardamine pratensis*
Deer grass	*Trichophorum germanicum*
Dock spp.	*Rumex* spp.
Douglas fir	*Pseudotsuga menziesii*
Duck weed	*Lemna minor*
European alder	*Alnus glutinosa*
False oat grass	*Arrhenatherum elatius*
Floating sweet grass	*Glyceria fluitans*
Germander speedwell	*Polygala serpyllifolia*
Goat willow	*Salex caprea*
Gorse	*Ulex europaeus*
Greater tussock sedge	*Carex paniculata*
Grey willow	*Salix cinerea*

Common name	Latin
Hare's-tail cottongrass	*Eriophorum vaginatum*
Hawthorn	*Crataegus monogyna*
Heath bedstraw	*Galium saxatile*
Heath rush	*Juncus squarrosus*
Heath woodrush	*Luzula multiflora*
Horsetail	*Equisetum* spp.
Ladies mantle	*Alchemilla vulgaris*
Lesser celandine	*Ranunculus ficaria*
Lesser knapweed	*Centaurea nigra*
lesser pond sedge	*Carex acutiformis*
Marsh cinquefoil	*Potentilla palustris*
Marsh lousewort	*Pedicularis palustris*
Marsh marigold	*Caltha palustris*
Marsh thistle	*Cirsium palustre*
Mat grass	*Nardus stricta*
Meadowsweet	*Filipendula ulmaria*
Moss	*Hypnum jutlandicum*
Moss	*Pleurozium schreberi*
Moss	*Rhytidiadelphus loreus*
Norway spruce	*Picea abies*
Perennial rye grass	*Lolium perenne*
Pondweed	*Potomageten spp.*
Purple moorgrass	*Molinia caerulea*
Reed canary grass	*Phalaris arundinacea*
Reed mace	*Typha latifolia*
Rosebay willowherb	*Chamerion angustifolium*
Rowan	*Sorbus aucuparia*
Sharp-flowered rush	*Juncus acutiflorus*
Sheeps fescue	*Festuca ovina*
Sitka spruce	*Picea sitchensis*
Soft rush	*Juncus effusus*
Spear thistle	*Cirsium vulgare*
Step moss	*Hylocomium splendens*
Sweet vernal grass	*Anthoxanthum odoratum*
Sycamore	*Acer pseudoplatanus*
Tall fescue	*Festuca arundinacea*
Tormentil	*Potentilla erecta*
Tufted hair-grass	*Deschampsia cespitosa*
Velvet bent	*Agrostis canina*
Water avens	*Geum rivale*
Wavy hair-grass	*Deschampsia flexuosa*
White clover	*Trifolium repens*

Common name	Latin
Wild angelica	*Angelica sylvestris*
Wild strawberry	*Fragaria vesca*
Wood anenome	*Anenome nemorosa*
Wood speedwell	*Veronica montana*
Yorkshire fog	*Holcus lanatus*

Technical Appendix 5.2

Highlee Hill Wind Farm

National Vegetation Classification Survey

Prepared by: Ben Averis
Reviewed by: Rafe Dewar

Date: 29/02/2016

Tel: 0141 342 5404
Email: rafe.dewar@macarthurgreen.com
Web: www.macarthurgreen.com
Address: 95 South Woodside Road | Glasgow | G20 6NT

Document Quality Record

Revision	Date	Originator	Checker	Approved	Status
Draft	29/02/2016	BA	AR	RD	Client Review
0					First Revision
01					Second Revision
02					Third Revision

VEGETATION SURVEY OF PROPOSED WIND FARM SITE AT HIGHLEE HILL, SCOTTISH BORDERS, AUGUST 2013

Ben Averis
6 Stonelaws Cottages, East Linton, East Lothian EH40 3DX
Tel: 01620 870 280 / 07767 058 322
E-mail: benandalisonaveris@tiscali.co.uk
www.benandalisonaveris.co.uk

September 2013

A survey commissioned by RES Ltd

3rd Floor, STV Building, Pacific Quay, Glasgow, G51 1PQ

http://www.res-group.com/

CONTENTS

1 INTRODUCTION

This survey was commissioned by RES Ltd in order to map the vegetation communities present at the proposed Highlee Hill Wind Farm (hereafter referred to as 'the proposed wind farm') in the Scottish Borders. The proposed wind farm is situated on gently sloping and undulating upland and upland margin land 14 km SSW of Jedburgh and 14 km south-east of Hawick (approximate centre at Ordnance Survey grid reference NT 625 075.

The southern half and the east-central part of the site are conifer plantation, and the remainder is open farmland. The conifer plantation makes up about two thirds of the site and includes mature spruce plantings and many recently felled areas, some of which have been replanted with spruce. As well as the felled areas there are many narrow open rides and other very narrow open areas along the sides of forest roads. There are also some long and narrow unplanted areas along the courses of streams running through the plantation. The open farmland varies from unimproved, cattle-grazed rush pasture to brighter green, uniform-looking agriculturally-improved swards of rye-grass (and one arable field in the far north). A few small conifer blocks are scattered among the farmland in the north of the site. The bedrock is all sedimentary: it belongs mainly to the Wenlock series of Silurian age, but also includes some Devonian Upper Old Red Sandstone and, in the SE, rocks in the Carboniferous Limestone series (British Geological Survey 1979).

2 METHODS

The fieldwork for this survey was carried out on 28th and 29th August 2013.

The vegetation was classified using the National Vegetation Classification (NVC) (Rodwell 1991 *et seq.*), to NVC sub-community level wherever possible. In many places it was mapped to community level because the vegetation was too species-poor or patches were too small to allow meaningful sub-community determination, or it showed features of two or more sub-communities.

Some areas of vegetation do not fit into any NVC community and were therefore classified and mapped as separate (non-NVC) types: CP (conifer plantation); YCP (young conifer plantation); YBP (young broadleaved plantation); Beech (small patch of mature beech); FC (felled conifers); Je (abundant *Juncus effusus* among an 'acid grassland' associated flora); Ja1 (abundant *J. acutiflorus* among an 'acid grassland' associated flora); Ja2 (abundant *J. acutiflorus* among a 'wet heath' type of associated flora); U6H (abundant *J. squarrosus* and *Calluna*); Arable. One small area of willow woodland in a wet valley bottom was labelled WW (wet woodland) because difficulties of physical access prevented a close enough look to allow NVC determination.

A few 'non-vegetation' habitats were also mapped: BG (bare ground/building/road/quarry), and SW (standing water).

Complex mosaics of two or more habitats were mapped as mosaic polygons with an estimated percentage cover value for each type.

The mapping was done onto ortho-rectified aerial photographs overlain with an OS 100 m grid; these aerial photos were supplied by MacArthur Green.

Botanical nomenclature in this report follows that of Stace (2010) for vascular plants, Atherton *et al* (2010) for bryophytes and Purvis *et al* (1992) for lichens.

3 DESCRIPTIONS OF VEGETATION AND HABITAT TYPES RECORDED IN THIS SURVEY

45 types of vegetation and habitat were recorded in this survey. They are listed in Table 1 and described on the following pages. Quadrat samples of many vegetation types are given in Appendix 1. Photographs of examples of the main vegetation types are given in Appendix 2. The NVC maps are in Appendix 3.

Table 1 Vegetation and habitat types recorded by Ben Averis in vegetation survey at the proposed wind farm in August 2013 (also shown in Figure 5.2).

W7 *Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland
W23 *Ulex europaeus-Rubus fruticosus* agg. scrub
M6c *Carex echinata-Sphagnum fallax/denticulatum* mire, *Juncus effusus* sub-community
M6d *Carex echinata-Sphagnum fallax/denticulatum* mire, *Juncus acutiflorus* sub-community
M15d *Trichophorum germanicum-Erica tetralix* wet heath, *Vaccinium myrtillus* sub-community
M17a *Trichophorum germanicum-Eriophorum vaginatum* blanket mire, *Drosera rotundifolia-Sphagnum* sub-community
M19a *Calluna vulgaris-Eriophorum vaginatum* blanket mire, *Erica tetralix* sub-community
M20 *Eriophorum vaginatum* blanket & raised mire
M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus acutiflorus* sub-community
M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus effusus* sub-community
M25a *Molinia caerulea-Potentilla erecta* mire, *Erica tetralix* sub-community
M25b *Molinia caerulea-Potentilla erecta* mire, *Anthoxanthum odoratum* sub-community
M27 *Filipendula ulmaria-Angelica sylvestris* tall-herb fen
MG1 *Arrhenatherum elatius* coarse grassland, *Festuca rubra* sub-community
MG2 *Filipendula ulmaria-Arrhenatherum elatius* grassland
MG5 *Cynosurus cristatus-Centaurea nigra* meadow and pasture
MG6 *Lolium perenne-Cynosurus cristatus* pasture
MG7a *Lolium perenne* leys and related grasslands, *Lolium perenne-Trifolium* repens leys
MG9 *Holcus lanatus-Deschampsia cespitosa* grassland
MG10a *Holcus lanatus-Juncus effusus* rush-pasture, Typical sub-community
MG12a *Festuca arundinacea* coarse grassland, *Lolium perenne-Holcus lanatus* sub-community
U2 *Deschampsia flexuosa* grassland
U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, Typical sub-community
U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community
U5a *Nardus stricta-Galium saxatile* grassland, Species-poor sub-community
U6d *Juncus squarrosus-Festuca ovina* grassland, *Agrostis capillaris-Luzula multiflora* sub-community
U6H *Juncus squarrosus-Festuca ovina* grassland, provisional heathy sub-community with abundant *Calluna vulgaris*
U20 *Pteridium aquilinum-Galium saxatile* community
OV25 *Urtica dioica-Cirsium arvense* community
OV27 *Chamerion angustifolium* community
S3 *Carex paniculata* swamp
S7 *Carex acutiformis* swamp
S22 *Glyceria fluitans* swamp
S28 *Phalaris arundinacea* fen
Je *Juncus effusus* 'acid grassland' community
Ja1 *Juncus acutiflorus* 'acid grassland' community
Ja2 *Juncus acutiflorus* 'wet heath' community
WW (wet willow woodland not classified to NVC type)
CP (conifer plantation)
YCP (young conifer plantation)
YBP (young broadleaved plantation)
Beech (small patch of mature beech)
FC (felled conifers)
BG (Bare ground/building/quarry)
SW (Standing water)

W7 *Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland

Most W7 in Britain has a canopy including alder or ash, but the examples found in this survey are of the predominantly upland form with a lower, scrubby, willow-dominated canopy (in this case of grey willow *Salix cinerea*). The ground vegetation is grass-herb-dominated, with species including *Deschampsia cespitosa, Holcus mollis, Juncus effusus, Filipendula ulmaria, Ranunculus repens, Rumex acetosa, Geum rivale, Primula vulgaris, Arrhenatherum elatius, Ajuga reptans* and the mosses *Kindbergia praelonga* and *Plagiomnium undulatum.* This flora indicates neutral soils. There are patches of this kind of woodland on damp slopes in Peden's Cleugh in the middle of the conifer plantation in the south of the site. The W7 here is associated with W23 gorse scrub, M27 meadowsweet fen, and acid and neutral grasslands (U4, MG1 and MG9).

W23 *Ulex europaeus-Rubus fruticosus* agg. scrub

This is dense scrub of gorse *Ulex europaeus* on well-drained and mostly sloping ground. There are small patches of it within and at the edges of the cattle-grazed north-western part of the site, and also on the steep slopes of Peden's Cleugh in the middle of the conifer plantation in the south of the site.

M6c *Carex echinata-Sphagnum fallax/denticulatum* mire, *Juncus effusus* sub-community

This is rush mire in which tussocky swards of *Juncus effusus acutiflorus* grow among carpets of the mosses *Sphagnum palustre, S. fallax* and *Polytrichum commune*. This flora indicates acidic soil conditions. M6c was found in just one small part of the survey area: in wet, shallow depressions among bog in the southern half of the cattle-grazed area in the north-west of the site.

M6d *Carex echinata-Sphagnum fallax/denticulatum* mire, *Juncus acutiflorus* sub-community

This is rush mire in which swards of *Juncus acutiflorus* grow mixed with some *Molinia caerulea, Agrostis canina, Anthoxanthum odoratum* and *Deschampsia flexuosa* among lower carpets of the mosses *Sphagnum palustre, S. fallax* and *Polytrichum commune*. The moss layer is dotted with small plants of *Potentilla erecta*. This flora indicates acidic soil conditions. M6d is uncommon here, most of the *J. acutiflorus*-dominated vegetation across the site being of a more mesotrophic nature (M23a) or drier (Ja1 and Ja2). However, patches of M6d occur in association with acid grassland, heathy *J. acutiflorus* vegetation (Ja2), *J. effusus* 'acid grassland' (Je) and bog (M17, M19 and M20) on wet, level to gently sloping ground in the southern half of the cattle-grazed area in the north-west of the site.

M15d *Trichophorum cespitosum-Erica tetralix* wet heath, *Vaccinium myrtillus* sub-community

This is wet heath vegetation in which short (10-15 cm) swards of *Calluna vulgaris* are mixed with smaller amounts of *Erica tetralix, Vaccinium myrtillus, Potentilla erecta* and *Molinia caerulea* and dotted abundantly and with conspicuous tufts of *Trichophorum germanicum* and lower rosettes of *Juncus squarrosus*. The grasses *Deschampsia flexuosa, Festuca ovina, Nardus stricta* and *Anthoxanthum odoratum*, and the sedges *Carex nigra* and *Eriophorum angustifolium* occur in small quantity. Mosses are abundant, especially *Hypnum jutlandicum, Hylocomium splendens, Pleurozium schreberi* and *Sphagnum capillifolium*. Patches of this vegetation are scattered within a N-S-orientated band in the western half of the cattle-grazed area in the north-west of the site. The M15d here is in mosaics with bog (mainly M19), heathy *J. squarrosus* vegetation (U6H) and heathy *J. acutiflorus* swards (Ja2). There is also a small outlying patch of M15d about 300 m to the west, at the western edge of this cattle-grazed area. Additionally, a very small patch of M15d was found on a damp slope in a ride in the north-east part of the conifer plantation; this M15d lacks *Trichophorum* and is composed mainly of *Calluna, Molinia* and *V. myrtillus*, dotted with *Potentilla erecta, Nardus stricta* and *Deschampsia flexuosa* and with patches of the moss *Pleurozium schreberi*.

M17a *Trichophorum cespitosum-Eriophorum vaginatum* blanket mire, *Drosera rotundifolia-Sphagnum* sub-community

This is wet bog in which tufts of *Trichophorum germanicum* and *Eriophorum vaginatum* grow abundantly along with *Molinia careulea, Carex nigra, Eriophorum angustifolium, Calluna vulgaris* (the heather mainly short and browsed) and carpets of the mosses *Spahgnum papillosum, S. capillifolium* and *S. cuspidatum*. Other mosses also occur in small quantity: these include *Polytrichum commune, Aulacomnium palustre* and *Rhytidiadelphus loreus*. M17 is rare here. This flora indicates markedly acidic conditions. Only a few small patches of M17a were found in this survey: these are on wet, level ground among drier M19 bog and less heathy M20 bog in the broad ridge top south-west of the top of Highlee Hill, in the southern part of the cattle-grazed area in the north-west of the site.

M19a *Calluna vulgaris-Eriophorum vaginatum* blanket mire, *Erica tetralix* sub-community

This is slightly drier bog (compared with the above-described M17) with abundant *Eriophorum vaginatum* and *Calluna vulgaris* mixed with smaller amounts of *Trichophorum germanicum, Erica tetralix, Vaccinium myrtillus, Carex nigra* and *Molinia caerulea*. There are extensive moss carpets with species including *Sphagnum capillifolium, Hypnum jutlandicum, Hylocomium splendens, Pleurozium schreberi* and *Rhytidiadelphus loreus*. M19a occurs very locally on level to gently sloping peaty ground to the south-west and north-west of the top of Highlee Hill, in the cattle-grazed north-western part of the survey area. It is in mosaics here with other types of bog (M17 and M20), wet heath (M15d) and heathy *Juncus squarrosus* vegetation (U6H). Its flora indicates markedly acidic conditions. Some M19 was also found in a narrow ride in the SE of the conifer plantation, the conifers at this location having been recently felled.

M20 *Eriophorum vaginatum* blanket & raised mire

This is bog vegetation in which the main vascular species is *Eriophorum vaginatum*. The abundance of this cottongrass gives the vegetation a very tussocky structure. There are also varied amounts of *Carex nigra* and small amounts of *Calluna vulgaris, Vaccinium myrtillus, Molinia caerulea* and *Eriophorum angustifolium*. Mosses are abundant, forming extensive carpets: among the species present *Sphagnum fallax, S. palustre* and *Polytrichum commune* are especially common. The vegetation is probably derived from M17 and M19 bog, both of which have more *Calluna, Trichophorum, Sphagnum papillosum* and *S. capillifolium*; it seems likely that in the M20 most of the heather has been grazed out. Patches of M20 occur among the more extensive M19 bog in the watershed peatland are south-west of the top of Highlee Hill in the cattle-grazed north-western part of the survey area. Some M19 was also found in narrow rides in the SE part of the conifer plantation, with M19 bog and M25 *Molinia*.

M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus acutiflorus* sub-community

The most prominent feature of this vegetation is the lush sward of *Juncus acutiflorus* some 30-50 cm tall. Growing with the rushes are grasses such as *Holcus lanatus, Deschampsia cespitosa, Molinia caerulea, Poa trivialis, Cynosurus cristatus, Anthoxanthum odoratum* and *Agrostis capillaris*, the sedge *Carex flacca*, and herbs including *Lotus pedunculatus, Plantago lanceolata, Ranunculus acris, R. repens, Trifolium repens, Cirsium palustre, Lathyrus pratensis, Achillea ptarmica, Filipendula ulmaria, Galium palustre, G. uliginosum, Valeriana dioica, Taraxacum* agg., *Scorzoneroides autumnalis, Cardamine pratensis, Rumex acetosa,* and, in some of the wetter places, *Caltha palustris, Pedicularis palustris* and *Potentilla palustris*. Mosses are common and include *Calliergonella cuspidata, Brachythecium rutabulum, B. rivulare* and *Plagiomniuim undulatum*. This flora indicates neutral soils. *J. effusus* can occur, but less commonly than *J. acutiflorus*; the reverse is the case in the M23b sub-community (see below). M23a is very extensive on damp to wet, level to gently sloping ground in the cattle-grazed north-west part of the site, where it is the single most extensive type of vegetation. It is evidently maintained by grazing, without which meadowsweet *F. ulmaria* (a species which is very palatable to large herbivores) would potentially be more abundant than the rushes (which are less palatable) and the vegetation type then being M27 meadowsweet fen. Smaller areas of M23a also occur on damp ground at the north-east edge of the site and along stream valleys within the conifer plantation part of the site.

M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus effusus* sub-community

This resembles the M23a just described, but the dominant rush is *Juncus effusus* instead of *J. acutiflorus*. M23b is not as common as M23a across the site, but there are small areas of it on damp to wet ground in the cattle-grazed north-west part of the site, in mosaics with M23a and U4/U5 grasslands.

M25a *Molinia caerulea-Potentilla erecta* mire, *Erica tetralix* sub-community

This is grassland dominated by lush, tussocky swards of *Molinia caerulea*. The purple moor-grass is accompanied by other species including *Potentilla erecta, Agrostis canina, Juncus effusus, Eriophorum vaginatum, Calluna vulgaris, Erica tetralix, Carex echinata, C. nigra* and mosses such as *Sphagnum capillifolium, S. fallax, S. palustre* and *Polytrichum commune*. *E. vaginatum, E. tetralix* and *Calluna* are only in small quantity; otherwise the vegetation would be classed as wet heath or bog. M25a was found on level to very gently sloping ground in various parts of the site, within and outside the conifer plantation. Some M25 was found to be so species-poor that it could not be clearly assigned to any sub-community, so it was mapped as M25 at the community level only but is probably slightly closer to M25a than to either of the other two sub-communities. Where scattered *E. vaginatum* occurs in M25a the vegetation appears to be derived (probably mostly by grazing) from previous bog vegetation and is mapped as M25a* to separate it from other M25a in which no clear bog affinities were observed.

M25b *Molinia caerulea-Potentilla erecta* mire, *Anthoxanthum odoratum* sub-community

In this slightly drier form of M25 the lush *Molinia caerulea* swards are accompanied by *Potentilla erecta* and grasses including *Anthoxanthum odoratum, Holcus lanatus, Deschampsia flexuosa, Nardus stricta*. The vegetation therefore shows some floristic shift toward the shorter U4 and U5 acid grassland communities. Small patches of M25b occur on damp, more or less level ground in the southern part of the cattle-grazed north-west part of the site (in mosaics with M23a rush mire) and in open ride and roadside situations within the conifer plantation.

M27 *Filipendula ulmaria-Angelica sylvestris* tall-herb fen

This is tall vegetation dominated by a dense growth of meadowsweet *Filipendula ulmaria*. It is not very species-rich but typically contains other species shared with M23 rush mires: for example *Juncus effusus, J. acutiflorus, Deschampsia cespitosa* and *Angelica sylvestris*. M27 occurs on damp, level to gently sloping ground along the stream valleys in the central and north-east part of the conifer plantation, mainly in association with MG1 and MG9 coarse grasslands, M23 rush mire and S7 sedge swamp. Patches of it also occur with similar associated communities on damp slopes further north, by Cleuch Burn (with MG1 on a slope surrounded by improved grassland) and near Southdean Cottages (at the north-east edge of the survey area). At all of these locations it is in places fenced off from grazing stock, so grazing is no more than very light (maybe the occasional deer). M27 is generally associated with such minimal grazing, as meadowsweet is very palatable to large herbivores. In more grazed places it is very commonly replaced by M23 rush mire/rush pasture, and indeed within the site M23 is much more extensive in the cattle-grazed pastures in the north-west (where there is no M27) than anywhere else. The flora of the M27 in this survey was not classified to sub-community level because it was either too species-poor or included characteristic species of at least two of the sub-communities.

MG1 *Arrhenatherum elatius* coarse grassland

This is tall, ungrazed or little-grazed grassland containing an abundance or dominance of *Arrhenatherum elatius*. It is generally species-poor, with a limited associated flora including *Holcus lanatus, Deschampsia cespitosa* and *Agrostis capillaris*. MG1 is the commonest type of tall ungrazed or little-grazed unimproved neutral grassland in Britain (for example it is very common along roadside verges), but it is local and not very extensive within the site. It was not seen at all in the cattle-grazed fields in the north-west. There are small areas of it in fenced (not stock-grazed) areas among improved grasslands further east in the north of the site, occurring in mosaics with M27 meadowsweet fen (another type of vegetation associated with no or minimal grazing). It is common in the lower parts of the stream valleys in the central and north-east parts of the conifer plantation, occurring here mainly with MG9 *D.cespitosa* grassland, MG10 and M23 rushy vegetation, M27 meadowsweet fen and U4 acid grassland. Its flora varies from very species-poor (MG1a *Festuca rubra* sub-community) to weedy with abundant *Urtica dioica* (MG1b *Urtica dioica* sub-community), damper with some meadowsweet (MG1c *Filipendula ulmaria* sub-community) and drier and rather herb-rich including much knapweed (MG1e *Centaurea nigra* sub-community). For the most part these sub-communities were not separated in the mapping because their relative proportions were not always clear. However, MG1e was found in association with MG5 shorter herb-rich neutral grassland on ground near one of the forest roads, and mapped here as MG1e.

MG2 *Filipendula ulmaria-Arrhenatherum elatius* grassland

This is grassland rather like the above-described MG1 in being tall (no more than minimally grazed) and with an abundance of *Arrhenatherum elatius*, but differing from MG1 in its greater richness in herb/wetland/woodland species which here include *Angelica sylvestris, Filipendula ulmaria, Holcus mollis, Lotus pedunculatus, Crepis paludosa, Juncus conglomeratus, Ranunculus repens*, *Festuca arundinacea* and the mosses *Calliergonella cuspidata, Plagiomnium unculatum* and *Thuidium tamariscinum*. This flora indicates damp, more or less neutral soils. MG2 was found only once in this survey, on a steep N-facing bank on the south side of Peden's Cleugh, a narrow, steep-sided valley in the central-north part of the conifer plantation. This type of sheltered, N-facing valley-side slope habitat is typical of MG2 in Britain. At this site the MG2 is associated with MG1 and MG9 coarse grasslands, M27 meadowsweet fen and U4 acid grassland.

MG5 *Cynosurus cristatus-Centaurea nigra* meadow and pasture

This is short to medium height grassland whose flora indicates neutral soils and in which the lack of *Lolium perenne* suggests that there has been little or no deliberate agricultural improvement. It was found on well-drained ground in two parts of the site, and its appearance and flora are very different between these two areas. Most of it was seen in the cattle-grazed north-west area, where the MG5 is short (5-10 cm) grassland with abundant to dominant *Cynosurus cristatus* accompanied by *Agrostis capillaris, Anthoxanthum odoratum, Holcus lanatus, Nardus stricta, Trifolium repens, Ranunculus acris, Cerastium fontanum, Potentilla erecta, Prunella vulgaris* and *Bellis perennis*. This vegetation looks very similar (until close inspection) to the U4 and MG6 grasslands found in the same part of the site, where MG5, U4 and U5 are the commonest communities in the areas of short grassland scattered widely among the taller and more extensive 'sea' of rush-pasture. Very different in appearance is the much taller, ungrazed or minimally grazed MG5 found in one part of the conifer plantation (to the north and south of a forest road E of Westshiels). Here the MG5 is 20-35 cm tall and contains abundant *Centaurea nigra* along with *Holcus lanatus, Carex flacca, Deschampsia cespitosa, Lathyrus pratensis, Hypochoeris radicata, Lotus corniculatus, Trifolium repens, Arrhenatherum elatius* and *Equisetum arvense*. This MG5 occurs in mosaics with MG1e grassland which has a similar flora but is taller, with more *Arrhenatherum*.

MG6 *Lolium perenne-Cynosurus cristatus* pasture

This is agriculturally improved, species-poor grassland in which *Lolium perenne* is very abundant and is accompanied by other species including *Cynosurus cristatus, Agrostis capillaris, Trifolium repens, Bellis perennis* and *Ranunculus repens*. Patches of MG6 are scattered among the more extensive rushy vegetation in the cattle-grazed area in the north-west of the site. There is also a field of MG6 further east in the north of the site.

MG7a *Lolium perenne* leys and related grasslands, *Lolium perenne-Trifolium* repens leys

This is agriculturally improved (and probably re-seeded) grassland consisting mainly of species-poor swards of *Lolium perenne* accompanied by a few other species including *Trifolium repens*. There are several fiels of MG7 in enclosed farmland on level to gently sloping land in the north of the survey area. There is also some MG7 in the north-east part of the cattle-grazed and largely rushy area of undulating terrain in the north-west of the survey area. MG7 represents the most strongly 'improved' grassland found in this survey.

MG9 *Holcus lanatus-Deschampsia cespitosa* grassland

This is grassland dominated by large tussocks of *Deschampsia cespitosa*, whose tall flowering heads are distinctive from a distance, especially from late summer onwards when they are very pale. The vegetation is generally species-poor – hence the classification to NVC community level only – but there are typically at least a few other species such as *Holcus lanatus, Juncus effusus, Agrostis capillaris* and *Potentilla erecta*. The flora of MG9 indicates that the soils (which are generally at least slightly damp) are more or less neutral. Most of the MG9 found in this survey is in the conifer plantation, where it is very common in areas of felled plantation and also along rides and roadsides. There are large solid patches of it in some places; in other places smaller patches of it occur in complex mosaics with other vegetation types, especially MG10a rushy vegetation, OV27 willowherb vegetation and U4 acid grassland. In these plantation habitats the *D. cespitosa* grows tall and lush. MG9 was also found very rarely in the cattle-grazed north-west part of the site, where it is much shorter and includes species such as *Cynosurus cristatus, Prunella vulgaris, Anthoxanthum odoratum* and *Trifolium repens*.

MG10a *Holcus lanatus-Juncus effusus* rush-pasture, Typical sub-community

This is vegetation in which tall tussocks of *Juncus effusus* are abundant to dominant. Floristically the vegetation has much in common with the MG9 described above, with species including *Deschampsia cespitosa, Holcus lanatus, Agrostis capillaris, Rumex acetosa, Poa trivialis, Cirsium palustre* and *Ranunculus repens*. As with MG9 its flora indicates that the soils (which are damp to wet) are more or less neutral. MG10a is very common throughout this site, in the conifer plantation and in the open grasslands in the north-west and far N. Hence it occurs in a variety of situations and with a varied range of associated plant communities. In the plantation it is very commonly associated with MG9, mosaics of the two occupying many rides and roadside strips. Small patches of it are also common in areas of felled plantation, typically in mosaics with MG9 and OV27 willowherb vegetation. In the grazed fields in the north-west and north the MG10 occurs mainly in association with MG6 and MG7 improved grasslands and with M23a *Juncus acutiflorus* rush-pasture; these patches of MG10 include species such as *Cynosurus cristatus, Prunella vulgaris, Trifolium repens, Ranunculus repens* and, where in mosaics with MG6/7, *Lolium perenne*.

MG12a *Festuca arundinacea* coarse grassland, *Lolium perenne-Holcus lanatus* sub-community

Small, rather diffuse-edged areas of this tall grassland were found on dampish, level to gently sloping unplanted ground within the north-eastern part of the conifer plantation. The vegetation looks rather like MG1 or MG9, but tussocks of the tall grass *Festuca arundinacea* are very common. The associated flora overlaps with that of MG1, MG9, MG10 and M23, and includes *Arrhenatherum elatius, Deschampsia cespitosa, Holcus lanatus, Poa trivialis, Juncus acutiflorus, Cirsium palustre, Angelica sylvestris, Lathyrus pratensis, Ranunculus acris, Carex flacca, Equisetum arvense, Galium uliginosum* and the bryophytes *Rhytidiadelphus squarrosus* and *Lophocolea bidentata*.

U2 *Deschampsia flexuosa* grassland

This is species-poor acid grassland dominated by swards of *Deschampsia flexuosa*, with other species including *Agrostis capillaris, Calluna vulgaris, Galium saxatile* and *Potentilla erecta*. It occurs patchily in the conifer plantation, on well-drained and rather disturbed ground: in areas of felled plantation and along some rides and roadside areas. These are typical habitats of U2, the community tending to last for some years but eventually develop – as other species increase and become co-dominant with *D. flexuosa* or even dominant themselves – into other vegetation types such as U4 acid grassland or H12 dry heath. In British conifer plantations it is common to see large extents of U2 on well-drained ground in felled areas during the few years following felling. At this site it was rather surprising to find that in these habitats U2 is actually much less extensive than U4 swards of *Holcus lanatus* and/or *Agrostis capillaris*.

U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, Typical sub-community

This is short grassland in which swards of *Agrostis capillaris, A. vinealis, Festuca ovina, Anthoxanthum odoratum, Deschampsia flexuosa* and a little *Nardus stricta* are accompanied by other vascualr species including *Potentilla erecta, Galium saxatile, Luzula multiflora* and *Rumex acetosa*, and mosses including *Rhytidiadelphus squarrosus, Hylocomium splendens* and *Pleurozium schreberi*. This flora indicates that the soils are acidic and that the grassland has not been subjected to agricultural 'improvement'. U4a occurs here as small patches on well-drained gently to moderately sloping ground scattered among the cattle-grazed rushy area in the north-west of the site (where it is mostly about 5 cm tall), and on steep slopes in Peden's Cleugh in the middle of the conifer plantation part of the site (where it is 5-15 cm tall).

U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community

This is widespread in the survey area, and varies according to its location. Within the cattle-grazed north-west part it is one of the communities forming small areas of short, heavily grazed grassland surrounded by extensive rush-pasture. In this area the U4b is about 5 cm tall and is similar in appearance and species composition to the U4a described above except that it contains *Holcus lanatus, Cynosurus cristatus, Trifolium repens, Achillea millefolium* and *Prunella vulgaris*, and has correspondingly less *Galium saxatile*. This slightly more mesotrophic flora appears to indicate slight nutrient enrichment, from herbivore dung or occasional application of fertiliser; hence this U4b can be regarded as 'semi-improved' acid grassland. Within the conifer plantation – in re-vegetating felled areas and along roadsides – the vegetation includes many patches of species-poor U4b grassland about 25-50 cm tall and no more than minimally grazed: this grassland has abundant to dominant *Holcus lanatus* along with varied amounts of other species including *Agrostis capillaris, Deschampsia flexuosa, Potentilla erecta* and *Galium saxatile*. Some of this U4b in the conifer plantation has a more distinct weedy look than the grazed forms, especially the swards strongly dominated by tall *H. lanatus*.

U5a *Nardus stricta-Galium saxatile* grassland, Species-poor sub-community

This is very similar to the U4a grassland described above, but with a noticeable abundance (or even dominance) of *Nardus stricta*, the pale tussocks of which can give the vegetation a rather different appearance, even from a distance. The flora is otherwise much the same as that of U4a. U5a is found on well-drained and mostly sloping ground in many places widely scattered through the cattle-grazed rush-dominated area in the north-west of the site. In many of the small grassland 'islands' surrounded by a 'sea' of rush pasture there are fine-scale mosaics of U4a and U5a, with variation in the abundance of *Nardus* accounting for the switch from one community to the other.

U6d *Juncus squarrosus-Festuca ovina* grassland, *Agrostis capillaris-Luzula multiflora* sub-community

This is another grassland very similar to the U4a grassland described above, but in this case it is distinguished by the abundance of *Juncus squarrosus*. The flora is otherwise much the same as that of U4a. U6d is found locally on damp, gently sloping ground in parts of the cattle-grazed rushy area in the north-west of the site.

U6H *Juncus squarrosus-Festuca ovina* grassland, provisional heathy sub-community with abundant *Calluna vulgaris*

This vegetation is distinctive in that it consists mainly of short (5-10 cm) swards of *Calluna vulgaris* dotted abundantly with the low rosettes of *Juncus squarrosus*. Other species here include *Vaccinium myrtillus, Deschampsia flexuosa, Molinia caerulea* and the mosses *Sphagnum capillifolium* and *Hylocomium splendens*. The vegetation looks rather like M15d wet heath with *Trichophorum germanicum* replaced by *J. squarrosus*. It does not fit into any existing NVC type, which is why it is classified separately as U6H ('H' standing for 'Heathy' or 'Heathery'). It is found here on damp peaty soils on level to very gently sloping ground in a few places in the cattle-grazed north-west of the site, mainly in association with M15d wet heath, M19 bog and U6d *J. squarrosus* grassland.

U20 *Pteridium aquilinum-Galium saxatile* community

This is bracken dominated vegetation with a tall sward of *Pteridium aquilinum*. It was seen only once in this survey, in association with MG1 *Arrhenatherum* grassland and OV27 willowherb vegetation in a narrow ride among open, felled (and now re-vegetating) conifer plantation in the south-west of the site. Its flora was not examined in detail; U20 is generally not species-rich and not of high conservation importance.

OV25 *Urtica dioica-Cirsium arvense* community

This is tall, weedy vegetation with abundant to dominant *Cirsium arvense* accompanied by other species including *Urtica dioica*. It was found only once in this survey, along the south side of a track in a large open area (felled plantation) in the northern part of the conifer plantation.

OV27 *Chamerion angustifolium* community

This is species-poor vegetation dominated by tall swards of *Chamerion angustifolium*, accompanied by a few other species including *Deschampsia cespitosa* and *Holcus lanatus*. It is very common within the conifer plantation part of the site, mainly in recently felled plantation areas; this reflects the tendency of *C. angustifolium* to grow best where it has been able to colonize relatively bare ground shortly after there has been some artificial disturbance. In some areas of felled plantation OV27 is the dominant type of vegetation over large areas; in others it is in patchy mosaics with other types of vegetation, especially MG9 *D. cespitosa* grassland.

S3 *Carex paniculata* swamp

This is wetland vegetation dominated by the large and unmistakeable tussocks of greater tussock-sedge *Carex paniculata*. Other species here include *Angelica sylvestris, Juncus effusus, Rorippa nasturtion-officinale, Festuca arundinacea, Tussilago farfara* and *Veronica beccabunga*. A small patch of this vegetation was found in a wet hollow at the edge of a ride within the conifer plantation, a short distance west of the eastern boundary of the survey area.

S7 *Carex acutiformis* swamp

This is vegetation consisting almost entirely of tall, long-leaved swards of *Carex acutiformis*, with a sparse associated flora including *Filipendula ulmaria.* These sedge stands are on wet, level (and locally gently sloping) ground in mosaics with M27 meadowsweet fen, MG1 *Arrhenatherum* grassland and M23 rush mire along the Jed Water (within the conifer plantation) and near Southdean Cottages at the north-east edge of the survey area.

S22 *Glyceria fluitans* swamp

One example of this community was found in this survey. This is a very small, species-poor sward of *Glyceria fluitans* in the bottom of a distinct, sharp-edged depression among MG7 improved grassland in the north-east part of the cattle-grazed area in the north-west of the site.

S28 *Phalaris arundinacea* fen

This is tall fen vegetation dominated by dense swards of *Phalaris arundinacea*. Small patches of it were found near the Jed Water in the central part of the conifer plantation, in association with M27 meadowsweet fen, MG1 tall grassland, M23 rush mire and S7 sedge swamp.

Je *Juncus effusus* 'acid grassland' community

This is vegetation in which tall tussocks of *Juncus effusus* grow abundantly among shorter 'acid grassland' swards including *Agrostis capillaris, Anthoxanthum odoratum, Holcus lanatus, J. squarrosus, Nardus stricta, Potentilla erecta, Galium saxatile* and the moss *Rhytidiadelphus squarrosus*. This vegetation does not fit into any NVC community: it lacks the wetland element of M6 and M23 *J. effusus* mires and has a more acidophilous flora than MG10 *J. effusus* rush-pasture. It is therefore classed separately. It occurs locally – in mosaics with U4 and U6 acid grasslands – in the cattle-grazed pasture in the north-west of the site, but is much less extensive than M23 and MG10.

Ja1 *Juncus acutiflorus* 'acid grassland' community

This vegetation is similar to the Je vegetation just described, but with abundant *Juncus acutiflorus* instead of *J. effusus*. The abundance of *J. acutiflorus* means that the vegetation looks very much like M6d or M23a rush mires, but the associated flora does not fit either of those NVC types and is more like U4 acid grassland. This vegetation was therefore classified separately. It was found on level to gently sloping ground in parts of the cattle-grazed area in the north-west of the site.

Ja2 *Juncus acutiflorus* 'wet heath' community

As with the Ja1 vegetation just described, this Ja2 has tall swards of *Juncus acutiflorus* which give it a resemblance to M6d and M23a mires and also to the Ja1 vegetation. This Ja2 vegetation differs from M6d, M23a and Ja1 in that the associated flora has something of a wet heath nature, including much *Calluna vulgaris* and at least some *Erica tetralix* and *Molinia caerulea*. Other species here include *Potentilla erecta, Deschampsia flexuosa, Vaccinium myrtillus, Agrostis vinealis, Juncus squarrosus* and the mosses *Hylocomium splendens* and *Polytrichum commune*. This flora indicates acidic soils. It is given a non-NVC code because its heathy flora precludes classification as any existing *J. acutiflorus*-dominated NVC type. Ja2 vegetation occurs here on level to very gently sloping ground, in mosaics with bog (M19), wet heath (M15d) and heathy *J. squarrosus* vegetation (U6H) in parts of the cattle-grazed north-west of the site. All of the occurrences recorded in this survey are within a narrow N-S-orientated band within that area – the same north-south band containing almost all of the M15d wet heath found in this survey.

WW (wet willow woodland not classified to NVC type)

This refers to a patch of *Salix cinerea* scrubby woodland on level ground in the bottom of the Jed Water valley in the south of the site, in the middle of the conifer plantation. Difficulties of physical access prevented a close view, so it is not clear which of the NVC wet woodland communities this vegetation belongs to: it is probably one of W1, W3, W5 or W7.

CP (conifer plantation)

This refers to the middle-aged to mature conifer plantations found extensively in the south of the site and more locally further north.

YCP (young conifer plantation)

This refers to the very young conifer plantations found in parts of the south of the site, on land which has been felled (from previous older conifer plantation) and replanted in recent years.

YBP (young broadleaved plantation)

This refers to small areas with young planted birch, alder, rowan and willow, within and at the north-west edge of the conifer plantation in the south of the site.

Beech (small patch of mature beech)

This is a small patch of mature beech (and a little sycamore) near an abandoned building at Westshiels in the middle of the conifer plantation in the south of the site. The beech was evidently planted here around the time the building was in use.

FC (felled conifers)

This refers to ground with recently felled conifer brash and vegetation too sparse and immature to be meaningfully classified to a vegetation type. It occurs within the conifer plantation area in the south of the site. Some areas of FC are large (very recent fellings). In other places – felled not so recently but still at an early stage of recolonisation – this habitat occurs in mosaics with vegetation types such as MG9, U4b and OV27. Where felling took place earlier still the vegetation cover is sufficiently complete for the areas in question to be labelled with vegetation codes only (mostly MG9, OV27, MG10 and U4b).

Standing Water (SW)

This refers to tiny ponds in two places in the northern part of the conifer plantation in the south of the site. The ponds are surrounded by felled plantation which has re-vegetated with MG9 *Deschampsia cespitosa*, MG10 *Juncus effusus* and OV27 *Chamerion angustifolium*.

Bare Ground/Buildings/Quarry (BG)

This code was used for several very small areas in the far north of the site. Two of these areas are buildings and associated grounds and include the house and garden at Whiteburn and a shed/barn and immediately adjacent land about 100 m to the south. Both are on the west side of the A6088 road. Other areas include farm buildings and immediately adjacent land (garden, etc) at Lustruther, and an area of arable field in the north of the Development. The BG code also encompasses two separate areas of quarry, one near the W end of the conifer plantation and the other among grazed rush-pasture in the north-west of the Development.

Correspondence with Phase One habitats

For each of the above-described vegetation and habitats types found in this survey, Table 2 (below) shows the equivalent habitat according to the Phase One habitat classification (JNCC 2010).

Table 2 Phase One habitat type equivalents of NVC communities and other habitats recorded in this survey

NVC	Phase One equivalent	
W7	A1.1.2	Woodland: broadleaved, plantation
M6c & M6d	E2.1	Flush and spring: acid/neutral
M15d	D2	Wet dwarf shrub heath
M17, M19 & M20	E1.6.1	Bog: blanket
M23a & M23b	B5	Marsh/marshy grassland
M25a*	E1.7	Bog: wet modified
M25a, M25b (& M25 no sub-comm.)	B5	Marsh/marshy grassland
MG1, MG2 & MG5	B2.1	Neutral grassland: unimproved
MG6 & MG7	B4	Improved grassland
MG9 & MG10a	B2.1	Neutral grassland: unimproved
MG12	B2.2	Neutral grassland: semi-improved
U4a (& U4 no sub-comm.)	B1.1	Acid grassland: unimproved
U4b	B1.2	Acid grassland: semi-improved
U5a	B1.1	Acid grassland: unimproved
U6d	B1.1	Acid grassland: unimproved
U6H	D2	Wet dwarf shrub heath *(poor fit)*
U20	C1.1	Bracken: continuous
S3, S7, S22 & S28	F1	Swamp
OV25 & OV27	C3.1	Other tall herb & fern: tall ruderal
Je & Ja1	B5	Marsh/marshy grassland
Ja2	D2	Wet dwarf shrub heath *(v. poor fit)*
WW (wet woodland; not seen close enough for NVC)	A1.1.2	Woodland: broadleaved, plantation
CP & YCP (conifer plantation)	A1.2.2	Woodland: coniferous, plantation
YBP (broadleaved plantation)	A1.1.2	Broadleaved woodland – plantation
Beech	A1.1.2	Broadleaved woodland – plantation
FC (felled conifers)	A4.2	Coniferous woodland – recently felled
Arable	J11	Cultivated/disturbed land: arable
Pond	G1	Standing water
Farm and Buildings, roads, and garden	J3	Built-up areas
Quarry	I2.1	Quarry

Note: the above list assumes that felled but now re-vegetating conifer plantation would be classified on the basis of their current vegetation, but it would be equally understandable if a Phase One surveyor classed them as Phase One type 'A4.2 Coniferous woodland – recently felled'.

4 EVALUATION OF BOTANICAL INTEREST

Among the vegetation types found in this survey, those which are of the most natural or semi-natural character are as follows:

W7 *Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland
M6d *Carex echinata-Sphagnum fallax/denticulatum* mire, *Juncus acutiflorus* sub-community
M15d *Trichophorum germanicum-Erica tetralix* wet heath, *Vaccinium myrtillus* sub-community
M17a *Trichophorum germanicum-Eriophorum vaginatum* blanket mire, *Drosera rotundifolia-Sphagnum* sub-community
M19a *Calluna vulgaris-Eriophorum vaginatum* blanket mire, *Erica tetralix* sub-community
M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus acutiflorus* sub-community
M27 *Filipendula ulmaria-Angelica sylvestris* tall-herb fen
MG2a *Filipendula ulmaria-Arrhenatherum elatius* grassland, *Filipendula ulmaria* sub-community
MG5 *Cynosurus cristatus-Centaurea nigra* meadow and pasture
MG12a *Festuca arundinacea* coarse grassland, *Lolium perenne-Holcus lanatus* sub-community
U6H *Juncus squarrosus-Festuca ovina* grassland, provisional heathy sub-community with abundant *Calluna vulgaris*
S3 *Carex paniculata* swamp
S7 *Carex acutiformis* swamp
S22 *Glyceria fluitans* swamp
S28 *Phalaris arundinacea* fen
Ja2 *Juncus acutiflorus* 'wet heath' community
WW (wet willow woodland not classified to NVC type)

Most of these are common in southern Scotland or in Britain generally, but a few are more local or uncommon in Britain:

MG2 *Filipendula ulmaria-Arrhenatherum elatius* grassland (uncommon; mainly in upland fringes in North England and Scotland)
MG12a *Festuca arundinacea* coarse grassland, *Lolium perenne-Holcus lanatus* sub-community (widespread; thinly scattered)
S3 *Carex paniculata* swamp (widely but rather thinly scattered in lowland and upland fringes in Britain)
Ja2 *Juncus acutiflorus* 'wet heath' community (distribution unclear)

Wet heath is most extensive in the west (especially the western Highlands) and is generally rather patchy in the southern Uplands outside Galloway, so the patches of M15d wet heath found here are of some interest in this respect, especially as they occur in association with M17/19 bog, U6H heathy *Juncus squarrosus* vegetation and Ja2 heathy *J. acutiflorus* vegetation.

MG5 is often regarded as a plant community of high conservation interest, largely because in traditionally managed unimproved meadows and pastures it contain a notable and colourful abundance and/or diversity of herbs. MG5 of that description would once have been much more common in Britain before widespread agricultural improvement and re-seeding took place. The MG5 found within the conifer plantation is noticeable (and colourful) because of the abundance of knapweed, but the patches of this community within the cattle-grazed north-west of the site are less noticeable and do not stand out from the other short green grassland swards in that area. The cattle-grazed MG5 is not particularly species-rich or herb-rich, and in these respects is less valuable for nature conservation than the above-mentioned and better known herb-rich examples of this community.

No nationally or locally uncommon plant species were found in this survey.

Most of the survey area is of low botanical interest. This applies especially to the agriculturally improved fields (MG6 and MG7) in the north, and to the extensive areas of standing and felled conifer plantation in the south (and the smaller conifer blocks scattered among farmland in the north). However, certain areas are of at least moderate botanical interest in having a good representation and diversity of semi-natural plant communities whose condition is such that they have not been markedly impoverished by anthropogenic land management. These are marked in red and labelled 1, 2, 3 and 4 in Map 1 (see Appendix 3). These areas are described very briefly below:

- Area 1 is that part of the north-western cattle-grazed open area which contains patches of bog (M17, M19 and M20) and wet heath (M15d).
- Area 2 is a small area at the north-east edge of the site, with a wet valley floor whose vegetation includes S7 sedge swamp and M27 meadowsweet fen.
- Area 3 is Peden's Cleugh, a narrow, steep-sided valley within the conifer plantation, with a good mix of contrasting habitats (acid and neutral grasslands U4, MG1, MG2 and MG9, meadowsweet fen S27, rush mire M23, willow woodland W7 and gorse scrub W23).
- Area 4 runs along two streams within the conifer plantation and has neutral grasslands (MG1, MG9 and MG12) and wetter areas with meadowsweet fen (M27), rush mires (M23), *Phalaris* fen (S28) and sedge swamp (S7).

The following NVC types found in this survey are classed by SEPA (2012) as Groundwater Dependent Terrestrial Ecosystems (GWDTE) of concern in relation to wind farm development (* = classed as highly groundwater-dependent; the remainder classed as moderately groundwater dependent):

W7 *Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland *
M6c *Carex echinata-Sphagnum fallax/denticulatum* mire, *Juncus effusus* sub-community *
M6d *Carex echinata-Sphagnum fallax/denticulatum* mire, *Juncus acutiflorus* sub-community *
M15d *Trichophorum germanicum-Erica tetralix* wet heath, *Vaccinium myrtillus* sub-community
M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus acutiflorus* sub-community *
M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus effusus* sub-community *
M25a *Molinia caerulea-Potentilla erecta* mire, *Erica tetralix* sub-community
M25b *Molinia caerulea-Potentilla erecta* mire, *Anthoxanthum odoratum* sub-community
M27 *Filipendula ulmaria-Angelica sylvestris* tall-herb fen
MG9 *Holcus lanatus-Deschampsia cespitosa* grassland
MG10a *Holcus lanatus-Juncus effusus* rush-pasture, Typical sub-community
U6d *Juncus squarrosus-Festuca ovina* grassland, *Agrostis capillaris-Luzula multiflora* sub-community
U6H *Juncus squarrosus-Festuca ovina* grassland, provisional heathy sub-community with abundant *Calluna vulgaris*
S3 *Carex paniculata* swamp
S7 *Carex acutiformis* swamp

In the light of the above, the following non-NVC types should also qualify for GWDTE status:

Je *Juncus effusus* 'acid grassland' community
Ja1 *Juncus acutiflorus* 'acid grassland' community
Ja2 *Juncus acutiflorus* 'wet heath' community
WW (wet willow woodland not seen close enough to allow NVC determination)

The location and extent of all identified wetlands and potential GWDTEs in relation to infrastructure are required to be provided on an appropriate NVC map. Such a map is provided here for the whole Development, which has the Development layout overlain (i.e. Figure 5.3). Within Figure 5.3 polygons consisting of a NVC community potentially moderately groundwater dependent have been shaded yellow and polygons consisting of a NVC community potentially highly groundwater dependent have been shaded red as per the table above and SEPA (2012).

Where mosaics of GWDTEs and non GWDTE NVC communities existed, and could not be split, the polygon was classified based on the dominant NVC community and was shaded the corresponding colour.

A proportion of the habitats and communities recorded across the site are considered to be groundwater dependent based on the above classification. However, many of the habitats and communities are not groundwater dependent and are fed by surface water or are ombrotrophic given the terrain and topography of where many of the communities were recorded. A more detailed assessment of groundwater at the proposed wind farm site part of the hydrology assessment within the Environmental Statement Chapter 8: Geology, Hydrology and Hydrogeology).

A number of Habitats Directive (92/43/EEC) Annex I habitats (http://jncc.defra.gov.uk/page-1523) occur within the Development, as follows;

- Blanket Bog:
    - M17 Trichophorum germanicum-Eriophorum vaginatum blanket mire;
    - M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire;
    - M20 *Eriophorum vaginatum* blanket mire; and
    - M25 *Molinia caerulea – Potentilla erecta* mire.
- North Atlantic Wet Heath:
    - M15d *Trichophorum germanicum – Erica tetralix* wet heath.
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*:
    - W7 *Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland

The M17, M19 and M20 bogs are also wetlands but are not classed as GWDTE habitats because hydrologically speaking they are rain-fed rather than groundwater-fed. They are still of significance, however, especially as Scotland is of international importance for blanket bog because it contains a significant proportion of the total world extent of this habitat. Bogs should also be considered seriously wherever a proposed development works includes cutting into the soils; cutting into the deep, wet peat of blanket bog habitats can produce ecologically adverse effects of physical instability and carbon release.

The M17, M19, M20, and M25 mire within the site constitute Annex I blanket bog habitats. The state and condition of these blanket bog communities (as well as all other Annex I habitats) has already been discussed above; the habitats within the study area vary in terms of their relative quality.

Annex I blanket bogs should also be considered wherever proposals include cutting into the peat and this should be minimised as far as possible, and where it is unavoidable restricted to the shallower peat areas.

6 REFERENCES

Atherton, I., Bosanquet, S. & Lawley, M. (2010). *Mosses and Liverworts of Britain and Ireland: a field guide.* British Bryological Society.

British Geological Survey (1979). *1:625,000 Geological Map of the United Kingdom. 3rd. Edition (solid).*

Joint Nature Conservation Committee (2010). *Handbook for Phase One habitat survey – a technique for environmental audit.* Available as a pdf file downloadable from the internet at http://www.jncc.gov.uk/page-2468

Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W. & Moore, D.M. (1992). *The Lichen Flora of Great Britain and Ireland.* The British Museum (Natural History).

Rodwell, J.S. (Ed.) (1991 *et seq.*). *British Plant Communities.* 5 volumes: *Vol. 1 (1991) - Woodlands and Scrub; Vol. 2 (1991) - Mires and Heaths; Vol. 3 (1992) - Grasslands and montane communities; Vol. 4 (1995) - Aquatic communities, swamps and tall-herb fens; Vol. 5 (2000) - Maritime Cliffs, Sand Dunes, Saltmarshes and Other Vegetation.* Cambridge University Press, Cambridge.

Scottish Environmental Protection Agency (2012). *Land Use Planning System; SEPA Guidance Note 4; Planning guidance on windfarm developments (version 6, published on 6th March 2012).*

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

APPENDIX 1 – QUADRAT DATA

These data were recorded from 2 m x 2 m quadrats in mire and grassland habitats in the open, cattle-grazed north-western part of the site on 26th August 2013.

Ordnance Survey 10-figure grid references (recorded using a GPS device) are given for quadrat locations.

Values for species occurrences within quadrats are those of the DOMIN scale:

1 = <4% cover (few individuals)
2 = <4% cover (several individuals)
3 = <4% cover (many individuals)
4 = 4-10% cover
5 = 11-25% cover
6 = 26-33% cover
7 = 34-50% cover
8 = 51-75% cover
9 = 76-90% cover
10 = 91-100% cover

The quadrat locations are shown in Map 7 in Appendix 3.

Code no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
100 km square	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Easting	61280	61436	61301	61318	61347	61779	61510	61728	61542	60845	61501	61359	61299	61382
Northing	07964	09057	07795	08340	07785	08820	08798	07405	08818	07247	08834	08795	08871	08698
Altitude	296	220	305	265	305	245	225	265	225	310	225	233	233	235
Slope gradient	1	1	0	1	0	3	1	1	5	10	10	2	1	2
Slope aspect	N	NE	-	N	-	NW	NE	SE	NW	N	SE	W	N	N
NVC type	M06d	M15d	M17a	M19a	M20	M23a	M23b	M25b	MG05	U04a	U05a	U06H	Ja1	Ja2
Vegetation height (cm)	40	15	25	25	25	30	70	40	5	7	20	10	40	40
Achillea millefolium									3					
Agrostis capillaris							2		4	7				
Agrostis canina	5													
Agrostis vinealis										5	5		4	1
Anthoxanthum odoratum	2	2						3		5	5		4	
Aulacomnium palustre			1		2									
Brachythecium rutabulum							3							
Calliergonella cuspidata						4	3		3					
Calluna vulgaris		7	5	7	4							7		5
Cardamine pratensis							2							
Carex echinata								5						
Carex flacca						4								
Carex nigra		2	3	3	5								1	
Carex panicea													5	
Cirsium palustre						1	1							
Cynosurus cristatus						4			8					
Deschampsia cespitosa							5		5				1	
Deschampsia flexuosa	3	3						4		3	2	3		2
Erica tetralix		1		1										2
Eriophorum angustifolium		1			1									
Eriophorum vaginatum			5	7	8									
Festuca ovina		2							1	5		1		
Filipendula ulmaria							1							
Galium palustre							3							
Galium saxatile										5				
Holcus lanatus						3	4	3	4				4	
Holcus mollis										2				
Hylocomium splendens		6		4					3	7	3	6	3	5
Hypnum jutlandicum		3												
Juncus acutiflorus	8					8		1					7	8
Juncus articulatus									1					
Juncus conglomeratus								4						
Juncus effusus							8							
Juncus squarrosus		5										7		
Kindbergia praelonga													3	
Lathyrus linifolius													1	
Lathyrus pratensis						1	3						1	
Lotus corniculatus									1					
Lotus pedunculatus						2	5						1	
Luzula multiflora		1								3	2			
Luzula pilosa												1		

Code no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
100 km square	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Easting	61280	61436	61301	61318	61347	61779	61510	61728	61542	60845	61501	61359	61299	61382
Northing	07964	09057	07795	08340	07785	08820	08798	07405	08818	07247	08834	08795	08871	08698
Altitude	296	220	305	265	305	245	225	265	225	310	225	233	233	235
Slope gradient	1	1	0	1	0	3	1	1	5	10	10	2	1	2
Slope aspect	N	NE	-	N	-	NW	NE	SE	NW	N	SE	W	N	N
NVC type	M06d	M15d	M17a	M19a	M20	M23a	M23b	M25b	MG05	U04a	U05a	U06H	Ja1	Ja2
Molinia caerulea	5	3	2	1	1	1		9			3	4	4	5
Myosotis secunda							1							
Nardus stricta									4	1	9		5	
Plagiomnium undulatum							2							
Plantago lanceolata						2	1		4					
Pleurozium schreberi		2		5	3						3	3		
Poa trivialis						2								
Pohlia wahlenbergii							2							
Polytrichum commune	4		3	3	4					1				3
Potentilla erecta	5	2						5	4	4	5		5	5
Prunella vulgaris									3					
Pseudoscleropodium purum									1				2	
Ranunculus acris						3			1				3	
Ranunculus repens							6							
Rhytidiadelphus loreus		3	2	3	3									
Rhytidiadelphus squarrosus								2	4	4	5		4	
Rumex acetosa							3			1				
Scorzoneroides autumnalis						3								
Sphagnum capillifolium		5	4	6	3							3		
Sphagnum cuspidatum			5											
Sphagnum fallax					7									
Sphagnum palustre	9				5									
Sphagnum papillosum			6											
Stellaria uliginosa							2							
Taraxacum agg.						1			1					
Trichophorum germanicum		7	8	4										
Trifolium repens						5			4					
Vaccinium myrtillus		3		4	3							4		2

APPENDIX 2 – PHOTOGRAPHS

These photos show examples of the main vegetation types found in this vegetation survey at Highlee Hill in the Scottish Borders in August 2013.

Photograph 1 Example of M23a *Juncus acutiflorus* neutral mire on lower north part of Highlee Hill

Photograph 2 Example of M23b *Juncus effusus* neutral mire on lower N part of Highlee Hill

Photograph 3 Example of M15d wet heath on lower north part of Highlee Hill

Photograph 4 Example of M25b *Molinia* mire/grassland on south side of Highlee Hill

Photograph 5 M17a bog on upper part of Highlee Hill

Photograph 6 M20 bog on upper part of Highlee Hill, in same area as that with M17a bog in Photograph 5

Photograph 7 M19a bog on north part of Highlee Hill

Photograph 8 M27 meadowsweet fen in stream valley within conifer plantation south of Highlee Hill

Photograph 9 Ja1 *Juncus acutiflorus* ‘acid grassland’ vegetation on lower north part of Highlee Hill

Photograph 10 Ja2 *Juncus acutiflorus* ‘wet heath’ vegetation on lower north part of Highlee Hill

Photograph 11 M6d *Juncus acutiflorus* mire on upper part of Highlee Hill

Photograph 12 S7 *Carex acutiformis* swamp in stream valley within conifer plantation south of Highlee Hill

Photograph 13 U4a acid grassland on N-facing slope south of Highlee Hill

Photograph 14 U5a *Nardus* grassland on lower north part of Highlee Hill

Photograph 15 U6H *Juncus squarrosus/Calluna vulgaris* vegetation on lower north part of Highlee Hill

Photograph 16 Heavily grazed, species-poor MG5 neutral grassland on lower north part of Highlee Hill

Photograph 17 Minimally grazed MG5 neutral grassland within conifer plantation south of Highlee Hill

Photograph 19 Tall, minimally grazed MG9 *Deschampsia cespitosa* grassland (pale) and MG10 *Juncus effusus* 'neutral grassland' (darker than MG9) as found very commonly within conifer plantation south of Highlee Hill

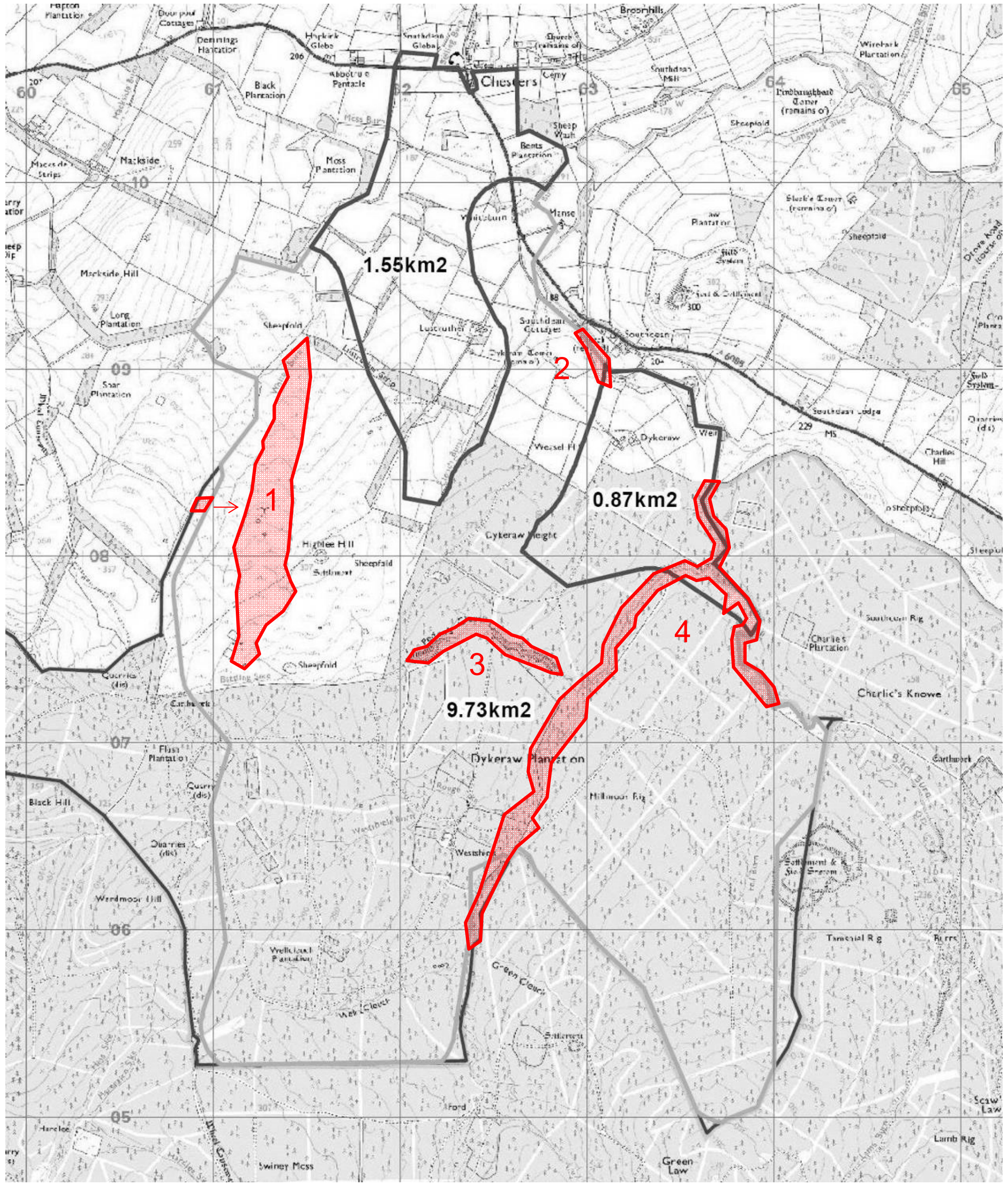
Photograph 18 Tall, minimally grazed MG9 *Deschampsia cespitosa* grassland as found very commonly within conifer plantation south of Highlee Hill

Photograph 20 Tall, minimally grazed OV27 rosebay willowherb vegetation as found very commonly within conifer plantation south of Highlee Hill; MG9 *Deschampsia cespitosa* grassland in distance at upper left (pale colour)

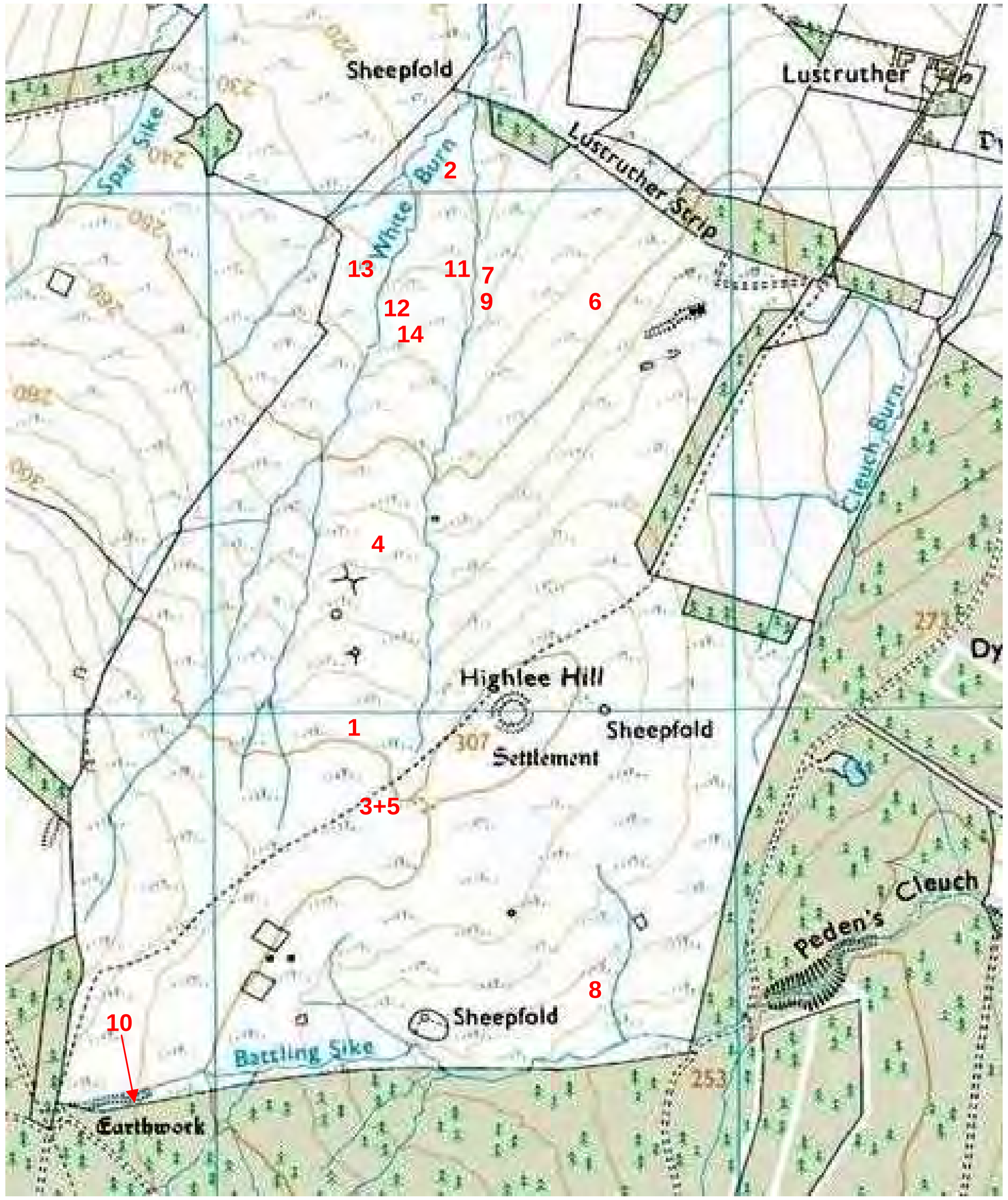
APPENDIX 3– MAPS

The following pages present the areas found in this survey to be of highest botanical interest (Map 1) and the location of the quadrat samples used in the survey (Map 2).

Map 1 Areas of highest botanical interest found in this survey



Map 2 Locations where quadrats were recorded in this survey



MacArthur Green

Technical Appendix 5.4

HIGHLEE HILL WIND FARM

Bat Survey Report

Technical Appendix 5.4

Prepared by: Leanne Cooke
Reviewed by: Rafe Dewar

Date: 05 February 2016

Tel: 0141 342 5404
Web: www.macarthurgreen.com
Address: 95 South Woodside Road | Glasgow | G20 6NT

Document Quality Record

Revision	Date	Originator	Checker	Approved	Status
Draft	02/12/2015	LC	RD	RI	Client Review
0					First Revision
01					Second Revision
02					Third Revision

CONTENTS

EXCUTIVE SUMMARY

MacArthur Green was commissioned by RES Ltd (RES) to complete bat surveys for the proposed Highlee Hill Wind Farm (referred to as the proposed wind farm).

These surveys were undertaken to aid and inform the ecological assessment for the Highlee Hill Wind Farm Environmental Statement (ES).

This report presents the results of the bat survey work undertaken between April and September 2012 and April and October 2013 at the proposed site (i.e. within the red line boundary, Figure 5.8 and Figure 5.11).

The survey area in 2012 covered the majority of the site around Dykeraw Planation and those in 2013 covered the open farmland in the north of the site at Highlee Hill.

The surveys in 2012 recorded four bat species during the temporal and spatial surveys: common pipistrelle (*Pipistrellus pipistrellus)*, soprano pipistrelle ***(****Pipistrellus pygmaeus)*, *Pipistrelle* sp.[1], *Myotis* sp. and brown long-eared bats (*Plecotus auritus*). The daytime inspection recorded potential tree roosts within the survey area, but over 200 m from any proposed infrastructure. These were surveyed during dusk and dawn emergence/ surveys and no roosts were identified.

The survey area in 2013 recorded five bat species during the temporal and spatial surveys: common pipistrelle, soprano pipistrelle*, Pipistrelle* sp.[1], *Nyctalus* sp., *Myotis* sp. and brown long-eared bats. The daytime inspection recorded potential tree roosts within the survey area but not within 200m of any proposed infrastructure.

The activity levels for species at high or low risk from turbines were low in 2012 and 2013.

The activity for medium risk species (soprano pipistrelle, common pipistrelle and pipstrelle species) would suggest that the survey area in 2012 (conifer plantation) is of low risk but that the survey area in 2013 (farmland) is of medium risk for these species.

[1] It should be noted that 'Pipistrelle sp.' is a bat call that overlaps between a soprano pipistrelle and common pipistrelle call which can only be classified to genus level. For the purposes of this report it is not included in the overall number of species recorded.

1. INTRODUCTION

MacArthur Green was commissioned by RES Ltd. (RES) to carry out protected species surveys at the proposed Highlee Hill Wind Farm, which is situated near the village of Chesters, in the Scottish Borders (hereafter referred to as the 'proposed wind farm'). It is 14 km SSW of Jedburgh and 14 km SE of Hawick (approximate centre at Ordnance Survey grid reference NT 625 075).

Bat surveys were conducted from April to September in 2012 and April to October in 2013. The survey programme included:

- A daytime inspection;
- Temporal (static) surveys;
- Spatial (point count) surveys; and
- Dawn and dusk surveys.

The aim of these surveys was to quantify roosting potential, site usage and variation of activity levels within the site (i.e. land within the red line application boundary, Figure 5.8). This was undertaken to aid and inform the ecological assessment for the Highlee Hill Wind Farm Environmental Statement (ES). Surveys were carried out during the main bat activity period and in optimum weather conditions in order to maximise the likelihood of recording bats.

2. THE SURVEY AREA

The survey area in 2012 and 2013 which bat surveys were carried out encompassed all proposed infrastructure, and a buffer around the infrastructure up to the site boundary. Habitat types are defined as edge, open and closed habitats according to their exposed or sheltered nature. Edge habitats are the preferred habitat of pipistrelle bats, while open habitats are favoured by *Nyctalus* bats and closed are favoured typically by long-brown ears and *Myotis* species. Daubenton's are usually found above open water habitats. The survey area is described in two sections below: survey area 2012 and 2013.

2.1 Survey Area 2012 – Dykeraw Planation

The survey area in 2012 covered the majority of the site around the Dykeraw Planation (Figure 5.8). The Dykeraw plantation has slightly undulating ground. Habitats throughout the planation mainly include conifer planation and felled plantation with associated habitats such as: rides, glades, tracks and burns present. Burns are located throughout the Site namely: Westshiels Burn, Rough Sike and Jed Water. Forestry works were ongoing at the time of survey with habitats changing from conifer plantation to felled habitat. Approximately 50% of the site is now open felled habitat and continues to be actively felled in 2016.

The 2012 survey area is delineated by conifer plantation to the south and east, open grassland habitat to the north and the B6357 to the west.

2.2 Survey Area 2013 – Highlee Hill

The survey Area in 2013 covered the area to the north of the site which encompasses open grassland habitats within the survey area. The highest section of the survey area is at Highlee Hill at an elevation of 307m. Habitats include: grassland habitats and pastures which were being grazed by cattle and are delineated by strips of conifer plantation that are dominated by Stika Spruce or Scots pine. Burns are located throughout the site namely: White Burn, Cleuch Burn and Battling Sike.

The survey area is delineated by conifer plantation to the south and east and open habitat to the north and west.

3. BATS AND WINDFARMS

3.1 Policy and Guidance

All bats species are protected under the following legislation shown below, which makes it an offence to deliberately or recklessly capture, injure or kill a bat. It is also an offence to disturb, damage or destroy a place of shelter i.e. a roost.

- The Habitats Directive 92/43/EEC and respective domestic legislation;
- The Conservation Regulations (1994) as amended; and
- The Nature Conservation (Scotland) Act 2004 (as amended).

Details pertaining to the legal status of bats are included within Annex 1.

In the UK, guidelines have been produced with regards to assessing the ecological impact upon bats from windfarm developments. These guidelines aid in producing mitigation and compensation strategies to minimise any negative impact upon local bat populations. The following guidance documents were used to design the surveys in 2012 and in 2013.

- Natural England (2012). Bats and onshore wind turbines: interim guidance. TIN051. Second Edition. Now updated to the Third Edition;
- Hundt, L. (2012) Bat Surveys: Good Practice Guidelines. 2nd Edition, Bat Conservation Trust; and
- Rodrigues, L., Bach, L., Dubourg-Savage, M.J., Goodwin J. & Harbusch C. (2008). Guidelines for consideration of bats in wind farm projects. EUROBATS Publication Series No. 3.

Since the surveys were carried out in 2012 and 2013, updates have been made to guidance documents. The survey methods discussed in this report are compatible with the versions which have been used in the preparation of this report;

- Natural England (2014) Bats and onshore wind turbines: interim guidance. TIN051. Third Edition.
- Rodrigues L., et al. (2014) Guidelines for consideration of bats in wind farm projects, revision 2014. EUROBATS Publication Series No. 6.

3.2 Potential Impacts

The most obvious direct impact for bats may be loss of habitat for purposes such as commuting, foraging and roosting, which could negatively affect the conservation status of a bat species.

It is now understood that, in some circumstances, bats may be at risk of death from wind turbines due to barotrauma as well as direct collision from blades (Baerwald *et al*. 2008) with a wind turbine in Europe and North America killing on average 2.3 birds and 2.9 bats per year (Rydell *et al*. 2012).

In the UK three taxa groups have been identified as high risk collision species with 98% of bat mortality predominantly among taxa adapted to open-air foraging such as: *Nyctalus, Pipistrellus* and *Eptesicus* (Rydell *et al*. 2010).

Natural England interim guidance (2014) includes a risk assessment for British bat species. This is divided into two parts: (i) bat species likely to be threatened due to impacts from wind turbines and (ii) bat populations likely to be threatened due to impacts from wind turbines (shown in Tables 1 and 2). Different bat species are considered to be at different levels of risk depending on their habitat preferences, flight behaviour and population status. Surveys have therefore been carried out for all bat species.

Natural England (2014) has identified the species of bats considered to be at low, medium and high risk (refer to Tables 1 and 2).

Table 1. *Bats likely to be at risk from wind turbines (taken from Natural England, 2014)*

Low Risk	Medium Risk	High Risk
Myotis species	Common pipistrelle	Noctule
Long-eared bats	Serotine	Leisler's
Horseshoe bats	Soprano pipistrelle	Nathusius pipistrelle
	Barbastelle	

Table 2. *Populations likely to be threatened due to impacts from wind turbines (taken from Natural England, 2014)*

Low Risk	Medium Risk	High Risk
Long-eared bats	Serotine	Nathusius pipistrelle
Myotis species	Barbastelle	Leisler's
Horseshoe bats		Noctule
Soprano pipistrelle		
Common pipistrelle		

Bats travel between hibernacula sites to summer roosts in spring and autumn and therefore could be impacted negatively if windfarms were positioned between these two areas.

A recent synthesis of European and American bat data by the Swedish Vindval research programme concluded the following habitats to be high risk locations for locating wind farms; coasts, wetlands, hills and ridges. Turbines sited along linear landscapes such as lake shores, rivers, treelines, hedgerows, etc., are also considered to increase the likelihood of collision (Rydell *et al.,* 2012).

3.3 Site Assessment

The appropriate level of effort for a bat survey at a proposed wind turbine development depends on the scale of its likely impact, which in turn depends on the size of the proposed Development and the quality of the habitat. BCT guidance (Hundt, 2012) provides recommendations of minimum standards of survey effort in instances where sampling is required. To determine the survey effort the site must be assigned a high, medium or low value. Annex 2 contains the BCT assessment table "*Factors to consider when determining the survey effort of a site*"; which was used to determine the survey effort for the site.

The 2012 and 2013 survey areas were assigned a medium value due to the suitability of the habitats within the site which were assessed to be of medium value to bats. For a medium value site BCT guidelines recommend a minimum survey effort of at least one visit per transect month between April and October for spatial surveys. For temporal surveys the guidelines recommend five consecutive nights for each pair of locations within the site per month (see Annex 3 for BCT bat survey minimum standards).

4. SURVEY METHODS

4.1 Desk-based Study

A desk-based study was carried out to establish the likelihood of species being present within the survey area. This included a search of *Ncytalus* records from the 'Scottish Leisler's bat Project' which were supplied to MacArthur Green by John Haddow in May 2015. These records include *Nyctalus* recordings from the whole of southern Scotland including long-tern monitoring at proposed windfarms, other developments and on-going research work being carried out by the 'Scottish Leisler's Bat Project' from 2010 to 2014.

4.2 Daytime Inspection

Daytime inspections of the survey area were carried out on 24th April 2012 and 2nd April 2013. Inspections involved a walkover of the survey area recording different habitat types and their suitability to support bats. The results of the daytime inspection were used to create the survey design i.e. spatial (point counts), temporal (static) surveys and roost surveys.

4.3 Tree Roost Surveys

Tree roost surveys were carried out on the 24th April 2012 and 2nd April 2013 during the daytime inspection. These surveys recorded potential bat roosting trees within the survey area. In accordance within BCT Guidelines (Hundt, 2012), potential bat tree/s within 200 m of a proposed turbine location or adjacent to a proposed access track (at that time – prior to design mitigation) were investigated further to determine if a roost is present.

4.4 Dusk and Dawn Roost Surveys

Dusk and dawn surveys were undertaken on identified potential bat roost trees at Westershils on the 17th May 2012 and 18th May 2012.

Dusk and dawn surveys were carried out in line with guidance from Hundt (2012). For the dusk surveys three surveyors were positioned at strategic locations at least 15 minutes before sunset and continued watching until 90 minutes or until it was too dark to see to cover the emergence time of all species. For the dawn surveys, two surveyors were in position at least 120 minutes before sunrise and continued until sunrise, or until no further activity was observed. One dusk and dawn survey was carried out.

4.5 Spatial Surveys - Point Counts

Spatial point count surveys were carried out over the main period of bat activity with surveys in 2012 starting in April and finishing in September and surveys in 2013 starting in May and finishing in September.

Each surveyor started their survey 30 minutes before sunset for dusk surveys or finished at dawn or 30 minutes after dawn for dawn surveys. The start and finish points were rotated in every survey. Each surveyor carried calibrated bat detectors of the same type and model (Anabat SD 2 and Bat Box)

The survey area in 2012 was divided into three transects and 61 point counts (Figure 5.8). Spatial survey effort is summarised in Table 3.

The survey area in 2013 was divided into two transects and 44 point counts (Figure 5.11). Spatial survey effort is summarised in Table 4.

Table 3. *Summary of Spatial Survey Effort 2012.*

Survey date	Transect	Surveyor	Survey type	Total survey Time (hrs:min)
25-26/04/12	1	Zoe Smith	Dusk	04:18
	2	Kieren Jones	Dusk	03:35
	3	Leanne Cooke	Dusk	04:15
18/05/12	1	Andrew Rattey	Dawn	04:24
	2	Ryan Walrath	Dawn	03:58
	3	Leanne Cooke	Dawn	04:35
20-21/06/12	1	Angus Betys	Dusk	05:09
	2	Ruth Abernethy	Dusk	03:32
	3	Leanne Cooke	Dusk	05:31
16-17/07/12	1	Rachel Cush	Dusk	04:59
	2	Ruth Abernethy	Dusk	04:00
	3	Ryan Walrath	Dusk	05:28
16-17/08/12	1	Ryan Walrath	Dusk	04:34
	2	Gemma Jennings	Dusk	05:33
	3	Leanne Cooke	Dusk	04:51
20/09/12	1	Sarah Sanders	Dusk	03:47
	2	Ruth Abernethy	Dusk	03:53
	3	Leanne Cooke	Dusk	04:35
Total survey time (hrs:mins)	**80:57**		**Total survey (nights)**	**18**

Table 4. *Summary of Spatial Survey Effort 2013.*

Survey date	Transect	Surveyor	Survey type	Total survey Time (hrs:min)
15/05/13	1	Paul Rowan	Dusk	02:49
	2	Euan Murray	Dusk	03:07
20-31/05/13	1	Leanne Cooke and Sarah Sanders	Dusk	02:57
	2	Leanne Cooke and Sarah Sanders	Dawn	03:11
25/06/13	1	Euan Murray	Dawn	02:45
	2	Lisa Ferguson	Dawn	03:03
08-09/08/13	1	Lisa Ferguson	Dusk	02:54

Survey date	Transect	Surveyor	Survey type	Total survey Time (hrs:min)
	2	Keith M	Dusk	04:18
21/08/13	1	Keith M	Dusk	02:53
	2	Lisa Ferguson	Dusk	02:56
26-27/09/13	1	Lisa Ferguson	Dawn	02:55
	2	Paul Rowan	Dusk	02:50
Total survey time (hrs:mins)	36:38:00		**Total survey (nights)**	**12**

4.6 Temporal Surveys – Static Detectors

Temporal surveys involved leaving static Anabat SD2 detectors within the survey area in order to record activity overnight and over prolonged periods of time. Five Anabat detectors were placed at five different locations in 2012 and four detectors were placed in four different locations with detectors 1 and 2 paired (i.e. within 200m of each other) in 2013.

The locations of the static detectors in 2012 and 2013 (refer to Figures 5.8 and 5.11) were selected based on two criteria:

(i) to allow comparison of temporal variation between open, edge and stream habitats within the survey area; and
(ii) to identify migratory or commuting patterns across the survey area.

Calibrated detectors were left out at these locations once a month for a minimum of five nights. The surveys covered spring, summer and autumn seasons. Each detector recorded bats from dusk to dawn with detectors starting 30 minutes before dusk and finishing 30 minutes after dawn. Tables 5 and 6 show the summary breakdown of temporal surveys in 2012 and 2013, respectively.

Table 5. *Summary of Temporal Survey Effort 2012.*

Survey dates	Time parameter	Location	Total Survey (hrs:mins)	Total no. of complete nights
20-25/04/12	20:10 – 06:15	1	50:25	5
		2	50:25	5
		3	50:18	4
		4	0*	0*
		5	49:45	4
		Total	**200:53:47**	**18**
18-24/05/12	20:54-05:26	1	51:12	6
		2	50:18	5
		3	51:12	6
		4	39:12	4
		5	51:12	6
		Total	**243:06:54**	**27**
21-27/06/12	21:27 – 04:59	1	13:24	1
		2	45:12	6
		3	45:12	6
		4	45:12	6
		5	45:12	6
		Total	**194:12:00**	**25**
16-23/07/12	21:12 – 05:22	1	49:30	5
		2	57:10	7
		3	57:10	7
		4	50:20	6
		5	57:10	7
		Total	**271:20:00**	**32**
16-23/08/12	20:12 – 06:17	1	54:00	5
		2	58:54	5
		3	70:35	7
		4	70:19	6
		5	69:13	6
		Total	**323:01:00**	**29**
13-19/09/12	19:02 – 07:10	1	68:21	5
		2	57:17	4
		3	60:58	5
		4	60:59	5
		5	53:15	4
		Total	**300:50:00**	**23**
Total Survey (hrs:mins)	**1533:23:41**		**Total complete nights**	**154**

* see Survey Limitation section for details.

Table 6. *Summary of Temporal Survey Effort 2013.*

Survey dates	Time parameter	Location	Total Survey (hrs:mins)	Total no. of complete nights
24-29/04/13	20:02 – 06:19	1	51:25	5
		2	51:25	5

Survey dates	Time parameter	Location	Total Survey (hrs:mins)	Total no. of complete nights
		3	0*	0*
		4	51:25	5
		Total	**154:15**	**15**
15-20/05/13	20:40 – 05:36	1	44:40	5
		2	27:15	3
		3	22:18	2
		4	44:40	5
		Total	**138:53**	**15**
30/05/13 – 04/06/13	21:08 – 05:10	1	40:10	5
		2	40:10	5
		3	40:10	5
		4	36:42	4
		Total	**157:12**	**19**
26/06/13 – 01/07/13	21:07 – 05:00	1	0*	0*
		2	31:32	4
		3	39:25	5
		4	18:40	2
		Total	**89:37**	**11**
09-14/08/13	20:32 – 06:00	1	37:52	4
		2	47:20	5
		3	37:52	4
		4	47:20	5
		Total	**170:24**	**18**
26/09/13 – 01/10/13	18:31 – 07:33	1	65:10	5
		2	65:10	5
		3	65:10	5
		4	0*	0*
		Total	**195:30**	**15**
Total Survey (hrs:mins)	**905:51:00**		**Total complete nights**	**94**

* see Survey Limitation section for details.

4.7 Method of Analysis

An individual bat can pass a particular feature on several occasions while foraging. It is therefore not possible to estimate the number of individual bats. Therefore, in accordance with BCT guidance (Hundt, 2012) a bat activity index (BAI) is used to calculate bat passes per hour which allows comparative analysis of bat activity:

BAI (per hour) = Total number of bat 'passes' / number of hours of recording

5. SURVEY LIMITATIONS

The surveys were undertaken during the main activity period of bats (April to October), therefore there is no seasonal limitation to the survey results.

Overall the point count surveys in 2012 and 2013 were generally carried out in optimal survey conditions (Annex 8). Light showers were experienced on the 27th September 2013 during the dawn survey and mist/drizzle with low temperatures on the 25th April 2012. Temperatures also dropped below the minimum survey temperature of 10 degrees on two occasions (15th April 2012 and 30th May 2013). Bats were still recorded to be actively commuting and foraging around the survey area on the 30th May 2013 but not on the 15th May 2012. As the majority of the surveys were carried out in optimal conditions with bats in the majority of cases still active in less than favourable conditions it is not considered to be a limitation on the data collected.

The automated static detectors are powered by 12v batteries and on some occasions the battery charge was not sufficient to complete a full survey period, or the equipment malfunctioned. The small loss of data is not considered to be significant in the context of the amount of data collected (see Tables 5 and 6 above).

There is some overlap between the frequency calls of the common and soprano pipistrelle's which echolocate at a peak frequency of approximately 45 kHz and 55kHz respectively. In instances where pipistrelle calls overlapped between 50kHz and 50.9kHz, they were recorded as 'pipistrelle species'.

Myotis species calls often overlap depending on their surrounding environs i.e. cluttered or open space. This often makes it difficult to identify *Myotis* bats to species level. If *Myotis* calls could not be identified to species level they were recorded as '*Myotis* species'.

Nyctalus species calls (noctule and leisler's bats) can be difficult to identify to species level as their calls overlap. Given that both these species have been assigned a high risk level for both collision and population risk, and given that they can be difficult to identify to species level, they were classified only to genus level.

Unknown calls were recorded during the spatial and temporal surveys. For spatial surveys this was due to very faint calls which were heard on the BatBox but not recorded on the Anabat SD2 (directional microphone). Therefore, desk analysis of the call could not be carried out using Analook to determine the species. Some temporal calls were assigned an 'unknown' value, due to a very faint call that could not be identified to species level on the spectogram.

Anabat detectors are the preferred bat detector for acoustic monitoring at windfarm sites (Kunz *et al*. 2007); however, Anabat detectors have limitations and will only monitor bat activity within a limited area. Furthermore the detection rate of bat calls varies with a bias towards loud bat calls with quieter calls, namely brown long-eared bats, potentially being under recorded. As a result of equipment limitations only relative rather than direct statistical comparisons of bat activity can be made between species and only a limited area within the survey area can be sampled.

The analysis of bat data is subject to experience, therefore the Anabat data was analysed by ecologists experienced with bat call analysis using AnalookW 4.3.19.

The survey design and effort was created in accordance to Hundt (2012) guidelines as shown in Annexes 2 and 3. The surveys carried out are considered to be sufficient to meet the guideline standards. The survey design was continually assessed with point count data analysed post survey visit to determine if the design was appropriate to the number and species of bats encountered within the survey areas. Surveys recorded high numbers of moderate risk species and therefore the initial proposed surveys were considered sufficient to meet the guideline standards.

In the absence of any recognised criteria to define levels of bat activity (e.g. what quantifies low, medium or high activity) professional judgement has been used, taking into consideration geographical location and experience gained through conducting similar surveys at other sites in the region and throughout Scotland.

6. SURVEY RESULTS

6.1 Desk-based Study

According to a search of the 'Scottish Leisler's bat Project' records the nearest *Nyctalus* record is 23km from the site boundary.

6.2 Daytime Inspection

The daytime inspection within and around the Dykeraw Plantation in 2012 recorded the majority of the survey area to be homogenous conifer habitats. Habitats of note for bats included watercourses namely the Black Burn and Jed Water. A stone quarry with a settlement pond was identified as potential forging habitat for bats. The stone ruin at Westshiels was also noted to be a potential roosting and foraging habitat for bats. Static detectors were deployed at both the quarry (location 1, Figure 5.8) and at Westshiels (location 2, Figure 5.8). Point counts were designed so that a point count transect followed the Jed Water and Black Burn throughout the survey area.

The daytime inspection within and around Highlee Hill in 2013 recorded the majority of the survey area to be homogenous open grassland habitats. Edge habitats are present in the form of linear Sitka planation or Scots pine plantation along field boundaries. These areas were noted to have commuting and foraging potential for bats and also to contain trees that could have potential for roosting bats. The fields were also stocked with gazing cattle which increased the foraging potential for bats as cattle provide food for invertebrates which bats then feed on. Static detectors were deployed along these linear habitats as well as open habitats. Paired detectors were used at location 1 and 2 to directly compare edge and open habitats in the survey area.

6.3 Tree Surveys

Tree surveys were carried out across the survey areas in 2012 and 2013. Potential bat roost trees were given a category rating in accordance with terminology as outlined in Hundt, 2012 and shown in Annex 4 which categorises trees in accordance to their suitability for bats. Trees with a category rating of 1*or 1 should be surveyed i.e. aerial inspection and/or dusk and dawn prior to felling, lopping works or if the root plate will be damaged by works. Trees with a category rating of 2 may require mitigation measures and Category 3 trees do not require any mitigation measures or further surveys.

In total, seven trees and one area with several trees within the 2012 and 2013 survey areas have the potential to support a bat roost with a category of 1* and/or 1). Category 1* and/or 1 trees require further survey work (aerial survey and/or dusk and dawn) if they are to be affected by works i.e. felling, lopping works or if the root plate will be damaged (see Figure 5.14 and Annex 5 for target notes).

At the time of survey, trees at Westershils were within 200m of proposed turbine locations, and therefore in accordance with Hundt, 2012 dusk and dawn surveys were carried out in 2012 to quantify the likelihood that a bat roost is present. Trees are now around 450m from the closest turbine locations in the final layout.

6.4 Dusk and Dawn Roost Surveys

Three surveyors carried out dusk and a dawn survey at Westershils. The first surveyor was position along the front of the trees along the track side, the second surveyors was positioned beside the stone ruin and the third surveyor was positioned to the back of the ancient woodland. No bats were identified to be emerging or entering the potential bat trees. The results of the dusk and dawn surveys can be seen in Annex 7.

During the roost surveys three species were recorded (common pipistrelle, soprano pipistrelle, and brown long-eared). During both surveys calls from common and soprano pipistrelles were recorded at all locations. Bats were recorded to be feeding around the woodland and along the track.

The nearest bat recorded near dusk was a feeding soprano pipistrelle at 21:40 which was recorded 16 minutes after dusk (sunset). The dawn survey did not record any swarming behaviour. The nearest records to dawn were a soprano pipistrelle and a brown long-eared bat which were recorded 49 and 59 minutes before dawn (sunrise), respectively.

It should be noted that since these surveys were completed the conifer plantation around the broadleaved woodland has been felled which has opened up this area and it is no longer as sheltered as it once has been. This could have a negative impact on the foraging opportunities of bats in this area and on roost suitability.

6.5 Spatial Surveys – Point Counts 2012

The fidelity of bats to particular foraging areas and commuting routes can be seen in Tables 7 and in Figure 5.9. Only total combined bat passes of five or more have been included in this assessment, to provide a concise overview of activity and relative importance of habitat areas. The majority of the survey area recorded bat passes with bats using the conifer tracks as commuting routes and foraging areas. The highest numbers of bats passes (>10 bat passes) were witnessed in the eastern section of the site around Westeshiels, Peden's Cleuch, Jed Water and Black Burn.

Table 7. *Total Point Count Bat Passes 2012.*

Point Count	Total Passes	Point Count	Total Passes
Between 1 and 2	5	Between 33 and 34	11
Between 3 and 4	8	34	6
Between 7 and 8	7	35	6
Between 8 and 9	5	Between 35 and 36	43
Between 9 and 10	5	36	7
Between 10 and 11	5	Between 38 and 39	6
11	7	41	30
Between 12 and 13	6	Between 42 and 43	8
Between 14 and 15	6	43	9
16	5	Between 44 and 45	20
18	20	Between 45 and 46	21
19	6	46	8
Between 19 and 20	13	Between 46 and 47	9

Point Count	Total Passes	Point Count	Total Passes
Between 20 and 21	12	47	11
22	6	Between 47 and 48	11
23	5	48	6
Between 23 and 24	6	Between 48 and 49	11
24	6	49	19
Between 24 and 25	15	Between 49 and 50	37
25	14	50	17
Between 25 and 26	10	Between 50 and 51	23
26	16	51	12
Between 26 and 27	6	Between 51 and 52	15
27	11	52	26
Between 27 and 28	7	Between 52 and 53	18
28	9	53	17
29	6	Between 53 and 54	33
Between 29 and 30	28	54	6
30	20	55	17
Between 30 and 31	16	Between 55 and 56	27
31	8	56	21
Between 31 and 32	30	Between 56 and 57	5
32	18	58	10
Between 32 and 33	36	59	7
33	10	Between 59 and 60	8

In total four bat species were recorded during the spatial surveys: soprano pipistrelle (s.pip); common pipistrelle (c.pip); *Myotis* sp. and brown long-eared bat (BLE) (unknown bat and Pipistrelle sp. (pip. sp.) are not included in the overall number of species recorded). *Myotis* species recorded were likely to be Daubenton's bats, although some *Myotis* records only identified to genus level i.e. *Myotis sp*. (see table 16).

The total bat passes per hour (bpph) recorded for each species is shown in Table 8. A total of 1036 passes equating to 12.80 bat passes per hour were recorded for the survey area. Of these species the most commonly recorded by bat passes per hour was soprano pipistrelle (5.76) followed by common pipistrelle (4.84), pipistrelle sp. (1.09) *Myotis* sp. (1.04), brown long-eared (0.01) (as illustrated in Graph 1).

Table 8. *Summary of Total Spatial Surveys Results 2012.*

Total Activity						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	466	392	88	84	1	5
Total bpph	5.76	4.84	1.09	1.04	0.01	0.06
		Total Passes	1036	Total bpph	12.80	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)

Tables 9 to 14 show the total spatial survey results per survey visit. These results are also illustrated in Graph 2. Total bat passes increased after May, peaking in July (from 0.49 bpph to 21.18). The rise in bat passes was mainly attributed to an increase in common and soprano pipistrelle numbers, which increased from 0 bpph in April to 20.21 bpph in July. Bat activity decreased in August (18.98) and in September (14.69).

Bats were recorded to be commuting and feeding within the Study Area (see Annex 9).

Table 9. *Summary of Total Spatial Surveys Results April 25-26/04/12*

Activity total 1 - April 25-26/04/12						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	0	0	4	1	0	1
Total bpph	0	0.00	0.33	0.08	0.00	0.08
		Total Passes	6	Total bpph	0.49	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)

Table 10. *Summary of Total Spatial Surveys Results May 18/05/13*

Activity total 2 - May 18/05/12						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	2	1	0	4	0	1
Total bpph	0.15	0.08	0.00	0.31	0.00	0.08
		Total Passes	8	Total bpph	0.62	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)

Table 11. *Summary of Total Spatial Surveys Results June 20-21/06/12*

Activity total 3 - June 20-21/06/12						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	100	119	29	4	0	0
Total bpph	7.04	8.38	2.04	0.28	0.00	0.00
		Total Passes	252	Total bpph	17.75	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)

Table 12. *Summary of Total Spatial Surveys Results August 16-17/07/12*

Activity total 4 - July 16-17/07/12						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	127.0	143	22	13	0	1
Total bpph	8.79	9.90	1.52	0.90	0.00	0.07
		Total Passes	306	Total bpph	21.18	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)

Table 13. *Summary of Total Spatial Surveys Results August 16-17/08/12*

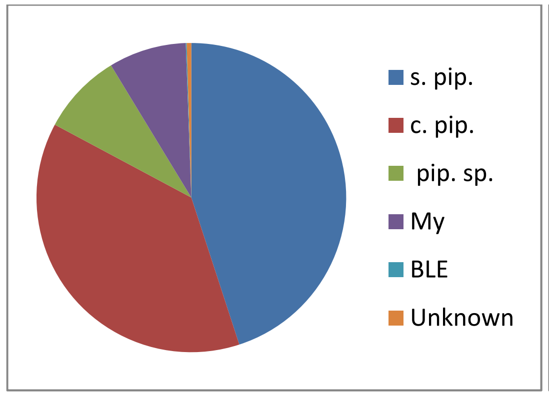
Activity total 5 - August 16-17/08/12						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	128.0	76	26	51	1	2
Total bpph	8.55	5.08	1.74	3.41	0.07	0.13
		Total Passes	284	Total bpph	18.98	

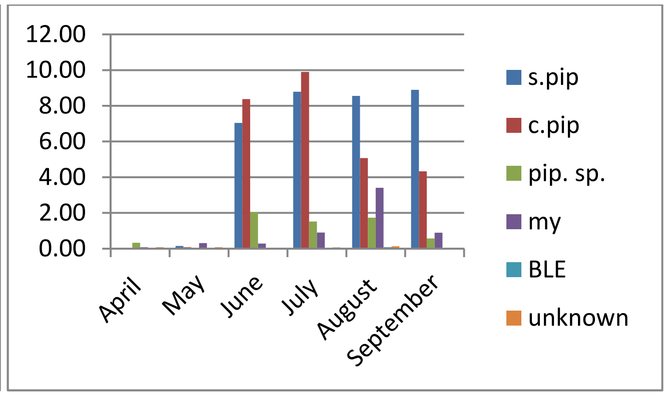
(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)

Table 14. *Summary of Total Spatial Surveys Results September 20/09/12*

Activity total 6 - September 20/09/12						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	109	53	7	11	0	0
Total bpph	8.90	4.33	0.57	0.90	0.00	0.00
		Total Passes	180	Total bpph	14.69	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)





Graph 1 (left). Spatial Survey Results: Species Composition in Study Area 2012 (bat passes per hour).
Graph 2 (right). Spatial Activity in Study Area 2012 (bat passes per hour).

6.6 Spatial Surveys – Point Counts 2013

The fidelity of bats to particular foraging areas and commuting routes can be seen in table 15 and in Figure 5.12. Only total bat passes of five or more have been included in this assessment. The majority of the survey area recorded bat passes. The highest numbers of bats passes (>10 bat passes) were witnessed in the northern section of the site parallel to linear plantations at Weasel Hill, Cleuch burn Lustruther Strip and Spar Spike.

Table 15. *Total Point Count Bat Passes 2013.*

Point Count	Total Passes	Point Count	Total Passes
Between 2 and 3	10	Between 32 and 33	45
3	6	33	42
10	5	Between 33 and 34	49
Between 10 and 11	14	34	38
11	30	Between 34 and 35	13
Between 11 and 12	5	35	24
12	15	Between 35 and 36	12
17	16	36	10
Between 26 and 27	5	Between 36 and 37	28
27	42	37	26
Between 27 and 28	8	Between 37 and 38	14
28	31	38	14
Between 28 and 29	6	Between 38 and 39	7
29	5	39	38
Between 29 and 30	11	Between 39 and 40	10
30	22	40	8
Between 30 and 31	31	Between 42 and 43	28
31	42	43	32
Between 31 and 32	28	44	39
32	34		

In total four bat species were recorded during the spatial surveys: soprano pipistrelle (s.pip); common pipistrelle (c.pip); *Myotis* sp. (My) and brown long-eared bat (unknown bat and Pipistrelle sp. (pip. sp.) are not included in the overall number of species recorded for the site). *Myotis* species recorded were Daubenton's bats with some *Myotis* records only identified to genus level i.e. *Myotis sp.* (see table 16).

The total bat passes per hour (bpph) recorded for each species is shown in Table 16. A total of 926 passes equating to 25.28 bat passes per hour were recorded. Of these species the most commonly recorded by bat passes per hour was soprano pipistrelle (13.81) followed by common pipistrelle (7.59), pipistrelle sp. (3.25) *Myotis* sp. (0.57), brown long-eared (0.03) (as illustrated in Graph 3).

Table 16. *Summary of Total Spatial Surveys Results 2013.*

Total Activity						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	506	278	119	21	1	1
Total bpph	13.81	7.59	3.25	0.57	0.03	0.03
		Total Passes	926.00	Total bpph	25.28	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)

Tables 17 to 22 show the total spatial survey results per survey visit. These results are also illustrated in Graph 4. Bat passes increased from May to June from 0.00 bpph to 64.48. Bat passes then decreased in early July (17.36) but then increased again in late July (30.95). A decrease in numbers was recorded in August (17.57). The rise in bat passes from May to June and then again in late July was mainly attributed to an increase in soprano and common pipistrelle numbers, which increased from 0.00 bpph in May to 62.9 bpph in June. *Myotis* sp. numbers also increased during these periods.

Bats were recorded to be commuting and feeding within the Study Area (see Annex 9).

Table 17. *Summary of Total Spatial Surveys Results May 15/05/13.*

Activity total 1 - May 15/05/13						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	0.00	0	0	0	0	0
Total bpph	0.00	0.00	0.00	0.00	0.00	0.00
		Total Passes	0	Total bpph	0.00	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; BLE – brown long-eared bat)

Table 18. *Summary of Total Spatial Surveys Results May 20-31/05/13.*

Activity total 2 - May 20-31/05/13						
Species	s. pip.	c. pip.	pip. sp.	My	BLE	Unknown
Bat passes	63	66	17	0	0	0
Total bpph	10.27	10.76	2.77	0.00	0.00	0.00

Total Passes	146	Total bpph	23.80

Table 19. *Summary of Total Spatial Surveys Results June 25/06/13.*

Activity total 3 - June 25/06/13						
Species	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**BLE**	**Unknown**
Bat passes	198	109	52	15	0	0
Total bpph	34.14	18.79	8.97	2.59	0.00	0.00
		Total Passes	**374**	**Total bpph**	**64.48**	

Table 20. *Summary of Total Spatial Surveys Results July 08-09/08/13.*

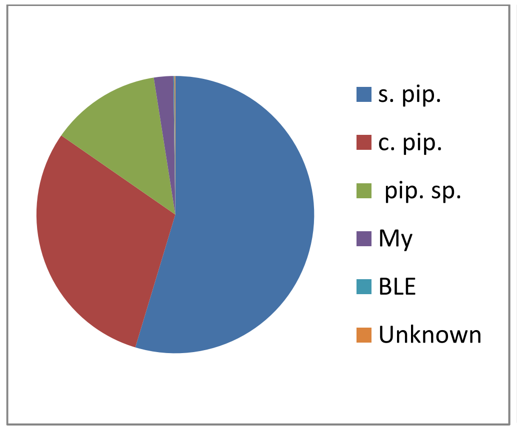
Activity total 4 - July 08-09/08/13						
Species	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**BLE**	**Unknown**
Bat passes	67.0	40	15	3	0	0
Total bpph	9.31	5.56	2.08	0.42	0.00	0.00
		Total Passes	**125**	**Total bpph**	**17.36**	

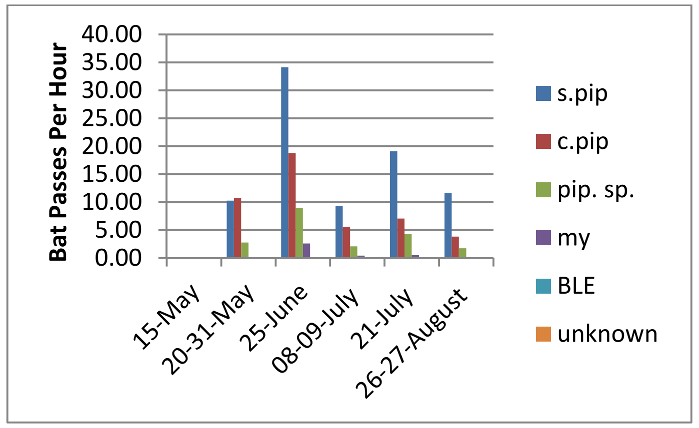
Table 21. *Summary of Total Spatial Surveys Results July 21/08/13.*

Activity total 5 - July 21/08/13						
Species	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**BLE**	**Unknown**
Bat passes	111.0	41	25	3	0	0
Total bpph	19.08	7.05	4.30	0.52	0.00	0.00
		Total Passes	**180**	**Total bpph**	**30.95**	

Table 22. *Summary of Total Spatial Surveys Results August 26-27/09/13.*

Activity total 6 - August 26-27/09/13						
Species	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**BLE**	**Unknown**
Bat passes	67	22	10	0	1	1
Total bpph	11.65	3.83	1.74	0.00	0.17	0.17
		Total Passes	**101**	**Total bpph**	**17.57**	





Graph 3 (left). Spatial Survey Results: Species Composition in Study Area 2013 (bat passes per hour).
Graph 4 (left). Spatial Activity in Study Area 2013 (bat passes per hour).

6.7 Temporal Surveys – Static Detectors 2012

Static detectors were deployed at five locations within the survey area for at least five days per survey month during the survey period (Figure 5.8). The total bat passes recorded for each species is shown in Table 23 and illustrated on Graphs 5 and 6. In total three bat species were recorded (unknown bat and Pipistrelle sp. (pip. sp.) are not included in the overall number of species recorded). Species recorded were common pipistrelle, soprano pipistrelle and *Myotis* sp. with a total of 3.25 bat passes per hour recorded. Of the species recorded the most commonly recorded by bat passes per hour was soprano pipistrelle (1.54), followed by common pipistrelle (1.44), pipistrelle species (0.19) and *Myotis* sp. (0.03). The habitat types that recorded the most bat passes per hour were edge/forest ride at location 4 (6.98) followed by edge/woodland at location 2 (5.58), open/clear fell at location 5 (2.24), edge/forest track wall at location 3 (1.65) and open/quarry at location 1 (0.23). (Figure 5.8).

Table 23*. Summary of Total Temporal Surveys Results 2012 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Location	Habitat type	rec. time	s. pip.	c. pip.	pip. sp.	My	Unknown	Total bat passes	Total bpph
1	open/quarry	286:52:00	33	27	4	1	1	66	**0.23**
2	edge/woodland	319:16:34	826	850	37	15	53	1781	**5.58**
3	edge/forest track	335:25:21	211	282	31	16	13	553	**1.65**
4	edge/forest ride	266:02:20	980	705	148	5	18	1856	**6.98**
5	open/clear fell	325:47:26	305	338	70	4	13	730	**2.24**
Total		**1533:23:41**	**2355**	**2202**	**290**	**41**	**98**	**4986**	**3.25**
Total bpph			**1.54**	**1.44**	**0.19**	**0.03**	**0.064**	**3.25**	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis*.)

Analysis of the temporal data is shown in Tables 24 to 29. Bat passes per hour in April were 0.23 which increased in May (0.89), peaking in June (10.83). Numbers then declined in July, August and September from 4.65, 4.41 to 0.60 bpph respectively. The increase from May to June was mainly attributed to the rise in common pipistrelle and soprano pipistrelle bpph. *Myotis* sp. bpph peaked in May.

Table 24. *Summary of Activity Totals April 20-25/04/12 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 1 April 20-25/04/12									
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**Unknown**	**passes**	**bpph**
1	open/quarry	50:25:00	1	1	0	1	0	3	**0.06**
2	closed/woodland	50:25:00	0	1	0	12	0	13	**0.26**
3	edge/forest track	50:18:21	1	19	0	4	2	26	**0.52**
4	closed/forest ride	0:00:00	0	0	0	0	0	0	**0.00**
5	open/clear fell	49:45:26	0	2	0	2	0	4	**0.08**
	Total bat passes		**2**	**23**	**0**	**19**	**2**		

	Total bpph	0.01	0.11	0.00	0.09	0.01		
	Total Bat Passes	46		Total bpph		0.23		

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis*.)

***Table 25**. Summary of Activity Totals May 18-24/05/12 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 2 May 18-24/05/12								
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**passes**	**bpph**
1	open/quarry	51:12:00	3	5	0	0	8	**0.16**
2	closed/woodland	50:18:34	11	3	0	3	17	**0.34**
3	edge/forest track	51:12:00	93	52	0	12	157	**3.07**
4	closed/forest ride	39:12:20	0	0	0	0	0	**0.00**
5	open/clear fell	51:12:00	9	23	0	2	34	**0.66**
	Total bat passes		**116**	**83**	**0**	**17**		
	Total bpph		**0.48**	**0.34**	**0.00**	**0.07**		
	Total Bat Passes		**216**		**Total bpph**		**0.89**	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis*.)

***Table 26**. Summary of Activity Totals Junes 21-27/06/12 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 3 June 21-27/06/12									
Location	**Habitat type**	**l rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**Unknown**	**passes**	**bpph**
1	open/quarry	13:24:00	0	0	0	0	0	0	**0.00**
2	closed/woodland	45:12:00	3	113	12	0	0	128	**2.83**
3	edge/forest track	45:12:00	9	17	3	0	0	29	**0.64**
4	closed/forest ride	45:12:00	842	611	125	5	2	1585	**35.07**
5	open/clear fell	45:12:00	152	156	46	0	7	361	**7.99**
	Total bat passes		**1006**	**897**	**186**	**5**	**9**		
	Total bpph		**5.18**	**4.62**	**0.96**	**0.03**	**0.05**		
	Total Bat Passes		**2103**		**Total bpph**		**10.83**		

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis*.)

***Table 27**. Summary of Activity Totals July 16-23/07/12 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 4 July 16-23/07/12									
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**unknown**	**passes**	**bpph**
1	open/quarry	49:30:00	7	8	0	0	0	15	**0.30**
2	closed/woodland	57:10:00	306	539	20	0	34	899	**15.73**
3	edge/forest track	57:10:00	60	154	26	0	4	244	**4.27**
4	closed/forest ride	50:20:00	16	42	6	0	0	64	**1.27**
5	open/clear fell	57:10:00	8	26	7	0	0	41	**0.72**
	Total bat passes		**397**	**769**	**59**	**0**	**38**		
	Total bpph		**1.46**	**2.83**	**0.22**	**0.00**	**0.14**		
	Total Bat Passes		**1263**		**Total bpph**		**4.65**		

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis*.)

***Table 28**. Summary of Activity Totals August 16-23/08/12 (bpph for location does not correspond* to species bpph as the species bpph is calculated to total survey effort).

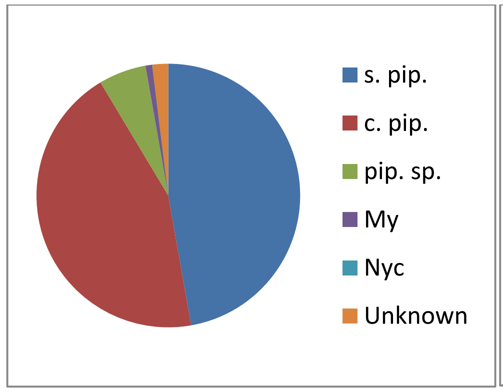
Activity total 5 August 16-23/08/12									
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**unknown**	**passes**	**bpph**
1	open/quarry	54:00:00	22	13	4	0	1	40	**0.74**
2	closed/woodland	58:54:00	430	141	5	0	19	595	**10.10**
3	edge/forest track	70:35:00	29	28	2	0	5	64	**0.91**
4	closed/forest ride	70:19:00	122	52	17	0	16	207	**2.94**
5	open/clear fell	69:13:00	136	131	17	0	6	290	**4.19**
	Total bat passes		**739**	**365**	**45**	**0**	**47**		
	Total bpph		**2.29**	**1.13**	**0.14**	**0.00**	**0.15**		
	Total Bat Passes		**1196**		**Total bpph**		**4.41**		

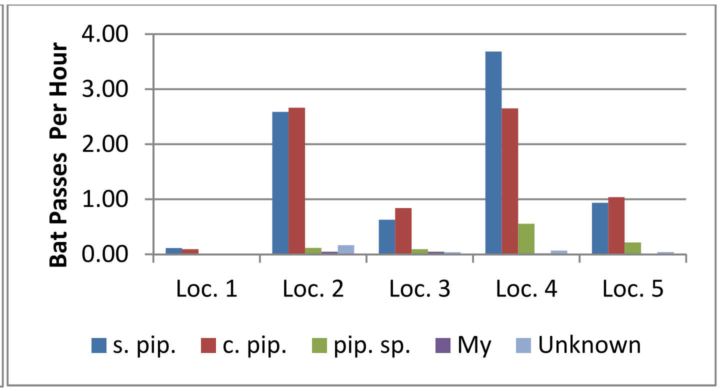
(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis*.)

***Table 29**. Summary of Activity Totals September 13-19/09/12 (bpph for location does not correspond* to species bpph as the species bpph is calculated to total survey effort).

Activity total 6 September 13-19/09/12									
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**unknown**	**passes**	**bpph**
1	open/quarry	68:21:00	0	0	0	0	0	0	**0.00**
2	closed/woodland	57:17:00	76	53	0	0	0	129	**2.25**
3	edge/forest track	60:58:00	19	12	0	0	2	33	**0.54**
4	closed/forest ride	60:59:00	0	0	0	0	0	0	**0.00**
5	open/clear fell	53:15:00	0	0	0	0	0	0	**0.00**
	Total bat passes		**95**	**65**	**0**	**0**	**2**		
	Total bpph		**0.32**	**0.22**	**0.00**	**0.00**	**0.01**		
	Total Bat Passes		**162**		**Total bpph**		**0.60**		

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis*.)





Graph 5 (left). Temporal Activity of survey area 2012 (bat passes per hour).
Graph 6 (right). Temporal Survey Results 2012: Species Composition of survey area (bat passes per hour).

6.8 Temporal Surveys – Static Detectors 2013

Static detectors were deployed at four locations within the survey area for at least five days per month during the survey period (Figure 5.11). The total bat passes recorded for each species is shown in Table 30 and illustrated on Graphs 7 and 8. In total four bat species were recorded (unknown bat and Pipistrelle sp. (pip. sp.) are not included in the overall number of species recorded for the Site). Species recorded were common pipistrelle, soprano pipistrelle, *Myotis* sp. and *Ncytalus* sp. with a total of 8.05 bat passes per hour recorded. Of the species recorded the most commonly recorded by bat passes per hour was soprano pipistrelle (3.83) followed by common pipistrelle (3.59), pipistrelle species (0.32), *Myotis* sp. (0.27) and *Nyctalus* sp. (0.01). The habitat type that recorded the most bat passes per hour was edge/conifer edge at location 3 (18.19) followed by edge/stone wall & conifer (12.55) at location 4, edge/stonewall and scrub (2.44) at location 1and open/moorland at location 2 (1.76).

Table 30. *Summary of Total Temporal Surveys Results 2013 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Location	Habitat type	rec. time	s. pip.	c. pip.	pip. sp.	My	Nyc	Unknown	Total bat passes	Total bpph
1	Edge/stonewall and scrub	280:45	371	249	29	32	1	2	684	**2.44**
2	Open/moorland	325:04	77	428	43	8	1	14	571	**1.76**
3	edge/conifer edge	246:23	2354	1858	83	169	4	13	4481	**18.19**
4	edge/stonewall &conifer	250:37	1422	1428	201	84	3	6	3144	**12.55**
Total		**1102:49**	**4224**	**3963**	**356**	**293**	**9**	**35**	**8880**	**8.05**
Total bpph			**3.83**	**3.59**	**0.32**	**0.27**	**0.01**	**0.032**	**8.05**	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.; nyc – *Nyctalus* sp.)

Analysis of the temporal data is shown in Tables 31 to 37. Bat passes per hour in April were 0.03 which increased in May (7.84), May – June (11.18) and June – July (12.33). Numbers then declined in August (5.23) but peaked in late August (17.50) and then declined again in September (2.99). The increase from May to July and then in late August was mainly attributed to the rise in common pipistrelle and soprano pipistrelle bpph. *Myotis* sp. bpph peaked in late August.

Table 31. *Summary of Activity Totals April 24-29/04/13 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 1 April 24-29/04/13									
Location	Habitat type	rec. time	s. pip.	c. pip.	pip. sp.	My	Nyc	passes	bpph
1	Edge/stonewall and scrub	51:25:00	0	0	0	0	0	0	**0.00**
2	Open/moorland	51:25:00	0	0	0	0	0	0	**0.00**
3	edge/conifer edge	0:00:00	0	0	0	0	0	0	**0.00**
4	edge/stonewall &conifer	51:25:00	4	1	0	0	0	5	**0.10**
	Total bat passes		**4**	**1**	**0**	**0**	**0**		
	Total bpph		**0.03**	**0.01**	**0.00**	**0.00**	**0.00**		
	Total Bat Passes		**5**		**Total bpph**			**0.03**	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp; nyc – *Nyctalus* sp.

Table 32. *Summary of Activity Totals May 15-20/05/13 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 2 May 15-20/05/13									
Location	Habitat type	rec. time	s. pip.	c. pip.	pip. sp.	My	Nyc	passes	bpph
1	Edge/stonewall and scrub	44:40:00	1	9	0	0	0	10	**0.22**
2	Open/moorland	27:15:00	0	0	0	0	0	0	**0.00**
3	edge/conifer edge	22:18:00	0	0	0	0	0	0	**0.00**
4	edge/stonewall &conifer	44:40:00	266	669	136	8	0	1079	**24.16**
	Total bat passes		**267**	**678**	**136**	**8**	**0**		
	Total bpph		**1.92**	**4.88**	**0.98**	**0.06**	**0.00**		
	Total Bat Passes		**1089**		**Total bpph**			**7.84**	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.;nyc – *Nyctalus* sp.)

Table 33. *Summary of Activity Totals May – June 30/05/13 – 04/06/13 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 3 May -June 30/05/13 - 04/06/13											
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**Nyc**	**Unknown**	**passes**	**bpph**
1	Edge/stonewall and scrub	40:10:00	9	21	1	1	0	0	32	**0.80**
2	Open/moorland	40:10:00	8	18	2	0		1	29	**0.72**
3	edge/conifer edge	40:10:00	629	1012	38	13	4	0	1696	**42.22**
4	edge/stonewall &conifer	36:42:00	0	0	0	0	0	0	0	**0.00**
	Total bat passes		**646**	**1051**	**41**	**14**	**4**	**1**		
	Total bpph		**4.11**	**6.69**	**0.26**	**0.09**	**0.03**	**0.01**		
	Total Bat Passes		**1757**		**Total bpph**			**11.18**		

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.;; nyc – *Nyctalus* sp.)

***Table 34**. Summary of Activity Totals June - July 26/06/13 – 01/07/13 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 4 June - July 26/06/13 - 01/07/13									
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**Nyc**	**passes**	**bpph**
1	Edge/stonewall and scrub	0:00:00	0	0	0	0	0	0	**0.00**
2	Open/moorland	31:32:00	0	0	0	0	0	0	**0.00**
3	edge/conifer edge	39:25:00	288	122	6	5	0	421	**10.68**
4	edge/stonewall &conifer	18:40:00	312	346	20	6	0	684	**36.64**
	Total bat passes		**600**	**468**	**26**	**11**	**0**		
	Total bpph		**6.70**	**5.22**	**0.29**	**0.12**	**0.00**		
	Total Bat Passes		**1105**		**Total bpph**			**12.33**	

(Abbreviations: s.pip – soprano pipistrelle; c.pip – common pipistrelle; pip. sp. – unidentified common or soprano pipistrelle; My – *Myotis* sp.;; nyc – *Nyctalus* sp.)

***Table 35**. Summary of Activity Totals August 09-14/08/13 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

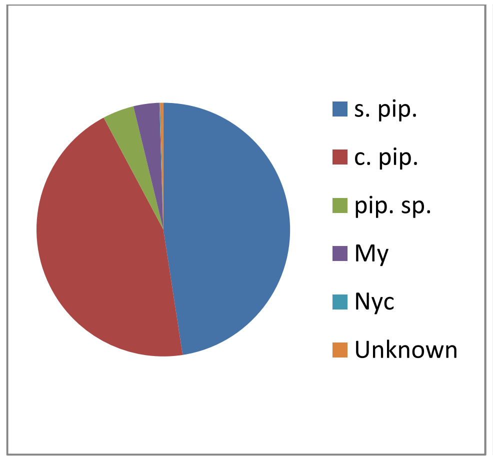
Activity total 5 August 09-14/08/13										
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**Nyc**	**unknown**	**passes**	**bpph**
1	Edge/stonewall and scrub	37:52:00	34	15	1	11	0	1	62	**1.64**
2	Open/moorland	47:20:00	6	8	0	3	0	3	20	**0.42**
3	edge/conifer edge	37:52:00	144	45	5	25	0	0	219	**5.78**
4	edge/stonewall &conifer	47:20:00	373	187	19	10	0	2	591	**12.49**
	Total bat passes		**557**	**255**	**25**	**49**	**0**	**6**		
	Total bpph		**6.22**	**2.85**	**0.28**	**0.55**	**0.00**	**0.07**		
	Total Bat Passes		**892**		**Total bpph**			**5.23**		

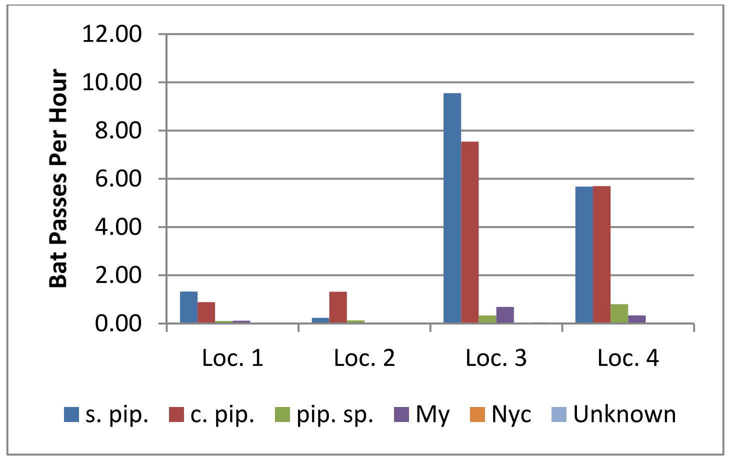
***Table 36**. Summary of Activity Totals August 22-27/08/13 (bpph for location does not correspond to species bpph as the species bpph is calculated to total survey effort).*

Activity total 6 August 22-27/08/13										
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**Nyc**	**Unknown**	**passes**	**bpph**
1	Edge/stonewall and scrub	41:28:00	288	185	27	19	0	1	520	**12.54**
2	Open/moorland	62:12:00	54	386	39	4	1	7	491	**7.89**
3	edge/conifer edge	41:28:00	981	511	30	118	0	11	1651	**39.82**
4	edge/stonewall &conifer	51:50:00	467	225	26	60	3	4	785	**15.14**
	Total bat passes		**1790**	**1307**	**122**	**201**	**4**	**23**		
	Total bpph		**19.97**	**14.58**	**1.36**	**2.24**	**0.04**	**0.26**		
	Total Bat Passes		**3447**		**Total bpph**			**17.50**		

***Table 37**. Summary of Activity Totals September – October 26/09/13 – 01/10/13 (bpph for location does not correspond* to species bpph as the species bpph is calculated to total survey effort).

Activity total 7 September - October 26/09/13 - 01/10/13										
Location	**Habitat type**	**rec. time**	**s. pip.**	**c. pip.**	**pip. sp.**	**My**	**Nyc**	**Unknown**	**passes**	**bpph**
1	Edge/stonewall and scrub	65:10:00	39	19	0	1	1	0	60	**0.92**
2	Open/moorland	65:10:00	9	16	2	1	0	3	31	**0.48**
3	edge/conifer edge	65:10:00	312	168	4	8	0	2	494	**7.58**
4	edge/stonewall &conifer	0:00:00	0	0	0	0	0	0	0	**0.00**
	Total bat passes		**360**	**203**	**6**	**10**	**1**	**5**		
	Total bpph		**4.02**	**2.27**	**0.07**	**0.11**	**0.01**	**0.06**		
	Total Bat Passes		**585**		**Total bpph**			**2.99**		





Graph 7 (left). Temporal Survey Results: Species Composition of survey area (bat passes per hour).
Graph 8 (right). Temporal Activity of survey area (bat passes per hour).

6.9 Collision Risk

Table 38 represents the total number of bat passes per hour for high, medium and low risk species. The figure for individual bat species has been achieved by combining the temporal and static survey results which is then presented as total survey time (spatial and temporal). The activity rate for unknown bat species is 0.01 which is not represented in the table below as it cannot be assigned a risk level.

Table 38*. Collision Risk Table 2012.*

Species	High	Medium	Low
s. pipistrelle	-	1.75	-
c. pipistrelle	-	1.61	-
Pipistrelle sp.	-	0.23	-
Myotis sp.		-	0.08
Total bat passes per hour	**-**	**3.59**	**0.08**

Table 39*. Collision Risk Table 2013.*

Species	High	Medium	Low
s. pipistrelle	-	4.2	-
c. pipistrelle	-	3.7	-
Pipistrelle sp.	-	0.4	-
Myotis sp.	-	-	0.3
Brown long-eared	-	-	0.001
Nyctalus sp.	0.01	-	-
Total bat passes per hour	**0.01**	**8.3**	**0.30**

7. DISCUSSION AND RECOMMENDATIONS

7.1 Survey Overview

The dusk and dawn surveys did not located bat roosts within 200 m of a proposed turbine. Potential tree roosts and potential bat buildings are within the site as shown in Figure 5.14 but have not been quantified as they are more than 200 m from a proposed turbine.

Much of the variation in activity between locations and surveys can be accounted for by changes in weather but also by the fidelity of bats to particular foraging areas and commuting routes.

The results of the 2012 spatial and temporal surveys show the highest concentration of fidelity (bpph) to be in the eastern section of the survey area around Westeshiels, Peden's Cleuch, Jed Water and Black Burn. Bat numbers peaked in July for spatial surveys (12.80 bpph) and peaked in June for temporal surveys (10.83 bpph).

The results of the 2013 spatial and temporal surveys show the highest concentration of fidelity (bpph) to be in the northern section of the survey area parallel to linear plantations at Weasel Hill, Cleuch burn Lustruther Strip and Spar Spike. Bat numbers peaked in June for spatial surveys (64.48 bpph) and peaked in August for temporal surveys (17.50 bpph). Paired detectors at locations 1 and 2 showed that open areas (1.76 bpph) had less bpph than edge habitat (2.44 bpph).

Five bat species were recorded within the 2012 and 2013 survey areas: common pipistrelle, soprano pipistrelle, *Myotis* sp., brown long-eared, and *Nyctalus* sp. (unknown bat and Pipistrelle sp. (pip. sp.) are not included in the overall number of species recorded). The most commonly recorded were common and soprano pipistrelles. *Nyctalus* species which are high risk species were only recorded during the 2013 surveys on the static (temporal) detectors.

The total bpph activity for the 2012 surveys was considered to be high for the spatial detectors at 12.80 bpph and low for the temporal detectors at 3.25 bpph. The activity levels for medium and low risk species is considered to be low at 3.59 and 0.08 bpph, respectively.

The total bpph activity for the 2013 surveys was considered to be high for the spatial surveys at 25.28 bpph and medium for the temporal surveys at 8.05 bpph. The activity levels for high risk and low risk species is considered to be low at 0.01 and 0.30, respectively. The activity levels for medium risk species is considered to be medium at 8.3

7.2 High Risk Species

Nyctalus sp. were only recorded during the 2013 surveys and were recorded on all static (temporal) detectors across the survey area but in low numbers. Location 3 recorded the most passes (4 passes) followed by temporal surveys at location 4 (3 passes), location 2 (1 pass) and location 1 (1 pass). As only 9 passes (0.01 total bpph) of *Nyctalus* species was recorded, it would suggest that *Nyctalus* species are only present within the site very infrequently.

Nyctalus species are relatively more active at a height of 30m than those species with high frequency echolocation calls such as *Myotis* and *Plecotus* (Collins & Jones, 2009*)*. A study on the difference of bat activity in relation to bat detector height found the difference between *Nyctalus* passes at the upper and lower detectors not to be statistically significant, despite proportionally more passes of these species being recorded at height (Collins & Jones, 2009). Not all sites in the study by Collins & Jones (2009) recorded more *Ncytalus* passes at height, with two sites recording more passes at the lower detectors than the higher detectors suggesting that habitat type can determine the activity height of *Nyctalus* species.

The temporal static ground level detectors in the survey areas could be under recording *Nyctalus* species, however according to the study above, surveying from ground level does appear to provide a reasonable accurate account of the species composition of bat populations except in closed canopy woodland situations such as within the site. The possible under recording of *Nyctalus* species in closed canopy has been factored into the ES assessment.

High risk species recorded a low activity rate of 0.01 bpph in 2013 which even when considering that this number could be an underestimated (doubling the bpph from 0.01 to 0.02) would still be considered low.

7.3 Medium Risk Species

The greatest activity seen throughout the spatial and temporal survey was a result of medium risk species such as common pipistrelle and soprano pipistrelle. These bat species are considered at medium risk of but are low risk species at the population level due to their distribution and abundance within the UK. Population estimates for common pistrelle and soprano pipstrelle batsin the UK in 2005 were 2,430,000 and 1,300,000 respectively (JNCC, 2007).

The conservation status of soprano pipistrelle is unknown with future prospects favourable with the species expected to survive and prosper (JNCC 2007).

The conservation status of common pipistrelle is favourable with future prospects favourable with the species expected to survive and prosper (JNCC 2007).

The total activity levels in 2012 for medium risk species is considered to be low at 3.59 while the activity levels in 2013 are considered to be medium at 8.3

Common and soprano pipistrelles were recorded around edge habitats such as plantation edge and burns which are the typical coummuting and foraging habiats of these species.

7.4 Low Risk Species

Only low numbers of *Myotis* sp. were recorded in the survey area during both spatial and temporal surveys in 2012 and 2013. Habitat usage was similar to pipistrelle species with *Myotis* also favouring edge habitats such as burns and planation edge.

Myotis species are low risk for collision and also low risk at the population level (Natural England, 2012*).*

Low risk species recorded a low bpph in 2012 and in 2013 of 0.80 and 0.30 respectively.

7.5 Mitigation Proposals

It may be required to fell particular areas of plantation within the site to facilitate the placement of turbines and other infrastructure. This will allow turbines to be placed over 50 m from the edge of the remaining plantation which is in accordance to best practice guidelines (Natural England, 2012). Recent on-going research at Stirling University is finding that bat activity (bpph) increases in felled plantation habitat, as it increases edge habitat (Lucinda Kirkpatrick, Bat Conservation Trust Conference, pers. comms.). However, key-holing also increases edge habitat and bpph, therefore felling is seen to be the favourable option, as it allows a 50 m buffer to be adhered to.

The loss of open (farmland) and closed (plantation) habitat within the site will only marginally reduce the forging opportunities. Given the abundance of these habitat types to be lost to the proposed wind farm in the surrounding environs, their loss is not considered to be significant.

The surveys identified medium risk species (pipistrelle species) to remain close to linear habitat features when commuting and utilise such areas for feeding. Following Natural England guidance (2014), it is recommend that a 50 m buffer from turbine blade tip to the feature is adhered to in areas with edge habitat such as burns and plantation edge. Areas identified during the 2012 and 2013 surveys as feeding and commuting resource which recorded high and medium bpph levels have been identified in Figure 5.9 and buffered with a 50 m turbine buffer as shown on the figure (NB, the buffers on the figure are 50 m, and not the calculated distance following the equation below) and in Annex 6.

The edge of the rotor-swept area needs to be at least 50 m from the nearest part, usually the highest point, of the habitat feature. Guidelines suggest a calculation, as shown below (blade length (bl), the hub height (hh) and feature height (fh));

$$b = \surd\ (50m + bl)\ 2 – (hh – fh)^2$$

If tree(s) with ivy, cracks and/or crevices are to be felled they must be investigated prior to works as bats can occupy a cavity that has not been historically used and thus there is the potential for an offence to occur if the tree/s is not inspected prior to felling works (refer to Annex 4). A summary of possible mitigation requirements is shown in table 40.

Table 40. *Summary of Mitigation*

Potential Impact	Mitigation
Direct Impact - Collision	Turbines positioned 50 m away from features (blade tip to feature) that are used by commuting and foraging bats identified within Figures 5.9 and 5.12.
Direct Impact - Loss of tree roost/s	If it is proposed to fell or prune trees with ivy, cracks and cavities they must be inspected prior to works by a suitability qualified bat ecologist. This mitigation will also will form part of the Species Protection Plan for the proposed wind farm (see ES Volume 4, Technical Appendix 5.7 for Draft Species Protection Plan)
Indirect Impact – Loss of potential tree roost/s	If it is proposed to fell potential tree roost/s habitats that do not contain a roost but are suitable, then the loss of potential roosting habitat should be mitigated by planting the same tree species in suitable habitat that has been lost to the proposed wind farm.

8. REFERENCES

Altringham, J. D. (2003). *British Bats*. Collins, New Naturalist Series. ISBN 000220147X.

Arnett, E. B. &13 others (2008). Patterns of bat fatalities at wind energy facilities in North America. *The Journal of Wildlife Management* 72(1): 61-78.

Baerwald, E. F., G. H. D'Amours, B. J. Klug, and R. M. R. Barclay. (2008). Barotrauma is a significant cause of bat fatalities at wind turbines. *Current Biology* 18 (16): 695-696.

Bat Conservation Trust (2009). *Determining the impact of wind turbines on bat populations in Great Britain:* Phase 1 Report. Bat Conservation Trust, London.

Bat Conservation Trust (2008). *Encouraging Bats. A Guide for Bat-friendly Gardening and Living*. Bat Conservation Trust, London.

Collins, J. and Jones, G (2009). Differences in bat activity in relation to bat detector height: implications for bat surveys at proposed windfarm sites. *Acta Chiropterologica* 11(2): 343-350. doi: http://dx.doi.org/10.3161/150811009X485576

Entwistle, A. C., Harris, S., Hutson, A. M., Racey, P. A., Walsh, A., Gibson, S. D., Hepburn, I. and Johnston, J. (2001). *Habitat management for bats – A guide for land managers, land owners and their advisors.* JNCC, Peterborough.

Haddow, J.F. (2012) *Looking for Leisler's – in Scotland*. Central Scotland Bat Group/Auritus Wildlife Consultancy.

Haddow, J. F. & Herman, J. S. (2000). *Scottish Bats*, Volume 5. ISBN 0952018241.

Harris, S., Morris P., Wray, S. and Yalden, D. (1995). *A review of British mammals: population estimates and conservation status of British mammals other than cetaceans*. JNCC, Peterborough.

Hundt, L. (2012) *Bat Surveys: Good Practice Guidelines, 2nd edition*. Bat Conservation Trust ISBN-13: 9781872745985.

Johnson, G. D. (2005). A review of bat mortality at wind-energy developments in the United States. *Bat Research News* 46: 45–49.

Kunz, T. H., E. B. Arnett, W. P. Erickson, A. R. Hoar, G. D. Johnson, R.P. Larkin, M. D. Strickland, R. W. Thresher, and M. D. Tuttle. (2007). Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. *Frontiers in Ecology and the Environment* 5: 315–324.

Mitchell-Jones, A. J. and McLeish, A. P. (2004). *Bat Workers Manual 3rd Edition*. JNCC, Peterborough.

Natural England (2012). *Bats and onshore wind turbines: interim guidance*. Second Edition TIN051. English Nature.

Osborn, B., Wallace, J. and McGuire, R. (2011) Bat Survey Report Loch Hill Proposed Windfarm. Direct Ecology.

Shiel, C. B., Shiel R.E, Fairley, J.S (1999). Seasonal Changes in the Foraging Behaviour of Leisler's bats (*Nyctalus leisleri*) in Ireland as revealed by radio-telemetry. *Journal of Zoology* 249(3): 347-358.

Richardson, P. (2000). *Distribution Atlas of Bats in Britain and Ireland 1980-1999*. The Bat Conservation Trust, London.

Rodrigues L., Bach L., Dubourg-Savage M.J., Goodwin J. & Harbusch C. (2008). *Guidelines for consideration of bats in wind farm projects*. EUROBATS Publication Series No. 3.

Russ, J. (1999). *The Bats of Britain & Ireland, Echolocation Calls, Sound Analysis and Species Identification*. Alana Books, ISBN 095360490X.

Rydell, J., Bach, L., Dubourg-Savage, M-J., Green, M., Rodrigues, L. and Hedenström, A. (2010a). Bat mortality at wind turbines in northwestern Europe, *Acta Chiropterologica* Volume 12(2): 261-274.

Rydell, J., Bach, L., Dubourg-Savage, M-J.,; Green, M., Rodrigues, L. and Hedenström, A. (2010b). Mortality of bats links to nocturnal insect migration European Journal of Wildlife Research 56(6): 823-827. DOI 10.1007/s10344-010-0444-3.

Rydell, J., Engstrom, H., Hedenström, A., Larsen, J-K., Pettersson, J. and Green, M. (2012). *The effects of wind power on birds and bats: A synthesis*. The Swedish Environmental Protection Agency, Report 6511, August 2012.

Scottish Natural Heritage (2007). *Natural Heritage and the Law: Bats and People*. Scottish Natural Heritage, Battleby.

Waters, D., Jones, G., Furlong, M. (1999). Foraging Ecology of Leisler's bat (*Nyctalus leisleri*) at two sites in Southern Britain. *Journal of Zoology* 249(2): 173-180.

ANNEX 1 – Protected Species Legal Status

All **bat** species receive protection under the Conservation Regulations (1994) (as amended) only[2].

Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)

Under Regulation 39 (1) it is an offence to:

(a) deliberately or recklessly to capture, injure or kill a wild animal of a European protected species;

(b) deliberately or recklessly:

- (i) to harass a wild animal or group of wild animals of a European protected species;
- (ii) to disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
- (iii) to disturb such an animal while it is rearing or otherwise caring for its young;
- (iv) to obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place (i.e. roost sites);
- (v) to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs; or
- (vi) to disturb such an animal 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;

(c) deliberately or recklessly to take or destroy the eggs of such an animal; or

(d) to damage or destroy a breeding site or resting place of such an animal.

Regulation 44 (2e) allows a licence to be granted for the activities noted in Regulation 39 such that:

Preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment.

[2] The Conservation Amendment (Scotland) Regulations (2007) removed EPS from Schedule 5 and 8 of the Wildlife and Countryside Act 1981.

ANNEX 2 – Determining Survey Effort

Factors to consider when determining the survey effort of a site (taken from Bat Conservation Trust: Hundt, 2012)			
Quality of habitat and number of habitat features likely to affect bat mortality rates if altered by development*	**Species likely to use the site***	**Importance of roosts, of species likely to use site, which may be affected by development***	**Potential risk level of development**
No potential habitat for roosting, foraging or commuting bats	None	Local	Lowest
Small number of potential roost features, of low. Low quality foraging habitat that could be used by small numbers of foraging bats Isolated site not connected to the wider landscape by prominent linear features.	Low number, single low risk species High number, several low risk species	Parish	Low
Buildings, trees or other structures with moderate high potential as roost sites on or near the site. Habitat could be used extensively by foraging bats. Site is connected to the wider landscape by linear features such as scrub, tree lines and streams.	Low number, medium risk species High number, medium risk species	District County	Medium
Numerous suitable buildings, trees (particularly mature ancient woodland) or other structures with moderate-high potential as roost sites on or near the site, and/or confirmed roosts present close to or on the site. Extensive and diverse habitat mosaic of high quality for foraging bats. Site is connected to the wider landscape by a network of strong linear features such as rivers, blocks of woodland and mature hedgerows.	High number, single high risk species High number, several high risk species High number, all high risk species	National International	High

ANNEX 3 – Risk Level and Minimum Survey Requirements

Risk Level (taken from Bat Conservation Trust: Hundt, 2012)			
	Low risk	**Medium risk**	**High risk**
	Roost survey		
Selection of roosts requiring further survey	If evidence of roosting by medium or high-risk species and/or roosts of district importance and above is found, further survey should follow SNCO guidance and guidelines given wherever possible.		
Survey period	Surveys should provide data for one season as a minimum.		
Survey area	Up to 200m + rotor radius from turbine locations or potential turbine locations	Up to 200m + rotor radius from turbine locations or potential turbine locations	Up to 200m + rotor radius from turbine locations or potential turbine locations
Ground level transect surveys	One visit per transect each season(spring, summer and autumn)	One visit per transect each month (April-Oct)	Up to two visits per transect each month may be required (April-Oct)
Automated surveys at ground level	5 consecutive nights for each single 18 or pair of locations within the survey area, per season	5 consecutive nights for each single or pair of locations within the survey area, per month	Up to 2 sets of 5 consecutive nights for each single or pair of locations within the survey area, per month
Automated surveys at height	For situations where at-height survey may be appropriate. For surveys undertaken from masts (met mast or other) survey effort is as outlined above for surveys at ground level.		

ANNEX 4 – Protocol for Visual Inspection

(Taken from Hundt, 2012)

Tree category and description	Stage 1 Initial survey requirements	Stage 2 Further measures to inform proposed mitigation	Stage 3 Likely mitigation
Known or confirmed roost	Follow SNCO guidance and these guidelines wherever possible, to establish the extent to which bats use the site. This is particularly important for roosts of high risk species and/or roosts of district or higher importance and above		The tree can be felled only under EPS licence following the installation of equivalent habitats as a replacement.
Category 1* Trees with multiple, highly suitable features capable of supporting larger roosts	Tree identified on a map and on the ground. Further assessment to provide a best expert judgement on the likely use of the roost, numbers and species of bat, by analysis of droppings or other field evidence. ***A consultant ecologist is required***	Avoid disturbance to trees, where possible. Further dusk and pre-dawn survey to establish more accurately the presence, species, numbers of bats present and the type of roost, and to inform the requirements for mitigation if felling is required.	Felling would be undertaken taking reasonable avoidance measures[3] such as 'soft felling' to minimise the risk of harm to individual bats.
Category 1 Trees with definite bat potential, supporting fewer suitable features that category 1* trees or with potential for use by single bats	Tree identified on a map and on the ground. Further assessed to provide a best expert judgement on the potential use of suitable cavities, based on the habitat preferences of bats. ***A consultant ecologist required***	Avoid disturbance to trees, where possible. More detailed, off the ground visual assessment. Further dusk and pre-dawn survey to establish the presence of bats, and if present, the species and numbers of bats and type of roost, to inform the requirements for mitigation if felling is required.	Trees with confirmed roosts following further survey are upgraded to Category 1* and felled under licence as above. Trees with no confirmed roosts may be downgraded to Category 2 dependent on survey findings
Category 2 Trees with no obvious potential, although the tree is of a size and age that elevated surveys may result in cracks or crevices being found; or the tree supports some features which may have limited potential to support bats.	None. ***A consultant ecologist is unlikely to be required***	Avoid disturbance to trees, where possible. No further surveys.	Trees may be felled taking reasonable avoidance measures. Stop works and seek advice in the event bats are found, in order to comply with relevant legislation.
Category 3 Trees with no potential to support bats	None. ***A consultant ecologist is not required unless new evidence is found***	None.	No mitigation for bats required.

ANNEX 5– Target Notes

TN	Feature	X	Y	Climbed/ Endoscoped	Category	Dusk and dawn	Notes	Recommendations
1	Scots pine	362177	608826	No	1	No	Found on the southeast patch of woodland. Branch wound facing wall. This tree is part of a patch of woodland that has several potential bat trees of category 1/1*.	If felling, lopping and/or working within the root plate then surveys (climbing and/or dusk and dawn) to be carried out prior to works.
2	Ash	362178	608825	No	1	No	Branch wound. This tree is part of a patch of woodland that has several potential bat trees of category 1/1*.	If felling, lopping and/or working within the root plate then surveys (climbing and/or dusk and dawn) to be carried out prior to works.
3	Ash	362178	608825	No	1	No	Two branch wounds. This tree is part of a patch of woodland that has several potential bat trees of category 1/1*.	If felling, lopping and/or working within the root plate then surveys (climbing and/or dusk and dawn) to be carried out prior to works.
4	Scots pine	361152	609604	No	1	No	Branch wound.	If felling, lopping and/or working within the root plate then surveys (climbing and/or dusk and dawn) to be carried out prior to works.
5	Oak	362331	609581	No	1*	No	Two branch wounds.	If felling, lopping and/or working within the root plate then surveys (climbing and/or dusk and dawn) to be carried out prior to works.
6	Scots pine	361768	609472	No	1*	No	Dead tree with hollow stem and multiple cavities.	If felling, lopping and/or working within the root plate then surveys (climbing and/or dusk and dawn) to be carried out prior to works.
7	Scots pine	361867	609270	No	1	No	Dead tree with hollow stem.	If felling, lopping and/or working within the root plate then surveys (climbing and/or dusk and dawn) to be carried out prior to works.
8	Broadleaved trees	362185	606484	No	1/1*	Yes	Patch of broadleaved trees near stone ruin with cavities that could provide roosting opportunities. Dusk and dawn surveys by three surveyors did not record any bats emerging or entering cavities.	If felling, lopping and/or working within the root plate then surveys (climbing and/or dusk and dawn) to be carried out prior to works.

ANNEX 6 – Illustration to Show 50 m Buffer Zone

Taken from Natural England (2012). Bats and onshore wind turbines: interim guidance. TIN051.Second Edition)

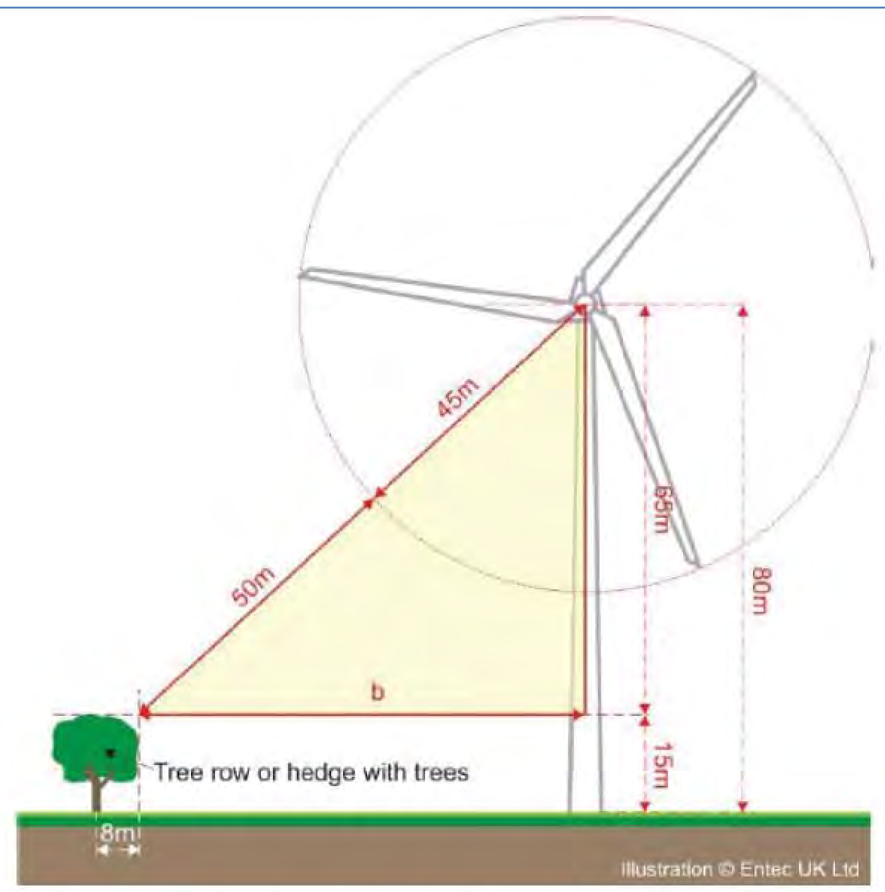


Figure 2-16: Illustration to show how to calculate the 50m buffer zone into which no part of the wind turbine should enter (taken from Natural England interim guidance 2009).

ANNEX 7 – Dusk and Dawn Roost Data

	Start survey	Finish survey	Weather								
21:24 – Dusk 17/05/12 Westershils	20:59	23:30	Hour	Temperature	Wind Speed	Wind Direction	Rain	Relative Humidity %	Cloud Cover	Cloud Height	Notes
			1	10	1	-	1	-	8/8	200m	Light Brief shower
			2	10	1	-	0	-	8/8	200m	
04:52– Dawn 18/07/2012 Westershils	03:30	05:00	Hour	Temperature	Wind Speed	Wind Direction	Rain	Relative Humidity %	Cloud Cover	Cloud Height	
			1	13	1	-	0	-	1/8	200m	
			2	13	1	-	0	-	1/8	200m	

Westershils Results

Survey	Date	Surveyor	Species	Time	No.	Roosting	Behaviour	Notes	Time after Dusk or Before Dawn
Dusk	17/05/2012	LC	0		0			No bats recorded	
Dusk	17/05/2012	RW	45 pip	22:35	1	No		3 passes	01:11
Dusk	17/05/2012	AR	55 pip	21:40	1	No	Feeding	1 pass	00:16
Dusk	17/05/2012	AR	45 pip	22:21	1	No	Feeding	3 passes	00:57
Dusk	17/05/2012	AR	pip sp.	22:33	1	No	Feeding	2 passes	01:09
Dusk	17/05/2012	AR	45 pip.	22:41	2	No	Feeding	1 pass	01:17

Westershils Results

Survey	Date	Surveyor	Species	Time	No.	Roosting	Behaviour	Notes	Time after Dusk or Before Dawn
Dawn	18/07/2013	RA	45 pip.	03:32	1	No	Feeding	Feeding around ancient trees until 04:00	01:20
Dawn	18/07/2013	RA	55 pip		1	No	Feeding	Feeding around ancient trees until 04:00. no bats after 04:00	00:52
Dawn	18/07/2013	RC	55 pip & 44 pip	03:45	2	No	Feeding around stone ruin		01:07
Dawn	18/07/2013	RC	BLE	03:49	1	No		seen but not heard	01:03
Dawn	18/07/2013	RC	BLE	04:00	1	No		seen but not heard	00:52
Dawn	18/07/2013	RW	45 pip	03:22	numerous	No	Feeding	Bat continually feeding/hunting until 03:54 all 45 pips.	01:30
Dawn	18/07/2013	RW	55 pip	04:03	1	No	Feeding		00:49

ANNEX 8 – Weather Data (Spatial Surveys)

Date	Transect	Surveyor	Start Time	Finish Time	Hour	Temperature	Relative Humidity	Wind Speed	Wind Direction	Moon phase	Rain	Cloud Cover	Cloud Height	Notes
25/04/2012	1	ZS	20:10	00:28	1	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	1	ZS	20:10	00:28	2	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	1	ZS	20:10	00:28	3	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	1	ZS	20:10	00:28	4	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	2	KJ	20:16	23:45	1	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	2	KJ	20:16	23:45	2	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	2	KJ	20:16	23:45	3	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	2	KJ	20:16	23:45	4	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	3	LC	20:24	00:39	1	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	3	LC	20:24	00:39	2	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	3	LC	20:24	00:39	3	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2012	3	LC	20:24	00:39	4	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
25/04/2013	3	LC	20:24	00:39	5	7	n/a	3 gentle breeze	n/a	waxing crescent	1 drizzle/mist	7/8'		Light infrequent rain
18/05/2012	1	AR	01:00	05:24	1	10	n/a		n/a	waning crescent	1 drizzle/mist	8/8'		Showers until 00:20
18/05/2012	1	AR	01:00	05:24	2	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	1	AR	01:00	05:24	3	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	1	AR	01:00	05:24	4	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	1	AR	01:00	05:24	5	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	2	RW	00:22	04:20	1	10	n/a		n/a	waning crescent	1 drizzle/mist	8/8'		Showers until 00:20
18/05/2012	2	RW	00:22	04:20	2	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	2	RW	00:22	04:20	3	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	2	RW	00:22	04:20	4	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	2	RW	00:22	04:20	5	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	3	LC	00:36	05:11	1	10	n/a		n/a	waning crescent	1 drizzle/mist	8/8'		Showers until 00:20
18/05/2012	3	LC	00:36	05:11	2	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	3	LC	00:36	05:11	3	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	3	LC	00:36	05:11	4	10	n/a		n/a	waning crescent	0 none	8/8'		
18/05/2012	3	LC	00:36	05:11	5	10	n/a		n/a	waning crescent	0 none	8/8'		
20/08/2012	1	AB	21:28	02:37	1	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	1	AB	21:28	02:37	2	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	1	AB	21:28	02:37	3	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	1	AB	21:28	02:37	4	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	1	AB	21:28	02:37	5	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	1	AB	21:28	02:37	6	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	2	RA	21:27	00:59	1	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	2	RA	21:27	00:59	2	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	2	RA	21:27	00:59	3	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	2	RA	21:27	00:59	3	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	3	LC	21:27	02:48	1	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	3	LC	21:27	02:48	2	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	3	LC	21:27	02:48	3	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm

Date	Transect	Surveyor	Start Time	Finish Time	Hour	Temperature	Relative Humidity	Wind Speed	Wind Direction	Moon phase	Rain	Cloud Cover	Cloud Height	Notes
20/08/2012	3	LC	21:27	02:48	4	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	3	LC	21:27	02:48	5	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
20/08/2012	3	LC	21:27	02:48	6	12	n/a		n/a	waxing crescent	0 none	5/8'		Dry and warm
16/07/2012	1	RC	21:12	02:11	1	13	n/a		n/a	third quarter	0 none			Dry and warm
16/07/2012	1	RC	21:12	02:11	2	13	n/a		n/a	third quarter	0 none			Dry and warm
16/07/2012	1	RC	21:12	02:11	3	13	n/a		n/a	third quarter	0 none			Dry and warm
16/07/2012	1	RC	21:12	02:11	4	13	n/a		n/a	third quarter	0 none			Dry and warm
16/07/2012	1	RC	21:12	02:11	5	13	n/a		n/a	third quarter	0 none			Dry and warm
16/07/2012	1	RC	21:12	02:11	6	13	n/a		n/a	third quarter	0 none			Dry and warm
16/07/2012	2	RA	21:12	02:11	1	13	n/a	1 Light air	n/a	third quarter	0 none	5/8'		Dry, light wind, humid
16/07/2012	2	RA	21:12	02:11	2	13	n/a	1 Light air	n/a	third quarter	0 none	5/8'		Dry, light wind, humid
16/07/2012	2	RA	21:12	02:11	3	13	n/a	1 Light air	n/a	third quarter	0 none	5/8'		Dry, light wind, humid
16/07/2012	2	RA	21:12	02:11	4	13	n/a	1 Light air	n/a	third quarter	0 none	5/8'		Dry, light wind, humid
16/07/2012	2	RA	21:12	02:11	5	13	n/a	1 Light air	n/a	third quarter	0 none	5/8'		Dry, light wind, humid
16/07/2012	2	RA	21:12	02:11	6	13	n/a	1 Light air	n/a	third quarter	0 none	5/8'		Dry, light wind, humid
16/07/2012	3	RW	21:30	02:16	1	13	n/a	1 Light air	n/a	third quarter	0 none	1/8'		Clear most of the night, wind 0-5mph
16/07/2012	3	RW	21:30	02:16	2	13	n/a	1 Light air	n/a	third quarter	0 none	1/8'		Clear most of the night, wind 0-5mph
16/07/2012	3	RW	21:30	02:16	3	13	n/a	1 Light air	n/a	third quarter	0 none	1/8'		Clear most of the night, wind 0-5mph
16/07/2012	3	RW	21:30	02:16	4	13	n/a	1 Light air	n/a	third quarter	0 none	1/8'		Clear most of the night, wind 0-5mph
16/07/2012	3	RW	21:30	02:16	5	13	n/a	1 Light air	n/a	third quarter	0 none	1/8'		Clear most of the night, wind 0-5mph
16/08/2012	1	RW	20:27	00:46	1	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	1	RW	20:27	00:46	2	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	1	RW	20:27	00:46	3	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	1	RW	20:27	00:46	4	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	1	RW	20:27	00:46	5	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	2	GJ	20:27	02:00	1	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	2	GJ	20:27	02:00	2	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	2	GJ	20:27	02:00	3	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	2	GJ	20:27	02:00	4	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	2	GJ	20:27	02:00	5	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	2	GJ	20:27	02:00	6	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	3	LC	20:20	01:11	1	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	3	LC	20:20	01:11	2	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	3	LC	20:20	01:11	3	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	3	LC	20:20	01:11	4	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
16/08/2012	3	LC	20:20	01:11	5	15	n/a	1 Light air	n/a	waning crescent	0 none	2/8'		Dry and warm
20/09/2012	1	SS	19:08	22:55	1	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool, light wind in exposed areas
20/09/2012	1	SS	19:08	22:55	2	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool, light wind in exposed areas
20/09/2012	1	SS	19:08	22:55	3	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool, light wind in exposed areas
20/09/2012	1	SS	19:08	22:55	4	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool, light wind in exposed areas
20/09/2012	2	RA	18:46	22:39	1	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool, light wind
20/09/2012	2	RA	18:46	22:39	2	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool, light wind

Date	Transect	Surveyor	Start Time	Finish Time	Hour	Temperature	Relative Humidity	Wind Speed	Wind Direction	Moon phase	Rain	Cloud Cover	Cloud Height	Notes
20/09/2012	2	RA	18:46	22:39	3	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool, light wind
20/09/2012	2	RA	18:46	22:39	4	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool, light wind
20/09/2012	3	LC	18:46	23:05	1	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool
20/09/2012	3	LC	18:46	23:05	2	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool
20/09/2012	3	LC	18:46	23:05	3	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool
20/09/2012	3	LC	18:46	23:05	4	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool
20/09/2012	3	LC	18:46	23:05	5	9	n/a	2 light breeze	n/a	waxing crescent	0 none	4/8'		Dry and cool

Date	Transect	Surveyor	Start Time	Finish Time	Hour	Temperature	Relative Humidity	Wind Speed	Wind Direction	Moon phase	Rain	Cloud Cover	Cloud Height	Notes
15/05/2013	1	PR	20:40	23:29	1	8.5	89.4	2 light breeze	W	waxing crescent	0 none	7/8'	2 >500m	
15/05/2013	1	PR	20:40	23:29	2	5.2	87.1	2 light breeze	SW	waxing crescent	0 none	4/8'	2 >500m	
15/05/2013	1	PR	20:40	23:29	3	3.8	88.9	2 light breeze	SW	waxing crescent	0 none	1/8'	2 >500m	
15/05/2013	2	EM	20:40	23:47	1	7.6	77.9	1 Light air	SW	waxing crescent	1 drizzle/mist	7/8'	1 150-500m	
15/05/2013	2	EM	20:40	23:47	2	5.8	84.6	0 calm	S	waxing crescent	0 none	4/8'	1 150-500m	
15/05/2013	2	EM	20:40	23:47	3	6.7	75.1	0 calm	S	waxing crescent	0 none	0/8		
15/05/2013	2	EM	20:40	23:47	4	4.3	82.4	0 calm	SW	waxing crescent	0 none	0/8		
30/05/2013	1	LC+SS	21:30	00:27	1	9	86	1 Light air	n/a	third quarter	0 none	0/8		Clear night
30/05/2013	1	LC+SS	21:30	00:27	2	8.1	94.6	1 Light air	n/a	third quarter	0 none	0/8		Clear night
30/05/2013	1	LC+SS	21:30	00:27	3	8	96	1 Light air	n/a	third quarter	0 none	1/8'		Clear night
30/05/2013	1	LC+SS	21:30	00:27	4	7.4	96.4	1 Light air	n/a	third quarter	0 none	2/8'		Clear night
30/05/2013	2	LC+SS	02:00	05:10	1	6.3	90.7	0 calm	n/a	third quarter	0 none	4/8'	2 >500m	
30/05/2013	2	LC+SS	02:00	05:10	2	10.7	74.9	0 calm	n/a	third quarter	0 none	5/8'	2 >500m	
30/05/2013	2	LC+SS	02:00	05:10	3	10.6	75	0 calm	n/a	third quarter	0 none	5/8'	2 >500m	
30/05/2013	2	LC+SS	02:00	05:10	4	9.9	87.7	1 Light air	SW	third quarter	0 none	2/8'	2 >500m	
25/06/2013	1	EM	00:19	03:04	1	9.3	88.4	0 calm	W	waning gibbous	0 none	1/8'	1 150-500m	
25/06/2013	1	EM	00:19	03:04	2	10.1	88.1	2 light breeze	W	waning gibbous	0 none	2/8'	1 150-500m	
25/06/2013	1	EM	00:19	03:04	3	8.3	91.5	1 Light air	SW	waning gibbous	0 none	4/8'	1 150-500m	
25/06/2013	2	LF	00:10	03:13	1	10.5	89.1	2 light breeze	S	waning gibbous	0 none	4/8'	2 >500m	
25/06/2013	2	LF	00:10	03:13	2	10.3	89.3	2 light breeze	S	waning gibbous	0 none	6/8'	2 >500m	
25/06/2013	2	LF	00:10	03:13	3	9.9	91.8	0 calm	S	waning gibbous	0 none	5/8'	2 >500m	
25/06/2013	2	LF	00:10	03:13	4	8.6	90.4	1 Light air	S	waning gibbous	0 none	5/8'	2 >500m	
08/08/2013	1	LF	20:32	23:26	1	15.7	68.8	0 calm	n/a	waxing crescent	0 none	4/8'	2 >500m	
08/08/2013	1	LF	20:32	23:26	2	12	84	2 light breeze	S	waxing crescent	0 none	5/8'	2 >500m	
08/08/2013	1	LF	20:32	23:26	3	13.8	85.2	1 Light air	SW	waxing crescent	1 drizzle/mist	7/8'	2 >500m	
08/08/2013	2	KM	20:32	00:50	1	17.8	58.5	1 Light air	S	waxing crescent	0 none	1/8'	2 >500m	
08/08/2013	2	KM	20:32	00:50	2	14.4	64	1 Light air	S	waxing crescent	0 none	3/8'	2 >500m	
08/08/2013	2	KM	20:32	00:50	3	15.3	67	0 calm	n/a	waxing crescent	0 none	7/8'	2 >500m	
08/08/2013	2	KM	20:32	00:50	4	17.1	64.8	0 calm	n/a	waxing crescent	0 none	7/8'	2 >500m	
08/08/2013	2	KM	20:32	00:50	5	14.5	69	2 light breeze	S	waxing crescent	0 none	8/8'	2 >500m	
21/08/2013	1	KM	20:02	22:55	1	16.4	83.9	1 Light air	S	full moon	0 none	4/8'	2 >500m	

Date	Transect	Surveyor	Start Time	Finish Time	Hour	Temperature	Relative Humidity	Wind Speed	Wind Direction	Moon phase	Rain	Cloud Cover	Cloud Height	Notes
21/08/2013	1	KM	20:02	22:55	2	14.5	87.2	3 gentle breeze	S	full moon	0 none	7/8'	2 >500m	
21/08/2013	1	KM	20:02	22:55	3	14.9	85.3	3 gentle breeze	S	full moon	0 none	7/8'	2 >500m	Wind dropped to 0 by 22:30
21/08/2013	2	LF	20:02	22:58	1	17.4	83.7	2 light breeze	SW	full moon	0 none	7/8'	1 150-500m	
21/08/2013	2	LF	20:02	22:58	2	15.5	85.8	1 Light air	SW	full moon	0 none	7/8'	1 150-500m	
21/08/2013	2	LF	20:02	22:58	3	15.3	88.2	0 calm	n/a	full moon	0 none	7/8'	1 150-500m	
27/09/2013	1	LF	03:55	06:50	1	10.2	89.3	2 light breeze	SW	third quarter	2 light showers	8/8'	2 >500m	Constant rain (persistant)
27/09/2013	1	LF	03:55	06:50	2	-	-	1 Light air	SW	third quarter	2 light showers	8/8'	1 150-500m	Too wet for weather gauge
27/09/2013	1	LF	03:55	06:50	3	10.5	92.4	0 calm	n/a	third quarter	1 drizzle/mist	8/8'	1 150-500m	Light drizzle (very light rain). Mist lying in valleys and on top of hills.
27/09/2013	2	PR	18:31	21:21	1	12.2	74.1	1 Light air	n/a	third quarter	0 none	6/8'	2 >500m	No moon; very dark
27/09/2013	2	PR	18:31	21:21	2	12.1	82.1	1 Light air	n/a	third quarter	0 none	7/8'	2 >500m	South wind increased to 4 at 8pm. No moon; very dark.
27/09/2013	2	PR	18:31	21:21	3	11	84.6	4 moderate breeze	SSE	third quarter	0 none	8/8'	2 >500m	No moon; very dark

ANNEX 9 – Behavioural Data (Spatial Surveys)

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
25/04/20112	3	47	LC	Pip sp.	1	likely commuting	unknown	unknown	
25/04/20112	3	52	LC	Pip sp.	3	likely commuting	unknown	unknown	
25/04/20112	3	52 to 53	LC	Daubenton's	1	unknown	unknown	unknown	
25/04/20112	3	59	LC	Unknown	1	unknown	unknown	unknown	
18/05/2012	1	16	AR	55 pip	1	likely commuting	unknown	unknown	
18/05/2012	2	31	RW	45 pip	1	likely commuting	unknown	unknown	
18/05/2012	2	39	RW	*Myotis* sp.	1		unknown	unknown	
18/05/2012	2	40	RW	*Myotis* sp.	1		unknown	unknown	
18/05/2012	2	41 to 40	RW	*Myotis* sp.	1		unknown	unknown	
18/05/2012	3	55	LC	55 pip	1		unknown	unknown	
18/05/2012	3	56	LC	Unknow bat	1		unknown	unknown	
18/05/2012	3	60 to 59	LC	*Myotis* sp.	1		unknown	unknown	
20/08/2012	1	6	AB	45 pip	2	likely commuting	unknown	0-5m	
20/08/2012	1	6 to 7	AB	45 pip	1	unknown	unknown	unknown	
20/08/2012	1	6 to 7	AB	55 pip	1	unknown	unknown	unknown	
20/08/2012	1	7 to 8	AB	45 pip	1	unknown	unknown	unknown	
20/08/2012	1	8 to 9	AB	55 pip	1	unknown	unknown	unknown	
20/08/2012	1	9 to 10	AB	45 pip	1	unknown	unknown	unknown	
20/08/2012	1	10 to 11	AB	45 pip	2	unknown	unknown	unknown	
20/08/2012	1	12 to 13	AB	45 pip	4	unknown	unknown	unknown	
20/08/2012	1	14 to 15	AB	45 pip	2	unknown	unknown	unknown	
20/08/2012	1	15	AB	45 pip	2	unknown	unknown	unknown	
20/08/2012	1	16 to 17	AB	55 pip	1	unknown	unknown	unknown	
20/08/2012	1	16 to 17	AB	45 pip	1	unknown	unknown	unknown	
20/08/2012	1	16 to 17	AB	pip sp.	1	unknown	unknown	unknown	
20/08/2012	1	18 to 19	AB	45 pip	3	unknown	unknown	unknown	
20/08/2012	1	19	AB	45 pip	2	unknown	unknown	unknown	
20/08/2012	1	19 to 20	AB	45 pip	7	unknown	unknown	unknown	
20/08/2012	1	19 to 20	AB	55 pip	3	unknown	unknown	unknown	
20/08/2012	1	20 to 21	AB	45 pip	7	unknown	unknown	unknown	
20/08/2012	1	20 to 21	AB	55 pip	1	unknown	unknown	unknown	
20/08/2012	1	21	AB	55 pip	2	unknown	unknown	unknown	
20/08/2012	1	22	AB	*Myotis* sp.	4	unknown	unknown	unknown	
20/08/2012	2	29 to 30	RA	45 pip	1	feeding buzz	unknown	10-15m	
20/08/2012	2	29 to 30	RA	55 pip	1	feeding buzz	unknown	5-10m	
20/08/2012	2	30	RA	45 pip	10	feeding buzz	unknown	5-10m	3 bats
20/08/2012	2	30 to 31	RA	45 pip	3	feeding buzz	unknown	5-10m	3 bats
20/08/2012	2	31	RA	45 pip	2	feeding buzz	unknown	unknown	2 bats
20/08/2012	2	31 to 32	RA	55 pip	1	feeding buzz	unknown	5-10m	
20/08/2012	2	31 to 32	RA	45 pip	2	feeding buzz	unknown	5-10m	
20/08/2012	2	32	RA	pip sp.	4	feeding buzz	unknown	5-10m	4 bats
20/08/2012	2	32 to 33	RA	45 pip	5	feeding buzz	unknown	unknown	
20/08/2012	2	32 to 33	RA	55 pip	7	feeding buzz	unknown	unknown	
20/08/2012	2	33	RA	45 pip	1	feeding buzz	unknown	unknown	
20/08/2012	2	33	RA	55 pip	5	feeding buzz	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
20/08/2012	2	33	RA	pip sp.	1	feeding buzz	unknown	unknown	
20/08/2012	2	33 to 34	RA	45 pip	1	feeding buzz	unknown	unknown	
20/08/2012	2	33 to 34	RA	55 pip	2	feeding buzz	unknown	unknown	
20/08/2012	2	33 to 34	RA	pip sp.	5	feeding buzz	unknown	unknown	
20/08/2012	2	34	RA	pip sp.	2	feeding buzz	unknown	unknown	2 bats
20/08/2012	2	35	RA	55 pip	4	feeding buzz	unknown	10-15m	2 bats
20/08/2012	2	35 to 38	RA	55 pip	7	feeding buzz	unknown	unknown	
20/08/2012	2	35 to 38	RA	45 pip	2	unknown	unknown	unknown	
20/08/2012	2	35 to 38	RA	pip sp.	1	unknown	unknown	unknown	
20/08/2012	2	38	RA	pip sp.	1	feeding buzz	unknown	unknown	2 bats
20/08/2012	2	38 to 39	RA	55 pip	3	feeding buzz	unknown	unknown	2 bats
20/08/2012	2	40	RA	55 pip	1	likely commuting	unknown	unknown	
20/08/2012	2	40	RA	pip sp.	1	likely commuting	unknown	unknown	
20/08/2012	2	41	RA	55 pip	16	feeding buzz	unknown	unknown	2 bats
20/08/2012	3	45 to 46	LC	45 pip	12	feeding buzz	unknown	0-5m	
20/08/2012	3	46	LC	45 pip	2	likely commuting	unknown	0-5m	
20/08/2012	3	46 to 47	LC	45 pip	2	unknown	unknown	unknown	
20/08/2012	3	46 to 47	LC	55 pip	5	unknown	unknown	unknown	
20/08/2012	3	47	LC	45 pip	7	feeding buzz	unknown	0-5m	
20/08/2012	3	47 to 48	LC	45 pip	1	unknown	unknown	unknown	
20/08/2012	3	48 to 49	LC	55 pip	1	unknown	unknown	unknown	
20/08/2012	3	50 to 51	LC	55 pip	6	feeding buzz	unknown	unknown	2 bats. Original point not completed due to windblow. Alternative route created.
20/08/2012	3	51	LC	45 pip	2	feeding buzz	unknown	unknown	Original point not completed due to windblow. Alternative route created.
20/08/2012	3	51	LC	55 pip	2	feeding buzz	unknown	unknown	Original point not completed due to windblow. Alternative route created.
20/08/2012	3	51 to 52	LC	45 pip	1	feeding buzz	unknown	unknown	
20/08/2012	3	51 to 52	LC	55 pip	2	feeding buzz	unknown	unknown	
20/08/2012	3	52	LC	45 pip	4	feeding buzz	unknown	unknown	
20/08/2012	3	52	LC	55 pip	4	feeding buzz	unknown	unknown	
20/08/2012	3	52	LC	pip sp.	1	feeding buzz	unknown	unknown	
20/08/2012	3	52 to 53	LC	45 pip	1	unknown	unknown	unknown	
20/08/2012	3	52 to 53	LC	55 pip	1	unknown	unknown	unknown	
20/08/2012	3	53	LC	45 pip	2	unknown	unknown	unknown	
20/08/2012	3	53	LC	55 pip	3	unknown	unknown	unknown	
20/08/2012	3	53 to 54	LC	55 pip	1	unknown	unknown	unknown	
20/08/2012	3	54	LC	55 pip	1	unknown	unknown	unknown	
20/08/2012	3	54 to 55	LC	55 pip	1	unknown	unknown	unknown	
20/08/2012	3	55	LC	55 pip	4	unknown	unknown	unknown	
20/08/2012	3	55	LC	45 pip	3	unknown	unknown	unknown	
20/08/2012	3	55 to 56	LC	55 pip	3	feeding buzz	unknown	unknown	
20/08/2012	3	55 to 56	LC	45 pip	4	feeding buzz	unknown	unknown	
20/08/2012	3	55 to 56	LC	pip sp.	4	feeding buzz	unknown	unknown	
20/08/2012	3	56	LC	55 pip	2	feeding buzz	unknown	unknown	
20/08/2012	3	56	LC	45 pip	5	feeding buzz	unknown	unknown	
20/08/2012	3	56	LC	pip sp.	4	feeding buzz	unknown	unknown	
20/08/2012	3	56 to 57	LC	55 pip	2	feeding buzz	unknown	unknown	
20/08/2012	3	56 to 57	LC	pip sp.	2	feeding buzz	unknown	unknown	
20/08/2012	3	58	LC	45 pip	1	likely commuting	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
20/08/2012	3	58 to 59	LC	45 pip	1	unknown	unknown	unknown	
20/08/2012	3	58 to 59	LC	55 pip	1	unknown	unknown	unknown	
20/08/2012	3	59	LC	45 pip	5	feeding buzz	unknown	unknown	3 bats
20/08/2012	3	59 to 60	LC	55 pip	4	unknown	unknown	unknown	
20/08/2012	3	59 to 60	LC	45 pip	3	unknown	unknown	unknown	
20/08/2012	3	60	Ĩ□□55 pip	55 pip	1	unknown	unknown	unknown	
20/08/2012	3	60 to 61	LC	45 pip	1	unknown	unknown	unknown	
16/07/2012	1	1	RC	45 pip	2	unknown	unknown	unknown	1 bat
16/07/2012	1	2	RC	55 pip	2	unknown	unknown	unknown	
16/07/2012	1	2	RC	45 pip	1	unknown	unknown	unknown	
16/07/2012	1	2 to 3	RC	45 pip	5	unknown	unknown	unknown	
16/07/2012	1	2 to 3	RC	55 pip	3	unknown	unknown	unknown	
16/07/2012	1	2 to 3	RC	pip sp.	1	unknown	unknown	unknown	
16/07/2012	1	3	RC	45 pip	3	unknown	unknown	unknown	
16/07/2012	1	3 to 4	RC	pip sp.	2	unknown	unknown	unknown	
16/07/2012	1	3 to 4	RC	55 pip	2	unknown	unknown	unknown	
16/07/2012	1	3 to 4	RC	45 pip	4	unknown	unknown	unknown	
16/07/2012	1	5 to 6	RC	45 pip	1	unknown	unknown	unknown	
16/07/2012	1	7 to 8	RC	55 pip	1	unknown	unknown	unknown	
16/07/2012	1	7 to 8	RC	45 pip	1	unknown	unknown	unknown	
16/07/2012	1	10	RC	pip sp.	1	unknown	unknown	unknown	
16/07/2012	1	10	RC	45 pip	1	unknown	unknown	unknown	
16/07/2012	1	11 to 12	RC	45 pip	1	feeding buzz	unknown	unknown	
16/07/2012	1	12	RC	pip sp.	1	feeding buzz	unknown	unknown	2 bats
16/07/2012	1	12 to 13	RC	45 pip	1	unknown	unknown	unknown	
16/07/2012	1	13	RC	pip sp.	1	feeding buzz	unknown	unknown	
16/07/2012	1	13 to 14	RC	45 pip	1	unknown	unknown	unknown	
16/07/2012	1	13 to 14	RC	55 pip	1	unknown	unknown	unknown	
16/07/2012	2	23	RA	55 pip	3	feeding buzz	unknown	unknown	2 bats
16/07/2012	2	23 to 24	RA	55 pip	3	feeding buzz	unknown	unknown	2 bats
16/07/2012	2	24	RA	55 pip	3	feeding buzz	unknown	unknown	
16/07/2012	2	24 to 25	RA	45 pip	8	feeding buzz	unknown	0-5m	2 bats
16/07/2012	2	24 to 25	RA	55 pip	4	feeding buzz	unknown	0-5m	2 bats
16/07/2012	2	25	RA	55 pip	5	feeding buzz	unknown	unknown	2 bats
16/07/2012	2	25 to 26	RA	55 pip	6	feeding buzz	unknown	unknown	2 bats
16/07/2012	2	26	RA	55 pip	5	feeding buzz	unknown	unknown	3 bats
16/07/2012	2	26 to 27	RA	55 pip	4	feeding buzz	unknown	unknown	2 bats
16/07/2012	2	27	RA	45 pip	2	feeding buzz	unknown	unknown	
16/07/2012	2	27	RA	55 pip	2	feeding buzz	unknown	unknown	
16/07/2012	2	27	RA	Daubenton’s	1	feeding buzz	unknown	unknown	
16/07/2012	2	27 to 28	RA	45 pip	1	feeding buzz	unknown	unknown	
16/07/2012	2	27 to 28	RA	55 pip	2	feeding buzz	unknown	unknown	
16/07/2012	2	28	RA	45 pip	3	feeding buzz	unknown	unknown	2 bats
16/07/2012	2	28	RA	55 pip	2	likely commuting	unknown	unknown	2 bats
16/07/2012	2	28 to 29	RA	45 pip	4	feeding buzz	unknown	unknown	3 bats
16/07/2012	2	29	RA	45 pip	2	feeding buzz	unknown	unknown	
16/07/2012	2	29	RA	55 pip	1	likely commuting	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
16/07/2012	2	29 to 30	RA	45 pip	1	feeding buzz	unknown	unknown	
16/07/2012	2	30 to 30	RA	55 pip	1	likely commuting	unknown	unknown	
16/07/2012	2	30	RA	45 pip	3	feeding buzz	unknown	unknown	
16/07/2012	2	30 to 31	RA	45 pip	2	feeding buzz	unknown	unknown	
16/07/2012	2	30 to 31	RA	55 pip	2	likely commuting	unknown	unknown	
16/07/2012	2	31	RA	55 pip	5	feeding buzz	unknown	unknown	2 bats
16/07/2012	2	31 to 32	RA	55 pip	7	feeding buzz	unknown	0-5m	3 bats
16/07/2012	2	31 to 32	RA	45 pip	5	feeding buzz	unknown	0-5m	4 bats
16/07/2012	2	31 to 32	RA	pip sp.	6	feeding buzz	unknown	0-5m	
16/07/2012	2	32	RA	45 pip	3	feeding buzz	unknown	0-5m	2 bats
16/07/2012	2	32	RA	55 pip	5	feeding buzz	unknown	0-5m	
16/07/2012	2	32	RA	pip sp.	4	feeding buzz	unknown	0-5m	
16/07/2012	2	32 to 33	RA	45 pip	7	feeding buzz	unknown	unknown	
16/07/2012	2	32 to 33	RA	55 pip	3	feeding buzz	unknown	unknown	
16/07/2012	2	32 to 33	RA	pip sp.	2	feeding buzz	unknown	unknown	
16/07/2012	2	33	RA	45 pip	1	feeding buzz	unknown	unknown	
16/07/2012	2	33	RA	55 pip	2				
16/07/2012	2	33 to 34	RA	45 pip	2	likely commuting	unknown	unknown	
16/07/2012	2	33 to 34	RA	55 pip	1				
16/07/2012	2	34	RA	45 pip	2	feeding buzz	unknown	0-5m	
16/07/2012	2	34 to 35	RA	45 pip	1	likely commuting	unknown	unknown	
16/07/2012	2	35	RA	45 pip	1	feeding buzz	unknown	unknown	2 bats
16/07/2012	2	35	RA	55 pip	1	feeding buzz	unknown	unknown	
16/07/2012	2	35 to 36	RA	45 pip	7	feeding buzz	unknown	5-10m	3 bats
16/07/2012	2	35 to 36	RA	55 pip	3	feeding buzz	unknown	5-10m	3 bats
16/07/2012	2	35 to 36	RA	pip sp.	2	feeding buzz	unknown	5-10m	
16/07/2012	2	36	RA	Unknown Bat	1	likely commuting	unknown	unknown	
16/07/2012	2	36 to 37	RA	45 pip	1	likely commuting	unknown	unknown	
16/07/2012	2	37	RA	45 pip	2	feeding buzz	unknown	10-15m	2 bats
16/07/2012	2	37 to 38	RA	45 pip	2	likely commuting	unknown	5-10m	5 bats
16/07/2012	3	42 to 43	RA	45 pip	1	likely commuting	unknown	unknown	
16/07/2012	3	42 to 43	RA	55 pip	5	likely commuting	unknown	unknown	4 bats
16/07/2012	3	43	RW	45 pip	1	likely commuting	unknown	unknown	
16/07/2012	3	43	RW	55 pip	2	likely commuting	unknown	unknown	
16/07/2012	3	45	RW	Daubenton's	1	likely commuting	unknown	unknown	
16/07/2012	3	45	RW	55 pip	1	likely commuting	unknown	unknown	
16/07/2012	3	45 to 46	RW	45 pip	2	likely commuting	unknown	unknown	2 bats
16/07/2012	3	45 to 46	RW	55 pip	2	likely commuting	unknown	unknown	
16/07/2012	3	47 to 48	RW	55 pip	2	likely commuting	unknown	unknown	
16/07/2012	3	48	RW	Daubenton's	1	unknown	unknown	unknown	4 bats
16/07/2012	3	48 to 49	RW	Daubenton's	3	feeding buzz	unknown	unknown	5 bats
16/07/2012	3	48 to 49	RW	45 pip	2	likely commuting	unknown	unknown	2 bats
16/07/2012	3	49	RW	Daubenton's	6	feeding buzz	unknown	unknown	3 bats
16/07/2012	3	49	RW	45 pip	2	likely commuting	unknown	unknown	
16/07/2012	3	49 to 50	RW	Daubenton's	1	likely commuting	unknown	unknown	
16/07/2012	3	49 to 50	RW	45 pip	3	likely commuting	unknown	unknown	3 bats
16/07/2012	3	50	RW	45 pip	4	likely commuting	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
16/07/2012	3	51	RW	45 pip	4		unknown	unknown	2 bats
16/07/2012	3	51 to 52	RW	45 pip	5	likely commuting	unknown	unknown	2 bats
16/07/2012	3	51 to 52	RW	55 pip	1	likely commuting	unknown	unknown	
16/07/2012	3	52	RW	45 pip	5	feeding buzz	unknown	unknown	2 bats
16/07/2012	3	52	RW	55 pip	6	likely commuting	unknown	unknown	
16/07/2012	3	52 to 53	RW	45 pip	9	feeding buzz	unknown	unknown	4 bats
16/07/2012	3	52 to 53	RW	55 pip	4	likely commuting	unknown	unknown	2 bats
16/07/2012	3	53	RW	45 pip	9	likely commuting	unknown	5-10m	3 bats
16/07/2012	3	53 to 54	RW	45 pip	13	feeding buzz	unknown	unknown	10 bats
16/07/2012	3	53 to 54	RW	55 pip	15	likely commuting	unknown	unknown	5 bats
16/07/2012	3	54	RW	45 pip	1	feeding buzz	unknown	unknown	4 bats
16/07/2012	3	54	RW	55 pip	2	likely commuting	unknown	unknown	
16/07/2012	3	55	RW	55 pip	6	feeding buzz	unknown	0-5m	4 bats
16/07/2012	3	55 to56	RW	45 pip	3	feeding buzz	unknown	5-10m	12 bats
16/07/2012	3	55 to56	RW	55 pip	5	feeding buzz	unknown	0-5m	4 bats
16/07/2012	3	56	RW	45 pip	4	feeding buzz	unknown	0-5m	6 bats
17/08/2012	1	5 to 6	RW	45 pip	1	likely commuting	unknown	unknown	
17/08/2012	1	6	RW	pip sp.	1	likely commuting	unknown	unknown	
17/08/2012	1	7	RW	45 pip	2	likely commuting	unknown	0-5m	
17/08/2012	1	7 to 8	RW	45 pip	2	likely commuting	unknown	15-20m	
17/08/2012	1	7 to 8	RW	55 pip	likely	likely commuting	unknown	15-20m	
17/08/2012	1	8	RW	45 pip	1	likely commuting	unknown	15-20m	
17/08/2012	1	8	RW	55 pip	2	likely commuting	unknown	15-20m	
17/08/2012	1	8 and 9	RW	55 pip	3	feeding buzz	unknown	unknown	
17/08/2012	1	8 and 9	RW	45 pip	1	likely commuting	unknown	unknown	
17/08/2012	1	9	RW	45 pip	1		unknown		
17/08/2012	1	9 to 10	RW	Daubenton’s	2	feeding buzz	unknown	0-5m	
17/08/2012	1	10	RW	45 pip	1	likely commuting	unknown		
17/08/2012	1	10	RW	Unknown bat	1	likely commuting	unknown		
17/08/2012	1	10 to 11	RW	45 pip	3	likely commuting	unknown		3 bats
17/08/2012	1	11	RW	45 pip	3	feeding buzz	unknown		
17/08/2012	1	11	RW	55 pip	4	feeding buzz	unknown		3 bats
17/08/2012	1	11 to 12	RW	45 pip	1	likely commuting	unknown		
17/08/2012	1	12	RW	Daubenton’s	1	likely commuting	unknown		
17/08/2012	1	12 to 13	RW	55 pip	1	likely commuting	unknown		
17/08/2012	1	14	RW	55 pip	3	feeding buzz	unknown		3 bats
17/08/2012	1	14 to 15	RW	55 pip	1	likely commuting	unknown		
17/08/2012	1	14 to 15	RW	45 pip	1	likely commuting	unknown		
17/08/2012	1	14 to 15	RW	BLE	1	likely commuting	unknown		
17/08/2012	1	16	RW	55 pip	1	likely commuting	unknown		
17/08/2012	1	16	RW	Unknown bat	1	likely commuting	unknown		
17/08/2012	1	16 to 17	RW	55 pip	1	feeding buzz	unknown	0-5m	
17/08/2012	1	18	RW	55 pip	20	feeding buzz	unknown	0-5m	2 bats
17/08/2012	1	18 to 19	RW	55 pip	1	likely commuting	unknown		
17/08/2012	1	19	RW	55 pip	4	likely commuting	unknown		5 bats
17/08/2012	1	19 to 20	RW	55 pip	3	likely commuting	unknown		3 bats
17/08/2012	1	20	RW	45 pip	1	likely commuting	unknown		

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
17/08/2012	1	20 to 21	RW	55 pip	4	feeding buzz	unknown		
17/08/2012	1	21	RW	55 pip	2	likely commuting	unknown		2 bats
17/08/2012	1	22	RW	55 pip	2	social call	unknown		2 bats
17/08/2012	2	29	GJ	pip sp.	3		unknown	10-15m	
17/08/2012	2	29 to 30	GJ	45 pip	10	feeding buzz	unknown		
17/08/2012	2	29 to 30	GJ	55 pip	6	feeding buzz	unknown		
17/08/2012	2	29 to 30	GJ	*Myotis* sp.	8	feeding buzz	unknown		
17/08/2012	2	30	GJ	55 pip	6	likely commuting	unknown		
17/08/2012	2	30 to 31	GJ	45 pip	6	likely commuting	unknown		
17/08/2012	2	30 to 31	GJ	Daubenton’s	1	likely commuting	unknown		
17/08/2012	2	30 to 31	GJ	55 pip	1	likely commuting	unknown		
17/08/2012	2	31 to 32	GJ	pip sp.	4	feeding buzz	unknown		
17/08/2012	2	31 to 32	GJ	Daubenton’s	2	feeding buzz	unknown		
17/08/2012	2	31 to 32	GJ	55 pip	1	likely commuting	unknown		
17/08/2012	2	32 to 33	GJ	55 pip	5		unknown		
17/08/2012	2	32 to 33	GJ	45 pip	1	likely commuting	unknown		
17/08/2012	2	34	GJ	*Myotis* sp.	2		unknown		
17/08/2012	2	35 to 36	GJ	45 pip	10	feeding buzz	unknown		2 bats
17/08/2012	2	35 to 36	GJ	Daubenton’s	5	feeding buzz	unknown		2 bats
17/08/2012	2	35 to 36	GJ	55 pip	1	likely commuting	unknown		
17/08/2012	2	35 to 36	GJ	pip sp.	3	feeding buzz	unknown		
17/08/2012	2	36	GJ	Daubenton’s	5		unknown		
17/08/2012	2	36 to 37	GJ	45 pip	2		unknown		3 bats
17/08/2012	2	38	GJ	45 pip	3	feeding buzz	unknown		2 bats
17/08/2012	2	38 to 39	GJ	45 pip	2		unknown		
17/08/2012	2	38 to 39	GJ	55 pip	1		unknown		
17/08/2012	2	39	GJ	55 pip	1		unknown		
17/08/2012	2	40 to 41	GJ	55 pip	2		unknown		
17/08/2012	2	41	GJ	55 pip	10	feeding buzz	unknown		
17/08/2012	2	41	GJ	Daubenton’s	4	feeding buzz	unknown		
17/08/2012	3	46	LC	45 pip	1	likely commuting	unknown		
17/08/2012	3	47	LC	45 pip	3	feeding buzz	unknown	5-10m	
17/08/2012	3	47 to 48	LC	Daubenton’s	3	feeding buzz	unknown		
17/08/2012	3	48	LC	Daubenton’s	3	likely commuting	unknown		
17/08/2012	3	48	LC	pip sp.	2	likely commuting	unknown		
17/08/2012	3	48 to 49	LC	Daubenton’s	1	likely commuting	unknown		
17/08/2012	3	49	LC	45 pip	8	feeding buzz	unknown		
17/08/2012	3	49 to 50	LC	Daubenton’s	12	feeding buzz	unknown	0-5m	
17/08/2012	3		LC	55 pip	5		unknown		
17/08/2012	3	50	LC	55 pip	7	feeding buzz	unknown		2 bats
17/08/2012	3	50 to 51	LC	55 pip	3	feeding buzz	unknown		
17/08/2012	3	51	LC	45 pip	3	feeding buzz	unknown		
17/08/2012	3	51 to 52	LC	pip sp.	5	feeding buzz	unknown		2 bats
17/08/2012	3	52	LC	Daubenton’s	1	feeding buzz	unknown		
17/08/2012	3		LC	pip sp.	1	feeding buzz	unknown		
17/08/2012	3	52 to 53	LC	55 pip	1	feeding buzz	unknown		
17/08/2012	3		LC	45 pip	1	feeding buzz	unknown		

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
17/08/2012	3	53	LC	55 pip	1	feeding buzz	unknown		
17/08/2012	3		LC	45 pip	2	feeding buzz	unknown		
17/08/2012	3	53 to 54	LC	45 pip	4	likely commuting	unknown		2 bats
17/08/2012	3	54	LC	55 pip	1	likely commuting	unknown		
17/08/2012	3		LC	45 pip	1	likely commuting	unknown		
17/08/2012	3	54 to 55	LC	55 pip	1	likely commuting	unknown		
17/08/2012	3	55	LC	55 pip	3	likely commuting	unknown		2 bats
17/08/2012	3	55 to 56	LC	55 pip	7	feeding buzz	unknown		2 bats
17/08/2012	3		LC	pip sp.	1	likely commuting	unknown		
17/08/2012	3	56	LC	55 pip	2	likely commuting	unknown		
17/08/2012	3		LC	45 pip	5	feeding buzz	unknown		
17/08/2012	3	56 to 57	LC	55 pip	1	likely commuting	unknown		
17/08/2012	3	57 to 58	LC	pip sp.	1	likely commuting	unknown		
17/08/2012	3	58	LC	pip sp.	4	likely commuting	unknown		3 bats
17/08/2012	3		LC	55 pip	5	feeding buzz	unknown		
17/08/2012	3	58 to 59	LC	pip sp.	1	likely commuting	unknown		
17/08/2012	3	59	LC	Daubenton's	1	likely commuting	unknown		
17/08/2012	3	60	LC	55 pip	1	likely commuting	unknown		
20/09/2012	1	1 to 2	SS	55 pip	5	unknown	unknown		
20/09/2012	1	2 to 3	SS	55 pip	1	unknown	unknown		
20/09/2012	1	4 to 5	SS	55 pip	1	unknown	unknown		
20/09/2012	1	6	SS	55 pip	1	unknown	unknown		
20/09/2012	1	6 to 7	SS	55 pip	1	unknown	unknown		
20/09/2012	1	7	SS	pip sp.	1	unknown	unknown		
20/09/2012	1	8 to 9	SS	55 pip	1	unknown	unknown		
20/09/2012	1	9	SS	45 pip	1	unknown	unknown		
20/09/2012	1	9 to 10	SS	55 pip	2	unknown	unknown		
20/09/2012	1	12	SS	55 pip	1	unknown	unknown		
20/09/2012	1	14 to 15	SS	55 pip	1	unknown	unknown		
20/09/2012	1	15	SS	pip sp.	1	unknown	unknown		
20/09/2012	1	16	SS	pip sp.	2	unknown	unknown		
20/09/2012	2	23	RA	45 pip	2	feeding buzz	unknown		
20/09/2012	2	23 to 24	RA	55 pip	3	feeding buzz	unknown		
20/09/2012	2	24	RA	55 pip	3	feeding buzz	unknown		
20/09/2012	2	24 to 25	RA	55 pip	2	feeding buzz	unknown		
20/09/2012	2	24 to 25	RA	Daubenton's	1	feeding buzz	unknown		
20/09/2012	2	25	RA	45 pip	4	feeding buzz	unknown		
20/09/2012	2	25	RA	55 pip		feeding buzz	unknown		
20/09/2012	2	25 to 26	RA	45 pip	1	feeding buzz	unknown		
20/09/2012	2	25 to 26	RA	55 pip	3	feeding buzz	unknown		
20/09/2012	2	26	RA	45 pip	7	feeding buzz	unknown	0-5m	
20/09/2012	2	26	RA	55 pip	2	feeding buzz	unknown	0-5m	
20/09/2012	2	26	RA	Daubenton's	2	feeding buzz	unknown	0-5m	
20/09/2012	2	26 to 27	RA	45 pip	1	feeding buzz	unknown		
20/09/2012	2	26 to 27	RA	55 pip	1	feeding buzz	unknown		
20/09/2012	2	27	RA	55 pip	6	feeding buzz	unknown		
20/09/2012	2	27 to 28	RA	Daubenton's	3	feeding buzz	unknown		

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
20/09/2012	2	27 to 28	RA	55 pip	1	feeding buzz	unknown		
20/09/2012	2	28	RA	45 pip	4	feeding buzz	unknown		2 bats
20/09/2012	2	30	RA	55 pip	1	likely commuting	unknown		
20/09/2012	2	30 to 31	RA	55 pip	1	likely commuting	unknown		
20/09/2012	2	31	RA	55 pip	1	likely commuting	unknown		
20/09/2012	2	31 to 32	RA	55 pip	1	likely commuting	unknown		
20/09/2012	2	32 to 33	RA	45 pip	1	likely commuting	unknown		
20/09/2012	2	32 to 33	RA	55 pip	3	likely commuting	unknown		2 bats
20/09/2012	2	35 to 36	RA	55 pip	2	likely commuting	unknown		
20/09/2012	2	36	RA	45 pip	1	likely commuting	unknown		
20/09/2012	3	42	LC	45 pip	1		unknown		
20/09/2012	3	42	LC	55 pip	1		unknown		
20/09/2012	3	42 to 43	LC	55 pip	1		unknown		
20/09/2012	3	42 to 43	LC	Daubenton’s	1		unknown		
20/09/2012	3	43	LC	55 pip	6	feeding buzz	unknown		2 bats
20/09/2012	3	43 to 44	LC	55 pip	2	likely commuting	unknown		
20/09/2012	3	44	LC	55 pip	1	feeding buzz	unknown		
20/09/2012	3	44	LC	55 pip	1	likely commuting	unknown		
20/09/2012	3	44 to 45	LC	55 pip	16	feeding buzz	unknown		5 bats
20/09/2012	3	44 to 45	LC	45 pip	4	feeding buzz	unknown		
20/09/2012	3	45	LC	55 pip	1	feeding buzz	unknown		
20/09/2012	3	45	LC	45 pip	1	likely commuting	unknown		
20/09/2012	3	45 to 46	LC	55 pip	10	feeding buzz	unknown		3 bats
20/09/2012	3	45 to 46	LC	45 pip	8	feeding buzz	unknown		2 bats
20/09/2012	3	46	LC	55 pip	2	feeding buzz	unknown		
20/09/2012	3	46	LC	45 pip	3	feeding buzz	unknown		
20/09/2012	3	46 to 47	LC	45 pip	1	likely commuting	unknown		
20/09/2012	3	46 to 47	LC	55 pip	1	likely commuting	unknown		
20/09/2012	3	47 to 48	LC	55 pip	1	likely commuting	unknown		
20/09/2012	3	47 to 48	LC	pip sp.	1	likely commuting	unknown		
20/09/2012	3	47 to 48	LC	Daubenton’s	2	likely commuting	unknown		
20/09/2012	3	47 to 48	LC	55 pip	1	feeding buzz	unknown		
20/09/2012	3	48 to 49	LC	55 pip	4	feeding buzz	unknown		3 bats
20/09/2012	3	48 to 49	LC	45 pip	2	feeding buzz	unknown		
20/09/2012	3	49	LC	pip sp.	1	likely commuting	unknown		
20/09/2012	3	49	LC	pip sp.		likely commuting	unknown		
20/09/2012	3	49	LC	Daubenton’s	1	unknown	unknown		
20/09/2012	3	49 to 50	LC	55 pip	11	feeding buzz	unknown		5 bats
20/09/2012	3	49 to 50	LC	45 pip	4	feeding buzz	unknown		2 bats
20/09/2012	3	49 to 50	LC	Daubenton’s	1	likely commuting	unknown		
20/09/2012	3	50	LC	45 pip	2	feeding buzz	unknown		2 bats
20/09/2012	3	50	LC	45 pip	1	likely commuting	unknown		
20/09/2012	3	50	LC	55 pip	1	likely commuting	unknown		
20/09/2012	3	50	LC	45 pip	1	feeding buzz	unknown		2 bats
20/09/2012	3	50	LC	55 pip	1	feeding buzz	unknown		2 bats
20/09/2012	3	50 to 51	LC	55 pip	1	unknown	unknown		
20/09/2012	3	50 to 51	LC	55 pip	8	feeding buzz	unknown		

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
20/09/2012	3	50 to 51	LC	45 pip	2	feeding buzz	unknown		
20/09/2012	3	50 to 51	LC	45 pip	3	feeding buzz	unknown		
20/09/2012	3	52	LC	45 pip	1	feeding buzz	unknown		
20/09/2012	3	54	LC	pip sp.	1	likely commuting	unknown		

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
30/05/2013	1	9 to 10	LC+SS	45 pip	2	unknown	unknown	5-10m	
30/05/2013	1	10	LC+SS	pip sp.	3	unknown	unknown	unknown	
30/05/2013	1	10 to 11	LC+SS	pip sp.	10	feeding buzz	unknown	unknown	Feeding on the edge of the plantation
30/05/2013	1	11	LC+SS	45 pip	10	feeding buzz	unknown	unknown	
30/05/2013	1	11	LC+SS	55 pip	11	feeding buzz	unknown	unknown	
30/05/2013	1	11 to 12	LC+SS	45 pip	2	feeding buzz	unknown	unknown	
30/05/2013	1	11 to 12	LC+SS	55 pip	2	unknown	unknown	unknown	
30/05/2013	1	12	LC+SS	pip sp.	1	unknown	unknown	unknown	
30/05/2013	1	12	LC+SS	45 pip	10	unknown	unknown	unknown	
30/05/2013	1	12	LC+SS	55 pip	3	unknown	unknown	unknown	
30/05/2013	1	12 to 13	LC+SS	45 pip	1	likely commuting	unknown	unknown	
30/05/2013	1	13	LC+SS	pip sp.	1	likely commuting	unknown	unknown	
30/05/2013	1	13	LC+SS	45 pip	1	feeding buzz	unknown	unknown	
30/05/2013	1	13 to 14	LC+SS	55 pip	3	unknown	unknown	unknown	
30/05/2013	1	14	LC+SS	55 pip	1	unknown	unknown	unknown	
30/05/2013	1	16	LC+SS	45 pip	1	likely commuting	unknown	unknown	
30/05/2013	1	16	LC+SS	55 pip	1	likely commuting	unknown	unknown	
30/05/2013	1	16 to 17	LC+SS	55 pip	2	unknown	unknown	unknown	
30/05/2013	1	17	LC+SS	45 pip	4	unknown	unknown	unknown	
30/05/2013	1	17	LC+SS	pip sp.	1	feeding buzz	unknown	unknown	
30/05/2013	1	17 to 18	LC+SS	45 pip	2	likely commuting	unknown	unknown	
30/05/2013	1	18	LC+SS	45 pip	2	unknown	unknown	unknown	
30/05/2013	2	28	LC+SS	55 pip	11	unknown	unknown	unknown	
30/05/2013	2	28 to 29	LC+SS	45 pip	1	unknown	unknown	unknown	
30/05/2013	2	29	LC+SS	45 pip	1	unknown	unknown	unknown	
30/05/2013	2	29 to 30	LC+SS	55 pip	6	feeding buzz	unknown	5-10m	
30/05/2013	2	30	LC+SS	45 pip	2	unknown	unknown	unknown	
30/05/2013	2	30 to 31	LC+SS	45 pip	2	unknown	unknown	unknown	
30/05/2013	2	30 to 31	LC+SS	55 pip	1	unknown	unknown	unknown	
30/05/2013	2	31 to 32	LC+SS	55 pip	3	feeding buzz	unknown	unknown	
30/05/2013	2	31 to 32	LC+SS	45 pip	4	feeding buzz	unknown	unknown	
30/05/2013	2	32	LC+SS	55 pip	3	unknown	unknown	unknown	
30/05/2013	2	32	LC+SS	45 pip	3	unknown	unknown	unknown	
30/05/2013	2	32 to 33	LC+SS	55 pip	6	feeding buzz	unknown	15-20m	
30/05/2013	2	32 to 33	LC+SS	45 pip	1	feeding buzz	unknown	15-20m	
30/05/2013	2	33	LC+SS	55 pip	5	feeding buzz	unknown	5-10m	
30/05/2013	2	33	LC+SS	45 pip	6	feeding buzz	unknown	unknown	
30/05/2013	2	33 to 34	LC+SS	45 pip	7	unknown	unknown	unknown	
30/05/2013	2	33 to 34	LC+SS	55 pip	4	unknown	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
30/05/2013	2	34	LC+SS	55 pip	1	unknown	unknown	unknown	
30/05/2013	2	34	LC+SS	45 pip	2	unknown	unknown	unknown	
30/05/2013	2	35 to 36	LC+SS	45 pip	2	unknown	unknown	unknown	
30/05/2013	2	36 to 37	LC+SS	45 pip	2	unknown	unknown	unknown	
25/06/2013	1	22	EM	45 pip	1	unknown	unknown	unknown	Not seen (00:21)
25/06/2013	1	22	EM	pip sp.	1	feeding buzz	W	0-5m	(00:24)
25/06/2013	1	19	EM	pip sp.	1	unknown	unknown	unknown	Not seen (00:43)
25/06/2013	1	18	EM	45 pip	2	unknown	unknown	unknown	Not seen and faint. 2nd pass closer (00:51)
25/06/2013	1	18 to 17	EM	pip sp.	1	unknown	unknown	unknown	Not seen
25/06/2013	1	17	EM	45 pip	3	feeding buzz	NW	5-10m	Flying along tree line
25/06/2013	1	17	EM	55 pip	4	unknown	unknown	unknown	
25/06/2013	1	15	EM	pip sp.	1	unknown	unknown	unknown	Not seen
25/06/2013	1	11	EM	55 pip	2	feeding buzz	unknown	unknown	Not seen (0047)
25/06/2013	1	11	EM	45 pip	1	feeding buzz	SW	5-10m	
25/06/2013	1	11 to 10	EM	pip sp.	1	unknown	unknown	unknown	Not seen
25/06/2013	1	9 to 8	EM	45 pip	1	feeding buzz	W	0-5m	Followed me for 30m
25/06/2013	1	9 to 8	EM	55 pip	2	unknown	unknown	unknown	
25/06/2013	1	8	EM	pip sp.	1	unknown	unknown	unknown	Not seen
25/06/2013	1	8 to7	EM	pip sp.	1	unknown	unknown	unknown	Not seen
25/06/2013	1	7	EM	55 pip	1	feeding buzz	unknown	unknown	Not seen
25/06/2013	1	2	EM	45 pip	1	unknown	unknown	unknown	Not seen (02:51)
25/06/2013	2	44	LF	55 pip	8	feeding buzz	NE	15-20m	Possibly more than one
25/06/2013	2	44	LF	55 pip	1	unknown	unknown	unknown	Faint
25/06/2013	2	44	LF	45 pip	4	feeding buzz	NE	5-10m	
25/06/2013	2	44	LF	Daubenton’s	1	unknown	unknown	unknown	
25/06/2013	2	44	LF	45 pip	4	unknown	NE	5-10m	(00:14)
25/06/2013	2	44	LF	55 pip	10	feeding buzz	NE	5-10m	
25/06/2013	2	44	LF	Daubenton’s	1	unknown	unknown	unknown	
25/06/2013	2	43	LF	55 pip	10	feeding buzz	SW	5-10m	
25/06/2013	2	43	LF	pip sp.	10	feeding buzz	SW	5-10m	
25/06/2013	2	43	LF	55 pip	3	feeding buzz	NE	5-10m	
25/06/2013	2	43	LF	45 pip	4	feeding buzz	NE	5-10m	
25/06/2013	2	43 to 42	LF	45 pip	1	likely commuting	NE	5-10m	
25/06/2013	2	43 to 42	LF	pip sp.	3	feeding buzz	NE	5-10m	
25/06/2013	2	43 to 42	LF	45 pip	10	feeding buzz	NE	5-10m	
25/06/2013	2	43 to 42	LF	55 pip	10	feeding buzz	NE	5-10m	
25/06/2013	2	43 to 42	LF	55 pip	1	likely commuting	unknown	unknown	(00:31)
25/06/2013	2	40	LF	pip sp.	1	likely commuting	unknown	unknown	
25/06/2013	2	40	LF	45 pip	1	unknown	unknown	unknown	
25/06/2013	2	39	LF	55 pip	10	feeding buzz	SW	5-10m	
25/06/2013	2	39	LF	45 pip	1	unknown	unknown	unknown	
25/06/2013	2	39	LF	45 pip	3	feeding buzz	unknown	unknown	
25/06/2013	2	39	LF	55 pip	3	feeding buzz	unknown	unknown	
25/06/2013	2	39	LF	55 pip	3	unknown	unknown	unknown	faint
25/06/2013	2	39	LF	55 pip	2	unknown	unknown	unknown	
25/06/2013	2	39 to38	LF	45 pip	2	feeding buzz	unknown	unknown	
25/06/2013	2	39 to38	LF	Daubenton’s	1	unknown	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
25/06/2013	2	38	LF	55 pip	1	unknown	unknown	unknown	
25/06/2013	2	38	LF	55 pip	2	feeding buzz	unknown	unknown	
25/06/2013	2	38	LF	45 pip	1	unknown	unknown	unknown	
25/06/2013	2	38	LF	55 pip	3	feeding buzz	unknown	unknown	
25/06/2013	2	38	LF	45 pip	2	feeding buzz	unknown	unknown	
25/06/2013	2	38 to 37	LF	45 pip	5	feeding buzz	unknown	unknown	
25/06/2013	2	38 to 37	LF	55 pip	5	feeding buzz	unknown	unknown	
25/06/2013	2	38 to 37	LF	Daubenton’s	1	unknown	unknown	unknown	
25/06/2013	2	37	LF	55 pip	10	feeding buzz	unknown	5-10m	
25/06/2013	2	37	LF	45 pip	1	feeding buzz	unknown	unknown	
25/06/2013	2	37	LF	pip sp.	1	unknown	unknown	unknown	
25/06/2013	2	37 to 36	LF	45 pip	2	feeding buzz	unknown	unknown	
25/06/2013	2	37 to 36	LF	45 pip	1	feeding buzz	unknown	unknown	
25/06/2013	2	37 to 36	LF	pip sp.	1	feeding buzz	unknown	unknown	
25/06/2013	2	36	LF	pip sp.	1	likely commuting	unknown	unknown	
25/06/2013	2	36	LF	pip sp.	1	likely commuting	unknown	unknown	
25/06/2013	2	36	LF	pip sp.	1	likely commuting	unknown	unknown	
25/06/2013	2	36	LF	55 pip	4	feeding buzz	unknown	unknown	
25/06/2013	2	36-35	LF	55 pip	1	likely commuting	unknown	unknown	
25/06/2013	2	36-35	LF	pip sp.	3	unknown	unknown	unknown	Circling
25/06/2013	2	35	LF	55 pip	2	likely commuting	unknown	unknown	
25/06/2013	2	35	LF	45 pip	5	feeding buzz	unknown	unknown	
25/06/2013	2	35	LF	pip sp.	5	unknown	unknown	unknown	
25/06/2013	2	35 to 34	LF	55 pip	4	unknown	unknown	unknown	
25/06/2013	2	35 to 34	LF	45 pip	2	unknown	unknown	unknown	
25/06/2013	2	34	LF	pip sp.	3	feeding buzz	unknown	unknown	
25/06/2013	2	34	LF	55 pip	10	feeding buzz	unknown	5-10m	Circling
25/06/2013	2	34	LF	45 pip	1	unknown	unknown	unknown	
25/06/2013	2	34 to 33	LF	55 pip	10	feeding buzz	unknown	unknown	
25/06/2013	2	34 to 33	LF	45 pip	1	unknown	unknown	unknown	
25/06/2013	2	33	LF	55 pip	1	likely commuting	unknown	unknown	
25/06/2013	2	33	LF	55 pip	2	feeding buzz	unknown	unknown	Feeding
25/06/2013	2	33 to 32	LF	Daubenton’s	6	feeding buzz	unknown	unknown	
25/06/2013	2	33 to 32	LF	pip sp.	2	unknown	unknown	0-5m	Along wood
25/06/2013	2	33 to 32	LF	55 pip	10	feeding buzz	unknown	unknown	
25/06/2013	2	32	LF	55 pip	6	unknown	unknown	unknown	
25/06/2013	2	32	LF	45 pip	3	likely commuting	unknown	unknown	Along wood
25/06/2013	2	32	LF	Daubenton’s	5	feeding buzz	unknown	unknown	
25/06/2013	2	32 to 31	LF	pip sp.	1	likely commuting	unknown	unknown	
25/06/2013	2	32 to 31	LF	55 pip	5	feeding buzz	unknown	unknown	
25/06/2013	2	32 to 31	LF	45 pip	5	feeding buzz	unknown	unknown	
25/06/2013	2	31	LF	55 pip	10	feeding buzz	unknown	5-10m	Along wood circling. Possibly two bats
25/06/2013	2	31	LF	45 pip	10	feeding buzz	unknown	unknown	
25/06/2013	2	31 to30	LF	55 pip	10	feeding buzz	unknown	unknown	
25/06/2013	2	31 to30	LF	45 pip	1	likely commuting	unknown	unknown	
25/06/2013	2	30	LF	55 pip	1	likely commuting	unknown	unknown	
25/06/2013	2	30	LF	55 pip	1	likely commuting	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
25/06/2013	2	30 to 29	LF	45 pip	1	likely commuting	unknown	unknown	
25/06/2013	2	29	LF	45 pip	1	likely commuting	unknown	unknown	
25/06/2013	2	29 to 28	LF	pip sp.	5	unknown	unknown	unknown	Circling
25/06/2013	2	28	LF	45 pip	7	feeding buzz	NW	0-5m	Circling along hedge
25/06/2013	2	28	LF	55 pip	3	feeding buzz	NW	0-5m	Circling along hedge
25/06/2013	2	28 to 27	LF	pip sp.	1	feeding buzz	unknown	unknown	Feeding along fence
25/06/2013	2	28 to 27	LF	45 pip	2	feeding buzz	unknown	unknown	Feeding along fence
25/06/2013	2	28 to 27	LF	55 pip	3	feeding buzz	unknown	unknown	Feeding along fence
25/06/2013	2	27	LF	pip sp.	4	feeding buzz	unknown	5-10m	Feeding along fence
25/06/2013	2	27	LF	45 pip	16	feeding buzz	unknown	5-10m	Feeding along fence
25/06/2013	2	27	LF	55 pip	21	feeding buzz	unknown	5-10m	Feeding along fence
25/06/2013	2	27 to 26	LF	45 pip	2	unknown	unknown	unknown	
25/06/2013	2	27 to 26	LF	55 pip	1	unknown	unknown	unknown	
25/06/2013	2	27 to 26	LF	pip sp.	1	unknown	unknown	unknown	
25/06/2013	2	26	LF	45 pip	1	unknown	unknown	unknown	Faint
25/06/2013	2	26	LF	55 pip	1	unknown	unknown	unknown	Faint
25/06/2013	2	26	LF	pip sp.	1	unknown	unknown	unknown	Faint
25/06/2013	2	24 to 23	LF	pip sp.	1	unknown	unknown	unknown	
25/06/2013	2	23	LF	55 pip	1	unknown	NE	5-10m	
25/06/2013	2	23	LF	45 pip	1	unknown	unknown	unknown	
08/08/2013	1	10	LF	pip sp.	1	likely commuting	E	5-10m	
08/08/2013	1	10	LF	pip sp.	1	likely commuting	E	5-10m	
08/08/2013	1	10 to 11	LF	55 pip	3	likely commuting	E	5-10m	
08/08/2013	1	11	LF	45 pip	2	likely commuting	unknown	unknown	Unseen
08/08/2013	1	11	LF	45 pip	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	11	LF	55 pip	1	feeding buzz	E	0-5m	
08/08/2013	1	11	LF	55 pip	1	unknown	E	5-10m	
08/08/2013	1	11 to 12	LF	45 pip	1	unknown	unknown	unknown	
08/08/2013	1	12	LF	55 pip	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	12 to 13	LF	45 pip	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	13	LF	55 pip	1	likely commuting	unknown	unknown	Unseen. Rain present
08/08/2013	1	14	LF	Daubenton’s	1	likely commuting	unknown	unknown	Unseen. Rain present
08/08/2013	1	14 to 15	LF	55 pip	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	14 to 15	LF	55 pip	3	unknown	unknown	unknown	Unseen
08/08/2013	1	15	LF	55 pip	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	15	LF	55 pip	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	15 to 16	LF	45 pip	2	likely commuting	unknown	unknown	Unseen
08/08/2013	1	16	LF	pip sp.	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	16 to 17	LF	55 pip	1	feeding buzz	unknown	unknown	Unseen
08/08/2013	1	17	LF	55 pip	1	likely commuting	unknown	unknown	Unseen. Faint
08/08/2013	1	17	LF	45 pip	3	unknown	unknown	unknown	
08/08/2013	1	17 to 18	LF	45 pip	1	likely commuting	unknown	unknown	unseen
08/08/2013	1	18	LF	45 pip	1	likely commuting	unknown	unknown	unseen
08/08/2013	1	19	LF	Daubenton’s	1	unknown	unknown	unknown	
08/08/2013	1	20	LF	pip sp.	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	20 to 21	LF	pip sp.	1	likely commuting	unknown	unknown	Unseen
08/08/2013	1	22	LF	45 pip	1	likely commuting	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
08/08/2013	2	29	KM	55 pip	1	unknown	unknown	unknown	
08/08/2013	2	29 to 30	KM	45 pip	3	unknown	unknown	unknown	
08/08/2013	2	30	KM	45 pip	5	unknown	unknown	unknown	
08/08/2013	2	30	KM	55 pip	2	unknown	unknown	unknown	
08/08/2013	2	30 to 31	KM	45 pip	2	unknown	unknown	unknown	
08/08/2013	2	30 to 31	KM	55 pip	2	unknown	unknown	unknown	
08/08/2013	2	31	KM	45 pip	1	unknown	unknown	unknown	
08/08/2013	2	31	KM	55 pip	1	unknown	unknown	unknown	
08/08/2013	2	31 to 32	KM	45 pip	1	unknown	unknown	unknown	
08/08/2013	2	31 to 32	KM	55 pip	3	unknown	unknown	unknown	
08/08/2013	2	31 to 32	KM	Daubenton's	1	unknown	unknown	unknown	
08/08/2013	2	32 to 33	KM	pip sp.	1	feeding buzz	unknown	unknown	
08/08/2013	2	32 to 33	KM	55 pip	9	unknown	unknown	unknown	
08/08/2013	2	32 to 33	KM	45 pip	2	unknown	unknown	unknown	
08/08/2013	2	33	KM	pip sp.	2	unknown	unknown	unknown	
08/08/2013	2	33	KM	45 pip	2	unknown	unknown	unknown	
08/08/2013	2	33	KM	55 pip	2	unknown	unknown	unknown	
08/08/2013	2	33 to 34	KM	pip sp.	4	unknown	unknown	unknown	Fast and slow calls
08/08/2013	2	33 to 34	KM	45 pip	1	unknown	unknown	unknown	
08/08/2013	2	33 to 34	KM	55 pip	7	unknown	unknown	unknown	
08/08/2013	2	34	KM	pip sp.	1	unknown	unknown	unknown	
08/08/2013	2	34	KM	55 pip	5	unknown	unknown	unknown	
08/08/2013	2	34 to 35	KM	55 pip	5	unknown	unknown	unknown	
08/08/2013	2	34 to 35	KM	45 pip	1	unknown	unknown	unknown	
08/08/2013	2	36	KM	pip sp	1	unknown	unknown	unknown	
08/08/2013	2	36	KM	55 pip	1	unknown	unknown	unknown	
08/08/2013	2	36 to 37	KM	45 pip	2	unknown	unknown	unknown	
08/08/2013	2	36 to 37	KM	55 pip	8	unknown	unknown	unknown	
08/08/2013	2	37	KM	45 pip	3	unknown	unknown	unknown	
08/08/2013	2	37	KM	pip sp.	1	unknown	unknown	unknown	
08/08/2013	2	37 to 38	KM	45 pip	1	unknown	unknown	unknown	
08/08/2013	2	38 to 39	KM	45 pip	1	unknown	unknown	unknown	
08/08/2013	2	38 to 39	KM	55 pip	2	unknown	unknown	unknown	
08/08/2013	2	39 to 40	KM	45 pip	1	unknown	unknown	unknown	
08/08/2013	2	39 to 40	KM	55 pip	1	unknown	unknown	unknown	
08/08/2013	2	40	KM	45 pip	1	unknown	unknown	unknown	
08/08/2013	2	42	KM	55 pip	1	unknown	unknown	unknown	
08/08/2013	2	42 to 43	KM	55 pip	1	unknown	unknown	unknown	
08/08/2013	2	44	KM	55 pip	1	unknown	unknown	unknown	
21/08/2013	1	11	KM	pip sp.	1	likely commuting	S	5-10m	Found at forest edge
21/08/2013	1	9 to 10	KM	45 pip	1	unknown	unknown	unknown	
21/08/2013	1	9 to 10	KM	55 pip	1	unknown	unknown	unknown	
21/08/2013	1	9	KM	45 pip	1	unknown	unknown	unknown	
21/08/2013	1	8 to 9	KM	55 pip	1	unknown	unknown	unknown	
21/08/2013	1	3	KM	55 pip	5	likely commuting	unknown	unknown	Heard both at 45 and 60kHz
21/08/2013	1	2 to 3	KM	45 pip	3	unknown	unknown	unknown	
21/08/2013	1	2 to 3	KM	55 pip	7	unknown	unknown	unknown	

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
21/08/2013	1	2	KM	55 pip	2	likely commuting	unknown	unknown	
21/08/2013	1	1	KM	45 pip	2	likely commuting	unknown	unknown	
21/08/2013	2	37	LF	55 pip	1	likely commuting	unknown	unknown	Not seen
21/08/2013	2	37	LF	55 pip	3	feeding buzz	NW	5-10m	Along tree line
21/08/2013	2	37 to 36	LF	55 pip	2	feeding buzz	NW	5-10m	Along tree line
21/08/2013	2	37 to 36	LF	55 pip	8	feeding buzz	NW	5-10m	Along tree line
21/08/2013	2	36	LF	pip sp.	1	likely commuting	unknown	unknown	
21/08/2013	2	36 to 35	LF	55 pip	4	feeding buzz	unknown	5-10m	Along trees and over open ground
21/08/2013	2	36 to 35	LF	55 pip	2	feeding buzz	unknown	unknown	Not seen
21/08/2013	2	35	LF	55 pip	10	feeding buzz	unknown	5-10m	Faint
21/08/2013	2	35 to 34	LF	55 pip	1	unknown	unknown	unknown	Faint. Not seen
21/08/2013	2	34	LF	45 pip	5	feeding buzz	unknown	unknown	Unseen
21/08/2013	2	34 to 33	LF	45 pip	3	feeding buzz	unknown	unknown	Same as bat from point 34
21/08/2013	2	34 to 33	LF	45 pip	1	unknown	unknown	unknown	
21/08/2013	2	34 to 33	LF	45 pip	3	unknown	unknown	unknown	Flying high up. Not seen and circling
21/08/2013	2	33	LF	pip sp.	11	feeding buzz	unknown	unknown	Flying high up. Not seen and circling
21/08/2013	2	33	LF	55 pip	6	feeding buzz	unknown	unknown	Flying high up. Not seen and circling
21/08/2013	2	33	LF	45 pip	2	unknown	unknown	unknown	
21/08/2013	2	33 to 32	LF	45 pip	6	feeding buzz	W	unknown	Feeding along the tree line
21/08/2013	2	33 to 32	LF	45 pip	2	feeding buzz	S	0-5m	
21/08/2013	2	32	LF	Daubenton's	2	unknown	unknown	unknown	
21/08/2013	2	32	LF	55 pip	4	feeding buzz	unknown	unknown	Not seen
21/08/2013	2	32	LF	55 pip	4	feeding buzz	unknown	unknown	Not seen
21/08/2013	2	32 to 31	LF	55 pip	2	feeding buzz	unknown	unknown	Not seen
21/08/2013	2	32 to 31	LF	45 pip	1	unknown	unknown	unknown	
21/08/2013	2	32 to 31	LF	pip sp.	1	unknown	unknown	unknown	
21/08/2013	2	31	LF	55 pip	15	feeding buzz	unknown	unknown	Possibly 2 bats. Constant activity.
21/08/2013	2	31	LF	pip sp.	2	feeding buzz	unknown	unknown	
21/08/2013	2	31 to 30	LF	55 pip	6	feeding buzz	unknown	unknown	Not seen, but activity at the tree line
21/08/2013	2	31 to 30	LF	45 pip	5	unknown	unknown	unknown	
21/08/2013	2	31 to 30	LF	pip sp.	2	unknown	unknown	unknown	
21/08/2013	2	30	LF	55 pip	6	feeding buzz	unknown	unknown	Not seen, but activity at the tree line
21/08/2013	2	30	LF	45 pip	2	unknown	unknown	unknown	
21/08/2013	2	30 to 29	LF	45 pip	1	unknown	unknown	unknown	
21/08/2013	2	29	LF	45 pip	1	likely commuting	unknown	unknown	Not seen
21/08/2013	2	29	LF	45 pip	1	likely commuting	unknown	unknown	Not seen
21/08/2013	2	28	LF	55 pip	5	feeding buzz	unknown	unknown	Not seen but feeding
21/08/2013	2	28	LF	pip sp.	4	feeding buzz	unknown	unknown	Not seen but feeding
21/08/2013	2	28 to 27	LF	pip sp.	1	unknown	unknown	unknown	Not seen
21/08/2013	2	28 to 27	LF	55 pip	1	unknown	unknown	unknown	Not seen
21/08/2013	2	27	LF	55 pip	1	unknown	unknown	unknown	
21/08/2013	2	27 to 26	LF	pip sp.	1	likely commuting	unknown	unknown	Not seen
21/08/2013	2	26	LF	55 pip	1	unknown	unknown	unknown	
21/08/2013	2	26 to 25	LF	pip sp.	2	likely commuting	unknown	unknown	Not seen
21/08/2013	2	25	LF	45 pip	1	feeding buzz	unknown	unknown	Not seen
21/08/2013	2	25	LF	55 pip	3	social call	unknown	unknown	
21/08/2013	2	25 to 24	LF	55 pip	1	social call	unknown	unknown	Faint, not seen

Date	Transect	Point count	Surveyor	Species	pass no.	Behaviour	Direction	Height	Notes
21/08/2013	2	24 to 23	LF	pip sp.	2	unknown	unknown	unknown	Not seen
21/08/2013	2	23	LF	55 pip	1	unknown	unknown	unknown	Detour taken along the side of the transect route due to field being full of turnips.
21/08/2013	2	23	LF	daubentonii	1	unknown	unknown	unknown	
27/09/2013	1	1	LF	pip sp.	2	likely commuting	unknown	unknown	Faint and not seen
27/09/2013	1	1 to 2	LF	55 pip	1	likely commuting	unknown	unknown	Not seen
27/09/2013	1	3	LF	45 pip	1	likely commuting	unknown	unknown	Not seen
27/09/2013	1	5	LF	Unknown Bat	1	likely commuting	unknown	unknown	Rain (2)
27/09/2013	2	28	PR	55 pip	1	likely commuting	S	5-10m	
27/09/2013	2	30	PR	45 pip	2	feeding buzz	unknown	0-5m	Flying in loops
27/09/2013	2	30	PR	45 pip	1	likely commuting	SW	5-10m	
27/09/2013	2	31	PR	55 pip	1	unknown	unknown	unknown	Unseen. Possible commuter
27/09/2013	2	31	PR	45 pip	2	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	31 to 32	PR	45 pip	1	likely commuting	unknown	unknown	Unseen
27/09/2013	2	32	PR	45 pip	1	unknown	unknown	unknown	Unseen
27/09/2013	2	32	PR	45 pip	3	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	33	PR	55 pip	2	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	33 to 34	PR	pip sp.	8	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	34	PR	55 pip	6	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	34	PR	45 pip	1	unknown	unknown	unknown	Unseen
27/09/2013	2	34 to 35	PR	55 pip	3	social call	unknown	unknown	
27/09/2013	2	35	PR	55 pip	2	unknown	unknown	unknown	Unseen
27/09/2013	2	36 to 37	PR	45 pip	2	unknown	unknown	unknown	Unseen
27/09/2013	2	37	PR	55 pip	2	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	37	PR	55 pip	4	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	37	PR	BLE	1	unknown	unknown	unknown	
27/09/2013	2	37 to 38	PR	45 pip	2	unknown	unknown	unknown	
27/09/2013	2	38	PR	45 pip	3	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	38	PR	55 pip	2	unknown	unknown	unknown	Faint
27/09/2013	2	38 to 39	PR	55 pip	1	unknown	unknown	unknown	
27/09/2013	2	39	PR	55 pip	16	feeding buzz	unknown	unknown	Possibly more than one
27/09/2013	2	39 to 40	PR	55 pip	8	unknown	unknown	unknown	
27/09/2013	2	40	PR	55 pip	4	feeding buzz	unknown	unknown	
27/09/2013	2	40	PR	45 pip	1	unknown	unknown	unknown	
27/09/2013	2	41 to 42	PR	55 pip	1	unknown	unknown	unknown	
27/09/2013	2	42 to 43	PR	45 pip	2	unknown	unknown	unknown	
27/09/2013	2	43	PR	55 pip	5	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	43 to 44	PR	55 pip	2	feeding buzz	unknown	unknown	Unseen
27/09/2013	2	44	PR	55 pip	9	feeding buzz	unknown	unknown	Unseen

ANNEX 10 – Spatial and Temporal Raw Data.

Due to the large amount of data that was collected during the temporal surveys (13,866 bat passes in total) and the large number of data sheets from the point count surveys the raw data has not been displayed here. However, this data can be provided electronically upon request.

Technical Appendix 5.5 – Fisheries Survey Report

FISH SURVEY RESULTS

for the proposed Highlea Windfarm

Survey work carried out by The *Tweed* Foundation for MacArthur Green Ltd

Initial survey : 15/07/2012
Report completed : 26/11/2012

Report written by The Tweed Foundation Assistant Biologist, James Hunt BSc MSc
Checked by The Tweed Foundation Biologist, Ronald Campbell BSC PhD MIFM

Address :

The *Tweed* Foundation
Drygrange Steading
Melrose
TD6 9DJ

BACKGROUND
The Tweed Foundation was commissioned by MacArthur Green Ltd to survey local fish populations for watercourses located within the proposed Highlea Windfarm area to inform the environmental impact assessment. Juvenile Salmon, Trout and Lamprey were selected as the target species for sampling due to their known presence within the local area and their conservation importance (the Tweed is a European Special Area of Conservation for both Salmon and Lamprey). Trout were selected both as a species native to the Tweed District and for their wide geographical distribution, particularly in the sort of smaller tributaries that were sampled.

METHOD
Five three minute samples were taken for juvenile Salmon and Trout on watercourses within the proposed windfarm boundary. Sections of fast-flowing, relatively shallow areas were selected, which are the preferred habitat of juvenile Salmon and Trout. Juvenile Salmon are usually commoner in main channels while Trout, by contrast, dominate the smaller burns where adult Trout spawn. Other tributaries of the Jed Water, Rule Water and Black Burn were visited within the windfarm boundary but were too small to contain any fish species and were therefore not sampled.

Semi-quantitative sampling involves electro-fishing for a three minute length of time while continuously working upstream. The advantage of this method is that with a short sampling period for each site, a high number of sites can be quickly established that provide a broad geographical coverage of the project area. The method follows an agreed protocol defined by the Scottish Fisheries Coordination Centre (SFCC). All members of the survey team are SFCC accredited to guarantee the quality of the data collection and ensure that it is collected in a safe manner.

The five sampling sites were also surveyed for Lamprey using the methodology adopted for the 2004 Tweed Lamprey SAC survey for semi-quantitative sampling, which is defined by Harvey & Cowyx (2003). The method is suited to sub-optimal habitat (i.e. where there are no large patches of sediment), which is typical of upland watercourses found within the Langhope windfarm area. Any larvae captured are anaesthetised for identification and measurement. The larvae of Brook and River Lamprey are not distinguishable in the field, although any over 150 mm will be those of Brook Lamprey.

All of the sites were photographed and accurately located using GPS (5 m accuracy). Future monitoring will rely on sampling exactly the same sections of river using an identical method to help reduce sampling error. Basic statistical tests will then be used to compare the average or median numbers of fish between different sampling years.

The life cycle of Salmon and Trout
To understand the results provided on the following pages, a brief guide to the life cycle of Salmon and Trout is provided:-

The fry are "the young of the year" that are spawned in the Autumn and emerge out of the gravel around April / May. By summer these fish are 5 to 7 cm in length. *(picture – a Salmon fry recently emerged)*

Parr are fish that have passed one or more winters in the stream. Features of Salmon parr that can be used to distinguish them from Trout parr include distinctive parr marks along the flank, a black spot on the gill cover, a more forked tail and generally an absence of red in the tail and adipose fin.
(picture – Salmon Parr (top), Trout Parr (bottom))

Most Salmon Parr leave the river in the Spring as Smolts at a length of around 12 cm (generally after two winters in the river). Trout Parr on the other hand either drop down into the main river to become adult Brown Trout or become Smolts in spring time and go to sea to become Sea Trout. *(picture – Salmon smolt)*

Adult Salmon and Sea Trout typically return from the sea after 1 or 2 winters, although some Sea Trout may return after the first summer. *(picture – adult Salmon (top), adult Sea Trout (bottom))*

The Tweed system has 3 types of Lamprey – Brook, River and Sea.

Brook Lamprey will remain resident in the area that they are spawned and seldom grow any larger than the individual shown in the first Lamprey picture (about 12-14 cm).

River Lamprey migrate down to the Estuary and the Sea Lamprey (see picture left) out to sea to feed before returning to the river. Both forms of Lamprey attach themselves to other fish (e.g. adult Sea Trout or Cod) to feed on their body fluids. River and Sea Lamprey larvae are typically found in the middle and lower reaches of the Tweed and it would be very unlikely to find them in the proposed windfarm area. Young lamprey (Ammocoetes) only live in silt, mud or fine sand.

RESULTS

The first point to look at when analysing the results is the relative abundance of different age classes (Fry and Parr). For example, absence of Fry, but presence of Parr would suggest there were no spawning fish in the local area the previous autumn. The absence of all age classes could indicate the presence of a terminal obstacle further downstream or a serious pollution incident. A high number of Fry but low number of Parr can suggest the habitat is not of prime quality for Parr or that this age class has moved into deeper water or migrated further downstream.

The results for the Salmonid timed electro-fishing (Table 2) can be classified using categories defined from data collected from the Tweed District (Table 1). Each sampling site can then be assigned to one of these classes using the appropriate colour coding (Table 2.). Trout and Salmon Parr were not included in the Tweed Catchment baseline survey and therefore results for this age class cannot be classified in the same way. Map 1 shows the location of each site.

Table 1. Classification table for Trout and Salmon Fry using semi-quantitative values from 2006-2008 data

Fish	Absent	Very Low	Low	Moderate	High	Very high
Salmon Fry	0	1 – 4	5 – 12	13 – 20	21 – 29	30 - 100
Trout Fry	0	1 – 4	5 – 9	10 – 16	17 – 24	25 – 100

Table 2. Timed electro-fishing results. Values represented as number per 3 minutes

Code	Easting	Northing	Water	Salmon Fry	Trout Fry	Salmon Parr	Trout Parr
L01	363674	607960	Jed Water	17	7	0	1
L02	363811	607796	Black Burn	16	8	1	1
L04	362958	607277	Jed Water	17	2	1	0
L05	362632	606544	Jed Water	13	18	1	1
L06	362013	607413	Peden's Cleuch	0	0	0	0

Four out of the five Salmon Fry sites were classified as 'Moderate' . The Peden's Cleuch site (L06) was the only site where no fish were detected.

The Trout Fry numbers were much more variable than for Salmon with one site classified at 'High' (L05), two sites as 'Low' (L01 and L02), one as 'Very Low' (L04) and one as 'Absent' (L06).

Salmon and Trout Parr were either absent or only present as single fish.

Lamprey

The Lamprey results are presented in Table 3.

Table 3. Lamprey presence or absence. Sites that are marked absent were sampled in the best patches of habitat available in the local area. If a Lamprey was detected a timed sample was then taken

Code	Water	Presence / absence	Time	Catch per minute
L01	Jed Water	Present	4:05	1.7
L02	Black Burn	Present	4:30	4.5
L04	Jed Water	Present	6:30	6.5
L05	Jed Water	Present	6:57	0.3
L06	Peden's Cleuch	Absent	5:00	0

Lamprey were detected at four out of the five sites that were sampled with a length range of 20 mm up to 120 mm.

Discussion of results and conclusions

Salmon Fry

The absence of Salmon Fry at the site visited on the Peden Cleuch Burn is almost certainly due to the small size of this watercourse, which will be too small for adult Salmon to ascend at spawning time. The other four sites that were categorised as 'Moderate' are on larger watercourses where access for adults is easier, although these sites are likely to be in the upper range of adult Salmon spawning and therefore numbers may be quite variable from year to year.

Trout Fry

The 'Very Low' to 'Low' results for three out of the four sites on the Jed Water and Black Burn is probably because this watercourse is too wide for Trout spawning. Numbers are likely to be higher further upstream and in some of the nearby tributaries. There were 'High' numbers recorded at L05 indicating that a number of adult Trout spawned in this locality in 2011. The Pedden Cleuch site would appear to be too small for Trout Fry production, although spawning may have taken place further downstream on this watercourse where access may be easier for adult fish.

Trout and Salmon Parr

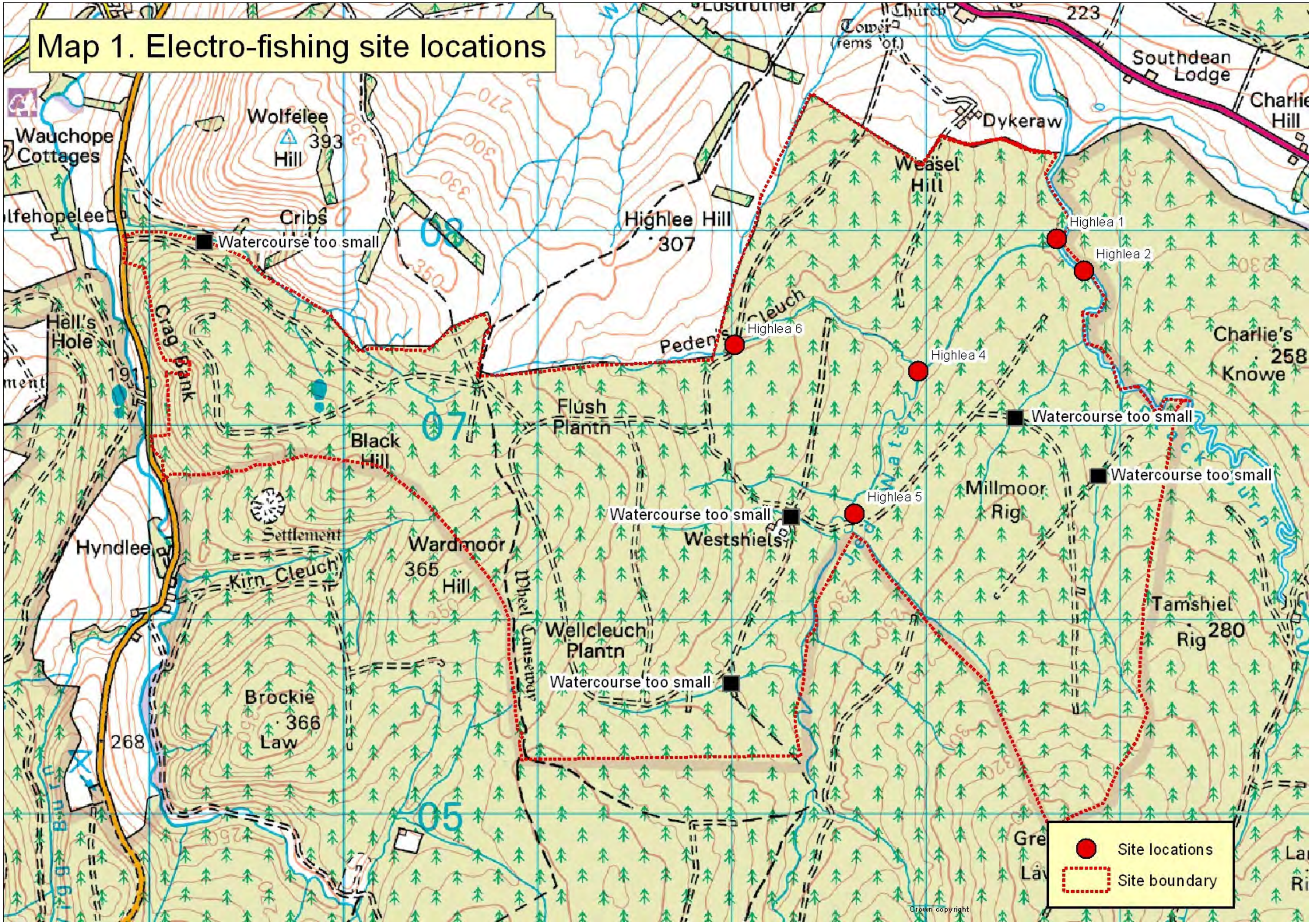
As shallow riffle habitat was selected for sampling, it is of no surprise that Salmon and Trout Parr were either absent or only present as single fish.

Lamprey

The presence of Lamprey at four out of five sites in the head waters of a major tributary is quite unusual as their preferred habitat of fine sediment (silt, sand and gravel) is normally absent in these areas. At the four sites that they were detected, fine sediment was present along the edges of the watercourse. The likelihood is that that the sampled Lamprey were resident Brook Lamprey rather than the migratory River and Sea Lamprey which are typically found in larger watercourses. The range of different lengths and their presence at all of the main channel sites demonstrates that there is a resident, stable, self-sustaining population.

Future monitoring

If future monitoring is required, then the target species for monitoring would be Salmon Fry and Lamprey on account of their presence in reasonable numbers. Further sites would need to be added to the main channel of the Jed Water and Black Burn to provide a representative sample to detect a population change.



Map 1. Electro-fishing site locations

Fry index sites

See Table 2 for the locations of each photo

Lamprey sites

L03 – no available habitat

L06 – no available habitat

See Table 3 for the locations of each photo

Technical Appendix 5.6

HIGHLEE HILL WIND FARM

Peat Depth Survey

&

Surface Vegetation Characteristics

Prepared by: Brian Henry
Reviewed by: Rafe Dewar

Date: 05 February 2016

Tel: 0141 342 5404
Web: www.macarthurgreen.com
Address: 95 South Woodside Road | Glasgow | G20 6NT

Document Quality Record

Version	Status	Originator	Authorised by	Date
1.0	Draft	Brian Henry	Rafe Dewar	29/02/2016

CONTENTS

LIST OF FIGURES

EXECUTIVE SUMMARY

MacArthur Green was commissioned by RES Ltd to carry out a peat depth survey and gather information on surface vegetation characteristics at the proposed Highlee Wind Farm site (the proposed wind farm site).

The purpose of this survey and assessment is to inform the following aims and objectives:

Aim 1	**Gather high resolution peat depth data on a 100m^2 systematic grid for the site.**
Objective 1.1	Inform the layout of the proposed wind farm infrastructure to help reduce impacts associated with peatland habitats.
Objective 1.2	Provide peat depth data to inform the impact of the wind farm on carbon losses arising from disturbance to peat based habitats.
Aim 2	**Determine surface vegetation characteristics of peatland areas within the site.**
Objective 2.1	Inform the EIA on the condition of the peatland habitats present.

The site was surveyed by MacArthur Green's survey team from the 16th to 26th September 2013. Peat depths and data on surface vegetation were collected at 1,140 sample points located on a 100m^2 systematic grid across the site (Figure 5.16).

The site is dominated by commercial coniferous plantation woodland and recent clearfell with few open and unplanted areas. Open areas within the forestry are mainly associated with forest rides. An area in the northern site is open farmland. Peat depths were shallow across the whole site with no peat recorded at over half of the sample points; resultantly peatland habitats were scarce and no areas of the site were considered blanket mire. Unplanted habitats present were predominately mesotrophic grasslands, acid grasslands and marshy grasslands on mineral soils and shallow peaty podzols and peaty gleys. The levels of commercial conifer plantation at the site has resulted in the loss of surface vegetation in many areas and reduced species diversity in others so that the habitats within the site have been largely degraded.

1. INTRODUCTION

MacArthur Green was commissioned by RES Ltd to carry out a peat depth survey and gather information on surface vegetation characteristics at the proposed Highlee Wind Farm site (hereafter referred to as the proposed wind farm site).

2. AIMS AND OBJECTIVES

The assessment has the following aims and objectives:

Aim 1	**Gather high resolution peat depth data on a 100m^2 systematic grid for the site.**
Objective 1.1	Inform the layout of the Wind Farm infrastructure to help reduce impacts associated with peatland habitats.
Objective 1.2	Provide peat depth data to inform the impact of the Wind Farm on carbon losses arising from disturbance to peat based habitats.
Aim 2	**Determine surface vegetation characteristics of peatland areas within the site.**
Objective 2.1	Inform the EIA on the condition of the peatland habitats present.

3. SURVEY AREA

The peat depth and vegetation sampling surveys were carried out within the full extent of the site boundary (see Figure XXX). The site is largely afforested with commercial coniferous woodland; open areas within the forestry are mainly associated with forest rides and recent clearfell areas. An area in the northern site is open farmland. Unplanted areas throughout the site tend to be dominated by mesotrophic grasslands, acid grasslands and marshy grasslands, there are very few areas of peatland or mire habitats (also see ES Volume 4, Technical Appendices 5.1 and 5.2). The site is drained by a number of minor watercourses. Access through the site is via a number of forestry tracks off adjoining public roads.

4. METHODOLOGY

The site was surveyed by MacArthur Green's survey team from the 16th to 26th September 2013. Surveys followed contemporary best practice guidance with regards surveying for developments on peatland (SNH *et al*., 2011 and Scottish Renewables & SEPA, 2012).

Methods employed for peat depth analysis and the characterisation of surface vegetation are detailed further in sections 4.1 and 4.2 below.

4.1 Peat Depth Analysis

Sampling frequency took due consideration of good practice and published guidance as cited above.

The following methods were employed:

1. The site was sampled using a 100m^2 systematic grid (Figures XXX). A random point was selected within the site and the grid was established around the random point. For ease of navigation the grid was orientated north to south.

2. GIS was used to generate the systematic grid and related sampling locations.

3. 1,142 samples were generated in total.

4. Sampling locations were downloaded on to hand held GPS units which were used to locate sampling locations in the field. Where GPS operation failed due to dense canopy cover, standard navigation techniques were employed to locate the sample point.

5. A custom made collapsible solid steel peat depth probe was used at each sample point to establish peat depth. Full depth was taken. (N.B. as this is a peat assessment, <u>only</u> peat depth was recorded; where the sample point fell on mineral soil the probe depth was recorded as zero).

6. Peat depth data were modelled using 'Inverse Distance Weighted' interpolation in ArcDesktop 10.1©. This interpolation method is best suited to situations where the density of samples is great enough to capture the local surface variation needed for the analysis (Childs, 2004).

7. A peat depth model was generated using the following categories of peat depth:

   0, 1-25; 26-50; 51-100, 101-150 and 50cm intervals thereafter.

4.2 Blanket Mire Condition

The Ecological Impact Assessment (ES Volume 2, Chapter 5), conducted as part of the Environmental Impact Assessment (EIA) for the proposed wind farm, assesses the condition of peatland habitats within the site. This report provides information on surface vegetation characteristics that has informed that assessment.

The under-noted methods were employed.

1. At each sampling point a 2m^2 quadrat was sampled. The following variables were recorded:

   - Percentage cover of key plant groups within the foliar and basal vegetation layers (assessed by eye) as detailed in Table 1.
   - Presence or absence of surface peat erosion. Peat erosion is defined as bare peat which shows signs of erosion (principally as a consequence of water movement); and
   - Presence or absence of drains. Drains include: agricultural drains, plough furrows; main forest drains; and subsidiary drains. No distinction between these drains was made during the survey.

Table 1: Key plant groups within the foliar and basal vegetation layers

Foliar Layer	Basal Layer
Calluna vulgaris	*Sphagnum* mosses (*Spp*. present recorded)
	Non-s*phagnum* mosses
Other dwarf shrubs	Bare ground/conifer needles
Eriophorum vaginatum	
Molinia caerulea	
Other Grasses, Rushes & Sedges	

2. At each sampling point where a drain dissected the quadrat, a 2 m section of 'drain' was surveyed to establish its activity. The following categories of activity were recorded:

    - Active: <30% occluded (visibly active);
    - Semi-Active: 30-90% occluded (some signs of running water current or recent); and
    - Inactive: 90-100% occluded (no sign of running water current or recent).

3. The data collected under points 1 and 2 above were used to characterise the peatland surface vegetation within the site using the following variables:

    - The mean % cover of *Sphagnum*;
    - The mean % cover of Non-*Sphagnum* mosses;
    - The mean % cover of *Calluna vulgaris*;
    - The mean % cover of *Eriophorum vaginatum*;
    - The mean % cover of *Molinia caerulea*;
    - The mean % cover of Grasses, Rushes & Bracken;
    - The mean % cover of bare ground/conifer needles;
    - Presence or absence of peat erosion; and
    - Drain activity and distribution.

Non peat-based habitats (e.g. improved and semi-improved grassland on mineral soils) were removed from the assessment).

Standard descriptive statistics are used to describe the data where appropriate.

5. RESULTS

The results of the survey are detailed below.

5.1 Peat Depth Analysis

Figures 5.17a to 5.17d illustrate the results of the peat depth modelling based on 1,140 sample points. The sampling grid generated 1,142 sample points; however two sample points were not sampled as due to a large area of windblown trees the area was completely inaccessible. Furthermore due to the high levels of windblow across the site a further 28 samples could not be surveyed at the specific sample point, in these cases the sample was taken as close as was possible to the sample point; the sample points reflect this and the points shown are the actual sample points at which depth measurements and vegetation survey were carried out.

SNH *et al*. (2011) define peat "*as land where the soil has an organic surface horizon over 0.5m deep*". In a further definition, areas where the peat depth is greater than 0.5 m deep the habitats are arbitrarily defined as blanket mire by MacDonald *et al*. (1998) and JNCC (2004). However, these organic surface horizons, and therefore peat, can be less than 0.5 m deep. As a result Figure 5.17a categorises peat depths into a number of intervals to show the variation in depth of peat accumulation and deposits across the site.

However, few areas of the site contained peat over 0.5 m in depth. Additionally peat deposits of all depths across the site often consisted of peaty gleys or podzols and no areas were considered true blanket mire (see Annex 1 for a description of blanket mire). This is also reinforced by the results of the surface vegetation surveys (section 5.2) and the Phase 1 Habitat and National Vegetation Classification surveys (ES Volume 4, Technical Appendices 5.1 and 5.2).

Figures 5.17a to 5.17d are based on data interpolation and consequently the peat depth boundaries are indicative; therefore they cannot be taken as definite boundaries, as actual peat depths 'in the field' may vary to a degree around these boundaries.

Charts.1 and 2 present the percentage and frequency of samples falling within the peat depth categories recorded on the site.

Chart 1: Percentage peat depths

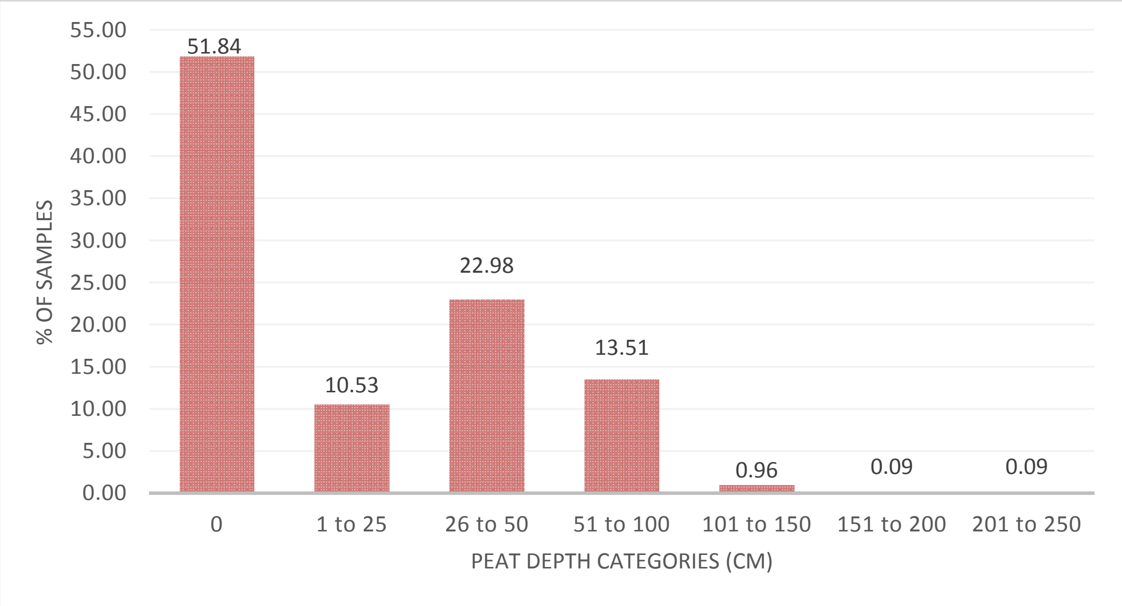
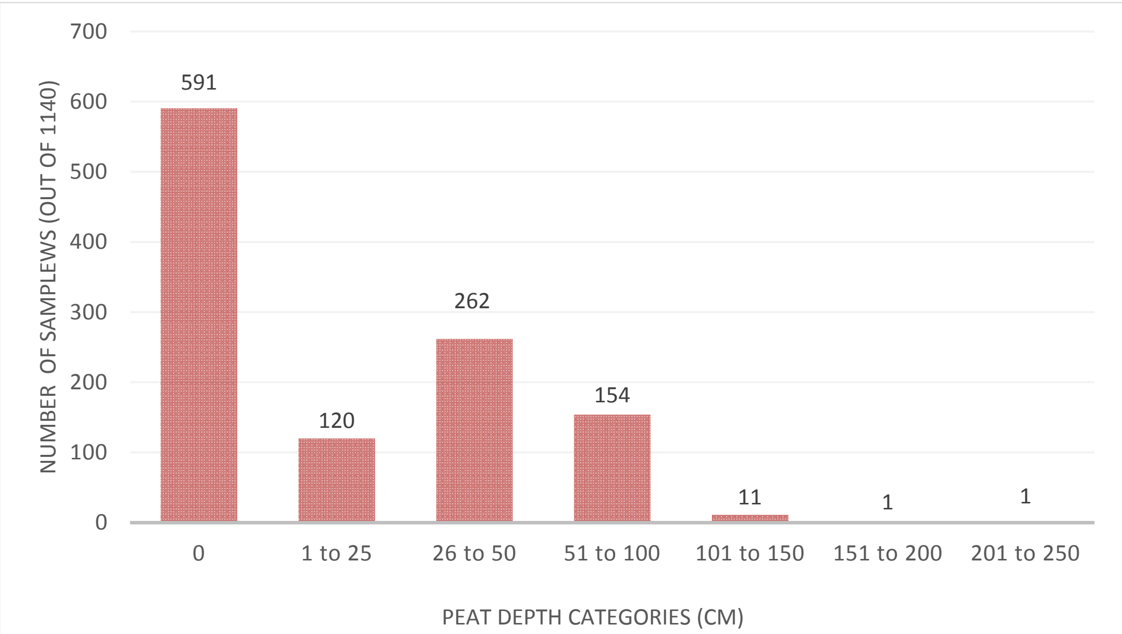


Chart 2: Peat depth frequency distribution



- As depicted in Figures 5.17a to 5.17d, peat depths are shallow throughout the site with much of it located in the east and south-east of the site. There are no areas of noticeably deeper peat.
- Figures 5.17a to 5.17d shows the extent and locations of areas with peat >0.5 m. Only 167 samples (14.7%) fell on land with more than 0.5m depth of peat.
- 382 samples (33.5%) fell on land with between 0.01 and 0.5 m depth of peat or peaty soils.
- 591 samples (51.8%) fell on land with solely mineral soils (mineral soils recorded as zero peat depth as per methodology above).
- 13 samples (1.1%) fell on land with more than 1m depth of peat.

5.2 Surface Vegetation Characteristics

This section presents the results of the vegetation quadrat surveys which characterises the surface vegetation present in peaty areas and which will help to inform the Ecological Impact Assessment.

Of the 1,140 sample points where data was collected, peat or a peaty soil was present at 549 (48.2%) sample points; the remainder were located in solely mineral soils or clays.

Note, with regards the analysis in the following sections:

- Peat has been arbitrarily defined as land where the soil has an organic surface horizon over 0.5 m deep (SNH *et al.*, 2011). Blanket mire has also been arbitrarily defined as habitat with more than 0.5 m depth of underlying peat (MacDonald *et al.*, 1998; JNCC, 2004).
- However, to comprehensively characterise the vegetation present at the site the statistical analysis of vegetation data and other variables for the peatland vegetation assessment has been carried out on all samples were peat or a peaty soil was deemed present, i.e. not restricted to samples over 0.5m in depth (n = 549). Samples where clay or mineral soils were present were excluded from analysis (n = 591).
- Figures 5.18 to 5.26 display the data collected for all peaty based areas; however, for clarity a backdrop of the 0.5 m peat depth interpolation cut-off is included in the figures to allow separation.
- Planted samples relate to the areas under conifer plantation or those that have been recently clear felled. Unplanted samples correlate to open areas and forestry rides.

5.2.1 *Sphagnum Distribution and Abundance (all Sphagnum Spp)*

Figure 5.18 illustrates the distribution and abundance of all *Sphagnum* species recorded within the site; overall *Sphagnum* abundance is very low.

Chart 3: Mean % cover of *Sphagnum* species in peat areas showing 95% confidence intervals.

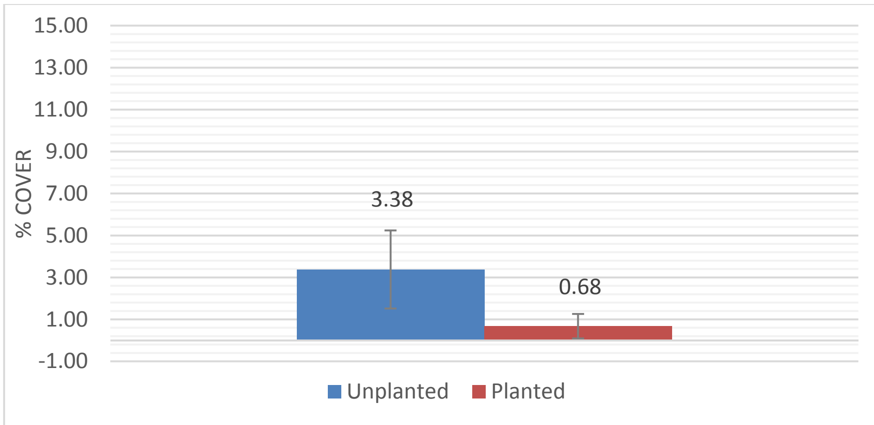


Table 2: Descriptive statistics

	Mean	Standard Deviation	Standard Error	95% Confidence Interval	95% CL Lower	95% CL Upper	Precision
Unplanted	3.38	11.54	0.94	1.86	1.51	5.24	55.17
Planted	0.68	5.86	0.29	0.58	0.09	1.26	86.28

- The mean % cover of *Sphagnum* species in Unplanted areas per quadrat was 3.38% with a precision of 55.17%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 55.17% or less.
- The mean % cover of *Sphagnum* species in Planted areas per quadrat was 0.68% with a precision of 86.28%.
- Figure 5.18 shows the low levels of *Sphagnum* abundance and distribution throughout the site.
- Only three *Sphagnum* species were recorded in sample quadrats, i.e. *S. capillifolium*, *S. fallax* and *S. palustre* – all in low abundances.

5.2.2 Non-Sphagnum moss Distribution and Abundance

Figure 5.19 illustrates the distribution and abundance of non-*Sphagnum* mosses recorded across the site. The levels of non-*Sphagnum* mosses are ubiquitously moderate to high throughout the site area and across all peat depths.

Chart 3: Mean % cover of non-*Sphagnum* mosses within mire showing 95% confidence intervals.

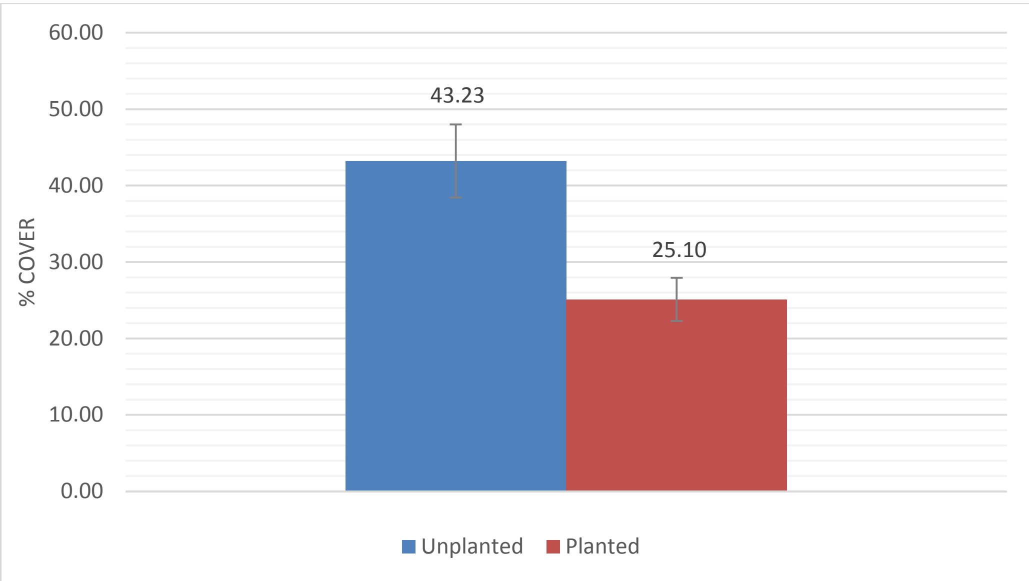


Table 3: Descriptive statistics

	Mean	Standard Deviation	Standard Error	95% Confidence Interval	95% CL Lower	95% CL Upper	Precision
Unplanted	43.23	29.58	2.41	4.78	38.45	48.00	11.05
Planted	25.10	28.32	1.42	2.82	22.28	27.92	11.22

- The mean % cover of non-*Sphagnum* species in Unplanted areas per quadrat was 43.23% with a precision of 11.05%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 11.05% or less.
- The mean % cover of non-*Sphagnum* species in Planted areas per quadrat was 25.10% with a precision of 11.22%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 11.22% or less.
- The confidence intervals and precision values further indicate the levels of non-*Sphagnum* mosses were consistently high across the site.

5.2.3 Distribution and Abundance of Calluna vulgaris

Figure 5.20 illustrates the distribution and abundance of *Calluna vulgaris* recorded across the site. The level of *Calluna vulgaris* is low with this species being absent in many areas.

Chart 4: Mean % cover of *Calluna vulgaris* within mire showing 95% confidence intervals.

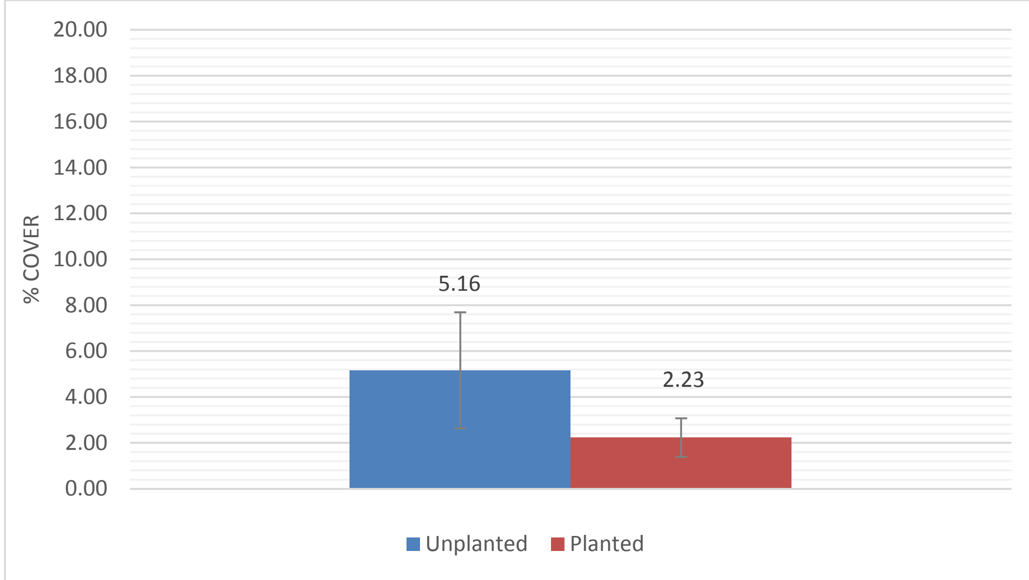


Table 4: Descriptive statistics

	Mean	Standard Deviation	Standard Error	95% Confidence Interval	95% CL Lower	95% CL Upper	Precision
Unplanted	5.16	15.68	1.28	2.53	2.63	7.69	49.06
Planted	2.23	8.40	0.42	0.84	1.40	3.07	37.43

- The mean % cover of *Calluna vulgaris* in Unplanted areas per quadrat was 5.16% with a precision of 49.06%.
- The mean % cover of *Calluna vulgaris* in Planted areas per quadrat was 2.23% with a precision of 37.43%.
- *Calluna vulgaris* was generally scarce across the site indicated by the lack of heath like or mire habitats observed.

5.2.4 Distribution and Abundance of Eriophorum vaginatum

Figure 5.21 illustrates the distribution and abundance of *Eriophorum vaginatum* recorded within the site. *Eriophorum vaginatum* occurrence is very low within the site.

Chart 5: Mean % cover of *Eriophorum vaginatum* within mire showing 95% confidence intervals

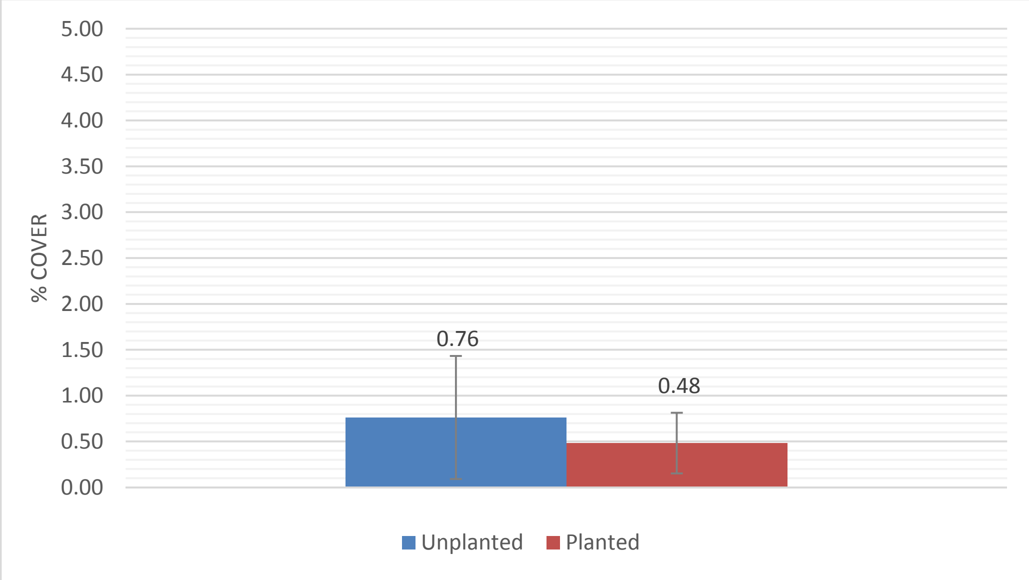


Table 5: Descriptive statistics

	Mean	Standard Deviation	Standard Error	95% Confidence Interval	95% CL Lower	95% CL Upper	Precision
Unplanted	0.76	4.14	0.34	0.67	0.09	1.43	87.78
Planted	0.48	3.28	0.16	0.33	0.16	0.81	67.54

- The mean % cover of *Eriophorum vaginatum* in Unplanted areas per quadrat was 0.76% with a precision of 87.78%.
- The mean % cover of *Eriophorum vaginatum* in Planted areas per quadrat was 0.48% with a precision of 67.54%.
- Abundances and coverage of *Eriophorum vaginatum* was very low across the whole site, and it was absent from many areas.

5.2.5 Distribution and Abundance of Molinia caerulea

Figure 5.22 illustrates the distribution and abundance of *Molinia caerulea* recorded within the site. *Molinia caerulea* occurrence is low throughout the site area.

Chart 6: Mean % cover of *Molinia caerulea* within mire showing 95% confidence intervals

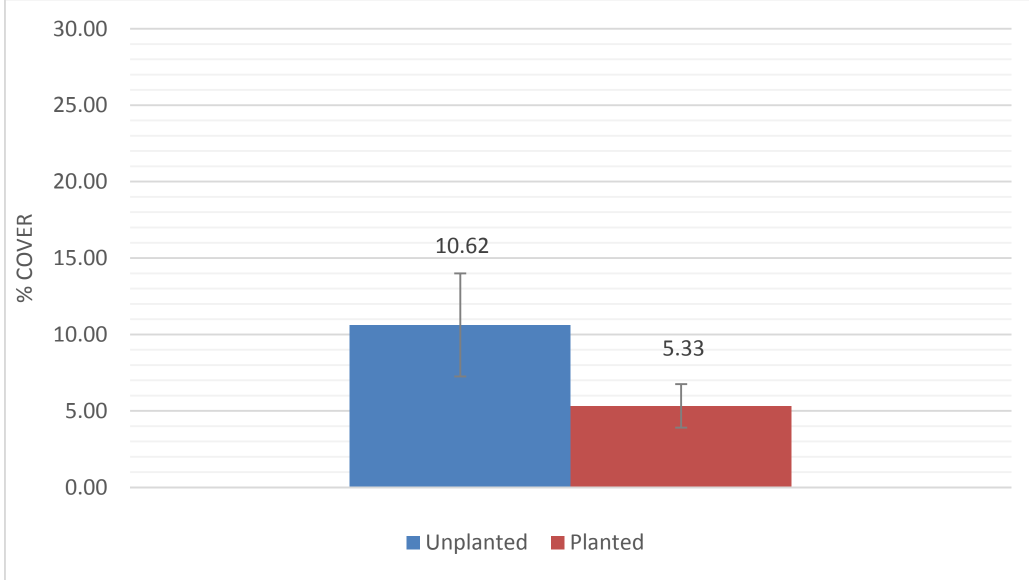


Table 6: Descriptive statistics

	Mean	Standard Deviation	Standard Error	95% Confidence Interval	95% CL Lower	95% CL Upper	Precision
Unplanted	10.62	20.88	1.70	3.37	7.25	13.99	31.74
Planted	5.33	14.30	0.72	1.42	3.91	6.75	26.69

- The mean % cover of *Molinia caerulea* in Unplanted areas per quadrat was 10.62% with a precision of 31.74%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 31.74% or less.
- The mean % cover of *Molinia caerulea* in Planted areas per quadrat was 5.33% with a precision of 26.69%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 26.69% or less.

5.2.6 Distribution and Abundance of Grasses, Rushes & Bracken

Figure 5.23 illustrates the distribution and abundance of grasses, rushes and bracken recorded within the site recorded within the site. This type of vegetation is the most common throughout the site area and is typically much more abundant in open and Unplanted areas.

Chart 7: Mean % cover of Grasses, Rushes & Bracken within mire showing 95% confidence intervals

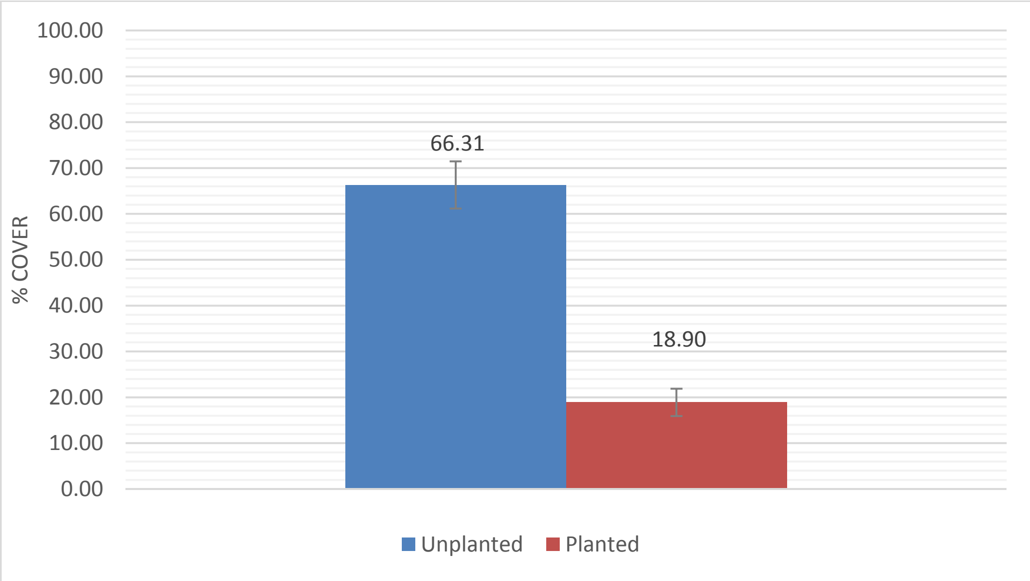


Table 7: Descriptive statistics

	Mean	Standard Deviation	Standard Error	95% Confidence Interval	95% CL Lower	95% CL Upper	Precision
Unplanted	66.31	31.95	2.60	5.16	61.15	71.47	7.78
Planted	18.90	30.13	1.51	3.00	15.90	21.89	15.85

- The mean % cover of grasses, rushes and bracken in Unplanted areas per quadrat was 66.31% with a precision of 7.78%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 7.78% or less.
- The mean % cover of grasses, rushes and bracken in Planted areas per quadrat was 18.90% with a precision of 15.85%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 15.85% or less.

5.2.7 Distribution and Abundance of Bare Ground/Conifer Needles

Figure 5.24 illustrates the distribution and abundance of bare ground and surface lying conifer needles recorded within the site. As would be expected the amount of bare ground/conifer needles was high within the commercial forestry sample areas, particularly given the mature nature of the forestry present in most parts of the site. There were moderate levels of bare ground/conifer needles in Unplanted areas, in these areas surface erosion and ground disturbance accounted for areas of bare ground which was more commonplace than the presence of conifer needles.

Chart 8: Mean % cover of Bare ground/Conifer needles within mire showing 95% confidence intervals

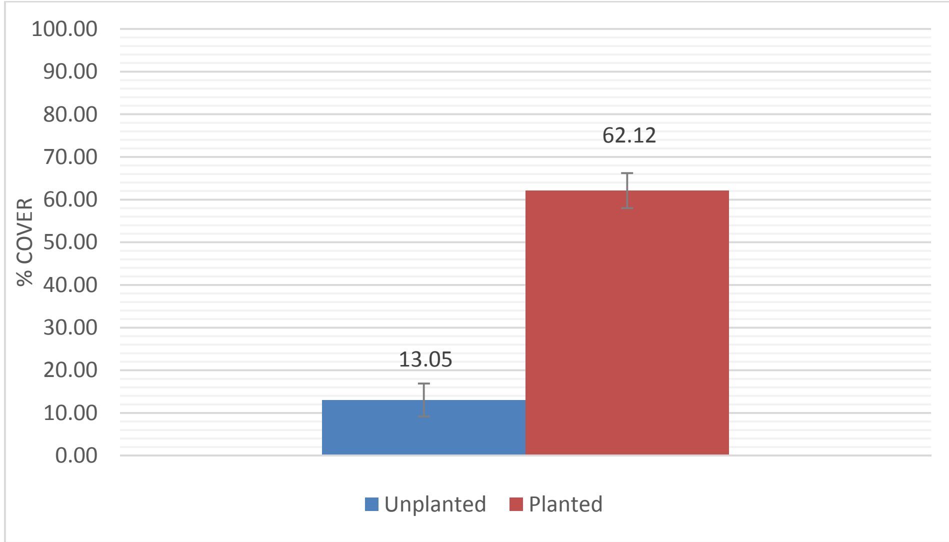


Table 8: Descriptive statistics

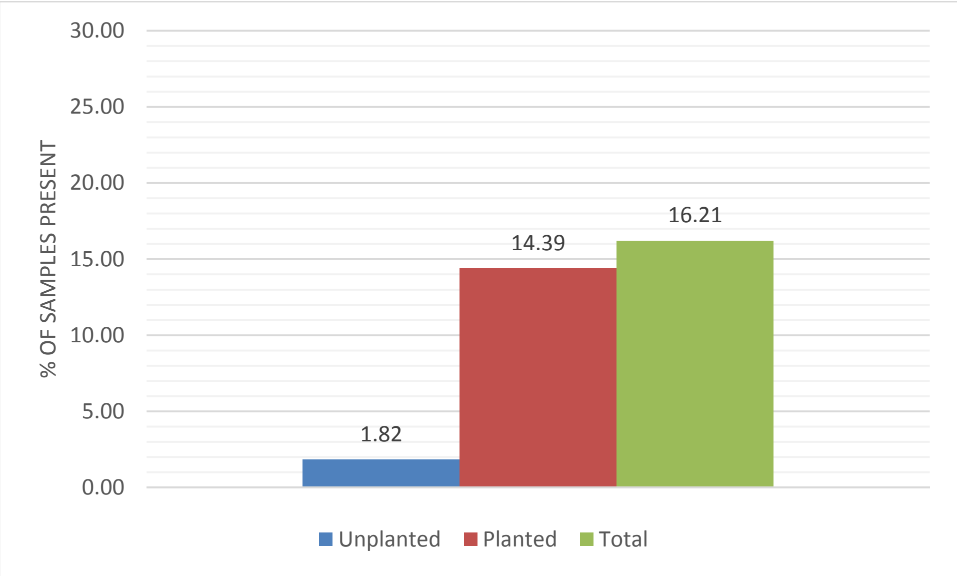
	Mean	Standard Deviation	Standard Error	95% Confidence Interval	95% CL Lower	95% CL Upper	Precision
Unplanted	13.05	23.93	1.95	3.86	9.18	16.91	29.62
Planted	62.12	41.35	2.07	4.11	58.01	66.23	6.62

- The mean % cover of bare ground/conifer needles in Unplanted areas per quadrat was 13.05% with a precision of 29.62%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 29.62% or less.
- The mean % cover of bare ground/conifer needles in Planted areas per quadrat was 62.12% with a precision of 6.62%. This means that 95% of the time the sample mean will under or over estimate the true population mean by 6.62% or less.

5.2.8 Presence or Absence of Peat Erosion

Figure 5.25 illustrates the distribution of peat erosion recorded throughout the site. Peat erosion is present throughout the site in both Planted and Unplanted peat based areas but is more common in Planted areas.

Chart 9: Presence of peat erosion within peat areas (% of samples)



- Peat erosion was recorded in 89 out of the 549 peat sample points (16.21% of samples).
- Peat erosion was more common in Planted areas (79 samples) than Unplanted areas (10 samples).

5.2.9 Drainage Activity

Figure 5.26 illustrates the distribution of Inactive, Semi-active and Active drains throughout the site within peaty areas.

Chart 10: Drain activity within peat based samples (Number of Samples)

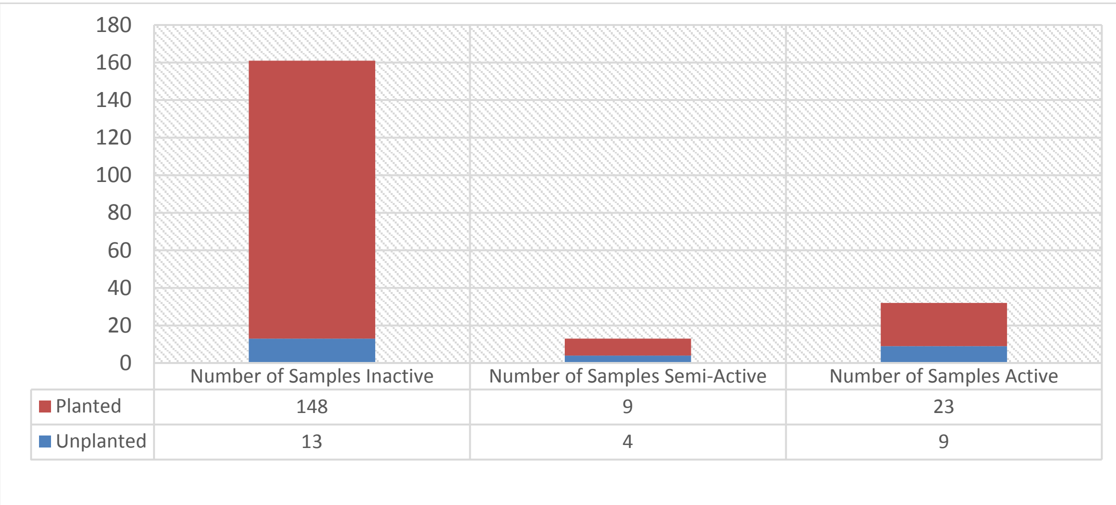
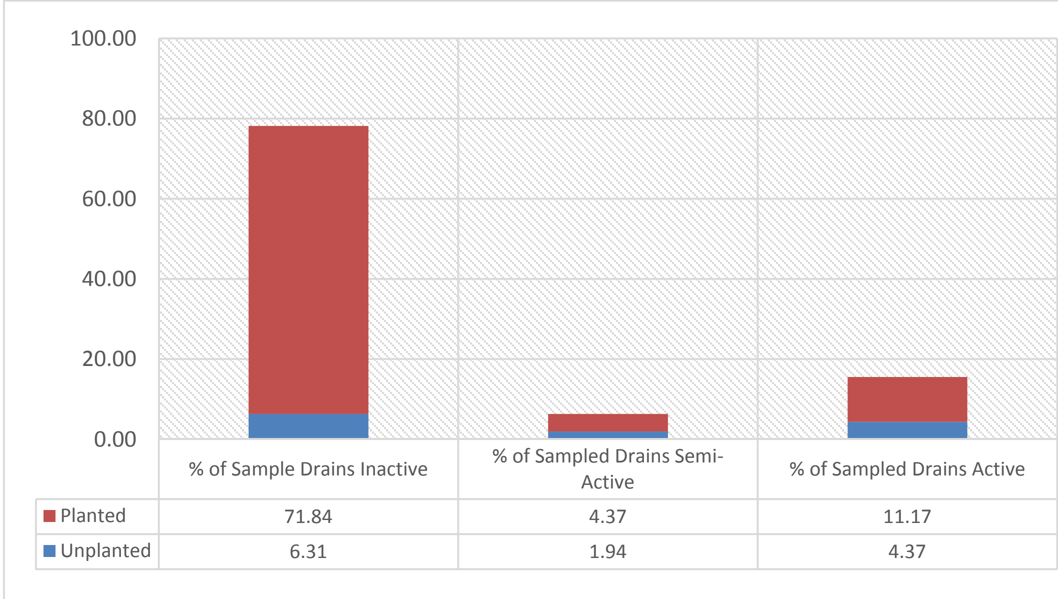


Chart 11: Drain activity within peat based samples (% of Samples)



- 206 peat based samples out of 549 had some form of drainage structure present; of which 161 were classified inactive, 13 were semi-active and 23 were active.
- Most commonly drains were classified as Inactive and were within Planted areas, these were most often forest drains or forest plough furrows which have largely occluded since planting of the forestry.

6. DISCUSSION

The following section is split into two parts: (1) peat depth analysis and, (2) surface vegetation characteristics.

6.1 Peat Depth Analysis

The peat depth analysis has the following Aim and related Objectives:

Aim 1	**Gather high resolution peat depth data on a 100m^2 systematic grid for the Study Area.**
Objective 1.1	Inform the layout of the Wind Farm infrastructure to help reduce impacts associated with blanket mire habitats.
Objective 1.2	Provide peat depth data to inform the impact of the Wind Farm on carbon losses arising from disturbance to peat based habitats.

6.1.1 Peat Depth and Types of Habitat and Vegetation

Section 5.1 of this report presents the results of the peat depth assessment for the site. The key results from the peat depth analysis are:

- 167 samples fell on land with more than 0.5 m depth of peat.
- 154 samples fell on land with between 0.01 and 0.5 m depth of peat.

- 591 samples fell on land with no peat – these were generally improved fields to the north and sections of forestry in the west, the associated area was excluded from the values given above.

SNH *et al*. (2011) define peat "*as land where the soil has an organic surface horizon over 0.5m deep*". Land where peat depth is greater than 0.5 m is also classified as 'blanket bog' by SNH (MacDonald *et al.*, 1998) and JNCC (JNCC, 2004); however, few areas of the site contained peat over 0.5m in depth and these areas were generally shallow, scattered and quite isolated (see Figures 5.17a to 5.17d). These areas were not considered true blanket bog (see Annex I) given the relatively shallow and scattered areas of ground with more than 0.5 m peat depth, furthermore the vegetation was dominated by conifer plantation woodland rendering any mire that may have been present moribund due to the lack of bog forming vegetation (section 5.2); the vegetation was dominated by a number of grasses and rushes and the habitats present in these areas corresponded more to acid grasslands and marshy grasslands than mire (see also ES Volume 4, Technical Appendices 5.1 and 5.2).

Organic horizons can also be less than 0.5m deep and appear peat like, these were still classified as peat during the survey and the depth recorded between 0.01 and 0.5m (Figure 2a). These areas often contained peaty podzols and peaty gleys as opposed to true peats and the habitats present were most often acid grasslands, marshy grasslands and some types of mesotrophic grassland - greater detail on habitats and species present is provided in the National Vegetation Classification report; ES Volume 4, Technical Appendix 5.2.

Finally, limitations to peat depth probing and analysis should be considered. These comprise:

- Obtaining a false depth measurement because of the probe meeting obstructions within the peat (e.g. hitting roots, stones etc). This was mitigated against as far as possible by taking an additional probe at each sample where it was suspected that the probe was hitting a barrier.
- In some cases peat depth may be over-estimated if the substratum underlying the peat is soft and/or saturated.
- Difficulty with inserting the probes into drier more humified peat. This was mitigated against as far as possible by designing a custom made solid steel probe with detachable steel handles to allow probes to be forced into the peat and then retrieved.

The above limitations associated with the method used to assess peat depth are not considered a significant factor and the data can be relied upon to inform the objectives of the survey.

6.2 Surface Vegetation Characteristics

The information presented in this section is sufficient to inform the following Aim and related Objective:

Aim 2	**Determine surface vegetation characteristics of peatland areas within the site.**
Objective 2.1	Inform the EIA on the condition of the peatland habitats present.

6.2.1 Information to Inform the EIA on the Present Condition of Peatland Areas

The methods used to inform the present condition of the peatland habitats within the site are outlined in Section 4.2. This methodology uses surface features such as species present, erosion and drains to determine the current condition of the habitats.

The variables used to establish the present condition (condition indicators) of peatland within the site are stated in Section 4.2. The results with respect to these variables, and their significance, are discussed below.

6.2.1.1 Commercial Forestry

The single largest factor affecting the condition of peatland habitats in much of Scotland is often commercial forestry and the number of negative impacts this has on peatland. This has been well documented by a number of authors (e.g. Pyatt *et al*., 1992; Anderson *et al*., 1995; Wheeler and Shaw, 1995; Brooks and Stoneman, 1997; Anderson *et al*., 2000; Wilkie and Mayhew, 2003; Holden *et al*., 2004). In summary, these effects include:

- Lowering of the water table via installation of high density drainage networks and ploughing (typically 0.5m to 2m between drains);
- Lowering of the water table via evapotranspiration;
- Increased peak flow runoff and lowered baseflow;
- Peat subsidence caused by consolidation of the peat through both its thickness and shrinkage of the drained layer;
- Modification of mire vegetation communities as a result of fertiliser application;
- Loss of typical mire vegetation communities as a result of drying;
- Loss of typical mire vegetation communities as a result of canopy closure; and
- Erosion of peat as a result of subsidence, peat compression, vegetation loss and drying of the Catotelmic peat.

Often the largest impact on the peatland is considered to be the damaging effects of the artificial drainage and the resulting lowering of the natural perched water table. The relative position of the water table within the peat ultimately controls the balance between accumulation and decomposition of peat. A lowering of the water-table permits the entry of oxygen into the formerly anaerobic Catotelmic zone resulting in peat 'wastage' (via erosion) and/or microbial decomposition (Hobbs, 1986; Wheeler and Shaw, 1995).

Drainage and loss of typical mire surface vegetation can ultimately lead to the cessation of peat accumulation and the erosion of peat from a blanket mire complex. Furthermore, this can lead to blanket mires switching from carbon sinks to carbon sources as a result of increased oxidation of organic matter (Holden *et al*., 2004; Holden, 2005).

Mire vegetation communities are directly affected by decreases in the water table. The magnitude of effect will depend on the degree of water-table change. A small, but sustained reduction in water level in blanket mire is likely to cause a shift in species composition away from the natural hummock-hollow complex, towards those species normally associated with hummocks and increases in species such as *Calluna vulgaris* and *Molinia caerulea,* and possibly the invasion of tree species. A large sustained reduction in water levels is likely to lead to an eventual loss of many mire species along with loss of the original Acrotelm and aeration of the upper Catotelm peat. This ultimately results in a cessation of peat accumulation (Wheeler and Shaw, 1995).

Commercial forestry also significantly affects mire vegetation through canopy closure as the forest matures and the associated shading out of the surface vegetation, ultimately leading to vegetation often disappearing under areas of mature forestry with the surface layer replaced by a covering of conifer needles.

Commercial forestry abutting open and unplanted peatland habitats can also have a negative impact as the effects of water drawdown from the trees and forestry drainage are not solely limited to the ground underneath plantation but also any adjacent hydrologically connected peatland.

The extensive forestry levels on the site have had adverse effects on large areas of the peatland for the reasons detailed above and greatly impacted on the vegetation of the site (see below), and as a result the multiple impacts of commercial forestry have severely degraded the peatland across the site.

6.2.1.2 Surface Vegetation

This section summarises the results of the vegetation quadrats sampled within the site.

As discussed in section 6.2.1.1 above the extent of mature conifer forest can have numerous negative impacts on the typical vegetation of peatland habitats through processes such as canopy closure and drying effects. The extensive mature forestry has resulted in the reduced abundance and distribution of many typical peatland species with many Planted areas having lost these species completely. The results of the surface feature and vegetation surveys have been presented in section 5.2 and can be summarised as follows:

- There are very low levels of *Sphagnum* moss within the site across all areas;
- Only three species of *Sphagnum* were recorded (*S. capillifoilum, S. fallax* and *S. palustre*) all of which are more tolerant of some surface drying and disturnance;
- No broad branched and good peat forming *Sphagnum* species were recorded;
- Non-*Sphagnum* mosses, which are more indicative of surface drying, have a high abundance in Unplanted areas and persist with moderate abundance in Planted areas;
- *Calluna vulgaris*, a typical mire and heath species, is sparse across the site;
- *Eriophorum vaginatum*, a typical mire species, is sparse across the site and present in very low abundances;
- *Molinia caerulea* can be a major component of some mire, heath and tussocky/marshy grassland habitat types; it is present in relatively low abundances throughout the site but is more common in Unplanted areas;
- Other grasses (to those already detailed above), rushes and bracken, can become increasingly invasive and dominant with the loss of typical peatland species as a result of surface drying, ground disturbance etc. These species were present in high abundances in survey quadrats and were widely dispersed throughout the site. On average these species accounted for 66% of the foliar cover within peatland vegetation quadrats;
- The abundance and distribution of bare ground and conifer needles was generally high across the site, particularly in Planted areas where the ground was often covered in a substantial layer of conifer needles;
- Peat erosion was present throughout the site and was most common within planted areas; and,
- As explained in preceding sections, the drainage of peatland habitat can have significant adverse effects on its condition and the flora present – ultimately leading to cessation of peat production and erosion of the peat. The impacts of drains are not limited to the immediate vicinity of the drain but can have much wider reaching influences on water movement and drainage of the peatland. Drainage structures of some sort were commonplace throughout the site, many were old forest drains or plough furrows and classed as Inactive and as a result they are less likely to be actively contributing to the drainage of the peatland. However, the main purpose of most of these forest drains would have been to drain the peatland initially to allow the plantation to establish. Large areas of trees are now well established and have taken over the active drainage of the peatland through drawing down the water table via transpiration and uptake through their root system.

In summary the levels of forestry have negatively impacted and degraded the peatland at the site and resulted in the loss of typical mire and heath species across much of the site area.

7. SUMMARY

In summary, peat depths across the site are relatively shallow with few areas of peat greater than 0.5 m in depth (Figures 5.17a to 5.17d); furthermore only 13 of 1,140 sample probes recorded a peat depth of greater than 1 m. The peat depth mapping would indicate that the patches of peat over 0.5 m in depth do not form part of an overall coherent and connected mire complex and as such it was not classified as blanket mire.

Areas of peat deeper than 0.5 m were also not classified as mire as the habitats within the site are dominated by mature commercial conifer plantation with some areas of recent clearfell. Apart from an area of open farmland in the north of the site open habitats are restricted to forest rides within the plantation. The extensiveness of the mature forestry plantation has degraded the peatland habitats present and resulted in the loss of typical peatland species in many areas or reduced their abundance to very low levels as found through the surveys of surface vegetation characteristics and features.

8. REFERENCES

Anderson, A.R., Pyatt, D.G., and White I.M.S. (1995) Impacts of conifer plantations on blanket bogs and prospects of restoration. In Wheeler, B.D., Shaw, S.C., Fojt, W., and Robertson, R.A. (Eds) *The restoration of temperate wetlands*. John Wiley & Sons, Chichester, 533-548.

Anderson, A.R., Ray, D., and Pyatt, D.G. (2000) Physical and hydrological impacts of blanket bog afforestation at Bad a' Cheo, Caithness: the first 5 years. *Forestry* 73, 467-478.

Brooks, S., and Stoneman, R. (1997) Tree Removal at Langlands Moss. In Parkyn, L., Stoneman, R.E. and Ingram, H.A.P. (Eds) *Conserving Peatlands*. CAB International, Wallingford, 315-322.

Childs, C (July-September, 2004) Interpolating Surfaces in Arc GIS Spatial Analyst. ArcUser. www.esri.com.

Clymo, R.S. (1963) Ion exchange in Sphagnum and its relation to bog ecology. *Annals of Botany*, New Series, 27, 309-324.

Clymo, R.S. (1983) Peat. In Gore, A.J.P. (Ed) *Ecosystems of the World 4A Mires: Swamp, Bog, Fen and Moor*. Elsevier, Oxford, 159-224.

Clymo, R.S. (1997) The Roles of *Sphagnum* in Peatlands. In Parkyn, L., Stoneman, R.E. and Ingram, H.A.P. (Eds) *Conserving Peatlands*. CAB International, Wallingford, 95-102.

Hobbs, N.B. (1986) Mire morphology and the properties and behaviour of some British and foreign peats. *Quarterly Journal of Engineering Geology* 19, 7-80.

Holden, J. (2005) Peatland hydrology and carbon release: why small-scale processes matter. *Philosophical Transactions of the Royal Society A* 363; 2891-2913.

Holden, J., Chapman, P.J., and Labadz, J.C. (2004) Artificial drainage of peatlands: hydrological and hydrochemical process and wetland restoration. *Progress in Physical Geography* 28 (1); 95-123.

Joosten, H. & Clarke, D. (2002). *Wise use of Mires and Peatlands – Background and Principles Including a Framework for Decision-Making*. International Mire Conservation Group & International Peat Society.

JNCC (2004) Handbook for Phase 1 Habitat Survey, Joint Nature Conservation Committee.

JNCC (July, 2009) Common Standards Monitoring for Upland Habitats. JNCC. ISSN 1743-8160.

Lindsay, R. (1995) *Bogs: The Ecology, Classification and Conservation of Ombrotrophic Mires*. SNH, Battleby, Perth.

MacDonald, A., Stevens, P., Armstrong, H., Immirzi, P. and Reynolds, P. (1998) *A Guide to Upland Habitats: Surveying Land Management Impacts (Volume 1)*. Scottish Natural Heritage, Edinburgh.

MacGowan, F. (2002) *Overgrazing, cutting and trampling and their effects on the ecology of bogs*. Irish Peatland Conservation Council Information Sheet. http://www.ipcc.ie/infoeffectsbogecology.html

Pyatt, D. G., John, A. L., Anderson, A. R. and White, I. M. S. (1992) The drying of blanket peatland by 20-year-old conifer plantations at Rumster Forest, Caithness. In *Peatland ecosystems and man: an impact assessment*, edited by O. M. Bragg, P. D. Hulme, H. A. P. Ingram and R. A. Robertson. Department of Biological Sciences, University of Dundee.

Rodwell, J.S. (Ed), *et al.* (1991). *British Plant Communities Volume 2; Mires and Heaths*. Cambridge, Cambridge University Press.

Scottish Natural Heritage, Scottish Environmental Protection Agency, Scottish Government, The James Hutton Institute (2011) Developments on Peatlands: site Surveys.

Scottish Renewables and Scottish Environmental Protection Agency (2012) Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste.

Wheeler, B.D., and Shaw, S.C. (1995) *Restoration of Damaged Peatlands*. Department of the Environment. HMSO, London.

Wilkie, N.M., and Mayhew, P.W. (2003) The Management and Restoration of Damaged Blanket Bog in the north of Scotland. *Botanical Journal of Scotland* 55 (1); 125-133.

ANNEX 1

The definition of 'blanket mire' habitat is used within this report to refer to blanket peat systems in aggregate. This includes both pure Ombrogenous blanket bogs, which receive their water input solely from rain water, and minerotrophic Peatlands. Minerotrophic Peatlands receive their water input from a mixture of sources comprising Ombrogenous, Topogenous[i] and Soligenous[ii] inputs.

The primary **conditions essential for blanket mire habitat to establish** is regularity of water supply and persistence of saturated conditions (Lindsay, 1995. P11., Wheeler, 1995. P2). These conditions are achieved through inputs of water exceeding outputs via seepage, evaporation and evapotranspiration. Inputs of water can arise from Ombrogenous, Topogenous or Soligenous sources as detailed above. The type of Peatland system and associated vegetation communities is dependent on the nature of the water supply (see Lindsay, 1995. P12 and Wheeler, 1995).

Persistent saturation creates the **ideal conditions for peat formation**, these comprise: (1) Low levels of available oxygen (Anoxic conditions), (2) Low pH (Acidic conditions), and (3) Low temperatures. These variables limit microbial activity and therefore the rate of decomposition in mires. This ultimately results in incompletely decomposed dead plant material building up over time. It is this incomplete decomposition and accumulation of organic matter which creates the 'carbon sink' properties of blanket mires (Joosten & Clarke, 2002. P25).

Peat accumulation can typically occur at a rate of approximately or 0.02 to 0.08 cm per year (Hobbs, 1986) in 'active' blanket mire where this process of incomplete decomposition is occurring. However, Clymo and Reddaway (1971) recorded rates of up to 0.2 cm per year in *Sphagnum* dominated habitats. This higher rate of accumulation in is a result of *Sphagnum's* high resistance to decomposer microbes (Lindsay, 1995. P12), this makes it a key species for peat accumulation.

Blanket mire habitat has a simple two layer (Diplotelmic) structure which is critical to its maintenance and continued development. The surface layer, called the Acrotelm, is a thin protective layer of living vegetation and some underlying recently dead vegetation. This layer is usually no more than 20-30 cm deep and lies on top of a layer of peat (Wheeler and Shaw, 1995., Lindsay 2005. P16). The Acrotelm serves a number of functions including (see Lindsay, 2005. P16):

- Protecting the underlying peat (Catotelmic peat) from erosion and drying;
- Regulates water input and output from the blanket mire system; and
- Acts as the principle mechanism of water discharge from the system.

The underlying peat layer (or Catotelm) also has a number of important functions:

- Sustaining nutrient poor conditions: It effectively separates the living vegetation in the Acrotelm from the more mineral rich influence of the ground water table and underlying mineral sub-soil. This helps create nutrient poor conditions which are more suitable for Sphagnum growth and peat accumulation;
- Water Regulation: It remains completely saturated and consequently water movement through the Catotelm is extremely slow although some faster movement may occur through peat pipes (Holden, 2005).
- Maintenance of perched water table: Although Catotelmic peat can exhibit some layered stratigraphy (Hobbs, 1986) it has a largely amorphous nature. This attribute, in additional to the water retaining attributes of dead sphagnum remains, limits water release from the Catotelm and helps to sustain a perched water table.

---

[i] Topogenous: 'topogenous mires depend on topographic conditions and are relatively independent of climate, because they "develop in terrestrialising lakes or river valleys, or at springs" (Joosten & Clarke, 2002. P41).

[ii] 'In soligenous mires, peat formation is not only induced and continued by direct precipitation, but "also by meteoric water running off from the surrounding terrain" (Von Post &Granlund 1926)' (Joosten & Clarke, 2002. P41).

Technical Appendix 5.7

HIGHLEE HILL WIND FARM

Draft Species Protection Plan

Prepared by: Rafe Dewar
Reviewed by: Rachael Iveson

Date: 26 February 2016

Tel: 0141 342 5404
Email: rafe.dewar@macarthurgreen.com
Web: www.macarthurgreen.com
Address: 95 South Woodside Road | Glasgow | G20 6NT

Document Quality Record.

Version	Status	Authorised by	Date
1.0	Draft	Rafe Dewar	04/02/16
1.1	Reviewed	Rachael Iveson	26/02/16
1.2			
2.0			

CONTENTS

1. INTRODUCTION

MacArthur Green has prepared this Draft Species Protection Plan (SPP) on behalf of RES Ltd (the "applicant") to ensure all reasonable protection measures are undertaken in relation to work associated with the construction and decommissioning phases of the proposed Highlee Hill Wind Farm.

The SPP has been produced to ensure the adequate preservation of protected species' interests into all construction and decommission activities within the site to safeguard the resident populations and ensure compliance with the relevant nature conservation legislation (see Annex 1).

The SPP will be a live document subject to review and updating, and will assist site staff in the protection of species during construction and decommission, under the guidance of the Ecological Clerk of Works (ECoW).

2. BACKGROUND INFORMATION

The protected species surveys were carried out between 2012 and 2015 (refer to Environmental Statement (ES), Volume 4, Technical Appendix 5.3 for details). The SPP is designed to reflect the results of the surveys and the distinct ecology and distributions of protected species within the respective study areas.

Protected species surveys conducted as part of the Environmental Impact Assessment (EIA) process confirmed the presence of otter (*Lutra lutra)*, badger (*Meles meles*), five bat species, Atlantic salmon (*Salmo salar*), brown/sea trout (*Salmo trutta*), European eel (*Anguilla anguilla*), brook lamprey (*Lampetra planeri*) using the study area. There was also unconfirmed presence of red squirrel (*Sciurus vulgaris*) and pine marten (*Martes martes*).

The presence of otter was confirmed through the identification of a number of separate sprainting locations; however no evidence of breeding was recorded. Spraints were recorded along sections of the Jed Water and the Peden's Cleuch Burn, and a small tributary of the Battle Sike Burn in the western edge of the site. Additional field signs in the form of slides and footprints were recorded along sections of the Fell Burn and the Black Burn in the eastern end of the site.

Presence of badger was confirmed through the identification of a number of field signs across the site as well as several confirmed badger sett locations. Details of the survey results from 2013 to 2015 are detailed in the Technical Appendix 5.3 and Confidential Figure 5.6.

Bat surveys within conifer plantation recorded the following bat species: common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), brown long-eared bats (*Plecotus auritus*), plus *Myotis* sp. which could not be identified below genus level. In addition to the aforementioned species, *Nyctalus sp*. was recorded within farmland to the north of the site.

Brown trout and eel have been recorded along the Black Burn and Jed Water, with Atlantic salmon recorded near the confluence of the Jed Water and Black Burn, and further upstream within Carter Burn to the northeast of the site. Brown/sea trout was also recorded within one of the small tributaries of the Jed Water, south of the site. Lampreys were recorded in Black Burn, Carter Burn and Jed Water, on the edge of the site boundary.

3. AIMS & OBJECTIVES OF THE SPECIES PROTECTION PLAN

The aim of the SPP is to ensure all reasonable precautions are taken by the applicant and their contractors to safeguard protected species from disturbance, injury and death and to protect any structure or place, which any such protected species uses for growth, breeding, resting, shelter or protection during the construction and decommission of the proposed wind farm.

The aim of the SPP will be fulfilled by the applicant adopting the following objectives throughout the construction and decommission of the proposed wind farm:

a) Objective A - Implement a monitoring and protection plan for protected species;

b) Objective B – Follow an approved procedure if an active feature is found; and

c) Objective C – Ensure adequate education and awareness of site personnel.

Objective A addresses the monitoring procedure to be followed to ensure that the Aim of this SPP is achieved. Objective B covers the detailed procedure in the event of a protected species feature being discovered. Objective C addresses the educational needs of appropriate personnel on the site to further reduce the risk of an offence being committed. The procedures to be adopted that will fulfil these objectives are detailed in Section 6.

4. RESPONSIBILITIES

The overall responsibility for ensuring that the planning conditions and the conditions of any licence granted are adhered to, in particular those conditions relating to protected species, will lie with the applicant. The personnel responsible for the day-to-day implementation of the SPP are detailed in Table 1 below.

Role of Ecological Clerk of Works

The ECoW will have the specific remit of monitoring compliance with the SPP during the construction and decommissioning phases and reporting any breaches to the applicant's Construction Project Management Team. The ECoW's role shall involve direct monitoring of all activities in the site to the extent the ECoW considers this to be required, and/or training of nominated personnel to carry these out in a manner likely to minimise the potential for impact on the protected species. The ECoW will also agree changes to construction operations to prevent breaches of the SPP.

Table 1: SPP Responsibilities

Task	Responsibility
Implementation of the SPP	The applicants Construction Project Management Team
Monitoring and Review of the SPP	Ecological Clerk of Works
Regular site monitoring for protected species and associated protected features, for: otter, bats, pine martens, reptiles, badger and water vole.	Ecological Clerk of Works or a suitably qualified ecological surveyor
On-going watching brief for the above	All site Personnel

5. THE POTENTIAL IMPACTS OF DEVELOPMENT

Impacts on protected species can result from the physical effects of construction such as soil stripping, road laying, turbine foundation construction and noise disturbance. These operations can negatively affect protected species in a number of ways including:

(i) Abandonment of a holt/burrow/roost/den/sett/pond etc. due to disturbance;
(ii) Abandonment of dependant young due to disturbance;
(iii) Damage to or destruction of a protected feature or species;
(iv) Damage to navigation/commuting routes (i.e. ditches, burns, fence lines etc.);
(v) Fragmentation of territories;
(vi) Damage to foraging areas (e.g. areas containing amphibians or fish in the case of otter);
(vii) Contamination of water;
(viii) Disturbance to a protected species that results in behaviour that negatively impacts their life stage; and
(ix) Accidental injury or death to species by machinery, tools or vehicles.

6. PROCEDURES FOR PROTECTING PROTECTED SPECIES

This section details the procedures to be followed to ensure all reasonable precautions have been adopted to protect species from disturbance, injury and death and to protect any structure or place that any such species uses for growth, breeding, resting, shelter or protection. This includes information for species not recorded during baseline surveys, but presence in the future cannot be ruled out.

The level of disturbance free zones for each species is shown on Table 2 below. If other protected species are identified suitable buffer zones will be advised by the ECoW and agreed in consultation with Scottish Natural Heritage (SNH).

Table 2: Level of Protection and Recommended Disturbance-free Zones

Species Feature	Level of Protection	Disturbance-free Zone
Otter (holts, etc.)	European	30/200 metres[1]
Bat (roost)	European	30/200 metres[2]
Badger (sett)	National	30/100 metres[3]
Water Vole (burrow)	National	5-10 metres[4]
Red Squirrel (drey)	National	50 metres
Pine Marten (den)	National	30 metres
Reptiles (hibernacula)	National	n/a[5]
Fish (watercourse)	European	50 metres[6]

6.1 Objective A - Monitoring and Protection Plan

Monitoring Plan

Arrangements will be made for pre-construction ecological monitoring to be conducted within six months of construction commencement as set out in a draft Construction and Decommissioning Method Statement (CDMS).

It will be the duty of the ECoW to check the status of the protected species and associated protected features immediately prior to construction activity progressing across the site. The ECoW will continue to conduct spot checks during construction for any new protected species features in the vicinity of the construction works.

Guidelines detailing the monitoring of protected species and associated protected features by the ECoW or suitably qualified ecological surveyor are described below:

<u>**Potential Features**</u>

(a) European Protected Species - fauna (otters, bats):
Checks for potential features will be completed during construction and all potential protection features will be clearly demarcated.

(i) If the potential protection feature remains unoccupied, construction may occur in the area, but not damaging the potential feature under close supervision by the ECoW; or

(ii) If the status of the feature changes to occupied then the under-noted procedure for occupied sites will be followed. The ECoW will be responsible for this survey work as required.

(b) Nationally Protected Species (badger, pine marten, red squirrel, water vole and reptiles)
Checks for potential features will be completed during construction and all sites will be clearly demarcated:

(i) If the status remains as unoccupied, construction may occur in the area, but not damaging the existing feature, under close supervision by the ECoW; or

(ii) If the status of the feature changes to occupied then the under-noted procedure for occupied features will be followed.

[1] The disturbance zone will be 30 m unless a breeding/natal holt is identified, in such an instance the disturbance zone will be increased to 200 m.
[2] The disturbance zone will be 30 m, however turbines must be positioned 200 m from potential roost habitats (Natural England, 2014).
[3] Disturbance is defined by SNH as any new procedure that approaches within a minimum of 30 m of a sett margin. For piling or blasting activities this buffer zone is extended to 100 m.
[4] Dependent on burrow location and bank profile.
[5] Due to the more limited nature of their protection and their ability to avoid machinery etc. during their active phase, no specified disturbance zone for reptiles is given; however if a hibernacula is discovered an appropriate disturbance exclusion zone will be demarcated.
[6] If construction is to be carried out near watercourses, a buffer zone of at least 50m should be established (ASFB/RAFTS, 2012).

Occupied Features and Habitats of Importance

(a) European Protected Species - fauna (otters, and bats)

Where an occupied feature exists within the site or disturbance free zone, and the infrastructure cannot be microsited away:

(i) A licence to disturb will be applied for to SNH; or

(ii) A licence to damage or destroy will be applied for to SNH if there are no reasonable alternatives.

(b) National Protected Species (badger, pine marten, red squirrel, water vole and reptiles)

(i) Where an active badger sett exists within the site or disturbance zone, and the infrastructure cannot be microsited away, it may be necessary to undertake a relocation exercise. This is a licensed activity which will require prior authorisation from SNH. Guidance for this process has been produced by SNH, who should be consulted throughout.

(ii) Where a pine marten den, red squirrel drey, water vole burrow or badger sett exists within the site or disturbance zone, and the infrastructure cannot be microsited away, the applicant will discuss any licensing requirements and appropriate mitigation with SNH.

(iii) Where reptiles are found to be occupying any infrastructure during their hibernacula period and the infrastructure cannot be microsited away, the applicant will discuss appropriate mitigation with SNH. Reptiles are capable of actively avoiding disturbances during their active phase.

Protection Plan

Protected Species

As previously mentioned it is possible that otter, badger, red squirrel and pine marten may use the site for foraging, commuting or shelter. In addition to the mitigation measures detailed above, further steps should be implemented to reduce general disturbance from the proposed wind farm:

- Night time working will be minimised to reduce disturbance to nocturnal and crepuscular fauna. Where this is not possible, directional lighting away from features (including mammal paths and watercourses) will be used to minimise light disturbance;
- A speed limit of 15 mph for all vehicles on the site; and
- Watercourse crossings will be designed to allow the passage small mammals on the site.

Apart from badger setts, no protected features were recorded during baseline surveys. However there is potential that other dens may be located during preconstruction monitoring.

Protection zones will be set up prior to any construction taking place to ensure the safety of the setts or dens from damage and to reduce disturbance to individuals while works are being carried out.

- The boundary of the protection zone should be at least 30 m from the sett/den;
- The zone should be clearly demarcated using coloured tape or some other form of obvious visible marking before any work starts on the site;
- All contractors and sub-contractors should be notified of the presence of the protected species and instructed to keep out of the protection zone.

Potential Bat Roosts

No signs of roosting bats were recorded during the surveys, although tree inspection surveys recorded seven individual trees, and one area of Category 1/1* for higher roost potential, albeit unlikely to be affected by any proposed construction activity (see Figure 5.14 of Appendix 5.4). If in future an identified Category 1/1* tree is to be felled and/or lopped it must be investigated prior to construction works as bats can occupy a cavity that has not been historically used. The cavity will be blocked if no bats or signs of bats are found. Trees must be felled within three months of the cavities being blocked; if this time lapses then the cavities will need to be re-checked to ensure the blockage remains effective and no bats are using the cavities.

If a tree is to be felled and or lopped that it is too dangerous to climb, a dusk and dawn survey is to be carried out immediately prior to works with a licenced bat person present.

If any trees that are to be felled or lopped, and identified during preconstruction surveys as having the potential for bat roosts, it is recommended that these trees are investigated further to ensure bats are not using the cavities.

If any roosts are found it is recommended that a 30m disturbance buffer is put in place, with the works delineated from this with a fence and sign indicating that the fence is an ‘ecological buffer zone’. Any works in this area are restricted during the main activity periods for bats during mid-April to September, inclusive: 30 minutes before sunset to 30 minutes following sun rise.

6.2 Objective B – Procedure if Active Feature is found

Procedure if previously unrecorded active feature or protected species found in advance of construction activity

If an active feature or protected species is found by the ECoW’s monitoring in advance of construction activity progressing across the site, the following text outlines the procedure to be followed.

If Obstruction, Damage or Destruction (ODD) to a protected species is likely, a location specific ODD risk assessment will be completed. This will consider all potential mitigation measures to avoid ODD. This may include micrositing of infrastructure away from the location and outwith the disturbance zone and the demarcation of the protected site.

If Disturbance is likely, a location specific Disturbance Risk Assessment will be completed. This should firstly consider revision to the disturbance zone as a result of the site-specific topography and habitat quality (e.g. if a ridge lies between activity and a holt then the disturbance zone may be reduced). Also, other measures which could reduce disturbance to an acceptable level should be considered (including micrositing and the demarcation of the protected site).

The Disturbance or ODD risk assessments will be submitted to SNH for consideration.

If it is not possible to microsite and, in consideration of the risk assessment, SNH determines that ODD and/or significant levels of Disturbance is likely to occur, the procedures described in Objective A will be adopted for unoccupied and occupied features. If there is uncertainty over whether the feature is occupied a precautionary approach will be adopted and occupancy will be assumed.

Procedure if previously unrecorded protected feature or species found during construction

In the event of any site personnel discovering an unrecorded protected feature or protected species, the following procedure must be followed:

(i) Work should stop immediately within the specified disturbance zone;

(ii) The ECoW should be contacted;

(iii) The location should be checked by the ECoW to determine the nature of the new find; and

If the protected species or feature is confirmed then the procedure detailed in Objective A above should be followed.

Objective C - Education and Awareness

The applicant will provide the necessary education and awareness as part of the site induction to all site personnel with regard to the protection of protected species that are or could be present on the site, in particular the actions that should be taken if protected species are seen on the site. All site personnel (including contractors and sub-contractors) will be informed of the objectives of the SPP to ensure they are aware of any species present on the site.

This information will include as a minimum:

(i) The requirements and use of the SPP;

(ii) Identification of protected species and features;

(iii) Key risk activities and sensitive areas; and

(iv) site personnel responsible for dealing with protected species.

The applicant will undertake that any person found on the site by them to be inadequately trained, or to be disregarding the terms of the SPP is immediately expelled from the site until such time that it is appropriate for them to be allowed to return. In general such persons will need to undertake retraining in the use and application of the SPP to ensure the impact on protected species is minimised.

7. REFERENCES AND RELEVANT LEGISALTION AND GUIDANCE

Association of Salmon Fisheries Boards & Rivers and Fisheries Trusts of Scotland (2012). Advice to Boards/Trusts on engaging with the planning process for terrestrial wind farms. http://www.asfb.org.uk/wp-content/uploads/2012/04/Advice-on-Terrestrial-Windfarm-Planning-Process.pdf

Capreolus Wildlife Consultancy. (2005). *The ecology and conservation of water voles in upland habitats*. Scottish Natural Heritage Commissioned Report No. 099 (ROAME No. F99AC320).

European Commission. (1979). *Directive 79/409/EEC: Conservation of Wild Birds.* HMSO, London.

European Commission. (1992). *Directive 92/43/EEC: Conservation of Natural Habitats and of Wild Flora and Fauna.* HMSO, London.

Forestry Commission. (2006). *Forest operations and red squirrels in Scotland's forests – the law and good practice*. FCS Guidance Note 33.

Forestry Commission. (2009). *Forest operations and great crested newts in Scotland*. FCS Guidance Note 35b.

Gent, T. & Gibson, S. (1998). *Herpetofauna Workers' Manual.* JNCC, Peterborough.

HMSO. (1994). *Biodiversity: The UK Action Plan*. HMSO, London.

HMSO. (1981). *Wildlife & Countryside Act 1981.* HMSO, London .

HMSO. (1994). *The Conservation (Natural Habitats, &c.) Regulations 1994*. HMSO, London.

HMSO. (1992). *Protection of Badgers Act 1992.* HMSO, London.

Hundt, L. (2012) *Bat Surveys: Good Practice Guidelines, 2nd edition*. Bat Conservation Trust ISBN-13: 9781872745985.

Mitchell-Jones, A. J. (2004). *Bat Mitigation Guidelines.* English Nature, Peterborough.

Mitchell-Jones, A. J. & McLeish, A. P. (2004). *Bat Workers Manual – 3rd Edition.* JNCC, Peterborough.

Morris, P.A., Morris, M.J., MacPhearson, D., Jefferies, D.J., Strachan, R & Woodroffe, G.L. (1998). *Estimating numbers of the water vole Arvicola terrestris: a correction to the published method.* Journal of Zoology 246: 61 – 62.

Natural England (2014). Bats and onshore wind turbines: interim guidance. TIN051. Third Edition.

Scottish Natural Heritage. (2001). *Scotland's Wildlife: Badgers and Development.* SNH, Battleby.

Scottish Natural Heritage. (1997). *Scotland's Wildlife: Otters and Development.* SNH, Battleby.

Strachan, R., Moorhouse, T. & Gelling, M. (2011). *Water Vole Conservation Handbook 3rd Edition.* Wildlife Conservation Research Unit, Oxford.

ANNEX 1 LEGAL PROTECTION

Bats and **Otters** receive protection under the Conservation Regulations (1994) (as amended) only[7].

Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)

Under Regulation 39 (1) it is an offence to:

(a) deliberately or recklessly to capture, injure or kill a wild animal of a European protected species;

(b) deliberately or recklessly:

- (i) to harass a wild animal or group of wild animals of a European protected species;
- (ii) to disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
- (iii) to disturb such an animal while it is rearing or otherwise caring for its young;
- (iv) to obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place including bat roost sites;
- (v) to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs; or
- (vi) to disturb such an animal 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;

(c) deliberately or recklessly to take or destroy the eggs of such an animal; or

(d) to damage or destroy a breeding site or resting place of such an animal.

Regulation 44 (2e) allows a licence to be granted for the activities noted in Regulation 39 such that:

Preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment.

Water Vole is not protected by Section 9, subsection 1 of the Wildlife and Countryside Act but is covered by Section 9, subsection 4 and Section 10[8].

Wildlife and Countryside Act (1981)
Nature Conservation (Scotland) Act 2004

Under Section 9 Subsection 1[9] it is an offence to:

- Intentionally or recklessly kill, injure or take any wild animal included in Schedule 5.

Under Section 9, Subsection 4, Paragraphs (a) and (b)[4], it is an offence to:

- Intentionally or recklessly damage or destroy, or obstruct access to, any structure or place which any wild animal included in Schedule 5 uses for shelter or protection.
- Intentionally or recklessly disturb any such animal while it is occupying a structure or place which it uses for that purpose.

Under Section 10, Subsection 3, Paragraph (c)[4], any person shall not be guilty of an offence by reason of:

- Any act made unlawful by that section if he shows:
  - (a) That each of the conditions specified in subsection (3A) was satisfied in relation to the carrying out of the unlawful act; or
  - (b) That the unlawful act was carried out in relation to an animal bred and, at the time the act was carried out, lawfully held in captivity.

- Section 3A states those conditions referred to in Subsection 3c are:
  - (a) That the unlawful act was the incidental result of a lawful operation or other activity;
  - (b) That the person who carried out the lawful operation or other activity:
    - (i) took reasonable precautions for the purpose of avoiding carrying out the unlawful act; or
    - (ii) did not foresee, and could not reasonably have foreseen, that the unlawful act would be an incidental result of the carrying out of the lawful operation or other activity; and
  - a. That the person who carried out the unlawful act took, immediately upon the consequence of that act becoming apparent to the person, such steps as were reasonably practicable in the circumstances to minimise the damage or disturbance to the wild animal, or the damage or obstruction to the structure or place, in relation to which the unlawful act was carried out.

Red Squirrels and **Pine Martens** are protected by the following legislation:

Wildlife and Countryside Act (1981)
Nature Conservation (Scotland) Act 2004

Under Section 9, Subsection 1, it is an offence to:

Intentionally or recklessly:

- Kill, injure or take any wild animal listed on Schedule 5;

[7] The Conservation Amendment (Scotland) Regulations (2007) removed EPS from Schedule 5 and 8 of the Wildlife and Countryside Act 1981.
[8] as amended by the Nature Conservation (Scotland) Act 2004
[9] as amended by the Nature Conservation (Scotland) Act 2004

- Damages or destroys or obstructs access to, any structure or place that any animal listed on Schedule 5 uses for shelter or protection;
- Disturbs any such animal while it is occupying a structure or place which is uses for that purpose
- Sell, offer or expose for sale, or possess or transport for the purpose of sale, any live or dead wild animal included in Schedule 5, or any part of, or anything derived from, such an animal.
- Publish or cause to be published any advertisement likely to be understood as conveying that he buys or sells, or intends to buy or sell, any of those things.

Badgers are protected under the Protection of Badgers Act 1992 (as amended by the Nature Conservation (Scotland) Act 2004 (as amended)).

The following applies under this legislation:
Part 1.–
(1) A person is guilty of an offence if, except as permitted by or under this Act, he wilfully kills, injures or takes, or attempts to kill, injure or take, a badger.

(2) If, in any proceedings for an offence under subsection (1) above consisting of attempting to kill, injure or take a badger, there is evidence from which it could reasonably be concluded that at the material time the accused was attempting to kill, injure or take a badger, he shall be presumed to have been attempting to kill, injure or take a badger unless the contrary is shown.

(3) A person is guilty of an offence if, except as permitted by or under this Act, he has in his possession or under his control any dead badger or any part of, or anything derived from, a dead badger.

Part 3. –
(1) A person is guilty of an offence if, except as permitted by or under this Act, he interferes with a badger sett by doing any of the following things–

(a) damaging a badger sett or any part of it;
(b) destroying a badger sett;
(c) obstructing access to, or any entrance of, a badger sett;
(d) causing a dog to enter a badger sett; or
(e) disturbing a badger when it is occupying a badger sett,

intending to do any of those things or being reckless as to whether his actions would have any of those consequences.

(2) A person is guilty of an offence if, except as permitted by or under this Act, he knowingly causes or permits to be done an act which is made unlawful by subsection (1) above.
Reptiles

The three native species of **reptile** to Scotland are protected by the following legislation:
Wildlife and Countryside Act (1981)
Nature Conservation (Scotland) Act 2004

Under Section 9 Subsection 1[10] it is an offence to:

- Intentionally or recklessly kill, injure or take any wild animal included in Schedule 5.

Under Section 9, Subsection 5, Paragraphs (a) and (b)[4], it is an offence to:

- Sell, offer or expose for sale, or possess or transport for the purpose of sale, any live or dead wild animal included in Schedule 5, or any part of, or anything derived from, such an animal.

- Publish or cause to be published any advertisement likely to be understood as conveying that he buys or sells, or intends to buy or sell, any of those things.

Under Section 10, Subsection 3, Paragraph (c)[4], any person shall not be guilty of an offence by reason of:

- Any act made unlawful by that section if he shows:

  (a) That each of the conditions specified in subsection (3A) was satisfied in relation to the carrying out of the unlawful act; or

  (b) That the unlawful act was carried out in relation to an animal bred and, at the time the act was carried out, lawfully held in captivity.

- Section 3A states those conditions referred to in Subsection 3c are:

  (a) That the unlawful act was the incidental result of a lawful operation or other activity;

  (b) That the person who carried out the lawful operation or other activity:

    (i) took reasonable precautions for the purpose of avoiding carrying out the unlawful act; or
    (ii) did not foresee, and could not reasonably have foreseen, that the unlawful act would be an incidental result of the carrying out of the lawful operation or other activity; and

  a. That the person who carried out the unlawful act took, immediately upon the consequence of that act becoming apparent to the person, such steps as were reasonably practicable in the circumstances to minimise the damage or disturbance to the wild animal, or the damage or obstruction to the structure or place, in relation to which the unlawful act was carried out.

[10] as amended by the Nature Conservation (Scotland) Act 2004

HIGHLEE HILL WIND FARM

ORNITHOLOGY
Appendix 6.1

Prepared: Sarah Sanders, Rafe Dewar
Reviewed: Brian Henry

Date: 03 June 2016

Tel: 0141 342 5404
Web: www.macarthurgreen.com

Address: 95 South Woodside Road | Glasgow | G20 6NT

Document Quality Record.

Revision	Date	Originator	Checker	Approved	Status
Draft	25/02/2016	SS	RD	BH	Client Review
0	03/06/2016	RD			First Revision
01					Second Revision
02					Third Revision

CONTENTS

FIGURES

1. INTRODUCTION

MacArthur Green was commissioned by RES Ltd to complete ornithological desk-based and field surveys at the proposed Highlee Hill Wind Farm site, near Hawick, the Scottish Borders (hereafter referred to as the "proposed wind farm site").

The work was commissioned to inform an assessment of the potential ornithological effects which may result from the proposed wind farm. A range of survey methods were employed in order to establish a thorough baseline dataset on bird activity within the site (area within the red line boundary where all infrastructure would be located) and wider study area (site plus appropriate species-specific buffer – see Figure 6.1).

This Technical Report summarises the methods employed and the results of the field surveys and is supported by the following Annexes and Appendix:

- Annex A: Legal Protection;
- Annex B: Bird Survey Methodologies;
- Annex C: Survey Effort and General Information;
- Annex D: Survey Results; and
- Annex E: Collision Risk Assessments.

- Confidential Technical Appendix 6.2

2. LEGAL PROTECTION

With limited exceptions, all wild birds and their eggs are protected by law. Specific levels of protection are determined by a species' inclusion on certain lists. Annex A to this report details the various levels of legal protection afforded to UK bird species.

3. METHODS

3.1 Consultations and Desk-Based Study

The following organisations and resources were consulted regarding the ornithological interests on and adjacent to the proposed wind farm site:

- Scottish Natural Heritage (SNH) SiteLink [http://gateway.snh.gov.uk/sitelink/] – information on designated sites in Scotland;
- Natural England website [https://designatedsites.naturalengland.org.uk/] and Magic [http://www.magic.gov.uk] website – information on designated sites in England;
- British Trust for Ornithology (BTO) BirdTrack website [http://app.bto.org/birdtrack/main/data-home.jsp] – OS Tiles NT60 and NT50;
- The Wildlife Information Centre (Lothian and Borders);
- The Southern Upland Partnership;
- The Lothian & Borders Raptor Study Group; and
- The Scottish Ornithologists' Club (SOC) including the South-East Scotland Bird Atlas [http://www.the-soc.org.uk/se-atlas/allrecords_index.htm] with records from 2000-06, and the Borders Bird Report No. 29 (2013).

3.2 Field Surveys

The following surveys were undertaken at the site between April 2011 and July 2015 inclusive:

- Flight activity (Vantage Point) Surveys (2 non-breeding seasons (2011/12 and 2012/13), and 2 breeding seasons (2012 and 2013));
- Black Grouse Surveys (2 breeding seasons in 2012 and 2013);
- Scarce Breeding Bird Surveys (3 breeding seasons in 2012, 2013 and 2015);
- Breeding Bird Surveys (2 breeding seasons in 2012 and 2013);
- Woodland Point Counts (3 breeding seasons in 2011-13, and 1 non-breeding season in 2011/12); and
- Winter Walkovers (2 non-breeding seasons in 2011/12 and 2012/13).

Survey methods followed the recommended guidelines and are described in detail within Annex B. The scarce breeding bird surveys which involve searching for Schedule 1/Annex 1 species' (see Annex A) breeding activity were carried out by appropriately licensed surveyors. All survey data were reviewed, inputted, and analysed by MacArthur Green.

Each survey was carried out beyond the extent of the site within a recommended buffer distance specific to that method. These extents are hereafter referred to as the 'study area' within this report and are detailed below for ease of reference:

- Flight activity surveys – proposed turbine layout plus a buffer of up to 500 m, where there was viewshed coverage;
- Breeding bird surveys – site plus a 500 m buffer;
- Scarce breeding bird surveys – site plus a 2 km buffer;
- Black grouse surveys – site plus a 1.5 km buffer;
- Woodland point count surveys – site plus a 500 m buffer; and
- Winter walkover surveys – site plus a 500 m buffer.

The relative importance of each species observed was determined by the specific level of protection assigned to that species recorded, coupled with its perceived susceptibility to potential effects resulting from the site, and followed guidelines on species' priorities by SNH (2006[1], 2010[2], 2013 and 2014[3]). The resulting 'Target Species' and 'Secondary Species' lists are a standard assessment tool for wind farm ornithological studies (see Annex B).

4. RESULTS

4.1 Designated Sites

Information gathered from the consultation exercise (using a search area of up to 20 km from the site) revealed that there are no designated sites within the site boundary. The site is however 1.1 km north of the Kielderhead Moors: Carter Fell to Peel Fell SSSI which has a listed breeding bird assemblage interest (Table 4.1).

The site is also around 16 km to the northeast of Langholm – Newcastleton Hills Special Protection Area (SPA) which is underpinned by the Langholm – Newcastleton Hills Site of Special Scientific Interest (SSSI). The SPA is designated for breeding hen harrier (Table 4.2) and the SSSI for hen harrier and a breeding moorland bird assemblage (Table 4.3).

Two National Nature Reserves (NNRs) are within 5 km of the site: Whitelee Moor NNR and Kielderhead NNR. Information pertaining to Whitelee Moor NNR lists merlin, buzzard, peregrine, hen harrier, golden plover, dunlin, skylark, stonechat and meadow pipit. Information pertaining to Kielderhead NNR site includes "a variety of upland birds".

---

[1] Scottish Natural Heritage (2006) *Assessing significance of impacts from onshore Wind farms on birds outwith designated areas*.
[2] Scottish Natural Heritage (2010). *Survey methods for use in assessing the impacts of onshore windfarms on bird communities*.
[3] Scottish Natural Heritage (2013, revised 2014) *Recommended Bird Survey Methods to inform impact assessment of Onshore Windfarms*.

Designated sites with ornithological interest within 20 km of the proposed wind farm are shown on Figure 6.2.

Table 4.1. Summary of qualifying features of Kielderhead Moors: Carter Fell to Peel Fell SSSI.

Feature	Description	Status
Breeding bird assemblage	Includes golden plover and dunlin on the higher moor, four Schedule 1 raptor species which depend upon large tracts of open moorland and one which utilises the forest edge. The deeply incised cleuchs have ring ouzel, wheatear and whinchat, while more open grassy burnsides and flushed haughland hold snipe, curlew, redshank and teal.	Jun 2003: Favourable, maintained

Table 4.2. Summary of qualifying features of Langholm – Newcastleton Hills SPA.

Feature	Description	Status
Hen harrier (Annex 1, Schedule 1), breeding	Average of 13 breeding females (3% of the UK breeding population (based on 1994-1998 counts)	Dec 2008: Unfavourable Recovering

Table 4.3. Summary of qualifying features of Langholm – Newcastleton Hills SSSI.

Feature	Description	Status
Hen harrier, breeding		Dec 2008: Favourable, recovered
Breeding bird assemblage	May include black and red grouse, as well as nine species of wader and six raptor species including hen harrier	Jul 2003: Unfavourable, declining

4.2 Desk-based Species Records

A search of the British Trust for Ornithology's (BTO) database of Timed Tetrad Visits, Roving Records and BirdTrack entries included records from 2007 up to March 2014 within OS tiles NT60 and NT50 of the species listed in Table 4.4.

A data request in March 2014, for all historic records from The Wildlife Information Centre added further species to the inventory in Table 4.4. Species that had data provided by the Lothian & Borders Raptor Study Group in June 2014 are also included.

Further information on target species recorded during baseline surveys is included within Section 4.3.

Table 4.4. Bird species list derived from desk-based studies and baseline surveys.

Species	Latin name	BTO (NT50 and NT60)	TWIC	L&B RSG
Barn Owl	***Tyto alba***	✓	✓	✓
Barn Swallow	***Hirundo rustica***	✓	✓	
Black Grouse	***Tetrao tetrix***	✓	✓	
Black-headed Gull	***Chroicocephalus ridibundus***	✓	✓	
Blue Tit	***Cyanistes caeruleus***	✓	✓	
Brambling	***Fringilla montifringilla***		✓	
Coal Tit	***Periparus ater***	✓	✓	
Common Bullfinch	***Pyrrhula pyrrhula***	✓	✓	
Common Buzzard	***Buteo buteo***	✓	✓	✓
Common Coot	***Fulica atra***		✓	
Common Crossbill	***Loxia curvirostra***	✓	✓	
Common Cuckoo	***Cuculus canorus***	✓	✓	
Common Goldeneye	***Bucephala clangula***		✓	
Common Grasshopper Warbler	***Locustella naevia***	✓	✓	
Common Kestrel	***Falco tinnunculus***	✓	✓	
Common Linnet	***Carduelis cannabina***	✓	✓	
Common Moorhen	***Gallinula chloropus***		✓	
Common Raven	***Corvus corax***	✓	✓	
Common Redpoll	***Carduelis flammea***		✓	
Common Redshank	***Tringa totanus***	✓	✓	
Common Redstart	***Phoenicurus phoenicurus***	✓	✓	
Common Sandpiper	***Actitis hypoleucos***	✓	✓	
Common Snipe	***Gallinago gallinago***	✓	✓	
Common Starling	***Sturnus vulgaris***	✓	✓	
Common Swift	***Apus apus***	✓	✓	
Common Whitethroat	***Sylvia communis***	✓	✓	
Dunlin	***Calidris alpina***		✓	
Eurasian Curlew	***Numenius arquata***	✓	✓	
Eurasian Oystercatcher	***Haematopus ostralegus***	✓	✓	
Eurasian Siskin	***Carduelis spinus***	✓	✓	
Eurasian Sparrowhawk	***Accipiter nisus***	✓	✓	✓
Eurasian Teal	***Anas crecca***		✓	
Eurasian Tree Sparrow	***Passer montanus***		✓	
Eurasian Treecreeper	***Certhia familiaris***	✓	✓	
Eurasian Woodcock	***Scolopax rusticola***	✓	✓	
European Golden Plover	***Pluvialis apricaria***	✓	✓	
European Goldfinch	***Carduelis carduelis***	✓	✓	
European Greenfinch	***Carduelis chloris***	✓	✓	
European Robin	***Erithacus rubecula***	✓	✓	
Fieldfare	***Turdus pilaris***	✓	✓	

Species	Latin name	BTO (NT50 and NT60)	TWIC	L&B RSG
Goldcrest	Regulus regulus	✓	✓	
Golden Eagle	Aquila chrysaetos		✓	
Goosander	Mergus merganser	✓	✓	
Great black-backed gull	Larus marinus			
Great Grey Shrike	Lanius excubitor		✓	
Great Spotted Woodpecker	Dendrocopos major	✓	✓	
Great Tit	Parus major	✓	✓	
Greater Canada Goose	Branta canadensis		✓	
Green Woodpecker	Picus viridis		✓	
Grey Heron	Ardea cinerea	✓	✓	
Grey Partridge	Perdix perdix	✓	✓	
Grey Wagtail	Motacilla cinerea	✓	✓	
Hedge Accentor	Prunella modularis	✓	✓	
Hen Harrier	Circus cyaneus	✓	✓	
Herring Gull	Larus argentatus	✓	✓	
House Martin	Delichon urbicum	✓	✓	
House Sparrow	Passer domesticus	✓	✓	
Lesser Black-backed Gull	Larus fuscus	✓	✓	
Lesser Redpoll	Carduelis cabaret	✓	✓	
Lesser Whitethroat	Sylvia curruca		✓	
Long-eared Owl	Asio otus		✓	
Mallard	Anas platyrhynchos	✓	✓	
Marsh Tit	Poecile palustris		✓	
Meadow Pipit	Anthus pratensis	✓	✓	
Merlin	Falco columbarius	✓	✓	✓
Mew Gull	Larus canus		✓	
Mistle Thrush	Turdus viscivorus	✓	✓	
Mute Swan	Cygnus olor		✓	
Northern Goshawk	Accipiter gentilis	✓	✓	✓
Northern Lapwing	Vanellus vanellus	✓	✓	
Northern Wheatear	Oenanthe oenanthe	✓	✓	
Osprey	Pandion haliaetus		✓	✓
Peregrine Falcon	Falco peregrinus	✓	✓	✓
Pied Flycatcher	Ficedula hypoleuca	✓	✓	
Pied Wagtail	Motacilla alba	✓	✓	
Redwing	Turdus iliacus		✓	
Red kite	Milvus milvus			
Reed Bunting	Emberiza schoeniclus	✓	✓	
Ring Ouzel	Turdus torquatus		✓	
Rock Pigeon	Columba livia	✓	✓	
Sand Martin	Riparia riparia	✓	✓	
Short-eared Owl	Asio flammeus		✓	
Sky Lark	Alauda arvensis	✓	✓	

Species	Latin name	BTO (NT50 and NT60)	TWIC	L&B RSG
Pink-footed goose	Anser brachyrhynchus	✓		
Greylag goose	Anser anser	✓		
Pheasant	Phasianus colchicus	✓		
Woodpigeon	Columba palumbus	✓		
Collared dove	Streptopelia decaocto	✓		
Blackbird	Turdus merula	✓		
Sedge warbler	Acrocephalus schoenobaenus	✓		
Blackcap	Sylvia atricapilla	✓		
Garden warbler	Sylvia borin	✓		
Chiffchaff	Phylloscopus collybita	✓		
Long-tailed tit	Aegithalos caudatus	✓		
Jay	Garrulus glandarius	✓		
Magpie	Pica pica	✓		
Jackdaw	Corvus monedula	✓		
Rook	Corvus frugilegus	✓		
Carrion crow	Corvus corone	✓		
Chaffinch	Fringilla coelebs	✓		
Red-legged partridge	Alectoris rufa	✓		
Corn bunting	Emberiza calandra	✓		
Song Thrush	Turdus philomelos	✓	✓	
Spotted Flycatcher	Muscicapa striata	✓	✓	
Stock Pigeon	Columba oenas		✓	
Stonechat	Saxicola torquata	✓	✓	
Tawny Owl	Strix aluco	✓	✓	✓
Tree Pipit	Anthus trivialis	✓	✓	
Tufted Duck	Aythya fuligula		✓	
Water Rail	Rallus aquaticus		✓	
Whinchat	Saxicola rubetra	✓	✓	
White-throated Dipper	Cinclus cinclus		✓	
Willow Ptarmigan	Lagopus lagopus	✓	✓	
Willow Warbler	Phylloscopus trochilus	✓	✓	
Winter Wren	Troglodytes troglodytes	✓	✓	
Wood Nuthatch	Sitta europaea	✓	✓	
Wood Warbler	Phylloscopus sibilatrix		✓	
Yellow Wagtail	Motacilla flava		✓	
Yellowhammer	Emberiza citrinella	✓	✓	

4.3 Field Survey

Survey effort and results of the field surveys are detailed within Annexes C & D. The following sections summarise the results from each survey undertaken.

4.3.1 Flight Activity Surveys

The flight activity (vantage point) surveys recorded all flights over the site and beyond, within a 2 km viewshed. The flight data used in a collision risk model are those flights recorded within the 'Collision Risk Analysis Area' (CRAA) (i.e. the area to be occupied by operational turbines, together with a 500m buffer).

Initially in 2011, five vantage points (VPs) (1-5) were selected to cover the original site (Figure 6.3). Due to a change in site boundary and maximum potential developable area made after the 2012 breeding season it was necessary to modify the area surveyed. This was achieved by ceasing flight activity surveys at the original VP locations and beginning flight activity surveys at three new VP locations (VPs 6, 7 and 9) during the 2012/13 non-breeding season and the 2013 breeding season (Table 4.5, Figure 6.4). The area around VP 4 was continuously surveyed from September 2011 until August 2013, although for the second year the VP moved slightly to cover better the proposed turbine locations (referred to as VP 4a in Figure 6.4 and VP 9 here). This change has been accounted for in the collision modelling process.

In both years three VPs provided sufficient coverage of the final proposed turbine locations and a 500 m buffer (highlighted red in Table 4.5).

Table 4.5. Summary of total hours of survey for each VP in each season*

Period	VP1	VP2	VP3	VP4	VP5	VP6	VP7	VP9
Winter (Non-breeding) 2011/2012	36	36	39	36	36	N/A	N/A	N/A
Summer (Breeding) 2012	30	30	37	30	35	N/A	N/A	N/A
Winter (Non-breeding) 2012/2013	N/A	N/A	N/A	N/A	N/A	36	36	31
Summer (Breeding) 2013	N/A	N/A	N/A	N/A	N/A	36	36	36

* excludes survey hours undertaken in poor visibility (<1 km). Values highlighted red indicate that the VP's viewshed covers the proposed turbine area.

From September 2011 to August 2013 inclusive, a total of nine Target Species were recorded during the flight activity surveys (further details within Annex D and Table 4.6). Figures 6.5 to 6.7 detail all flight lines observed.

Table 4.6. Target species and total number of flights recorded during flight activity surveys, 2011-2013.

Species	Total number of flight lines recorded	Total number of birds recorded	Total bird seconds
Curlew	9	11	333
Golden plover	3	208	9,360
Goshawk	19	19	1,239
Hen harrier	1	1	150
Merlin	3	3	50
Osprey	1	1	240
Peregrine falcon	7	8	218
Pink-footed goose	2	105	12,075
Red kite	2	2	200

4.3.2 Collision Risk Modelling

It is planned that the proposed wind farm will incorporate two types of turbine: 11 with a rotor diameter of 117 m and an upper tip height of 176 m; and two (T6 and T7) with a rotor diameter of 117 m and an upper tip height of 150 m. The three flight height bands used during flight activity surveys were: 0-20 m; 21-125 m; and 126+ m (see Annex B for further details on methods). This means that flight height bands 2 and 3 will incorporate flights at rotor heights. Although some of these flights are likely to have occurred above 176 m (upper tip height for the higher turbine type), and therefore were not technically at rotor height, all flights over the Collision Risk Analysis Area (CRAA) in height band 3 have been included in the model as a precaution, since there is no cut-off height for band 3. Some flights occurring in height band 2 between 21 m and 33/59 m (lower rotor tip height, turbine type A/B) were technically not at rotor height, and so a proportion of total flight duration within height band 2 has been excluded to represent this (assuming an even distribution in flight altitude within this height band).

The collision model, following methods described in SNH (2000[4]) and Band *et al.* (2007[5]) was run twice, assuming that all turbines within the proposed wind farm were of the same type. The worst-case results were taken forward for the impact assessment in ES Chapter 6.

Flights within the CRAA and those recorded at potential collision height (PCH) are summarised below in Table 4.7 for both turbine types. "At-risk" flights are those that are defined as: at PCH, within the CRAA and recorded within the 2 km viewshed of the associated VP. Note that Figures 6.5 to 6.7 show all flights, regardless of location. Full survey results detailing the findings from each survey visit (including those not at-risk and secondary species information) can be found within Annex D.

Table 4.7. At-risk flights recorded during flight activity surveys, 2011-2013. Numbers of individuals in parenthesis.

Species	Number of flightlines recorded within CRAA	Number of at-risk flightlines recorded
Curlew	1 (1)	0 (0)
Golden plover	1 (200)	1 (200)
Goshawk	7 (7)	6 (6)
Hen harrier	0 (0)	0 (0)
Merlin	0 (0)	0 (0)
Osprey	0 (0)	0 (0)
Peregrine falcon	5 (6)	5 (6)
Pink-footed goose	1 (20)	1 (20)
Red kite	1 (1)	1 (1)

Target Species' seasonal flight line observations detailing the number, duration and proportion of flight activity within each flight category per species observed in the CRAA are provided in Tables 4.8 to 4.1 below.

[4] Scottish Natural Heritage (2000) Windfarms and birds: calculating a theoretical collision risk assuming no avoidance action. SNH Guidance Note. SNH

[5] Band, W., Madders, M. and Whitfield, D.P. (2007). Developing field and analytical methods to assess avian collision risk at Windfarms. In: de Lucas, M., Janss, G.F.E. and Ferrer, M. (eds.) Birds and Windfarms: Risk Assessment and Mitigation. Pp. 259-275. Quercus, Madrid.

Table 4.8. Target species bird seconds within the CRAA during the 2011/2012 non-breeding season* - 150 m turbines.

Species		Bird seconds recorded within height bands				
		Flights	Below PCH	At PCH	Above PCH	Total
Golden plover	Seconds	1	0.00	1806	7194	9000
	Percentage		0.00	20.06	79.94	100
Goshawk	Seconds	1	6	42	0.00	48
	Percentage		0.00	20.06	79.94	100
Peregrine falcon	Seconds	4	13	89	0.00	101
	Percentage		12.38	87.62	0.00	100
Pink-footed goose	Seconds	1	37	264	0.00	301
	Percentage		12.38	87.62	0.00	100

*The non-breeding season is defined as September to mid-March inclusive by SNH (2014). These observations were recorded between the dates of 27th September 2011 to 9th March 2012.

Table 4.9. Target species bird seconds within the CRAA during the 2011/2012 non-breeding season* - 176 m turbines.

Species		Bird seconds recorded within height bands				
		Flights	Below PCH	At PCH	Above PCH	Total
Golden plover	Seconds	1	0.00	3676	5324	9000
	Percentage		0.00	40.85	59.15	100
Goshawk	Seconds	1	18	30	0.00	48
	Percentage		37.14	62.86	0.00	100
Peregrine falcon	Seconds	4	38	64	0.00	101
	Percentage		37.14	62.86	0.00	100
Pink-footed goose	Seconds	1	112	190	0.00	301
	Percentage		37.14	62.86	0.00	100

*The non-breeding season is defined as September to mid-March inclusive by SNH (2014). These observations were recorded between the dates of 27th September 2011 to 9th March 2012.

Table 4.10. Target species bird seconds within the CRAA Area during the 2012 breeding season* - 150 m turbines.

Species		Bird seconds recorded within height bands				
		Flights	Below PCH	At PCH	Above PCH	Total
Curlew	Seconds	1	20	0.00	0.00	20
	Percentage		100.00	0.00	0.00	100
Goshawk	Seconds	6	92	152	0.00	244
	Percentage		37.53	62.47	0.00	100.00
Peregrine falcon	Seconds	1	1	7	0.00	8
	Percentage		12.38	87.62	0.00	100.00

*The breeding season is defined as mid-March to August inclusive by SNH (2014). These observations were recorded between the dates of 16th March to 23rd August 2012.

Table 4.11. Target species bird seconds within the CRAA Area during the 2012 breeding season* - 176 m turbines.

Species		Bird seconds recorded within height bands				
		Flights	Below PCH	At PCH	Above PCH	Total
Curlew	Seconds	1	20	0.00	0.00	20
	Percentage		100.00	0.00	0.00	100.00
Goshawk	Seconds	6	135	109	0.00	244
	Percentage		55.18	44.82	0.00	100.00
Peregrine falcon	Seconds	1	3	5	0.00	8
	Percentage		37.14	62.86	0.00	100.00

*The breeding season is defined as mid-March to August inclusive by SNH (2014). These observations were recorded between the dates of 16th March to 23rd August 2012.

Table 4.12 Target species bird seconds within the CRAA during the 2013 breeding season* - 150 m turbines.

Species		Bird seconds recorded within height bands				
		Flights	Below PCH	At PCH	Above PCH	Total
Red kite	Seconds	1	38	103	0.00	141
	Percentage		26.98	73.02	0.00	100.00

*The breeding season is defined as mid-March to August inclusive by SNH (2014). These observations were recorded between the dates of 26th March to 29th August 2013.

Table 4.13 Target species bird seconds within the CRAA during the 2013 breeding season* - 176 m turbines.

Species		Bird seconds recorded within height bands				
		Flights	Below PCH	At PCH	Above PCH	Total
Red kite	Seconds	1	67	74	0.00	141
	Percentage		47.62	52.38	0.00	100.00

*The breeding season is defined as mid-March to August inclusive by SNH (2014). These observations were recorded between the dates of 26th March to 29th August 2013.

The total occupancy (in seconds) for Target Species flights within the CRAA at PCH were then input into a collision risk model (CRM) to calculate the predicted collision mortality (Tables 4.14 to 4.17). The full CRM calculations for each species can be found in Annex E.

Table 4.14. Collision Risk Model Outputs, 176m Turbines (collisions per season)

Species	Collision rate (2011/2012 non-breeding)	Collision rate (2012 breeding)	Collision rate (2012/2013 non-breeding)	Collision rate (2013 breeding)
Golden plover	0.342	-	-	-
Goshawk	0.003	0.016	-	-
Peregrine falcon	0.006	0.001	-	-
Pink-footed goose	0.002	-	-	-
Red kite	-	-	-	0.014

Table 4.15. Collision Risk Model Outputs, 176m Turbines (one collision every *x* years)

Species	Equivalent To One Bird Every *X* Seasons (2011/2012 non-breeding)	Equivalent To One Bird Every *X* Seasons (2012 breeding)	Equivalent To One Bird Every *X* Seasons (2012/2013 non-breeding)	Equivalent To One Bird Every *X* Seasons (2013 breeding)
Golden plover	2.9	-	-	-
Goshawk	365	64	-	-
Peregrine falcon	182	1384	-	-
Pink-footed goose	442	-	-	-
Red kite	-	-	-	71

Table 4.16. Collision Risk Model Outputs, 150m Turbines (collisions per season)

Species	Collision rate (2011/2012 non-breeding)	Collision rate (2012 breeding)	Collision rate (2012/2013 non-breeding)	Collision rate (2013 breeding)
Golden plover	0.168	-	-	-
Goshawk	0.004	0.022	-	-
Peregrine falcon	0.008	0.001	-	-
Pink-footed goose	0.003	-	-	-
Red kite	-	-	-	0.020

Table 4.17. Collision Risk Model Outputs, 150m Turbines (one collision every *x* years)

Species	Equivalent To One Bird Every *X* Seasons (2011/2012 non-breeding)	Equivalent To One Bird Every *X* Seasons (2012 breeding)	Equivalent To One Bird Every *X* Seasons (2012/2013 non-breeding)	Equivalent To One Bird Every *X* Seasons (2013 breeding)
Golden plover	6.0	-	-	-
Goshawk	262	46	-	-
Peregrine falcon	130	993	-	-
Pink-footed goose	317	-	-	-
Red kite	-	-	-	51

4.2.4 Black Grouse

No black grouse or signs were recorded on site during the 2012 or 2013 black grouse surveys or at any other time (September 2011 to August 2013) throughout all the surveys on site and within a 1.5 km buffer.

Black grouse records from 1996 to 2012 were obtained from the Southern Uplands Partnership Black Grouse Project and The Wildlife Information Centre. Details can be found in the Confidential Technical Appendix 6.2.

4.2.5 Woodland Point Counts

Surveys in the 2011, 2012 and 2013 breeding seasons and the 2012/2013 non-breeding season recorded common crossbill (Schedule 1) as well as six BoCC Red-Listed species (cuckoo, hawfinch, lesser redpoll, song thrush, tree pipit and wood warbler). Woodland Point Count results are found in Annex D.

4.2.6 Breeding Bird Survey

The 2012 Breeding Bird Survey (BBS) recorded the following breeding birds within the survey area (Figure 6.10):

- Curlew (1 territory); and
- Oystercatcher (1 territory).

The 2013 BBS (conducted in open habitat in the north of the site) recorded the following breeding birds within the survey area (Figure 6.10):

- Curlew (0-2 territories);
- Golden plover (0-1 territories);
- Lapwing (9-10 territories);
- Oystercatcher (1-2 territories); and
- Snipe (7-12 territories).

Details on the methodology and full details of the results can be found in Annexes C and D respectively.

4.2.7 Scarce Breeding Bird Survey

Searches to locate breeding raptors, owls and their nest sites were carried out during the 2012, 2013 and 2015 breeding seasons. The site and an associated 2 km buffer were surveyed as per SNH guidance for breeding target raptor species. Full details of raptor surveys are provided within Annexes C and D. Results of Schedule 1-listed, and other sensitive breeding species are presented in Confidential Technical Appendix 6.2.

During baseline surveys in 2012 to 2015, two target raptor species showed evidence of breeding within the study area: goshawk and peregrine. Long-eared owl was also recorded breeding.

Three separate goshawk territories, two of which were within the site, were recorded (two territories in 2012 and three territories in 2013). In each year, one pair was successful in breeding.

One of the territories within the site appeared to be occupied again in 2015, with a small number of individual observations, but no breeding was confirmed. At the other two locations where activity was previously recorded, there was no evidence of goshawk breeding in 2015. Felling operations have been undertaken within 500m of the area marked as a potential goshawk site, and this may have affected any breeding attempt in 2015.

Historic records were also made available from TWIC and the Lothian & Borders Raptor Study Group which indicated merlin and barn owl breed in the wider area, and a historic golden eagle territory exists within 6 km of the site (most recent evidence of occupation was in 2004).

4.2.8 Winter Walkovers

Winter Walkover surveys carried out over the 2011/2012, 2012/2013 and 2013/2014 winter seasons recorded 35, 19 and 19 bird species respectively. Target Species observations included common crossbill, fieldfare, goshawk, golden plover, kestrel, lapwing, peregrine falcon, redwing and snipe. Full details of the winter walkover surveys are provided within Annexes C and D.

ANNEX A: LEGAL PROTECTION

In Scotland, all wild birds are protected under the Wildlife and Countryside Act 1981 (the 'Act'), as amended by the Nature Conservation (Scotland) Act 2004. This protection also extends to their eggs and nests, with it being an offence to intentionally or recklessly[1]:

- kill, injure or take any wild bird[2];
- take, damage, destroy or otherwise interfere with the nest of any wild bird while it is being built or is in use[3];
- at any other time takes, damage, destroys or otherwise interferes with any nest habitually used by any wild bird included in Schedule A1 (Protected Nests and Nest Sites for Birds: White-Tailed Eagle and Golden Eagle)[4];
- obstructs or prevents any wild bird from using its nest[5]; or
- take or destroy an egg of any wild bird[6].

It is also an offence to have in possession or control any live or dead wild bird or any part thereof; or any egg or part of an egg of any wild bird.[7]

Further special protection under this legislation is afforded to those species listed on Schedule 1 of the Act. For these species, it is an offence to intentionally or recklessly disturb any wild bird listed on Schedule 1 while it is nest building, or is in, on or near a nest containing eggs or young, or disturb the dependent young of such a bird[8];

- Intentionally or recklessly disturb any wild birds included on Schedule 1 which leks, while it is doing so.[9] (In Scotland the capercaillie is the only bird this offence applies to);
- Intentionally or recklessly harass any wild bird included in Schedule 1A.[10] (White-tailed eagle, are the only birds currently listed);

It is also an offence to knowingly cause or permit to be done an act which is made unlawful by any of the above provisions.

- Intentionally or recklessly take, damage, destroy or otherwise interfere with any nest and/or nest site habitually used by any bird on Schedule A1 at any time. White-tailed eagle and golden eagle are the only birds currently listed in Schedule A1 at this time[11].
- Schedule 1A of the Wildlife and Countryside Act 1981 (as amended) lists those birds that are protected from harassment. Section 1, subsection 5B states, '*Subject to the provisions of this Part, any person who intentionally or recklessly harasses any wild bird included in Schedule 1A shall be guilty of an offence*'. Schedule 1A includes white-tailed eagle, golden eagle, hen harrier and red kite. This updated legislation was introduced on 16 March 2013

[1] Exceptions to these offences exist under various circumstances (e.g. controlling pest species; taking birds during specific seasons; and killing sick or injured birds etc.).
[2] Wildlife and Countryside Act 1981 Section 1(1)(a)
[3] Wildlife and Countryside Act 1981 Section 1(1)(b)
[4] Wildlife and Countryside Act 1981 Section 1(1)(ba)
[5] Wildlife and Countryside Act 1981 Section 1(1)(bb)
[6] Wildlife and Countryside Act 1981 Section 1(1)(c)
[7] Wildlife and Countryside Act 1981 Section 1(2)
[8] Wildlife and Countryside Act 1981 Section 1(5)
[9] Wildlife and Countryside Act 1981 Section 1(5A)
[10] Wildlife and Countryside Act 1981 Section 1(5B)
[11] This reflects the changes introduced by the Wildlife and Countryside Act 1981 (as amended by: Variation of Schedules A1 and 1A (Scotland) Order 2013

Further protection is described under the EU Birds Directive which requires member states to maintain wild bird species in favourable conservation status[12] and promote the conservation of bird species listed within Annex 1 through the protection of their habitat. This is achieved via the designation of Special Protection Areas (SPAs).

Red List bird species are those deemed to be globally threatened and to be suffering population declines within the UK. Although not legally enforceable, the conservation of Red List bird species represents a material consideration, in planning terms.

[12] While the term 'favourable conservation status' is not used in the Birds Directive, EU court cases over recent years have progressively interpreted the concept as meaningful in a Birds Directive context (SNH, 2006).

ANNEX B: BIRD SURVEY METHODOLOGIES

A range of ornithological surveys have been carried out at the proposed Highlee Wind Farm (the "proposed wind farm"). The methodologies used in these surveys are summarised in the sections below; more detailed descriptions are provided in the SNH guidance on which these surveys are based.

Regarding updates to bird survey guidance after surveys commenced at the proposed wind farm (SNH, draft August 2013 and full May 2014), SNH advised in an email that "*This document updates guidance first published by SNH in 2005 which had minor amendments in 2010. It replaces the 2005 document.* ***It should be used for projects where survey work is about to commence or has only very recently started****. For ongoing proposals consultants should continue to follow any previous specific advice we have given at either formal EIA Scoping or pre-application stage"* (02 September 2013).

The SNH (2010) guidance therefore formed the basis of the survey programme, although those conducted after the publication of the SNH (2013) guidance and subsequent SNH (May 2014) update also took these into account wherever possible.

SURVEY AREAS

The survey areas used for flight activity, black grouse, scarce breeding bird, breeding bird, winter walkover and woodland point count surveys sufficiently covered all areas of planned infrastructure. Survey areas were amended in September 2012 after one full year of surveys (one non-breeding (2011/2012) and one breeding (2012) season). The site boundary was extended to the north due to a new proposed access route.

Once the layout and design of the proposed wind farm was frozen, the final area relevant to the collision risk analysis was identified: the Collision Risk Analysis Area (CRAA). This area was defined by buffering all turbine locations by 500 m (to allow for any observer inaccuracies in determining flightline location). Target Species flight activity within this area was used to inform the Collision Risk Analysis.

B1. Flight Activity Surveys

The aims of the flight activity (vantage point) surveys are: (1) to record flight activity within the vicinity of the site in order to identify areas of importance to birds; and (2) to quantify flight activity within 500 m of the proposed turbine in order to estimate the likelihood of collision (SNH, 2014 P.10).

Timing

- A survey period of 36 hours is recommended as the minimum level of sampling intensity at each Vantage Point (VP) for each season (breeding, non-breeding, migratory) (SNH, 2010. P.48-50 and 2014. P.16-17);
- Watches were spread as evenly throughout the year as possible to ensure that temporally representative data is collected (see Annex C). Specific consideration was given to the period around dawn and twilight for breeding waders and to changing raptor behaviour across seasons (SNH, 2010. P.48-50 and 2014. P.16-17);
- Watches were suspended and resumed to take account of changes in visibility (e.g. fluctuations in cloud base). Watches were undertaken in conditions of good ground visibility when the cloud base was higher than the most elevated ground being observed; and
- Watches were conducted in a range of weather conditions and were spread throughout the day (see Annexes C and D).

Field methods

- Viewshed analysis was conducted using Arc GIS to confirm suitable VP locations and their associated visible areas[1];
- Reconnaissance surveys were undertaken to refine VP locations;
- The VP locations and associated viewsheds are detailed in Figures 6.3 and 6.4
- Care was taken to maximize the area visible whilst minimising disturbance to birds;
- The final three[2] VP locations were selected with the aim of achieving coverage of the whole study area such that no point was greater than 2 km from a VP.
- A maximum 180˚ view arc was scanned. This rule did not however apply when tracking migratory waterfowl, divers or raptors across the CRAA;
- Although all points within the study area were required to be within the 2 km of the VP, observations from the VP were not constrained to a 2 km radius (i.e. birds are recorded regardless of their distance from the VP) SNH (2010. P.46 and 2014.); and
- Each watch lasted a maximum of three hours but was suspended and then resumed to take account of changes in visibility (e.g. fluctuations in the cloud base).

For species of high nature conservation importance (target species) the following data were recorded (SNH, 2010. P.42-45 and 2014. P.14-19, 32):

- The flightlines by individuals or flocks of birds;
- The time the target bird was detected and the duration (seconds) spent flying over a defined study area (the viewshed);
- The birds' flight height (defined into the following height bands: 0-20 m, 21-125 m, >126 m) was recorded at the point of detection and at 15 second intervals thereafter. From this the proportion of time spent flying below, at (referred to as Potential Collision Height (PCH)) and above approximate rotor height could be estimated. The actual lower rotor tip heights are 33 m and 59 m and this difference is accounted for within the collision risk models on the assumption of even flight distribution;
- The route followed was plotted in the field onto 1:25,000 scale maps;
- For secondary species, activity summaries were sub-divided into 5 minute periods at the end of which the number and activity of all secondary species were recorded;
- If a target species was being tracked during a 5 minute period, then the activity summary for that period was abandoned and a new one started once observations of the target species had ended;
- Observation of target species took priority over recording secondary species;
- The number of birds recorded were the minimum number of individuals that could account for the activity observed; and
- Observers only recorded perched birds and birds on water-bodies once only on arrival at the VP. Thereafter only flying birds and newly noticed perched/swimming birds were included in the activity summaries.

B2. Black Grouse

The survey methodology used is outlined in SNH Guidance (SNH, 2010. P24 and 2014. P.12, and followed Gilbert *et al.* 1998 methods). A summary is provided below. Surveys were conducted in April and May in 2012 and 2013.

- Breeding black grouse were surveyed within 1.5 km of the site by counting total numbers of males and females at leks, most lekking activity taking place at or soon after dawn in spring.
- Known lek sites and other areas of suitable habitat which can host leks were identified and visited during April and May within two hours of dawn on calm dry days with good visibility;
- Visits involved listening and scanning for lekking black grouse from strategic locations (avoiding disturbance of leks) and during walks between these locations ensuring that all potential habitat was covered;
- The maximum count of males in the two hours around dawn gives the standard count estimate but the maximum number of females seen was also presented; and

[1] The viewsheds are based on a 5m DTM to provide a representation of visibility from the observer locations; this is confirmed and refined through field site visits.

[2] Five VP locations were originally selected in September 2011 and these were surveyed until August 2012. From September 2012 until August 2013, three VP locations were surveyed due to the change in the site boundary and proposed development area.

- Leks that were at least 200 m apart within the same year were treated as separate leks.

B3. Scarce Breeding Bird Survey

The aims were to determine the distribution of occupied nests/territories for target raptor and diver species within 2 km of the site and record breeding success (SNH, 2010. P.16-18 and 2014. P.11-12). Secondary species such as buzzard, sparrowhawk and kestrel were included in a survey within 1 km of the Development. Surveys were undertaken during the 2012, 2013 and 2015 breeding seasons.

Surveys were undertaken by experienced and licensed field ornithologists. Extreme care was taken to avoid unnecessary disturbance to breeding birds.

Guidance from SNH (2010, P16-18 and 2014. P.11-12), 'Bird Monitoring Methods' (Gilbert *et al.* 1998) and 'Raptors: a field guide to survey and monitoring' (Hardey *et al.* 2009 and 2013) were all consulted to inform survey methodology and are referenced where appropriate in the species methodologies below.

Barn owl

- The surveys used the methodology outlined in Gilbert *et al* (1998), as mentioned in SNH Guidance (SNH, 2010. P26-27 and 2014. P.12-13);
- Surveys were undertaken within 1 km of the site; and
- Surveyors checked for signs of occupation (moulted feathers, pellets) in all suitable buildings within this 1 km buffer.

Goshawk

Methodology outlined in Hardey *et al* (2009 and 2013) was used as guidance for the surveying of areas for potential goshawk breeding. This methodology is summarised below. Extreme care was taken not to disturb potential nests especially around the time of year when females were likely to be laying or incubating.

- Areas of suitable woodland were observed for the presence of nests. Searches for goshawk nests were focused on mature forestry blocks, although their presence was not ruled out of other wooded areas on site;
- Searches carried out in March to April focussed on observing territorial and nest building behaviours;
- Where nests were known to be present, scans were carried out between mid-March and May to confirm breeding. Scans were kept brief – carried out for between 5-10 minutes and from a distance; and
- When breeding was confirmed, searches for further nests were deferred until such a time as the young had hatched. Searches were then undertaken in late May to late June for evidence of provisioning young and then in late July to early August to watch for fledgling activity, this included listening for the begging calls of newly fledged young.

Hen harrier

Methodology outlined in Hardey *et al*. (2009 and 2013) was used as guidance for the surveying of areas for potential hen harrier breeding. This methodology is summarised below. Extreme care was taken not to disturb potential nests especially around the time of year when females were likely to be laying or in cold/wet weather when females were likely to be incubating or brooding. Areas of suitable habitat were visited during four time periods across the breeding season to:

- Check for territory occupancy (March to mid-April) – this consisted of watching over suitable habitat from a good vantage point for displaying males (and females) and checking all areas of suitable habitat to within 250 m (watching out for signs of kills);
- Locate incubating females (mid-April to late May) by listening for female begging calls and watching for food passes between the male and female – surveyors watched for at least four hours as Hardey *et al*. (2009 and 2013) notes that when the female is incubating it can be up to six hours between feeding visits from the male, but on average it is less than every four hours. Surveys were undertaken between 06:00 to 12:00 or 16:00 to 20:00;
- Check for young or breeding evidence (late May to late June) again by listening for female begging calls and watching for food passes between male and female when the female is brooding and watching for the male and female provisioning the nest with food once brooding has ended– surveyors watched for at least two hours as Hardey *et al*. (2009 and 2013) notes that an adult bird will visit the nest every 1-2 hours. Surveyors also watched for display behaviour which could indicate a failed breeding attempt; and
- Check for fledged young (late June to late August).

Unsuitable habitat areas include: land above 600m; improved pasture and arable land; extensive areas of degraded land with no heather cover and low vegetation; the vicinity of cliffs, rocky outcrops, boulder fields and scree; areas within 100m of hill farms and occupied dwellings.

Merlin

Methodology outlined in Hardey *et al*. (2009 and 2013) was used as guidance for the surveying of areas for potential merlin breeding. This methodology is summarised below.

- Areas of suitable nesting habitat (including forest edge where trees are >5m high) were closely observed during the period 20th March to 30th April;
- Boulders, fence lines, isolated posts, stone dykes, grouse butts, hummocks, stream banks, crags, trees and recently burnt areas of heather were checked for signs of occupation (e.g. plucked prey, moulted feathers, pellets and faeces);
- If merlin were observed, or signs found, areas were visited at least twice to verify occupation of the site; and
- Potential nest areas were watched for 4-6 hours if necessary.

Peregrine falcon

- Potential nest sites were visited and checked for evidence of occupation in March and April;
- Sites checked included crags and steep banks identified from OS maps and searches of the study area;
- Surveyors checked for signs of occupation (e.g. faecal splash, fresh plucked prey);
- If occupied sites were found they were re-visited to verify incubation; and
- Searches were made for eyries. Where this was not possible sites were watched from a suitable vantage point for 3-4 hours or until a nest was located.

Short-eared owl

- At least two visits between early April and the end of May were carried out;
- Surveys were undertaken within 500 m of the development site;
- Suitable habitat was visited and checked for evidence of hunting males, territorial activity and other signs of presence; and
- If breeding was confirmed, a further visit was be made in June to watch birds, locate nest-sites and confirm breeding behaviour wherever possible.

B4. Breeding Bird Survey

Upland breeding bird survey methodology was employed as detailed within SNH Guidance (SNH, 2010. P.14-15 and 2014. P.11). In summary, surveys involved the following:

- Open upland (including hedgerows, scrub, isolated trees and copses) was surveyed using an intensive version of the Brown and Shepherd (1993) method for upland bird survey;
- The objectives were to map the distribution of breeding bird territories and estimate the approximate size of breeding bird populations;
- After each survey visit one overview map was then produced showing all target species. The maps from all four survey visits from that year were then compared, enabling the production of composite breeding territory maps. This was done by grouping the observations into territories using the methodology described by Bibby *et al*. (2000). Due to the cryptic nature of many breeding birds and the necessary assumptions made when plotting territories, a minimum and maximum number of territories was identified for each target species
- The survey covered all areas within 500 m of the site; and
- All upland wader species were recorded during the breeding bird survey.

Timing

- Surveys were undertaken in 2011 (April and June) and 2012 (May) with additional surveys following the extension of the site boundary undertaken in 2013 (April, May, June and July);
- Fieldwork was undertaken between sunrise and sunrise and 1800hrs; and
- Fieldwork was not undertaken in conditions considered likely to affect bird detection rates, for example in winds greater than Beaufort Scale Force 4, persistent precipitation, poor visibility (less than 300 m), or in unusually hot weather.

Field methods

- Walk-routes were used that optimised ground visibility;
- Surveyors paused at appropriate vantage and listening points;
- Isolated trees, copses and patches of scrub were approached and examined;
- Streams, ditches and hedgerows were walked;
- All other areas were approached to within 100 m; and
- Registrations were mapped at the first location that behaviour indicative of breeding was observed. Standard BTO activity codes were used.

B5. Winter Walkover

Winter walkovers were performed in the 2011/2012 and 2012/2013 non-breeding seasons to map wintering populations of birds within the site. Additional surveys were undertaken in the 2013/2014 non-breeding season following the extension of the site boundary. SNH guidance provides full details on this methodology (SNH, 2010. P.28 and 2014. P.10) and a summary is given below.

- The original study area was surveyed three times in the 2011/2012 and three times in the 2012/2013 non-breeding seasons (December 2011; January, February and December 2012; January and February 2013);
- The additional study area was surveyed twice in the 2013/2014 non-breeding season (November 2011 and January 2014);
- These surveys involved following a route that optimised ground coverage, such that observers walked within 250 m of every point; and
- Observers periodically stopped at appropriate viewing and listening points along the route and longer vantage point watches were included within the walkover to allow potentially important areas to be monitored in greater detail.

References

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

Colin J. Bibby, Neil D. Burgess, David A. Hill and Simon H. Mustoe (2000) Bird Census Techniques, 2nd Edition, London, Academic Press

Gilbert, G., Gibbons, D. W. & Evans, J. (1998) *Bird Monitoring Methods*. RSPB, Sandy.

Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2009) Raptors: a field guide for surveys and monitoring (2nd edition). The Stationery Office, Edinburgh.

Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013) Raptors: a field guide for surveys and monitoring (2nd edition). The Stationery Office, Edinburgh.

Scottish Natural Heritage (2005 – revised December 2010) *Survey Methods for Use in Assessing the Impacts of Onshore Windfarms on Bird Communities.*

Scottish Natural Heritage (2013) *Survey Methods for use in assessing the impacts of onshore Windfarms on Bird Communities.*

Scottish Natural Heritage (2014) Recommended Bird *Survey Methods to inform impact assessment of Onshore Windfarms.*

ANNEX C: SURVEY EFFORT AND GENERAL INFORMATION

Table C1 shows the system used for recording weather conditions on all the surveys detailed in sections C1 to C6 below.

Table C1. Key to meteorological conditions recorded during al surveys.

Wind Speed		Rain		Cloud Cover		Cloud Height	
alm	0	None	0	In eighths		<150m	0
Light air	1	Drizzle/Mist	1	*e.g.*	3/8	150-500m	1
Light breeze	2	Light showers	2			>500m	2
Gentle breeze	3	Heavy showers	3				
Mod. breeze	4	Heavy rain	4				
Fresh breeze	5						
Strong breeze	6	**Snow**		**Frost**		**Visibility**	
Mod. gale	7	None	0	None	0	Poor (<1km)	0
Fresh gale	8	On site	1	Ground	1	Moderate (1-2km)	1
Strong gale	9	High ground	2	All day	2	Good (>2km)	2
Whole gale	10						
Storm	11						
Hurricane	12						

C1. Flight Activity Surveys

A series of flight activity surveys were performed across a total of eight Vantage Points (VPs). Surveys were performed in accordance with Scottish Natural Heritage (SNH) Guidance (2010) and subsequent updates (2014). The flight activity surveys were used to record the presence and activity of Target Species and Secondary Species. The details of the flight activity surveys undertaken at all strategic VP locations are detailed below.

Table C2. Summary of flight activity surveys performed at Highlee.

Date	Season	Observer	VP	VP Start	VP Finish	VP Hours
27/09/2011	NBR 2011/2012	ZS	1	1218	1518	3
27/09/2011	NBR 2011/2012	ZS	1	1518	1818	3
27/09/2011	NBR 2011/2012	RP	2	1235	1535	3
27/09/2011	NBR 2011/2012	RP	2	1550	1850	3
27/09/2011	NBR 2011/2012	KJ	5	1230	1530	3
27/09/2011	NBR 2011/2012	KJ	5	1545	1845	3
28/09/2011	NBR 2011/2012	ZS	2	0650	0950	3
28/09/2011	NBR 2011/2012	ZS	2	0950	1250	3
28/09/2011	NBR 2011/2012	KJ	3	0705	1005	3
28/09/2011	NBR 2011/2012	KJ	3	1020	1320	3
28/09/2011	NBR 2011/2012	RP	4	0715	1015	3
28/09/2011	NBR 2011/2012	RP	4	1030	1330	3
18/10/2011	NBR 2011/2012	ZS	1	1150	1450	3
18/10/2011	NBR 2011/2012	ZS	1	1505	1805	3
18/10/2011	NBR 2011/2012	KJ	3	1145	1445	3
18/10/2011	NBR 2011/2012	KJ	3	1500	1800	3
18/10/2011	NBR 2011/2012	RP	4	1140	1440	3
18/10/2011	NBR 2011/2012	RP	4	1455	1755	3
19/10/2011	NBR 2011/2012	RP	2	0850	1150	3
19/10/2011	NBR 2011/2012	RP	2	1205	1505	3
19/10/2011	NBR 2011/2012	ZS	3	0840	1140	3
19/10/2011	NBR 2011/2012	ZS	3	1200	1500	3
19/10/2011	NBR 2011/2012	KJ	4	0845	1145	3
19/10/2011	NBR 2011/2012	KJ	4	1200	1500	3
29/11/2011	NBR 2011/2012	ZS	3	1100	1300	2
29/11/2011	NBR 2011/2012	ZS	3	1315	1515	2
30/11/2011	NBR 2011/2012	ZS	5	0910	1140	2.5
30/11/2011	NBR 2011/2012	ZS	5	1200	1430	2.5
01/12/2011	NBR 2011/2012	RP	1	0810	1010	2
01/12/2011	NBR 2011/2012	RP	1	1010	1210	2
01/12/2011	NBR 2011/2012	ZS	5	0745	0945	2
01/12/2011	NBR 2011/2012	ZS	5	1000	1200	2
23/12/2011	NBR 2011/2012	TC	1	0930	1200	2.5
23/12/2011	NBR 2011/2012	TC	1	1230	1500	2.5
23/12/2011	NBR 2011/2012	MC	5	0930	1200	2.5
23/12/2011	NBR 2011/2012	MC	5	1230	1500	2.5
11/01/2012	NBR 2011/2012	TC	1	0900	1200	2
11/01/2012	NBR 2011/2012	TC	1	1300	1600	3
11/01/2012	NBR 2011/2012	MC	2	0900	1200	3
11/01/2012	NBR 2011/2012	MC	2	1300	1600	3
14/01/2012	NBR 2011/2012	MC	5	0900	1200	3
14/01/2012	NBR 2011/2012	MC	5	1300	1600	3
15/01/2012	NBR 2011/2012	MC	5	0900	1200	3

Date	Season	Observer	VP	VP Start	VP Finish	VP Hours
15/01/2012	NBR 2011/2012	MC	5	1300	1600	3
18/01/2012	NBR 2011/2012	TC	3	0900	1200	3
18/01/2012	NBR 2011/2012	TC	3	1300	1600	3
18/01/2012	NBR 2011/2012	MC	4	0900	1200	3
18/01/2012	NBR 2011/2012	MC	4	1300	1600	3
03/02/2012	NBR 2011/2012	JN	3	1245	1545	3
05/02/2012	NBR 2011/2012	RW	1	1215	1515	3
05/02/2012	NBR 2011/2012	JN	3	1245	1545	3
06/02/2012	NBR 2011/2012	RW	3	1130	1330	2
06/02/2012	NBR 2011/2012	RW	3	1400	1700	3
06/02/2012	NBR 2011/2012	JN	5	1230	1430	2
06/02/2012	NBR 2011/2012	JN	5	1500	1700	2
07/02/2012	NBR 2011/2012	JN	2	0800	1100	3
07/02/2012	NBR 2011/2012	JN	2	1200	1500	3
07/02/2012	NBR 2011/2012	RW	4	0800	1100	3
07/02/2012	NBR 2011/2012	RW	4	1200	1500	3
03/03/2012	NBR 2011/2012	RW	2	1300	1500	2
03/03/2012	NBR 2011/2012	RW	2	1530	1830	3
09/03/2012	NBR 2011/2012	RW	1	0945	1245	3
09/03/2012	NBR 2011/2012	RW	1	1345	1645	3
09/03/2012	NBR 2011/2012	RW	2	1745	1845	1
09/03/2012	NBR 2011/2012	JN	4	1010	1310	3
09/03/2012	NBR 2011/2012	JN	4	1410	1710	3
16/03/2012	BR 2012	ARC	5	1015	1315	3
22/03/2012	BR 2012	ARC	1	0955	1255	3
22/03/2012	BR 2012	ARC	2	1420	1720	3
23/03/2012	BR 2012	ARC	3	0905	1205	3
23/03/2012	BR 2012	ARC	4	0500	0800	3
04/04/2012	BR 2012	CL	3	1015	1315	3
04/04/2012	BR 2012	CL	3	1345	1645	3
04/04/2012	BR 2012	SLR	4	1030	1330	3
04/04/2012	BR 2012	SLR	4	1430	1730	3
05/04/2012	BR 2012	CL	1	0945	1245	3
05/04/2012	BR 2012	CL	1	1315	1615	3
05/04/2012	BR 2012	SLR	2	1000	1300	3
05/04/2012	BR 2012	SLR	2	1400	1700	3
06/04/2012	BR 2012	SLR	5	0715	1015	3
06/04/2012	BR 2012	SLR	5	1115	1415	3
14/05/2012	BR 2012	BA	2	1900	2100	2
14/05/2012	BR 2012	GT	3	1915	2115	2
15/05/2012	BR 2012	BA	1	1630	1930	3
15/05/2012	BR 2012	BA	2	0630	0930	3
15/05/2012	BR 2012	BA	2	1030	1330	3
15/05/2012	BR 2012	BA	2	1430	1530	1
15/05/2012	BR 2012	GT	3	0630	0730	1
15/05/2012	BR 2012	GT	3	0830	1130	3
15/05/2012	BR 2012	GT	3	1230	1530	3
15/05/2012	BR 2012	GT	4	1630	1930	3
16/05/2012	BR 2012	BA	1	1215	1515	3
16/05/2012	BR 2012	BA	1	1615	1915	3

Date	Season	Observer	VP	VP Start	VP Finish	VP Hours
16/05/2012	BR 2012	GT	4	1230	1530	3
16/05/2012	BR 2012	GT	4	1630	1930	3
31/05/2012	BR 2012	KH	5	0740	1040	3
02/06/2012	BR 2012	CL	5	0335	0635	3
02/06/2012	BR 2012	CL	5	0735	1035	3
25/06/2012	BR 2012	CL	2	1250	1550	3
25/06/2012	BR 2012	CL	2	1650	1950	3
25/06/2012	BR 2012	CL	3	0845	1145	3
25/06/2012	BR 2012	CS	3	1705	2005	3
25/06/2012	BR 2012	CS	4	0900	1200	3
25/06/2012	BR 2012	CS	4	1300	1600	3
26/06/2012	BR 2012	CL	1	0620	0920	3
26/06/2012	BR 2012	CL	1	1020	1320	3
26/06/2012	BR 2012	CS	5	0700	1000	3
26/06/2012	BR 2012	CS	5	1100	1400	3
09/07/2012	BR 2012	CL	1	0850	1150	3
09/07/2012	BR 2012	CL	1	1250	1550	3
09/07/2012	BR 2012	CS	4	0800	1100	3
09/07/2012	BR 2012	CS	4	1200	1500	3
09/07/2012	BR 2012	SR	5	0745	1045	3
09/07/2012	BR 2012	SR	5	1145	1445	3
25/07/2012	BR 2012	KS	2	1040	1340	3
25/07/2012	BR 2012	KS	2	1440	1740	3
26/07/2012	BR 2012	KS	3	0925	1225	3
26/07/2012	BR 2012	KS	3	1325	1625	3
22/08/2012	BR 2012	ZS	5	1630	1900	2.5
22/08/2012	BR 2012	ZS	5	1915	2145	2.5
23/08/2012	BR 2012	ZS	3	0530	0830	3
23/08/2012	BR 2012	ZS	3	0845	1145	3
23/08/2012	BR 2012	ZS	3	1145	1245	1
13/09/2012	NBR 2012/2013	KJ	7	1445	1745	3
13/09/2012	NBR 2012/2013	ZS	9	1245	1545	3
13/09/2012	NBR 2012/2013	ZS	9	1600	1900	3
14/09/2012	NBR 2012/2013	ZS	7	0630	0930	3
14/09/2012	NBR 2012/2013	ZS	7	1000	1300	3
14/09/2012	NBR 2012/2013	KJ	9	0645	0945	3
14/09/2012	NBR 2012/2013	KJ	9	0955	1255	3
01/10/2012	NBR 2012/2013	SS	6	1250	1550	3
01/10/2012	NBR 2012/2013	SS	6	1600	1900	3
01/10/2012	NBR 2012/2013	RC	7	1245	1545	3
01/10/2012	NBR 2012/2013	RC	7	1555	1855	3
01/10/2012	NBR 2012/2013	GJ	9	1320	1620	3
01/10/2012	NBR 2012/2013	GJ	9	1635	1935	3
02/10/2012	NBR 2012/2013	RC	6	0915	1115	2
02/10/2012	NBR 2012/2013	SS	7	0920	1220	3
02/10/2012	NBR 2012/2013	GJ	8	0945	1145	2
17/10/2012	NBR 2012/2013	SS	6	1240	1510	2.5
17/10/2012	NBR 2012/2013	SS	6	1520	1750	2.5
17/10/2012	NBR 2012/2013	RA	7	1245	1515	2.5
17/10/2012	NBR 2012/2013	RA	7	1525	1755	2.5

Date	Season	Observer	VP	VP Start	VP Finish	VP Hours
17/10/2012	NBR 2012/2013	ZS	9	1245	1515	2.5
17/10/2012	NBR 2012/2013	ZS	9	1530	1800	2.5
18/10/2012	NBR 2012/2013	SS	6	0900	1130	2.5
18/10/2012	NBR 2012/2013	SS	6	1140	1410	2.5
18/10/2012	NBR 2012/2013	RA	7	0900	1130	2.5
18/10/2012	NBR 2012/2013	RA	7	1140	1410	2.5
18/10/2012	NBR 2012/2013	ZS	8	0910	1140	2.5
18/10/2012	NBR 2012/2013	ZS	8	1150	1420	2.5
04/12/2012	NBR 2012/2013	SS	9	0915	1115	2
04/12/2012	NBR 2012/2013	SS	9	1125	1325	2
16/01/2013	NBR 2012/2013	KJ	6	0815	1015	2
16/01/2013	NBR 2012/2013	KJ	6	1025	1225	2
16/01/2013	NBR 2012/2013	AR	7	0805	1005	2
16/01/2013	NBR 2012/2013	AR	7	1015	1215	2
26/02/2013	NBR 2012/2013	AR	6	1015	1315	3
26/02/2013	NBR 2012/2013	AR	6	1330	1630	3
27/02/2013	NBR 2012/2013	AR	4	0815	1215	4
27/02/2013	NBR 2012/2013	ZS	6	1250	1450	2
27/02/2013	NBR 2012/2013	ZS	7	0830	1245	4
28/02/2013	NBR 2012/2013	ZS	6	0815	1115	3
28/02/2013	NBR 2012/2013	AR	6	1130	1230	3
26/03/2013	BR 2013	RA	9	1250	1450	2
26/03/2013	BR 2013	RA	9	1500	1700	2
26/03/2013	BR 2013	SS/JM	6	1310	1510	2
26/03/2013	BR 2013	SS/JM	6	1520	1720	2
27/03/2013	BR 2013	JM	9	1010	1210	2
27/03/2013	BR 2013	JM	9	1220	1420	2
27/03/2013	BR 2013	RA	7	0920	1120	2
27/03/2013	BR 2013	RA	7	1130	1330	2
23/04/2013	BR 2013	RC	9	0700	0900	2
23/04/2013	BR 2013	RC	9	0910	1110	2
23/04/2013	BR 2013	PR	6	0700	900	2
23/04/2013	BR 2013	PR	6	0910	1110	2
22/05/2013	BR 2013	RS	9	1410	1710	3
22/05/2013	BR 2013	RS	9	1810	2110	3
22/05/2013	BR 2013	CS	7	1400	1700	3
22/05/2013	BR 2013	CS	7	1800	2100	3
23/05/2013	BR 2013	CS	6	0835	1135	3
23/05/2013	BR 2013	RS	6	1135	1435	3
30/05/2013	BR 2013	MO	7	0500	0800	3
30/05/2013	BR 2013	MO	7	0900	1200	3
05/06/2013	BR 2013	MO	6	1410	1810	4
05/06/2013	BR 2013	MO	7	1925	2125	2
06/06/2013	BR 2013	MO	7	1100	1400	3
06/06/2013	BR 2013	MO	7	1500	1800	3
18/06/2013	BR 2013	MO	9	0915	1215	3
18/06/2013	BR 2013	RS	6	0925	1225	3
19/06/2013	BR 2013	MO	9	0520	0820	3
19/06/2013	BR 2013	RS	6	0530	0830	3
05/07/2013	BR 2013	JM	9	0535	0835	0
05/07/2013	BR 2013	JM	9	0845	1145	0
05/07/2013	BR 2013	ND	7	0530	0830	3
05/07/2013	BR 2013	ND	7	0845	1145	3
24/07/2013	BR 2013	JM	6	1430	1730	3
24/07/2013	BR 2013	JM	6	1740	2040	3
25/07/2013	BR 2013	JM	9	0550	0850	3
25/07/2013	BR 2013	JM	9	0900	1200	3
01/08/2013	BR 2013	ND	9	1345	1645	3
01/08/2013	BR 2013	ND	6	1150	1320	1.5
27/08/2013	BR 2013	ND	9	1645	2000	3
28/08/2013	BR 2013	ND	7	1350	1650	3
28/08/2013	BR 2013	ND	7	1700	2000	3
29/08/2013	BR 2013	JM	6	0555	0855	2
29/08/2013	BR 2013	JM	6	0905	1205	2.5

Table C3: Meteorological conditions during flight activity surveys at Highlee (conditions per hour of survey).

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
27/09/2011	1	ZS	1218	1518	1	3	NE	0	8	0	1	0	0
27/09/2011	1	ZS	1218	1518	2	3	NE	0	8	0	2	0	0
27/09/2011	1	ZS	1218	1518	3	3	NE	0	8	0	1	0	0
27/09/2011	1	ZS	1518	1818	1	6	NE	0	8	0	1	0	0
27/09/2011	1	ZS	1518	1818	2	6	NE	0	8	0	1	0	0
27/09/2011	1	ZS	1518	1818	3	4	NE	0	8	0	1	0	0
27/09/2011	2	RP	1235	1535	1	4	SW	0	8	2	2	0	0
27/09/2011	2	RP	1235	1535	2	5	S	0	8	1	2	0	0
27/09/2011	2	RP	1235	1535	3	6	SW	0	8	1	1	0	0
27/09/2011	2	RP	1550	1850	1	6	SW	0	8	1	2	0	0
27/09/2011	2	RP	1550	1850	2	5	S	1	8	1	2	0	0
27/09/2011	2	RP	1550	1850	3	5	S	0	7	2	2	0	0
27/09/2011	5	KJ	1230	1530	1	5	N	0	8	2	2	0	0
27/09/2011	5	KJ	1230	1530	2	6	N	0	8	2	2	0	0
27/09/2011	5	KJ	1230	1530	3	6	N	0	8	2	2	0	0
27/09/2011	5	KJ	1545	1845	1	6	N	0	8	2	2	0	0
27/09/2011	5	KJ	1545	1845	2	6	N	0	8	2	2	0	0
27/09/2011	5	KJ	1545	1845	3	6	NNE	0	7	2	2	0	0
28/09/2011	2	ZS	0650	0950	1	2	NW	0	6	1	2	0	0
28/09/2011	2	ZS	0650	0950	2	3	NW	0	7	1	2	0	0
28/09/2011	2	ZS	0650	0950	3	4	N	0	7	1	1	0	0
28/09/2011	2	ZS	0950	1250	1	2	N	0	6	1	1	0	0
28/09/2011	2	ZS	0950	1250	2	2	N	0	4	1	1	0	0
28/09/2011	2	ZS	0950	1250	3	3	N	0	3	1	1	0	0
28/09/2011	3	KJ	0705	1005	1	1	0	0	2	2	2	0	0
28/09/2011	3	KJ	0705	1005	2	1	0	0	2	2	2	0	0
28/09/2011	3	KJ	0705	1005	3	1	0	0	2	2	2	0	0
28/09/2011	3	KJ	1020	1320	1	1	0	0	1	2	2	0	0
28/09/2011	3	KJ	1020	1320	2	2	N	0	1	2	2	0	0
28/09/2011	3	KJ	1020	1320	3	3	N	0	1	2	2	0	0
28/09/2011	4	RP	0715	1015	1	1	S	0	2	2	2	0	0
28/09/2011	4	RP	0715	1015	2	1	S	0	2	2	2	0	0
28/09/2011	4	RP	0715	1015	3	2	S	0	2	2	2	0	0
28/09/2011	4	RP	0715	1015	2	1	S	0	2	2	2	0	0
28/09/2011	4	RP	1030	1330	1	2	SW	0	1	2	2	0	0
28/09/2011	4	RP	1030	1330	2	2	SW	0	1	2	2	0	0
28/09/2011	4	RP	1030	1330	3	4	SW	0	1	2	2	0	0
18/10/2011	1	ZS	1150	1450	1	9	SW	2	6	1	2	0	0
18/10/2011	1	ZS	1150	1450	2	9	SW	0	7	1	2	0	0
18/10/2011	1	ZS	1150	1450	3	10	SW	4	7	0	1	0	0
18/10/2011	1	ZS	1505	1805	1	9	SW	0	5	0	1	0	0
18/10/2011	1	ZS	1505	1805	2	10	SW	1	7	0	2	0	0
18/10/2011	1	ZS	1505	1805	3	9	SW	0	6	0	2	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
18/10/2011	3	KJ	1145	1445	1	6	SE	2	7	2	2	0	0
18/10/2011	3	KJ	1145	1445	2	5	SE	3	7	2	2	0	0
18/10/2011	3	KJ	1145	1445	3	5	SE	1	5	2	2	0	0
18/10/2011	3	KJ	1500	1800	1	5	SE	1	7	2	2	0	0
18/10/2011	3	KJ	1500	1800	2	3	SE	2	7	2	2	0	0
18/10/2011	3	KJ	1500	1800	3	4	SE	1	6	2	2	0	0
18/10/2011	4	RP	1140	1440	1	4	W	3	7	2	2	0	0
18/10/2011	4	RP	1140	1440	2	3	W	3	6	2	2	0	0
18/10/2011	4	RP	1140	1440	3	5	NW	0	6	2	2	0	0
18/10/2011	4	RP	1455	1755	1	5	NW	0	4	2	2	0	0
18/10/2011	4	RP	1455	1755	2	5	NW	2	4	2	2	0	0
18/10/2011	4	RP	1455	1755	3	5	NW	2	4	2	2	0	0
19/10/2011	2	RP	0850	1150	1	2	SW	0	2	2	2	0	0
19/10/2011	2	RP	0850	1150	2	3	W	0	1	2	2	0	0
19/10/2011	2	RP	0850	1150	3	3	WNW	0	1	2	2	0	0
19/10/2011	2	RP	1205	1505	1	3	NW	0	5	2	2	0	0
19/10/2011	2	RP	1205	1505	2	4	NW	0	5	2	2	0	0
19/10/2011	2	RP	1205	1505	3	3	NW	2	4	2	2	0	0
19/10/2011	3	ZS	0840	1140	1	3	SW	0	3	1	2	0	0
19/10/2011	3	ZS	0840	1140	2	4	SW	0	4	1	2	0	0
19/10/2011	3	ZS	0840	1140	3	5	SW	0	2	2	2	0	0
19/10/2011	3	ZS	1200	1500	1	4	SW	0	3	1	2	0	0
19/10/2011	3	ZS	1200	1500	2	3	SW	0	6	1	2	0	0
19/10/2011	3	ZS	1200	1500	3	3	SW	0	5	2	2	0	0
19/10/2011	4	KJ	0845	1145	1	0	0	0	4	2	2	0	0
19/10/2011	4	KJ	0845	1145	2	1	SE	0	3	2	2	0	0
19/10/2011	4	KJ	0845	1145	3	2	SE	0	3	2	2	0	0
19/10/2011	4	KJ	1200	1500	1	1	SE	0	6	2	2	0	0
19/10/2011	4	KJ	1200	1500	2	1	SE	0	5	2	2	0	0
19/10/2011	4	KJ	1200	1500	3	3	SE	0	4	2	2	0	0
29/11/2011	3	ZS	1100	1300	1	6	W	4	8	0	1	0	0
29/11/2011	3	ZS	1100	1300	2	4	W	4	8	0	1	0	0
29/11/2011	3	ZS	1315	1515	3	4	W	4	8	0	1	0	0
30/11/2011	5	ZS	0910	1140	1	4	S	0	7	1	2	1	0
30/11/2011	5	ZS	0910	1140	2	4	S	1	6	1	2	1	0
30/11/2011	5	ZS	0910	1140	2.5	4	S	0	7	1	2	1	0
30/11/2011	5	ZS	1200	1430	1	4	S	2	8	1	2	1	0
30/11/2011	5	ZS	1200	1430	2	5	S	1	8	1	2	1	0
30/11/2011	5	ZS	1200	1430	2.5	5	S	3	8	1	2	1	0
01/12/2011	1	RP	0810	1010	1	3	SW	0	4	2	2	0	0
01/12/2011	1	RP	0810	1010	2	3	SW	0	4	2	2	0	0
01/12/2011	1	RP	1010	1210	1	4	SW	0	3	2	2	0	0
01/12/2011	1	RP	1010	1210	2	4	SW	0	3	2	2	0	0
01/12/2011	5	ZS	0745	0945	1	2	S	0	6	1	2	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
01/12/2011	5	ZS	0745	0945	2	3	S	0	5	1	2	0	0
01/12/2011	5	ZS	1000	1200	1	2	S	0	7	2	2	0	0
01/12/2011	5	ZS	1000	1200	2	2	S	0	5	2	2	0	0
23/12/2011	1	TC	0930	1200	1	2	WNW	0	6	1	2	0	0
23/12/2011	1	TC	0930	1200	2	3	W	0	8	1	2	0	0
23/12/2011	1	TC	0930	1200	2.5	3	S	0	8	1	2	0	0
23/12/2011	1	TC	1230	1500	1	3	SW	0	8	1	2	0	0
23/12/2011	1	TC	1230	1500	2	3	SW	0	8	1	2	0	0
23/12/2011	1	TC	1230	1500	2.5	4	SW	3	8	1	1	0	0
23/12/2011	5	MC	0930	1200	1	2	NW	0	6	2	2	0	0
23/12/2011	5	MC	0930	1200	2	1	W	0	8	1	1	0	0
23/12/2011	5	MC	0930	1200	2.5	3	SW	0	8	1	1	0	0
23/12/2011	5	MC	1230	1500	1	3	SW	0	8	1	1	0	0
23/12/2011	5	MC	1230	1500	2	2	SW	0	8	1	1	0	0
23/12/2011	5	MC	1230	1500	2.5	3	SW	3	8	1	1	0	0
11/01/2012	1	TC	0900	1200	1	3	WSW	0	6	1	2	0	0
11/01/2012	1	TC	0900	1200	2	3	WSW	0	6	1	2	0	0
11/01/2012	1	TC	0900	1200	3	4	WSW	0	8	1	1	0	0
11/01/2012	1	TC	1300	1600	1	5	WSW	0	7	1	1	0	0
11/01/2012	1	TC	1300	1600	2	6	WSW	1	7	1	1	0	0
11/01/2012	1	TC	1300	1600	3	6	WSW	2	8	1	0	0	0
11/01/2012	2	MC	0900	1200	1	3	WSW	0	6	1	1,2	0	0
11/01/2012	2	MC	0900	1200	2	3	WSW	0	6	1	1,2	0	0
11/01/2012	2	MC	0900	1200	3	4	WSW	0	8	1	1,2	0	0
11/01/2012	2	MC	1300	1600	1	6	WSW	0	8	1	1	0	0
11/01/2012	2	MC	1300	1600	2	6	WSW	1	7	1	1	0	0
11/01/2012	2	MC	1300	1600	3	6	WSW	2	8	1	1	0	0
14/01/2012	5	MC	0900	1200	1	2	S	0	8	2	1	1	0
14/01/2012	5	MC	0900	1200	2	2	S	0	7	2	1	1	0
14/01/2012	5	MC	0900	1200	3	1	S	0	6	2	2	1	0
14/01/2012	5	MC	1300	1600	1	0	0	0	6	2	2	1	0
14/01/2012	5	MC	1300	1600	2	1	SSW	0	3	2	2	1	0
14/01/2012	5	MC	1300	1600	3	0	0	0	4	2	2	1	0
15/01/2012	5	MC	0900	1200	1	1	W	0	1	2	2	2	0
15/01/2012	5	MC	0900	1200	2	1	W	0	1	2	2	2	0
15/01/2012	5	MC	0900	1200	3	1	W	0	1	2	2	2	0
15/01/2012	5	MC	1300	1600	1	2	SW	0	1	2	2	2	0
15/01/2012	5	MC	1300	1600	2	2	SW	0	1	2	2	2	0
15/01/2012	5	MC	1300	1600	3	2	SW	0	1	2	2	2	0
18/01/2012	3	TC	0900	1200	1	3	SW	0	8	0	1	0	0
18/01/2012	3	TC	0900	1200	2	3	SW	0	8	0	1	0	0
18/01/2012	3	TC	0900	1200	3	3	WSW	0	6	1	2	0	0
18/01/2012	3	TC	1300	1600	1	3	WSW	0	4	1	2	0	0
18/01/2012	3	TC	1300	1600	2	4	WSW	0	4	1	2	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
18/01/2012	3	TC	1300	1600	3	4	WSW	0	6	1	2	0	0
18/01/2012	4	MC	0900	1200	1	4	WSW	0	8	1	1	0	0
18/01/2012	4	MC	0900	1200	2	4	WSW	0	7	1	1	0	0
18/01/2012	4	MC	0900	1200	3	3	WSW	0	8	1	1	0	0
18/01/2012	4	MC	1300	1600	1	4	WSW	0	4	1	2	0	0
18/01/2012	4	MC	1300	1600	2	4	WSW	0	4	1	2	0	0
18/01/2012	4	MC	1300	1600	3	4	WSW	0	7	1	2	0	0
03/02/2012	3	JN	1245	1545	1	2	SW	0	2	2	2	2	1
03/02/2012	3	JN	1245	1545	2	3	SW	0	4	2	2	2	1
03/02/2012	3	JN	1245	1545	3	3	SW	0	5	2	2	2	1
05/02/2012	1	RW	1215	1515	1	3	WSW	0	3	2	2	0	1
05/02/2012	1	RW	1215	1515	2	3	WSW	0	4	2	2	0	1
05/02/2012	1	RW	1215	1515	3	2	WSW	0	5	1	2	0	1
06/02/2012	3	RW	1130	1330	1	1	NNE	0	4	2	2	0	1
06/02/2012	3	RW	1130	1330	2	1	NNE	0	4	2	2	0	1
06/02/2012	3	RW	1400	1700	1	1	NNE	0	4	1	2	0	1
06/02/2012	3	RW	1400	1700	2	1	NNE	0	3	1	2	0	1
06/02/2012	3	RW	1400	1700	3	1	NNE	0	3	1	2	0	1
06/02/2012	5	JN	1230	1430	1	2	SW	0	4	2	2	2	1
06/02/2012	5	JN	1230	1430	2	2	SW	0	2	2	2	2	1
06/02/2012	5	JN	1500	1700	1	1	E	0	2	2	2	2	1
06/02/2012	5	JN	1500	1700	2	1	E	0	1	2	2	2	1
07/02/2012	2	JN	0800	1100	1	0	0	0	0	2	2	2	1
07/02/2012	2	JN	0800	1100	2	1	SW	0	0	2	2	2	1
07/02/2012	2	JN	0800	1100	3	2	SW	0	1	2	2	2	1
07/02/2012	2	JN	1200	1500	1	2	SW	0	2	2	2	2	1
07/02/2012	2	JN	1200	1500	2	2	SW	0	3	2	2	2	1
07/02/2012	2	JN	1200	1500	3	2	SW	0	4	2	2	2	1
07/02/2012	4	RW	0800	1100	1	1	SW	0	0	0	2	1	1
07/02/2012	4	RW	0800	1100	2	1	SW	0	0	0	2	1	1
07/02/2012	4	RW	0800	1100	3	1	SW	0	0	0	2	0	1
07/02/2012	4	RW	1200	1500	1	2	S	0	3	2	2	0	1
07/02/2012	4	RW	1200	1500	2	2	S	0	5	2	2	0	1
07/02/2012	4	RW	1200	1500	3	2	S	0	7	2	2	0	1
03/03/2012	2	RW	1300	1500	1	3	WSW	0	6	1	1	0	0
03/03/2012	2	RW	1300	1500	2	4	WSW	2	6	1	2	0	0
03/03/2012	2	RW	1530	1830	1	4	SW	3	7	1	2	0	0
03/03/2012	2	RW	1530	1830	2	3	SW	2	7	1	2	0	0
03/03/2012	2	RW	1530	1830	3	4	NW	0	6	1	2	0	0
09/03/2012	1	RW	0945	1245	1	5	WSW	0	8	1	2	0	0
09/03/2012	1	RW	0945	1245	2	5	WSW	0	8	1	2	0	0
09/03/2012	1	RW	0945	1245	3	4	WSW	0	7	1	2	0	0
09/03/2012	1	RW	1345	1645	1	4	WSW	0	8	1	2	0	0
09/03/2012	1	RW	1345	1645	2	3	SW	0	8	1	2	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
09/03/2012	1	RW	1345	1645	3	3	SW	1	8	1	2	0	0
09/03/2012	2	RW	1745	1845	1	3	WSW	0	3	1	2	0	0
09/03/2012	4	JN	1010	1310	1	4	SW	0	8	1	2	0	0
09/03/2012	4	JN	1010	1310	2	4	SW	0	8	2	2	0	0
09/03/2012	4	JN	1010	1310	3	4	SW	0	8	2	2	0	0
09/03/2012	4	JN	1410	1710	1	4	SW	0	8	2	2	0	0
09/03/2012	4	JN	1410	1710	2	3	SW	0	8	2	2	0	0
09/03/2012	4	JN	1410	1710	3	3	SW	2	8	1	1	0	0
16/03/2012	5	ARC	1015	1315	1	4	NNW	2	8	1	1	0	0
16/03/2012	5	ARC	1015	1315	2	4	NNW	2	8	1	1	0	0
16/03/2012	5	ARC	1015	1315	3	4	NNW	2	8	1	1	0	0
22/03/2012	1	ARC	0955	1255	1	2	SSE	0	2	2	2	0	0
22/03/2012	1	ARC	0955	1255	2	2	SSE	0	2	2	2	0	0
22/03/2012	1	ARC	0955	1255	3	2	SSE	0	2	2	2	0	0
22/03/2012	2	ARC	1420	1720	1	1	SSE	0	2	2	2	0	0
22/03/2012	2	ARC	1420	1720	2	1	SSE	0	2	2	2	0	0
22/03/2012	2	ARC	1420	1720	3	1	SSE	0	2	2	2	0	0
23/03/2012	3	ARC	0500	0800	1	0	0	0	7	2	2	0	0
23/03/2012	3	ARC	0500	0800	2	0	0	0	7	2	2	0	0
23/03/2012	3	ARC	0500	0800	3	1	SW	0	6	2	2	0	0
23/03/2012	3	ARC	0905	1205	1	0	SSE	0	5	2	2	0	0
23/03/2012	3	ARC	0905	1205	2	1	SSE	0	7	2	2	0	0
23/03/2012	3	ARC	0905	1205	3	1	SSE	0	8	2	2	0	0
04/04/2012	3	CL	1015	1315	1	2	NE	0	4	2	2	2	1
04/04/2012	3	CL	1015	1315	2	1	NE	0	4	2	2	2	1
04/04/2012	3	CL	1015	1315	3	2	NE	2	6	2	2	2	1
04/04/2012	3	SLR	1030	1330	1	2	NE	0	4	2	2	0	1
04/04/2012	3	SLR	1030	1330	2	2	NE	0	4	2	2	0	1
04/04/2012	3	SLR	1030	1330	3	2	NE	0	7	2	2	0	1
04/04/2012	3	CL	1345	1645	1	2	NE	2	7	2	2	2	1
04/04/2012	3	CL	1345	1645	2	2	NE	1	7	2	2	2	1
04/04/2012	3	CL	1345	1645	3	1	NE	1	6	2	2	2	1
04/04/2012	4	SLR	1430	1730	1	1	NNE	0	6	2	2	0	1
04/04/2012	4	SLR	1430	1730	2	1	N	0	5	2	2	0	1
04/04/2012	4	SLR	1430	1730	3	1	NNW	0	5	2	2	0	1
05/04/2012	1	CL	0945	1245	1	1	NW	0	1	2	2	1	1
05/04/2012	1	CL	0945	1245	2	1	NW	0	1	2	2	1	1
05/04/2012	1	CL	0945	1245	3	1	WNW	0	1	2	2	1	1
05/04/2012	1	CL	1315	1615	1	1	WNW	0	3	2	2	1	1
05/04/2012	1	CL	1315	1615	2	2	WNW	0	4	2	2	0	1
05/04/2012	1	CL	1315	1615	3	2	WNW	0	5	2	2	0	1
05/04/2012	2	SLR	1000	1300	1	1	NW	0	1	2	2	0	1
05/04/2012	2	SLR	1000	1300	2	1	NW	0	1	2	2	0	1
05/04/2012	2	SLR	1000	1300	3	2	NW	0	1	2	2	0	1

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
05/04/2012	2	SLR	1400	1700	1	2	NW	0	1	2	2	0	1
05/04/2012	2	SLR	1400	1700	2	2	NW	0	0	0	2	0	1
05/04/2012	2	SLR	1400	1700	3	1	NW	0	5	2	2	0	1
06/04/2012	5	SLR	0715	1015	1	1	NNE	0	8	2	2	0	0
06/04/2012	5	SLR	0715	1015	2	1	NE	0	8	2	2	0	0
06/04/2012	5	SLR	0715	1015	3	1	NE	0	8	2	2	0	0
06/04/2012	5	SLR	1115	1415	1	1	NE	0	8	2	2	0	0
06/04/2012	5	SLR	1115	1415	2	1	NE	0	8	2	2	0	0
06/04/2012	5	SLR	1115	1415	3	0	0	1	8	2	2	0	0
14/05/2012	2	BA	1900	2100	1	3	SW	0	4	2	2	0	0
14/05/2012	2	BA	1900	2100	2	3	SW	0	5	2	2	0	0
14/05/2012	3	GT	1915	2115	1	3	SW	0	5	2	2	0	0
14/05/2012	3	GT	1915	2115	2	3	SW	0	5	2	2	0	0
15/05/2012	1	BA	1630	1930	1	3	N	2	4	2	2	0	0
15/05/2012	1	BA	1630	1930	2	3	N	0	4	2	2	0	0
15/05/2012	1	BA	1630	1930	3	3	N	0	8	2	2	0	0
15/05/2012	2	BA	0630	0930	1	4	N	2	8	1	2	0	0
15/05/2012	2	BA	0630	0930	2	3	N	2	7	1	2	0	0
15/05/2012	2	BA	0630	0930	3	3	N	0	5	2	2	0	0
15/05/2012	2	BA	1030	1330	1	4	N	0	6	2	2	0	0
15/05/2012	2	BA	1030	1330	2	4	N	0	5	2	2	0	0
15/05/2012	2	BA	1030	1330	3	4	N	0	7	2	2	0	0
15/05/2012	2	BA	1430	1530	1	4	N	2	7	2	1	0	0
15/05/2012	3	GT	0630	0730	1	3	NNW	2	8	1	2	0	0
15/05/2012	3	GT	0830	1130	1	3	NNW	2	6	1	2	0	0
15/05/2012	3	GT	0830	1130	2	4	NNW	0	6	2	2	0	0
15/05/2012	3	GT	0830	1130	3	4	NNW	0	7	2	2	0	0
15/05/2012	3	GT	1230	1530	1	5	NNW	0	6	2	2	0	0
15/05/2012	3	GT	1230	1530	2	4	NNW	2	7	2	2	0	0
15/05/2012	3	GT	1230	1530	3	4	NNW	0	7	2	2	0	0
15/05/2012	4	GT	1630	1930	1	3	NW	0	3	2	2	0	0
15/05/2012	4	GT	1630	1930	2	3	NW	2	7	2	2	0	0
15/05/2012	4	GT	1630	1930	3	3	NW	0	6	2	2	0	0
16/05/2012	1	BA	1215	1515	1	4	W	2	6	2	2	0	0
16/05/2012	1	BA	1215	1515	2	4	W	2	6	2	2	0	0
16/05/2012	1	BA	1215	1515	3	4	W	0	7	2	2	0	0
16/05/2012	1	BA	1615	1915	1	4	W	0	7	2	2	0	0
16/05/2012	1	BA	1615	1915	2	3	W	0	8	2	2	0	0
16/05/2012	1	BA	1615	1915	3	3	W	2	8	2	2	0	0
16/05/2012	4	GT	1230	1530	1	3	SW	0	7	2	2	0	0
16/05/2012	4	GT	1230	1530	2	3	SW	0	7	2	2	0	0
16/05/2012	4	GT	1230	1530	3	4	SW	2	8	2	2	0	0
16/05/2012	4	GT	1630	1930	1	3	NW	0	8	2	2	0	0
16/05/2012	4	GT	1630	1930	2	2	NW	0	8	2	2	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
16/05/2012	4	GT	1630	1930	3	2	NW	0	8	2	2	0	0
31/05/2012	5	KH	0740	1040	1	1	SE	0	8	2	2	0	0
31/05/2012	5	KH	0740	1040	2	1	SE	1	8	2	2	0	0
31/05/2012	5	KH	0740	1040	3	1	SE	3	8	2	2	0	0
02/06/2012	5	CL	0335	0635	1	1	N	0	8	2	1	0	0
02/06/2012	5	CL	0335	0635	2	1	N	0	8	2	1	0	0
02/06/2012	5	CL	0335	0635	3	1	NNE	0	6	2	2	0	0
02/06/2012	5	CL	0735	1035	1	2	NNE	0	6	2	2	0	0
02/06/2012	5	CL	0735	1035	2	3	NNE	0	5	2	2	0	0
02/06/2012	5	CL	0735	1035	3	3	NE	0	6	2	2	0	0
25/06/2012	2	CL	1250	1550	1	0	0	0	8	2	2	0	0
25/06/2012	2	CL	1250	1550	2	1	NW	0	8	2	2	0	0
25/06/2012	2	CL	1250	1550	3	1	NW	0	8	2	2	0	0
25/06/2012	2	CL	1650	1950	1	1	NW	0	8	2	2	0	0
25/06/2012	2	CL	1650	1950	2	1	WSW	0	8	2	2	0	0
25/06/2012	2	CL	1650	1950	3	2	SW	0	8	2	2	0	0
25/06/2012	3	CL	0845	1145	1	1	NW	0	8	2	2	0	0
25/06/2012	3	CL	0845	1145	2	1	NW	0	8	2	2	0	0
25/06/2012	3	CL	0845	1145	3	1	NW	0	8	2	2	0	0
25/06/2012	3	CS	1705	2005	1	2	SE	0	8	2	2	0	0
25/06/2012	3	CS	1705	2005	2	2	SE	0	8	2	2	0	0
25/06/2012	3	CS	1705	2005	3	2	SE	0	8	2	2	0	0
25/06/2012	4	CS	0900	1200	1	0	0	0	8	2	2	0	0
25/06/2012	4	CS	0900	1200	2	0	0	0	8	2	2	0	0
25/06/2012	4	CS	0900	1200	3	0	0	0	8	2	2	0	0
25/06/2012	4	CS	1300	1600	1	0	0	0	8	2	2	0	0
25/06/2012	4	CS	1300	1600	2	0	0	0	8	2	2	0	0
25/06/2012	4	CS	1300	1600	3	0	0	0	8	2	2	0	0
26/06/2012	1	CL	0620	0920	1	1	NW	0	1	2	1	0	0
26/06/2012	1	CL	0620	0920	2	1	NW	0	4	2	1	0	0
26/06/2012	1	CL	0620	0920	3	2	WNW	0	6	2	2	0	0
26/06/2012	1	CL	1020	1320	1	1	SE	0	4	2	2	0	0
26/06/2012	1	CL	1020	1320	2	2	SSE	0	5	2	2	0	0
26/06/2012	1	CL	1020	1320	3	2	SSE	0	4	2	2	0	0
26/06/2012	5	CS	0700	1000	1	1	N	0	2	2	1	0	0
26/06/2012	5	CS	0700	1000	2	1	SE	0	6	2	2	0	0
26/06/2012	5	CS	0700	1000	3	1	SE	0	2	2	2	0	0
26/06/2012	5	CS	1100	1400	1	1	S	0	3	2	2	0	0
26/06/2012	5	CS	1100	1400	2	1	S	0	3	2	2	0	0
26/06/2012	5	CS	1100	1400	3	1	S	0	4	2	2	0	0
09/07/2012	1	CL	0850	1150	1	2	NW	1	8	1	1	0	0
09/07/2012	1	CL	0850	1150	2	1	NW	1	8	1	2	0	0
09/07/2012	1	CL	0850	1150	3	1	NW	1	8	2	1	0	0
09/07/2012	1	CL	1250	1550	1	1	NW	0	8	1	1	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
09/07/2012	1	CL	1250	1550	2	2	NW	1	8	2	1	0	0
09/07/2012	1	CL	1250	1550	3	2	NW	1	8	2	2	0	0
09/07/2012	4	CS	0800	1100	1	3	NE	1	8	1	2	0	0
09/07/2012	4	CS	0800	1100	2	3	NE	1	8	1	2	0	0
09/07/2012	4	CS	0800	1100	3	2	NE	1	8	1	1	0	0
09/07/2012	4	CS	1200	1500	1	2	NE	1	8	1	1	0	0
09/07/2012	4	CS	1200	1500	2	2	NE	1	8	1	1	0	0
09/07/2012	4	CS	1200	1500	3	2	NE	1	8	1	1	0	0
09/07/2012	5	SR	0745	1045	1	2	NE	1	8	1	2	0	0
09/07/2012	5	SR	0745	1045	2	2	NE	1	8	1	2	0	0
09/07/2012	5	SR	0745	1045	3	1	NE	1	8	1	2	0	0
09/07/2012	5	SR	1145	1445	1	1	NE	1	8	2	2	0	0
09/07/2012	5	SR	1145	1445	2	0	0	1	8	1	2	0	0
09/07/2012	5	SR	1145	1445	3	0	0	1	8	1	2	0	0
25/07/2012	2	KS	1040	1340	1	1	W	0	4	2	2	0	0
25/07/2012	2	KS	1040	1340	2	2	W	0	5	2	2	0	0
25/07/2012	2	KS	1040	1340	3	2	W	0	5	2	2	0	0
25/07/2012	2	KS	1440	1740	1	2	W	0	5	2	2	0	0
25/07/2012	2	KS	1440	1740	2	2	W	0	4	2	2	0	0
25/07/2012	2	KS	1440	1740	3	2	W	0	5	2	2	0	0
26/07/2012	3	KS	0925	1225	1	1	W	0	7	2	2	0	0
26/07/2012	3	KS	0925	1225	2	1	W	0	7	2	2	0	0
26/07/2012	3	KS	0925	1225	3	1	W	0	7	2	2	0	0
26/07/2012	3	KS	1325	1625	1	1	W	2	7	2	2	0	0
26/07/2012	3	KS	1325	1625	2	1	NW	3	7	2	2	0	0
26/07/2012	3	KS	1325	1625	3	0	0	0	6	2	2	0	0
22/08/2012	5	ZS	1630	1900	1	3	SE	2	6	2	2	0	0
22/08/2012	5	ZS	1630	1900	2	3	SE	2	7	2	2	0	0
22/08/2012	5	ZS	1630	1900	2.5	3	SE	0	4	2	2	0	0
22/08/2012	5	ZS	1915	2145	1	2	S	0	4	2	2	0	0
22/08/2012	5	ZS	1915	2145	2	2	S	0	5	2	2	0	0
22/08/2012	5	ZS	1915	2145	2.5	2	S	0	5	2	2	0	0
23/08/2012	3	ZS	0530	0830	1	4	W	0	8	2	2	0	0
23/08/2012	3	ZS	0530	0830	2	4	W	0	8	2	2	0	0
23/08/2012	3	ZS	0530	0830	3	3	W	0	8	2	2	0	0
23/08/2012	3	ZS	0845	1145	1	3	W	0	8	2	2	0	0
23/08/2012	3	ZS	0845	1145	2	3	W	0	8	2	2	0	0
23/08/2012	3	ZS	0845	1145	3	3	W	0	7	2	2	0	0
23/08/2012	3	ZS	1145	1245	1	3	W	2	7	2	2	0	0
13/09/2012	9	ZS	1245	1545	1	3	S	0	8	1	2	0	0
13/09/2012	9	ZS	1245	1545	2	3	S	2	8	2	2	0	0
13/09/2012	9	ZS	1245	1545	3	2	SW	0	8	2	2	0	0
13/09/2012	9	ZS	1600	1900	1	4	SW	2	8	2	2	0	0
13/09/2012	9	ZS	1600	1900	2	4	SW	4	8	2	2	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
13/09/2012	9	ZS	1600	1900	3	4	SW	5	8	2	2	0	0
13/09/2012	7	KJ	1445	1745	1	5	5	0	8	2	2	0	0
13/09/2012	7	KJ	1445	1745	2	5	5	0	8	2	2	0	0
13/09/2012	7	KJ	1445	1745	3	5	5	0	8	2	2	0	0
14/09/2012	9	KJ	0645	0945	1	5	N	0	8	2	2	0	0
14/09/2012	9	KJ	0645	0945	2	5	N	2	8	2	2	0	0
14/09/2012	9	KJ	0645	0945	3	5	N	0	7	2	2	0	0
14/09/2012	9	KJ	0955	1255	1	5	N	2	8	2	2	0	0
14/09/2012	9	KJ	0955	1255	2	5	N	2	8	2	2	0	0
14/09/2012	9	KJ	0955	1255	3	5	N	2	8	2	2	0	0
14/09/2012	7	ZS	0630	0930	1	4	WSW	0	6	2	2	0	0
14/09/2012	7	ZS	0630	0930	2	4	W	0	8	2	2	0	0
14/09/2012	7	ZS	0630	0930	3	4	W	0	8	2	2	0	0
14/09/2012	7	ZS	1000	1300	1	4	W	0	8	2	2	0	0
14/09/2012	7	ZS	1000	1300	2	4	W	0	8	2	2	0	0
14/09/2012	7	ZS	1000	1300	3	4	W	0	8	2	2	0	0
01/10/2012	9	GJ	1320	1620	1	3	SW	2	6	2	2	0	0
01/10/2012	9	GJ	1320	1620	2	4	W	0	7	2	2	0	0
01/10/2012	9	GJ	1320	1620	3	3	S	0	7	2	2	0	0
01/10/2012	9	GJ	1635	1935	1	4	S	4	8	2	2	0	0
01/10/2012	9	GJ	1635	1935	2	3	S	3	6	2	2	0	0
01/10/2012	9	GJ	1635	1935	3	2	SW	1	7	2	2	0	0
01/10/2012	6	SS	1250	1550	1	4	SW	1	7	2	2	0	0
01/10/2012	6	SS	1250	1550	2	5	SW	1	6	2	2	0	0
01/10/2012	6	SS	1250	1550	3	5	SW	0	6	2	2	0	0
01/10/2012	6	SS	1600	1900	1	5	SW	2	8	2	2	0	0
01/10/2012	6	SS	1600	1900	2	5	SW	2	6	2	2	0	0
01/10/2012	6	SS	1600	1900	3	5	SW	0	4	2	2	0	0
01/10/2012	7	RC	1245	1545	1	4	SE	0	7	2	2	0	0
01/10/2012	7	RC	1245	1545	2	5	S	3	6	2	2	0	0
01/10/2012	7	RC	1245	1545	3	4	S	0	7	2	2	0	0
01/10/2012	7	RC	1555	1855	1	4	S	3	7	2	2	0	0
01/10/2012	7	RC	1555	1855	2	4	S	3	6	2	2	0	0
01/10/2012	7	RC	1555	1855	3	5	S	0	3	2	2	0	0
02/10/2012	6	RC	0915	1115	1	3	S	2	8	1	1	0	0
02/10/2012	6	RC	0915	1115	2	4	S	4	8	1	1	0	0
02/10/2012	7	SS	0920	1220	1	4	SW	1	8	2	2	0	0
02/10/2012	7	SS	0920	1220	2	5	SW	3	8	1	1	0	0
02/10/2012	7	SS	0920	1220	3	5	SW	2	8	1	0	0	0
02/10/2012	8	GJ	0945	1145	1	2	SE	4	8	1	1	0	0
02/10/2012	8	GJ	0945	1145	2	2	SE	4	8	1	1	0	0
17/10/2012	9	ZS	1245	1515	1	3	SW	2	7	2	2	0	0
17/10/2012	9	ZS	1245	1515	2	2	SW	0	7	2	2	0	0
17/10/2012	9	ZS	1245	1515	2.5	2	SW	4	8	1	1	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
17/10/2012	9	ZS	1530	1530	1	2	SW	4	8	1	1	0	0
17/10/2012	9	ZS	1530	1530	2	2	SW	4	8	1	1	0	0
17/10/2012	9	ZS	1530	1530	2.5	2	SW	0	7	2	2	0	0
17/10/2012	6	SS	1240	1510	1	3	SE	0	7	2	2	0	0
17/10/2012	6	SS	1240	1510	2	3	SE	0	7	2	2	0	0
17/10/2012	6	SS	1240	1510	2.5	4	SW	2	8	2	1	0	0
17/10/2012	6	SS	1520	1750	1	3	SW	2	8	2	1	0	0
17/10/2012	6	SS	1520	1750	2	2	SW	2	8	2	1	0	0
17/10/2012	6	SS	1520	1750	2.5	2	SW	0	6	2	2	0	0
17/10/2012	7	RA	1245	1515	1	2	SSW	0	7	2	2	0	0
17/10/2012	7	RA	1245	1515	2	3	SSW	3	7	2	2	0	0
17/10/2012	7	RA	1245	1515	2.5	2	WSW	3	8	1	2	0	0
17/10/2012	7	RA	1525	1755	1	1	SSW	2	8	2	2	0	0
17/10/2012	7	RA	1525	1755	2	1	SSW	1	7	2	2	0	0
17/10/2012	7	RA	1525	1755	2.5	1	SSW	0	5	2	2	0	0
18/10/2012	8	ZS	0910	1140	1	1	WSW	0	5	2	2	0	0
18/10/2012	8	ZS	0910	1140	2	2	WSW	0	6	2	2	0	0
18/10/2012	8	ZS	0910	1140	2.5	2	WSW	0	7	2	2	0	0
18/10/2012	8	ZS	1150	1420	1	2	WSW	3	8	2	2	0	0
18/10/2012	8	ZS	1150	1420	2	2	WSW	0	7	2	2	0	0
18/10/2012	8	ZS	1150	1420	2.5	2	WSW	2	8	2	2	0	0
18/10/2012	6	SS	0900	1130	1	0	0	0	4	2	2	0	0
18/10/2012	6	SS	0900	1130	2	1	SSW	0	4	2	2	0	0
18/10/2012	6	SS	0900	1130	2.5	0	0	0	6	2	2	0	0
18/10/2012	6	SS	1140	1410	1	0	0	0	6	2	2	0	0
18/10/2012	6	SS	1140	1410	2	0	0	0	7	2	2	0	0
18/10/2012	6	SS	1140	1410	2.5	1	SSW	1	8	2	2	0	0
18/10/2012	7	RA	0900	1130	1	0	0	0	3	1	2	0	0
18/10/2012	7	RA	0900	1130	2	1	SSW	0	4	1	2	0	0
18/10/2012	7	RA	0900	1130	2.5	1	SW	0	6	1	2	0	0
18/10/2012	7	RA	1140	1410	1	2	SW	0	7	2	2	0	0
18/10/2012	7	RA	1140	1410	2	3	WSW	0	7	2	2	0	0
18/10/2012	7	RA	1140	1410	2.5	2	SW	1	8	2	2	0	0
04/12/2012	9	SS	0915	1115	1	1	WSW	0	3	2	2	1	1
04/12/2012	9	SS	0915	1115	2	1	WSW	0	3	2	2	1	1
04/12/2012	9	SS	1125	1325	1	1	WSW	0	7	2	2	1	1
04/12/2012	9	SS	1125	1325	2	1	WSW	0	7	2	2	1	1
16/01/2013	9	KJ	0815	1015	1	0	0	0	6	2	2	2	1
16/01/2013	9	KJ	0815	1015	2	0	0	0	6	2	2	2	1
16/01/2013	9	KJ	1025	1225	1	1	0	0	6	2	2	2	1
16/01/2013	9	KJ	1025	1225	2	1	0	0	6	2	2	2	1
16/01/2013	7	AR	0805	1005	1	0	0	0	3	2	2	0	1
16/01/2013	7	AR	0805	1005	2	0	0	0	4	2	2	0	1
16/01/2013	7	AR	1015	1215	1	0	0	0	5	2	2	0	1

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
16/01/2013	7	AR	1015	1215	2	0	0	0	6	2	2	0	1
26/02/2013	6	AR	1015	1315	1	3	E	0	4	2	2	0	2
26/02/2013	6	AR	1015	1315	2	4	E	0	3	2	2	0	2
26/02/2013	6	AR	1015	1315	3	3	E		3	2	2	0	2
26/02/2013	6	AR	1330	1630	1	3	E	0	2	2	2	0	2
26/02/2013	6	AR	1330	1630	2	2	E	0	2	2	2	0	2
26/02/2013	6	AR	1330	1630	3	2	E	0	2	2	2	0	2
27/02/2013	9	AR	0815	1215	1	0	0	0	0	0	2	2	2
27/02/2013	9	AR	0815	1215	2	0	0	0	0	0	2	2	2
27/02/2013	9	AR	0815	1215	3	0	0	0	0	0	2	2	2
27/02/2013	9	AR	0815	1215	4	0	0	0	0	0	2	2	2
27/02/2013	6	ZS	1250	1450	1	3	NW	0	0	2	2	2	2
27/02/2013	6	ZS	1250	1450	2	3	NW	0	0	2	2	2	2
27/02/2013	7	ZS	0830	1245	1	1	NE	0	0	0	2	2	2
27/02/2013	7	ZS	0830	1245	2	2	NE	0	0	0	2	2	2
27/02/2013	7	ZS	0830	1245	3	2	NE	0	0	0	2	2	2
27/02/2013	7	ZS	0830	1245	4	2	NE	0	0	0	2	2	2
28/02/2013	6	ZS	0815	1115	1	1	N	0	8	0	1	2	2
28/02/2013	6	ZS	0815	1115	2	2	N	0	8	0	1	2	2
28/02/2013	6	ZS	0815	1115	3	3	N	0	8	0	2	2	2
28/02/2013	6	AR	1130	1430	4	2	N	0	2	2	2	2	2
28/02/2013	6	AR	1130	1430	5	3	N	0	7	2	2	2	2
28/02/2013	6	AR	1130	1430	6	4	N	0	8	2	2	2	2
26/03/2013	9	RA	1250	1450	1	4	E	2	7	2	2	1	1
26/03/2013	9	RA	1250	1450	2	4	E	2	8	2	2	1	1
26/03/2013	9	RA	1500	1700	1	4	E	2	8	2	2	1	1
26/03/2013	9	RA	1500	1700	2	4	E	2	6	2	2	1	1
26/03/2013	6	SS/JM	1310	1510	1	6	NE	2	8	1	1	2	1
26/03/2013	6	SS/JM	1310	1510	2	6	NE	2	8	1	1	2	1
26/03/2013	6	SS/JM	1520	1720	1	6	NE	2	8	1	1	2	1
26/03/2013	6	SS/JM	1520	1720	2	7	NE	2	8	1	1	2	1
27/03/2013	9	JM	1010	1210	1	6	E	0	8	1	1	1	1
27/03/2013	9	JM	1010	1210	2	4	E	3	8	1	1	1	1
27/03/2013	9	JM	1220	1420	1	4	E	0	6	1	2	1	1
27/03/2013	9	JM	1220	1420	2	5	E	1	7	1	1	1	1
27/03/2013	7	RA	0920	1120	1	5	NE	3	8	1	2	2	1
27/03/2013	7	RA	0920	1120	2	6	NE	2	8	1	2	2	1
27/03/2013	7	RA	1130	1330	1	6	NE	3	8	1	1	2	1
27/03/2013	7	RA	1130	1330	2	5	NE	2	8	1	2	2	1
23/04/2013	9	RC	0700	0900	1	4	SW	1	8	1	1	0	0
23/04/2013	9	RC	0700	0900	2	4	SW	0	6	2	1	0	0
23/04/2013	9	RC	0910	1110	1	3	SW	0	6	2	2	0	0
23/04/2013	9	RC	0910	1110	2	4	SW	0	7	2	2	0	0
23/04/2013	6	PR	0700	0900	1	4	SW	0	5	1	1	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
23/04/2013	6	PR	0700	0900	2	4	SW	0	6	2	2	0	0
23/04/2013	6	PR	0910	1110	1	4	W	0	4	2	2	0	0
23/04/2013	6	PR	0910	1110	2	4	SW	0	6	2	2	0	0
22/05/2013	9	RS	1410	1710	1	3	NE	0	4	2	2	0	0
22/05/2013	9	RS	1410	1710	2	2	NE	0	4	2	2	0	0
22/05/2013	9	RS	1410	1710	3	3	N	0	6	2	2	0	0
22/05/2013	9	RS	1810	2110	1	3	N	0	5	2	2	0	0
22/05/2013	9	RS	1810	2110	2	3	N	0	4	2	2	0	0
22/05/2013	9	RS	1810	2110	3	2	N	0	7	2	2	0	0
22/05/2013	7	CS	1400	1700	1	2	NW	0	4	2	2	0	0
22/05/2013	7	CS	1400	1700	2	2	NW	0	4	2	2	0	0
22/05/2013	7	CS	1400	1700	3	2	NE	0	7	2	2	0	0
22/05/2013	7	CS	1800	2100	1	2	NW	0	3	2	2	0	0
22/05/2013	7	CS	1800	2100	2	3	NW	0	3	2	2	0	0
22/05/2013	7	CS	1800	2100	3	1	NW	0	4	2	2	0	0
23/05/2013	6	CS	0835	1135	1	3	NW	3	8	2	2	0	0
23/05/2013	6	CS	0835	1135	2	3	NW	3	8	2	2	0	0
23/05/2013	6	CS	0835	1135	3	2	NW	3	8	2	2	0	0
23/05/2013	6	RS	1135	1435	1	3	NW	0	7	2	2	0	0
23/05/2013	6	RS	1135	1435	2	3	NW	2	7	2	2	0	0
23/05/2013	6	RS	1135	1435	3	3	NW	2	7	2	2	0	0
30/05/2013	7	MO	0900	1200	1	3	NE	1	8	1	1	0	0
30/05/2013	7	MO	0900	1200	2	2	NE	1	8	0	0	0	0
30/05/2013	7	MO	0900	1200	3	2	NE	1	8	0	0	0	0
30/05/2013	7	MO	0500	0800	1	2	N	0	8	2	2	0	0
30/05/2013	7	MO	0500	0800	2	3	NE	0	8	2	2	0	0
30/05/2013	7	MO	0500	0800	3	4	NE	2	8	1	1	0	0
05/06/2013	7	MO	1925	2125	1	2	S	0	8	2	2	0	0
05/06/2013	7	MO	1925	2125	2	2	S	0	8	2	2	0	0
05/06/2013	6	MO	1410	1810	1	3	NE	0	3	2	2	0	0
05/06/2013	6	MO	1410	1810	2	3	NE	0	6	2	2	0	0
05/06/2013	6	MO	1410	1810	3	3	N	0	7	2	2	0	0
05/06/2013	6	MO	1410	1810	4	3	N	0	7	2	2	0	0
06/06/2013	7	MO	1100	1400	1	1	N	0	6	2	2	0	0
06/06/2013	7	MO	1100	1400	2	1	N	0	5	2	2	0	0
06/06/2013	7	MO	1100	1400	3	0	0	0	5	2	2	0	0
06/06/2013	7	MO	1500	1800	1	2	N	0	7	2	2	0	0
06/06/2013	7	MO	1500	1800	2	2	N	0	7	2	2	0	0
06/06/2013	7	MO	1500	1800	3	2	E	0	7	2	2	0	0
18/06/2013	9	MO	0915	1215	1	2	SW	0	2	2	2	0	0
18/06/2013	9	MO	0915	1215	2	2	SW	0	3	2	2	0	0
18/06/2013	9	MO	0915	1215	3	1	SW	0	3	2	2	0	0
18/06/2013	6	RS	0925	1225	1	1	SSW	0	4	2	2	0	0
18/06/2013	6	RS	0925	1225	2	2	SSW	0	4	2	2	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
18/06/2013	6	RS	0925	1225	3	2	SSW	0	4	2	2	0	0
19/06/2013	9	MO	0520	0820	1	0	0	0	3	2	2	0	0
19/06/2013	9	MO	0520	0820	2	1	SW	0	7	2	2	0	0
19/06/2013	9	MO	0520	0820	3	1	SW	0	8	2	2	0	0
19/06/2013	6	RS	0530	0830	1	0	0	0	5	2	2	0	0
19/06/2013	6	RS	0530	0830	2	0	0	0	7	2	2	0	0
19/06/2013	6	RS	0530	0830	3	1	SSW	0	7	2	2	0	0
05/07/2013	7	ND	0530	0830	1	4	SW	0	8	2	2	0	0
05/07/2013	7	ND	0530	0830	2	4	SW	0	8	2	2	0	0
05/07/2013	7	ND	0530	0830	3	4	SW	0	8	2	2	0	0
05/07/2013	7	ND	0845	1145	1	4	SW	0	8	2	2	0	0
05/07/2013	7	ND	0845	1145	2	5	S	0	6	2	2	0	0
05/07/2013	7	ND	0845	1145	3	5	S	0	6	2	2	0	0
25/07/2013	6	JM	1430	1730	1	2	SW	0	6	2	2	0	0
25/07/2013	6	JM	1430	1730	2	2	SW	0	5	2	2	0	0
25/07/2013	6	JM	1430	1730	3	3	SW	0	6	2	2	0	0
25/07/2013	6	JM	1740	2040	1	3	S	0	6	2	2	0	0
25/07/2013	6	JM	1740	2040	2	2	S	2	8	2	2	0	0
25/07/2013	6	JM	1740	2040	3	2	S	0	6	2	2	0	0
24/07/2013	9	JM	0550	0850	1	0	0	0	6	1	1	0	0
24/07/2013	9	JM	0550	0850	2	1	SSE	0	5	2	2	0	0
24/07/2013	9	JM	0550	0850	3	1	SSE	0	5	2	2	0	0
24/07/2013	9	JM	0900	1200	1	1	S	0	4	2	2	0	0
24/07/2013	9	JM	0900	1200	2	1	SW	0	5	2	2	0	0
24/07/2013	9	JM	0900	1200	3	2	SW	0	6	2	2	0	0
27/08/2013	6	ND	1150	1320	1	3	WNW	0	7	2	2	0	0
27/08/2013	6	ND	1150	1320	2	2	WSW	0	5	2	2	0	0
28/08/2013	9	ND	1345	1645	1	3	SW	0	8	1	2	0	0
28/08/2013	9	ND	1345	1645	2	4	SSW	0	8	1	2	0	0
28/08/2013	9	ND	1345	1645	3	4	SW	0	6	2	2	0	0
28/08/2013	9	ND	1700	2000	1	4	SW	0	5	2	2	0	0
28/08/2013	9	ND	1700	2000	2	4	SSW	0	6	2	2	0	0
28/08/2013	9	ND	1700	2000	3	5	SSW	0	5	2	2	0	0
29/08/2013	7	ND	1350	1650	1	5	WNW	0	8	2	2	0	0
29/08/2013	7	ND	1350	1650	2	4	WNW	0	8	2	2	0	0
29/08/2013	7	ND	1350	1650	3	3	W	2	8	2	2	0	0
29/08/2013	7	ND	1700	2000	1	4	WSW	2	8	2	2	0	0
29/08/2013	7	ND	1700	2000	2	3	WSW	2	8	2	2	0	0
29/08/2013	7	ND	1700	2000	3	2	W	2	8	1	2	0	0
01/08/2013	6	JM	0555	0855	1	4	SSW	4	8	1	0	0	0
01/08/2013	6	JM	0555	0855	2	3	SSW	4	8	1	1	0	0
01/08/2013	6	JM	0555	0855	3	4	SSW	4	8	1	0	0	0
01/08/2013	6	JM	0905	1205	1	3	SSW	4	8	0	0	0	0
01/08/2013	6	JM	0905	1205	2	4	S	3	8	1	1	0	0

Date	VP	Observer	Start	Finish	Survey Hour	Wind speed	Wind direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
01/08/2013	6	JM	0905	1205	3	4	S	3	8	1	2	0	0

C2. Black Grouse Surveys

Table C4. Meterological conditions during black grouse surveys at Highlee Hill.

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
19/04/2012	1	ARC	0505	1000	1	1	SW	0	8	2	2	0	0
19/04/2012	1	ARC	0505	1000	2	1	SW	0	8	2	2	0	0
19/04/2012	1	ARC	0505	1000	3	1	SW	0	7	2	2	0	0
19/04/2012	1	ARC	0505	1000	4	1	SW	0	6	2	2	0	0
11/05/2012	2	ARC	0425	0845	1	1	NE	1	8	2	1	0	0
11/05/2012	2	ARC	0425	0845	2	1	NE	2	8	2	1	0	0
11/05/2012	2	ARC	0425	0845	3	1	NE	2	8	2	1	0	0
11/05/2012	2	ARC	0425	0845	4	1	NE	2	8	2	1	0	0
23/04/2013	3	RC	0500	0700	1	6	SW	0	8	2	1	0	0
23/04/2013	3	RC	0500	0700	2	4	SW	0	7	2	1	0	0
23/04/2013	3	PR	0500	0700	1	6	SW	0	8	2	1	0	0
23/04/2013	3	PR	0500	0700	2	4	SW	0	7	2	1	0	0
23/05/2013	4	RS	0415	0730	1	2	N	0	8	2	2	0	0
23/05/2013	4	RS	0415	0730	2	2	N	1	8	2	2	0	0
23/05/2013	4	RS	0415	0730	3	2	N	0	7	2	2	0	0
23/05/2013	4	CS	0415	0730	1	2	N	0	8	2	2	0	0
23/05/2013	4	CS	0415	0730	2	2	N	1	8	2	2	0	0
23/05/2013	4	CS	0415	0730	3	2	N	0	7	2	2	0	0

C3. Scarce Breeding Bird Surveys

Table C4. Meterological conditions during scarce breeding bird surveys at Highlee Hill.

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Survey Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
15/03/2012	1	KDS	0935	1605	1	2	SSW	0	8	2	2	0	0
15/03/2012	1	KDS	0935	1605	2	3	SSW	0	8	2	2	0	0
15/03/2012	1	KDS	0935	1605	3	3	SSW	0	8	2	2	0	0
15/03/2012	1	KDS	0935	1605	4	4	SSW	0	8	1	2	0	0
15/03/2012	1	KDS	0935	1605	5	4	SSW	1	8	1	1	0	0
15/03/2012	1	KDS	0935	1605	6	4	SSW	0	8	2	2	0	0
15/03/2012	1	KDS	0935	1605	7	5	SSW	0	7	2	2	0	0
28/03/2012	1	KDS	0905	1650	1	1	SW	0	2	2	2	0	0
28/03/2012	1	KDS	0905	1650	2	1	SW	0	1	2	2	0	0
28/03/2012	1	KDS	0905	1650	3	2	SW	0	1	2	2	0	0
28/03/2012	1	KDS	0905	1650	4	2	SW	0	1	2	2	0	0
28/03/2012	1	KDS	0905	1650	5	2	SW	0	2	2	2	0	0
28/03/2012	1	KDS	0905	1650	6	3	SW	0	2	2	2	0	0
28/03/2012	1	KDS	0905	1650	7	3	SW	0	2	2	2	0	0
28/03/2012	1	KDS	0905	1650	8	4	SW	0	3	2	2	0	0
17/04/2012	2	PC	0845	1145	1	4	NW	0	7	2	2	0	0
17/04/2012	2	PC	0845	1145	2	4	NW	0	7	2	2	0	0
17/04/2012	2	PC	0845	1145	3	4	NW	0	7	2	2	0	0
31/05/2012	3	KDS	1045	1640	1	1	SE	2	8	2	2	0	0
31/05/2012	3	KDS	1045	1640	2	1	SE	2	8	2	2	0	0
31/05/2012	3	KDS	1045	1640	3	1	SE	2	8	2	2	0	0
31/05/2012	3	KDS	1045	1640	4	1	SE	2	8	2	2	0	0
31/05/2012	3	KDS	1045	1640	5	1	SE	1	8	2	2	0	0
31/05/2012	3	KDS	1045	1640	6	1	SE	0	8	2	2	0	0

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Survey Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
31/05/2012	3	KDS	1045	1640	7	1	SE	0	8	2	2	0	0
15/06/2012	4	KDS	0840	1440	1	2	E	0	6	2	2	0	0
15/06/2012	4	KDS	0840	1440	2	3	E	2	7	2	2	0	0
15/06/2012	4	KDS	0840	1440	3	3	E	3	8	2	2	0	0
15/06/2012	4	KDS	0840	1440	4	4	E	3	8	2	1	0	0
15/06/2012	4	KDS	0840	1440	5	4	E	4	8	1	1	0	0
15/06/2012	4	KDS	0840	1440	6	5	E	4	8	1	1	0	0
18/06/2012	4	KDS	0930	1550	1	2	E	0	4	2	2	0	0
18/06/2012	4	KDS	0930	1550	2	2	E	0	3	2	2	0	0
18/06/2012	4	KDS	0930	1550	3	2	E	0	2	2	2	0	0
18/06/2012	4	KDS	0930	1550	4	2	E	0	3	2	2	0	0
18/06/2012	4	KDS	0930	1550	5	2	E	0	4	2	2	0	0
18/06/2012	4	KDS	0930	1550	6	3	E	0	5	2	2	0	0
18/06/2012	4	KDS	0930	1550	7	3	E	0	5	2	2	0	0
19/07/2012	5	KDS	1110	1750	1	2	NW	0	7	2	2	0	0
19/07/2012	5	KDS	1110	1750	2	2	NW	0	7	2	2	0	0
19/07/2012	5	KDS	1110	1750	3	2	NW	0	7	2	2	0	0
19/07/2012	5	KDS	1110	1750	4	2	NW	0	6	2	2	0	0
19/07/2012	5	KDS	1110	1750	5	2	NW	0	6	2	2	0	0
19/07/2012	5	KDS	1110	1750	6	2	NW	0	7	2	2	0	0
19/07/2012	5	KDS	1110	1750	7	2	NW	0	6	2	2	0	0
20/07/2012	5	KDS	0850	1615	1	1	0	0	5	2	2	0	0
20/07/2012	5	KDS	0850	1615	2	1	0	0	6	2	2	0	0
20/07/2012	5	KDS	0850	1615	3	1	0	0	5	2	2	0	0
20/07/2012	5	KDS	0850	1615	4	1	0	0	5	2	2	0	0
20/07/2012	5	KDS	0850	1615	5	1	0	0	4	2	2	0	0
20/07/2012	5	KDS	0850	1615	6	1	0	0	5	2	2	0	0

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Survey Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
20/07/2012	5	KDS	0850	1615	7	1	0	0	5	2	2	0	0
20/07/2012	5	KDS	0850	1615	8	1	0	0	4	2	2	0	0
27/03/2013	6	SS	0950	1330	1	6	E	2	8	1	1	2	1
27/03/2013	6	SS	0950	1330	2	6	E	3	8	1	1	2	1
27/03/2013	6	SS	0950	1330	3	6	E	0	8	2	2	2	1
27/03/2013	6	SS	0950	1330	4	6	E	1	8	2	2	2	1
16/05/2013	7	KDS	1055	1802	1	1	SW	0	5	2	2	0	0
16/05/2013	7	KDS	1055	1802	2	1	SW	0	5	2	2	0	0
16/05/2013	7	KDS	1055	1802	3	1	SE	0	6	2	2	0	0
16/05/2013	7	KDS	1055	1802	4	1	SE	0	7	2	2	0	0
16/05/2013	7	KDS	1055	1802	5	1	SE	3	7	2	2	0	0
16/05/2013	7	KDS	1055	1802	6	1	SE	0	7	2	2	0	0
16/05/2013	7	KDS	1055	1802	7	1	S	0-4	8	1	1	0	0
17/05/2013	7	KDS	0600	0815	1	1	NE	0	8	2	2	0	0
17/05/2013	7	KDS	0600	0815	2	1	NE	0	8	2	2	0	0
17/05/2013	7	KDS	0900	1505	1	2	NE	0	5	2	2	0	0
17/05/2013	7	KDS	0900	1505	2	2	NE	0	4	2	2	0	0
17/05/2013	7	KDS	0900	1505	3	2	NE	0	4	2	2	0	0
17/05/2013	7	KDS	0900	1505	4	2	NE	0	3	2	2	0	0
17/05/2013	7	KDS	0900	1505	5	2	NE	0	2	2	2	0	0
17/05/2013	7	KDS	0900	1505	6	1	E	0	2	2	2	0	0
13/06/2013	8	KDS	1040	1800	1	2	SW	0	3	2	2	0	0
13/06/2013	8	KDS	1040	1800	2	2	SW	0	3	2	2	0	0
13/06/2013	8	KDS	1040	1800	3	2	SW	0	3	2	2	0	0
13/06/2013	8	KDS	1040	1800	4	2	SW	0	4	2	2	0	0
13/06/2013	8	KDS	1040	1800	5	3	SW	0	5	2	2	0	0
13/06/2013	8	KDS	1040	1800	6	2	SW	0	6	2	2	0	0

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Survey Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
13/06/2013	8	KDS	1040	1800	7	2	SW	0	5	2	2	0	0
13/06/2013	8	KDS	1040	1800	8	2	SW	0	5	2	2	0	0
14/06/2013	8	KDS	0905	1645	1	2	SW	0	2	2	2	0	0
14/06/2013	8	KDS	0905	1645	2	2	SW	0	3	2	2	0	0
14/06/2013	8	KDS	0905	1645	3	2	SW	0	4	2	2	0	0
14/06/2013	8	KDS	0905	1645	4	3	SW	0	4	2	2	0	0
14/06/2013	8	KDS	0905	1645	5	3	SW	0	5	2	2	0	0
14/06/2013	8	KDS	0905	1645	6	3	SW	2	7	2	2	0	0
14/06/2013	8	KDS	0905	1645	7	4	SW	3	8	2	2	0	0
14/06/2013	8	KDS	0905	1645	8	4	SW	3	8	1	1	0	0
26/07/2013	9	KDS	1140	1850	1	3	SE	0	3	2	2	0	0
26/07/2013	9	KDS	1140	1850	2	3	SE	0	3	2	2	0	0
26/07/2013	9	KDS	1140	1850	3	4	SE	0	4	2	2	0	0
26/07/2013	9	KDS	1140	1850	4	4	SE	0	4	2	2	0	0
26/07/2013	9	KDS	1140	1850	5	4	SE	0	4	2	2	0	0
26/07/2013	9	KDS	1140	1850	6	3	SE	0	5	2	2	0	0
26/07/2013	9	KDS	1140	1850	7	3	SE	0	5	2	2	0	0
27/07/2013	9	KDS	0400	1600	1	1	SE	0	0	2	2	0	0
27/07/2013	9	KDS	0400	1600	2	1	SE	0	0	2	2	0	0
27/07/2013	9	KDS	0400	1600	3	1	SE	0	1	2	2	0	0
27/07/2013	9	KDS	0400	1600	4	2	SE	0	3	2	2	0	0
27/07/2013	9	KDS	0400	1600	5	2	SE	0	5	2	2	0	0
27/07/2013	9	KDS	0400	1600	6	2	SE	0	7	2	2	0	0
27/07/2013	9	KDS	0400	1600	7	1	SE	0	5	2	2	0	0
27/07/2013	9	KDS	0400	1600	8	2	SE	0	4	2	2	0	0
27/07/2013	9	KDS	0400	1600	9	1	SE	0	5	2	2	0	0
27/07/2013	9	KDS	0400	1600	10	1	SE	0	6	2	2	0	0

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Survey Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
27/07/2013	9	KDS	0400	1600	11	2	SE	2	5	2	2	0	0
27/07/2013	9	KDS	0400	1600	12	2	SE	3	8	2	2	0	0
21/04/2015	10	AWT	0850	1645	1	1	NW	0	0	2	2	0	0
21/04/2015	10	AWT	0850	1645	2	2	NE	0	0	2	2	0	0
21/04/2015	10	AWT	0850	1645	3	2	NE	0	0	0	2	0	0
21/04/2015	10	AWT	0850	1645	4	2	NE	0	0	0	2	0	0
21/04/2015	10	AWT	0850	1645	5	3	NE	0	0	0	2	0	0
21/04/2015	10	AWT	0850	1645	6	2	NE	0	0	0	2	0	0
21/04/2015	10	AWT	0850	1645	7	2	NE	0	0	0	2	0	0
21/04/2015	10	AWT	0850	1645	8	2	NE	0	0	0	2	0	0
16/05/2015	11	AWT	0850	1700	1	4	NW	0	7	2	2	0	0
16/05/2015	11	AWT	0850	1700	2	4	NW	0	7	2	2	0	0
16/05/2015	11	AWT	0850	1700	3	5	W	0	6	2	2	0	0
16/05/2015	11	AWT	0850	1700	4	5	W	0	6	2	2	0	0
16/05/2015	11	AWT	0850	1700	5	5	W	0	6	2	2	0	0
16/05/2015	11	AWT	0850	1700	6	5	W	0	5	2	2	0	0
16/05/2015	11	AWT	0850	1700	7	5	W	0	5	2	2	0	0
16/05/2015	11	AWT	0850	1700	8	5	W	0	5	2	2	0	0
29/05/2015	11	AWT	0805	1700	1	2	W	1	8	1	2	0	0
29/05/2015	11	AWT	0805	1700	2	2	W	0	7	2	2	0	0
29/05/2015	11	AWT	0805	1700	3	2	W	0	6	2	2	0	0
29/05/2015	11	AWT	0805	1700	4	2	W	0	6	2	2	0	0
29/05/2015	11	AWT	0805	1700	5	2	W	0	6	2	2	0	0
29/05/2015	11	AWT	0805	1700	6	2	W	2	6	2	2	0	0
29/05/2015	11	AWT	0805	1700	7	2	W	3	6	2	2	0	0
29/05/2015	11	AWT	0805	1700	8	2	W	3	7	2	2	0	0
29/05/2015	11	AWT	0805	1700	9	2	W	2	6	2	2	0	0

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Survey Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
15/06/2015	12	AWT	0815	1600	1	1	W	0	5	2	2	0	0
15/06/2015	12	AWT	0815	1600	2	2	W	0	7	2	2	0	0
15/06/2015	12	AWT	0815	1600	3	2	W	0	8	2	2	0	0
15/06/2015	12	AWT	0815	1600	4	2	W	0	8	2	2	0	0
15/06/2015	12	AWT	0815	1600	5	2	W	0	8	2	2	0	0
15/06/2015	12	AWT	0815	1600	6	2	W	0	8	2	2	0	0
27/06/2015	12	AWT	0815	1600	1	3	SW	0	6	2	2	0	0
27/06/2015	12	AWT	0815	1600	2	3	SW	0	7	2	2	0	0
27/06/2015	12	AWT	0815	1600	3	3	SW	0	7	2	2	0	0
27/06/2015	12	AWT	0815	1600	4	4	SW	0	6	2	2	0	0
27/06/2015	12	AWT	0815	1600	5	3	SW	0	6	2	2	0	0
27/06/2015	12	AWT	0815	1600	6	3	SW	1	7	2	2	0	0
05/07/2015	13	AWT	0830	1630	1	2	SW	0	5	2	2	0	0
05/07/2015	13	AWT	0830	1630	2	2	SW	0	5	2	2	0	0
05/07/2015	13	AWT	0830	1630	3	2	SW	0	7	2	2	0	0
05/07/2015	13	AWT	0830	1630	4	3	SW	0	7	2	2	0	0
05/07/2015	13	AWT	0830	1630	5	3	SW	0	8	2	2	0	0
05/07/2015	13	AWT	0830	1630	6	3	SW	0	7	2	2	0	0
23/07/2015	13	AWT	0900	1645	1	3	SW	0	4	2	2	0	0
23/07/2015	13	AWT	0900	1645	2	4	SW	0	6	2	2	0	0
23/07/2015	13	AWT	0900	1645	3	4	SW	0	7	2	2	0	0
23/07/2015	13	AWT	0900	1645	4	4	SW	0	7	2	2	0	0
23/07/2015	13	AWT	0900	1645	5	4	SW	0	7	2	2	0	0
23/07/2015	13	AWT	0900	1645	6	4	SW	0	7	2	2	0	0
23/07/2015	13	AWT	0900	1645	7	4	SW	0	7	2	2	0	0

C4. Breeding Bird Surveys

Table C5. Meterological conditions during breeding bird surveys at Highlee Hill.

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Survey Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
25/04/2011	1	RP	No weather data										
06/06/2011	2	RP	850	1740	All day		N		7				
16/05/2012	3	BA,GT	0550	1130	1	0	0	0	0	2	2	0	0
16/05/2012	3	BA,GT	0550	1130	2	1	W	0	0	2	2	0	0
16/05/2012	3	BA,GT	0550	1130	3	2	W	0	2	2	2	0	0
16/05/2012	3	BA,GT	0550	1130	4	3	W	2	4	2	2	0	0
16/05/2012	3	BA,GT	0550	1130	5	3	W	2	6	2	2	0	0
22/04/2013	1	PR	1345	1630	1	8	SW	1	8	2	1	0	0
22/04/2013	1	PR	1345	1630	2	9	SW	1	8	0	0	0	0
22/04/2013	1	PR	1345	1630	3	6	SW	0	8	2	1	0	0
24/04/2013	1	PR	0930	1240	1	5	SSW	1	8	1	0	0	0
24/04/2013	1	PR	0930	1240	2	5	SW	1	8	0	0	0	0
24/04/2013	1	PR	0930	1240	3	7	SW	4	8	0	0	0	0
22/05/2013	2	RS/CS	0845	1230	1	3	NW	0	7	2	2	0	0
22/05/2013	2	RS/CS	0845	1230	2	2	NW	0	4	2	2	0	0
22/05/2013	2	RS/CS	0845	1230	3	2	NW	0	5	2	2	0	0
22/05/2013	2	RS/CS	0845	1230	4	2	NW	0	5	2	2	0	0
18/06/2013	3	RS/MO	550	905	1	1	S	0	8	2	2	0	0
18/06/2013	3	RS/MO	550	905	2	1	S	0	8	2	2	0	0
18/06/2013	3	RS/MO	550	905	3	1	S	0	8	2	2	0	0
11/07/2013	4	ND	1400	2030	1	2	W	0	0	2	2	0	0
11/07/2013	4	ND	1400	2030	2	2	W	0	0	2	2	0	0
11/07/2013	4	ND	1400	2030	3	2	W	0	0	2	2	0	0
11/07/2013	4	ND	1400	2030	4	2	E	0	0	2	2	0	0
11/07/2013	4	ND	1400	2030	5	1	SW	0	0	2	2	0	0
11/07/2013	4	ND	1400	2030	6	1	SW	0	1	2	2	0	0
12/07/2013	4	ND	1130	1730	1	3	W	0	6	2	2	0	0
12/07/2013	4	ND	1130	1730	2	4	SW	0	5	2	2	0	0
12/07/2013	4	ND	1130	1730	3	4	W	0	5	2	2	0	0
12/07/2013	4	ND	1130	1730	4	4	SW	0	6	2	2	0	0
12/07/2013	4	ND	1130	1730	5	4	NW	0	7	2	2	0	0
12/07/2013	4	ND	1130	1730	6	4	WNW	0	6	2	2	0	0

C5. Winter Walkover Surveys

Table C6. Meterological conditions during winter walkover surveys at Highlee Hill.

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
27/12/2011	1	TC/MD	0930	1330	1	2	WNW	0	4	1	2	0	0
27/12/2011	1	TC/MD	0930	1330	2	2	WNW	0	4	1	2	0	0
27/12/2011	1	TC/MD	0930	1330	3	2	WNW	0	4	1	2	0	0
27/12/2011	1	TC/MD	0930	1330	4	2	WNW	0	4	1	2	0	0
25/01/2012	2	TC	0915	1245	1	3	SW	1	8	1	1	0	0
25/01/2012	2	TC	0915	1245	2	3	SSW	0	8	1	1	0	0
25/01/2012	2	TC	0915	1245	3	3	SSW	0	8	__	1	0	0
25/01/2012	2	TC	0915	1245	4	3	SSW	2	8	1	1	0	0
05/02/20	3	JN	1020	1225	1	1	SW	0	6	2	2	2	1

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
12													
05/02/2012	3	JN	1020	1225	2	2	SW	0	4	2	2	2	1
05/02/2012	3	RW	1015	1215	1	2	WSW	0	5	2	2	0	1
03/12/2012	4	SS/ZS	1150	1550	1	4	W	0	3	2	2	1	1
03/12/2012	4	SS/ZS	1150	1550	2	4	W	0	5	2	2	1	1
03/12/2012	4	SS/ZS	1150	1550	3	3	W	1	8	1	1	1	1
03/12/2012	4	SS/ZS	1150	1550	4	3	W	1	6	1	2	1	1
04/12/2012	4	ZS	0915	1415	1	3	WSW	0	6	2	2	1	1
04/12/2012	4	ZS	0915	1415	2	3	WSW	0	5	2	2	1	1
04/12/2012	4	ZS	0915	1415	3	3	WSW	0	4	2	2	1	1
04/12/2012	4	ZS	0915	1415	4	2	WSW	0	7	2	2	1	1
04/12/2012	4	ZS	0915	1415	5	2	WSW	0	8	1	2	1	1
14/01/2013	5	KJ	1100	1530	1	2	N	0	5	2	2	0	2
14/01/2013	5	KJ	1100	1530	2	4	N	0	6	2	2	0	2
14/01/2013	5	KJ	1100	1530	3	4	N	0	6	2	2	0	2
14/01/2013	5	KJ	1100	1530	4	5	N	0	7	2	2	0	2
14/01/2013	5	KJ	1100	1530	5	5	N	0	7	2	2	0	2
14/01/2013	5	AR	1100	1530	1	2	w	0	4	2	2	0	0
14/01/2013	5	AR	1100	1530	2	1	w	0	6	2	2	0	0
14/01/2013	5	AR	1100	1530	3	2	w	0	6	2	2	0	0
14/01/2013	5	AR	1100	1530	4	2	w	0	6	2	2	0	0
15/01/2013	5	KJ	0900	1400	1	2	SW	0	6	2	2	2	2
15/01/2013	5	KJ	0900	1400	2	2	SW	0	5	2	2	2	2
15/01/20	5	KJ	0900	1400	3	2	SW	0	5	2	2	2	2
13													
15/01/2013	5	KJ	0900	1400	4	2	SW	0	5	2	1	2	2
15/01/2013	5	KJ	0900	1400	5	2	SW	0	5	2	1	2	2
15/01/2013	5	AR	0900	1400	1	1	0	0	6	2	2	1	1
15/01/2013	5	AR	0900	1400	2	2	0	0	6	2	2	1	1
15/01/2013	5	AR	0900	1400	3	1	0	0	5	2	2	1	1
15/01/2013	5	AR	0900	1400	4	2	0	0	5	2	2	1	1
25/02/2013	6	AR/ZS	1145	1645	1	4	NE	0	5	2	2	2	1
25/02/2013	6	AR/ZS	1145	1645	2	4	NE	0	5	2	2	2	1
25/02/2013	6	AR/ZS	1145	1645	3	4	NE	0	4	2	2	2	1
25/02/2013	6	AR/ZS	1145	1645	4	4	NE	0	4	2	2	2	1
25/02/2013	6	AR/ZS	1145	1645	5	4	NE	0	4	2	2	2	2
26/02/2013	6	ZS	1015	1415	1	3	0	0	8	1	2	2	1
26/02/2013	6	ZS	1015	1415	2	3	0	0	8	2	2	2	2
26/02/2013	6	ZS	1015	1415	3	2	0	0	6	2	2	2	2
26/02/2013	6	ZS	1015	1415	4	2	0	0	6	2	2	2	2
27/02/2013	6	AR	1230	1500	1	2	NW	0	2	2	2	2	2
27/02/2013	6	AR	1230	1500	2	2	NW	0	2	2	2	2	2
28/02/2013	6	AR	0815	1115	1	1	N	0	8	0	1	2	2
28/02/2013	6	AR	0815	1115	2	2	N	0	8	0	1	2	2
28/02/2013	6	AR	0815	1115	3	3	N	0	8	0	2	2	2
12/11/2013	1	PR/AW	0900	1500	1	3	SW	0	2	2	2	0	0
12/11/2013	1	PR/AW	0900	1500	2	3	SW	0	4	2	2	0	0
12/11/20	1	PR/AW	0900	1500	3	3	SW	0	3	2	2	0	0

Date	Survey Visit	Observer	Survey Start Time	Survey Finish Time	Hour	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
13													
12/11/2013	1	PR/AW	0900	1500	4	2	SW	0	1	2	2	0	0
12/11/2013	1	PR/AW	0900	1500	5	3	SW	0	2	2	2	0	0
12/11/2013	1	PR/AW	0900	1500	6	3	SW	0	3	2	2	0	0
24/01/2014	2	FD/AW	0950	1450	1	2	SE	0	6	2	2	1	0
24/01/2014	2	FD/AW	0950	1450	2	3	SE	0	7	2	2	1	0
24/01/2014	2	FD/AW	0950	1450	3	4	SE	0	7	2	2	1	0
24/01/2014	2	FD/AW	0950	1450	4	4	SE	0	7	2	2	0	0
24/01/2014	2	FD/AW	0950	1450	5	4	S	0	7	2	2	0	0

ANNEX D: SURVEY RESULTS

D1. Target Species Recorded During Flight Activity Surveys

In accordance with SNH Guidance (2010), target species are those which may be considered to be at risk from the potential effects of wind farms. The methodology for defining target species is detailed within ES Chapter 6: Ornithology. All flights of Target Species within the site and the surrounding area were mapped and details of each flight recorded. Observations of Target Species were recorded on data sheets and maps. Information on species, time of observation, flight height (in bands), location, and the length of each observation was recorded. The details are given below. For collision risk analysis purposes, the Collision Risk Analysis Area (CRAA) refers to the 500m buffer around the turbines. All flightlines of Target Species are displayed in Figures 6.5 to 6.7.

Table D1. Target species recorded during flight activity surveys 2011-13.

Species	Total number of flightlines recorded	Total number of birds recorded
Curlew	9	11
Golden plover	3	208
Goshawk	19	19
Hen harrier	1	1
Merlin	3	3
Osprey	1	1
Peregrine falcon	7	8
Pink-footed goose	2	105
Red kite	2	2

Table D2. Details of target species recorded during flight activity surveys.

Date	VP	Observer	Flight Start Time	Species	No. Of Birds	Duration (s)	Inside CRAA (seconds)			Outside CRAA (seconds)		
							0-20m	21-125m	>126m	0-20m	21-125m	>126m
28/09/2011	2	ZS	0650	Peregrine falcon	1	65	0.00	13.07	0.00	0.00	51.93	0.00
28/09/2011	3	KJ	0911	Peregrine falcon	1	20	0.00	20.00	0.00	0.00	0.00	0.00
28/09/2011	3	KJ	1020	Peregrine falcon	2	25	0.00	25.00	0.00	0.00	0.00	0.00
28/09/2011	3	KJ	1021	Peregrine falcon	1	18	0.00	18.00	0.00	0.00	0.00	0.00
19/10/2011	2	RP	1002	Pink footed goose	20	30	0.00	15.07	0.00	0.00	14.93	0.00
19/10/2011	2	RP	1056	Golden plover	200	45	0.00	0.00	45.00	0.00	0.00	0.00
19/10/2011	2	RP	1139	Peregrine falcon	1	5	0.00	0.00	0.00	0.00	5.00	0.00
01/12/2011	1	RP	1055	Goshawk	1	15	0.00	0.00	0.00	0.00	15.00	0.00
01/12/2011	1	RP	1151	Merlin	1	5	0.00	0.00	0.00	0.00	5.00	0.00
15/01/2012	5	MC	1332	Goshawk	1	300	0.00	0.00	0.00	0.00	300.00	0.00
05/02/2012	1	RW	1244	Goshawk	1	30	0.00	0.00	0.00	30.00	0.00	0.00
05/02/2012	1	RW	1301	Goshawk	1	15	0.00	0.00	0.00	15.00	0.00	0.00
05/02/2012	1	RW	1558	Goshawk	1	15	0.00	0.00	0.00	0.00	15.00	0.00
06/02/2012	3	RW	1437	Goshawk	1	75	0.00	0.00	0.00	15.00	60.00	0.00
06/02/2012	3	RW	1553	Goshawk	1	30	0.00	0.00	0.00	0.00	30.00	0.00
07/02/2012	2	JN	0938	Pink footed goose	85	135	0.00	0.00	0.00	0.00	0.00	135.00
07/02/2012	2	JN	1250	Golden plover	1	45	0.00	0.00	0.00	0.00	0.00	45.00
07/02/2012	2	JN	1257	Golden plover	7	45	0.00	0.00	0.00	15.00	25.00	5.00
09/03/2012	1	RW	1223	Goshawk	1	60	0.00	0.00	0.00	30.00	30.00	0.00
09/03/2012	1	RW	1347	Goshawk	1	90	0.00	0.00	0.00	30.00	60.00	0.00
09/03/2012	4	JN	1157	Goshawk	1	60	0.00	48.06	0.00	0.00	11.94	0.00
22/03/2012	1	ARC	1118	Curlew	1	10	0.00	0.00	0.00	10.00	0.00	0.00
22/03/2012	2	ARC	1437	Curlew	1	25	0.00	0.00	0.00	15.00	10.00	0.00
04/04/2012	3	CL	1456	Hen harrier	1	150	0.00	0.00	0.00	150.00	0.00	0.00
04/04/2012	3	CL	1521	Goshawk	1	25	25.00	0.00	0.00	0.00	0.00	0.00
05/04/2012	1	CL	1413	Goshawk	1	145	0.00	0.00	0.00	145.00	0.00	0.00
05/04/2012	1	CL	1421	Goshawk	1	75	0.00	0.00	0.00	0.00	75.00	0.00
05/04/2012	1	CL	1516	Peregrine falcon	1	30	0.00	0.00	0.00	0.00	30.00	0.00
05/04/2012	2	SLR	1156	Curlew	1	20	19.52	0.00	0.00	0.48	0.00	0.00
05/04/2012	2	SLR	1523	Curlew	1	15	0.00	0.00	0.00	15.00	0.00	0.00
06/04/2012	5	SLR	0828	Goshawk	1	45	0.00	0.00	0.00	0.00	0.00	45.00
15/05/2012	2	BA	0914	Goshawk	1	20	0.00	17.78	0.00	0.00	2.22	0.00
15/05/2012	3	GT	0908	Goshawk	1	120	45.00	75.00	0.00	0.00	0.00	0.00
02/06/2012	5	CL	0605	Merlin	1	30	0.00	0.00	0.00	30.00	0.00	0.00
02/06/2012	5	CL	0617	Merlin	1	15	0.00	0.00	0.00	15.00	0.00	0.00
25/06/2012	2	CL	1714	Peregrine falcon	1	30	0.00	8.40	0.00	0.00	21.60	0.00
25/07/2012	2	KS	1245	Goshawk	1	30	0.00	21.27	0.00	0.00	8.73	0.00
26/07/2012	3	KS	1531	Goshawk	1	29	0.00	26.75	0.00	0.00	2.25	0.00
22/08/2012	5	ZS	1915	Osprey	1	240	0.00	0.00	0.00	0.00	105.00	135.00
23/08/2012	3	ZS	0728	Goshawk	1	60	0.00	33.11	0.00	0.00	26.89	0.00
22/05/2013	7	CS	1509	Curlew	1	13	0.00	0.00	0.00	13.00	0.00	0.00
22/05/2013	7	CS	2052	Curlew	1	10	0.00	0.00	0.00	10.00	0.00	0.00
30/05/2013	7	MO	0743	Curlew	1	20	0.00	0.00	0.00	20.00	0.00	0.00

Date	VP	Observer	Flight Start Time	Species	No. Of Birds	Duration (s)	Inside CRAA (seconds)			Outside CRAA (seconds)		
							0-20m	21-125m	>126m	0-20m	21-125m	>126m
30/05/2013	7	MO	0750	Curlew	2	100	0.00	0.00	0.00	40.00	60.00	0.00
30/05/2013	7	MO	1017	Red kite	1	20	0.00	0.00	0.00	5.00	15.00	0.00
30/05/2013	7	MO	1133	Red kite	1	180	23.57	117.87	0.00	6.43	32.13	0.00
06/06/2013	7	MO	1304	Curlew	2	10	0.00	0.00	0.00	10.00	0.00	0.00

D2. Secondary Species Recorded During Flight Activity Surveys

Secondary Species were recorded to give an indication of the use of the site by these species and to allow 5 minute activity summaries to be calculated. Details of the VP, species, minimum number present, the flight height (in bands), and location in relation to the proposed development were all recorded (i.e. On Site - within the Maximum Potential Wind farm Boundary (MPWB), within the 500 m buffer area, or out-with the buffer area). The data collected in the course of undertaking VP watches is provided below

Table D3. Secondary species recorded during flight activity surveys 2011-13.

Species	Number of Records	Total Number of Birds
Black-headed gull	2	6
Buzzard	316	402
Canada goose	2	90
Great black-backed gull	1	1
Grey heron	5	5
Greylag goose	2	44
Herring gull	2	4
Kestrel	44	45
Lesser black-backed gull	11	107
Mallard	2	4
Raven	83	124
Snipe	2	2
Sparrowhawk	9	9

Table D4. Details of secondary species recorded during flight activity surveys.

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
27/09/2011	1	ZS	1218	1818	1250	1255	Kestrel	1	2	1		
27/09/2011	1	ZS	1218	1818	1300	1305	Buzzard	1	2		1	
27/09/2011	1	ZS	1218	1818	1315	1320	Buzzard	1	2	1		
27/09/2011	1	ZS	1218	1818	1510	1515	Buzzard	1	3	1		
27/09/2011	2	RP	1235	1550	1235	1240	Raven	1	2	1		
27/09/2011	2	RP	1235	1550	1245	1250	Raven	1	2		1	
27/09/2011	2	RP	1235	1550	1310	1315	Raven	1	1		1	
27/09/2011	2	RP	1235	1550	1315	1320	Raven	1	1	1		
27/09/2011	2	RP	1235	1550	1435	1440	Raven	1	1	1		
27/09/2011	2	RP	1235	1550	1600	1605	Raven	1	2	1		
27/09/2011	2	RP	1235	1550	1610	1615	Raven	1	1		1	
27/09/2011	2	RP	1235	1550	1800	1805	Kestrel	1	1	1	1	
27/09/2011	2	RP	1235	1550	1800	1805	Raven	1	1	1	1	
27/09/2011	2	RP	1535	1850	1815	1820	Raven	2	1	1	1	
27/09/2011	5	KJ	1230	1545	1250	1255	Buzzard	1	2	1	1	
27/09/2011	5	KJ	1230	1545	1355	1400	Buzzard	2	2	1		
27/09/2011	5	KJ	1230	1545	1405	1410	Kestrel	1	2	1		
27/09/2011	5	KJ	1230	1545	1435	1440	Buzzard	2	1	1		
27/09/2011	5	KJ	1230	1545	1440	1445	Grey heron	1	1	1	1	
27/09/2011	5	KJ	1230	1545	1515	1520	Raven	1	2	1	1	
27/09/2011	5	KJ	1530	1830	1610	1615	Grey heron	1	2	1	1	
27/09/2011	5	KJ	1530	1830	1820	1825	Grey heron	1	2	1	1	
28/09/2011	2	ZS	0650	0950	0915	0920	Kestrel	1	2		1	
28/09/2011	2	ZS	0950	1250	1050	1100	Buzzard	1	2	1		
28/09/2011	2	ZS	0950	1250	1140	1145	Buzzard	1	1	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
28/09/2011	2	ZS	0950	1250	1200	1205	Buzzard	3	3	1		
28/09/2011	2	ZS	0950	1250	1240	1245	Buzzard	1	3	1		
28/09/2011	3	KJ	1005	1305	1250	1255	Buzzard	1	2	1	1	
28/09/2011	4	RP	0715	1015	0835	0840	Raven	1	1		1	
28/09/2011	4	RP	1030	1330	1105	1110	Raven	1	2	1	1	1
28/09/2011	4	RP	1030	1330	1215	1220	Buzzard	1	2			1
28/09/2011	4	RP	1030	1330	1220	1225	Kestrel	1	2	1		
28/09/2011	4	RP	1030	1330	1225	1230	Buzzard	1	2	1	1	
28/09/2011	4	RP	1030	1330	1255	1300	Buzzard	1	2	1		
18/10/2011	1	ZS	1150	1450	1250	1255	Raven	1	2		1	
18/10/2011	1	ZS	1150	1450	1340	1345	Buzzard	1	3	1	1	
18/10/2011	1	ZS	1150	1450	1405	1410	Buzzard	1	3		1	
18/10/2011	1	ZS	1505	1805	1640	1645	Kestrel	1	2		1	1
18/10/2011	1	ZS	1505	1805	1650	1655	Raven	3	2	1	1	
18/10/2011	1	ZS	1505	1805	1705	1710	Buzzard	1	3	1	1	
18/10/2011	3	KJ	1500	1800	1510	1515	Buzzard	1	2	1	1	
18/10/2011	4	RP	1455	1755	1705	1710	Kestrel	1	1		1	
19/10/2011	2	RP	850	1150	0925	0930	Raven	1	1	1		
19/10/2011	2	RP	850	1150	1055	1100	Buzzard	1	1		1	1
19/10/2011	2	RP	850	1150	1055	1100	Buzzard	1	1		1	
19/10/2011	2	RP	1205	1505	1300	1305	Raven	2	1		1	
19/10/2011	2	RP	1205	1505	1350	1355	Buzzard	1	1			1
19/10/2011	2	RP	1205	1505	1435	1440	Lesser black-backed gull	2	3	1	1	
19/10/2011	3	ZS	0840	1140	0900	0905	Buzzard	1	2	1	1	
19/10/2011	3	ZS	0840	1140	0925	0930	Raven	1	3	1	1	
19/10/2011	3	ZS	0840	1140	1000	1005	Greylag goose	2	2			

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
19/10/2011	3	ZS	0840	1140	1030	1035	Buzzard	1	3			1
19/10/2011	3	ZS	0840	1140	1040	1045	Buzzard	1	3	1	1	
19/10/2011	3	ZS	0840	1140	1115	1120	Kestrel	1	2	1		
19/10/2011	3	ZS	1200	1500	1200	1205	Kestrel	1	2	1		
19/10/2011	3	ZS	1200	1500	1205	1210	Kestrel	1	2	1		
19/10/2011	3	ZS	1200	1500	1210	1215	Kestrel	1	3	1		
19/10/2011	3	ZS	1200	1500	1210	1215	Raven	3	3	1		
19/10/2011	3	ZS	1200	1500	1255	1300	Buzzard	1	3	1		
19/10/2011	3	ZS	1200	1500	1300	1305	Raven	2	3	1		
19/10/2011	3	ZS	1200	1500	1310	1315	Buzzard	1	2	1	1	
19/10/2011	3	ZS	1200	1500	1310	1315	Raven	2	3	1	1	
19/10/2011	3	ZS	1200	1500	1345	1350	Buzzard	1	2		1	
19/10/2011	3	ZS	1200	1500	1400	1405	Raven	1	3		1	
19/10/2011	3	ZS	1200	1500	1425	1430	Buzzard	1	3	1	1	
19/10/2011	3	ZS	1200	1500	1430	1435	Buzzard	1	3	1	1	
19/10/2011	3	ZS	1200	1500	1435	1440	Buzzard	2	3	1	1	
19/10/2011	4	KJ	1200	1500	1250	1255	Buzzard	1	2	1	1	
30/11/2011	5	ZS	0910	1140	1035	1040	Buzzard	1	3	1		
01/12/2011	1	RP	0810	1010	0800	0805	Buzzard	1	1			1
01/12/2011	1	RP	0810	1010	0840	0845	Buzzard	1	1	1	1	
01/12/2011	1	RP	0810	1010	0905	0910	Buzzard	2	1		1	
01/12/2011	1	RP	0810	1010	0930	0935	Buzzard	1	2		1	
01/12/2011	1	RP	0810	1010	0945	0950	Raven	1	2		1	
01/12/2011	1	RP	0810	1010	0950	0955	Buzzard	1	1		1	
01/12/2011	1	RP	1010	1210	1015	1020	Buzzard	1	2	1	1	
01/12/2011	1	RP	1010	1210	1020	1025	Buzzard	1	2		1	1

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
01/12/2011	1	RP	1010	1210	1020	1025	Raven	1	1		1	
01/12/2011	1	RP	1010	1210	1050	1055	Kestrel	1	1		1	
01/12/2011	1	RP	1010	1210	1105	1110	Raven	1	1		1	
01/12/2011	5	ZS	0745	945	0905	0910	Raven	2	3	1		
23/12/2011	5	MC	0930	1200	0945	0950	Raven	1	2		1	
23/12/2011	5	MC	0930	1200	1046	1051	Raven	1	2		1	
23/12/2011	5	MC	0930	1200	1130	1135	Raven	2	2		1	
23/12/2011	5	MC	0930	1200	1140	1145	Raven	1	2		1	
11/01/2012	1	TC	0900	1200	1130	1135	Raven	1	2		1	
11/01/2012	2	MC	0900	1000	1140	1145	Raven	2	2		1	
14/01/2012	5	MC	1300	1600	1330	1335	Raven	1	1	1		
15/01/2012	5	MC	0900	1200	0935	0940	Buzzard	1	1		1	
15/01/2012	5	MC	0900	1200	0945	0950	Buzzard	1	1		1	
15/01/2012	5	MC	1300	1600	1305	1310	Buzzard	1	2		1	
18/01/2012	3	TC	0900	1600	1235	1240	Buzzard	1	2	1		
18/01/2012	3	TC	0900	1600	1245	1250	Buzzard	1	2	1		
18/01/2012	3	TC	0900	1600	1340	1345	Buzzard	1	1	1		
18/01/2012	4	MC	0900	1200	0910	0915	Buzzard	1	2	1		
05/02/2012	1	RW	1215	1515	1250	1255	Buzzard	1	3	1		
05/02/2012	1	RW	1215	1515	1335	1340	Raven	1	2		1	
05/02/2012	1	RW	1215	1515	1405	1410	Raven	1	2	1		
05/02/2012	1	RW	1215	1515	1410	1415	Buzzard	1	2	1		
06/02/2012	3	RW	1130	1330	1205	1210	Raven	2	2	1		
06/02/2012	3	RW	1130	1330	1305	1310	Buzzard	1	1	1		
06/02/2012	5	JN	1230	1430	1305	1310	Sparrowhawk	1	3		1	1
06/02/2012	5	JN	1230	1430	1325	1330	Buzzard	1	3	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
06/02/2012	5	JN	1230	1430	1350	1355	Buzzard	1	3		1	
06/02/2012	5	JN	1230	1430	1425	1430	Buzzard	1	3		1	1
06/02/2012	5	JN	1500	1700	1515	1520	Buzzard	2	2		1	1
06/02/2012	5	JN	1500	1700	1530	1535	Buzzard	2	3	1	1	
07/02/2012	2	JN	0800	1100	0920	0925	Raven	1	2		1	
07/02/2012	2	JN	0800	1100	0925	0930	Raven	1	2		1	1
07/02/2012	2	JN	0800	1100	1000	1005	Buzzard	1	3	1		
07/02/2012	2	JN	0800	1100	1050	1055	Buzzard	1	1	1		
07/02/2012	2	JN	1200	1500	1205	1210	Raven	1	2	1	1	
07/02/2012	2	JN	1200	1500	1215	1220	Raven	1	1	1		
07/02/2012	2	JN	1200	1500	1415	1420	Buzzard	1	2			
07/02/2012	2	JN	1200	1500	1425	1430	Raven	1	2			
07/02/2012	4	RW	1200	1500	1305	1310	Buzzard	1	2	1		
07/02/2012	4	RW	1200	1500	1325	1330	Buzzard	1	1	1		
03/03/2012	2	RW	1300	1500	1305	1310	Buzzard	1	2	1		
03/03/2012	2	RW	1300	1500	1335	1340	Buzzard	2	3		1	
03/03/2012	2	RW	1300	1500	1350	1355	Buzzard	1	3	1		
03/03/2012	2	RW	1530	1830	1600	1605	Buzzard	3	3	1		
03/03/2012	2	RW	1530	1830	1740	1745	Raven	1	2	1		
09/03/2012	1	RW	0945	1245	1015	1020	Buzzard	1	2	1		
09/03/2012	1	RW	0945	1245	1125	1130	Buzzard	1	2		1	
09/03/2012	1	RW	0945	1245	1205	1210	Buzzard	1	3	1		
09/03/2012	1	RW	0945	1245	1215	1220	Buzzard	1	2	1		
09/03/2012	1	RW	0945	1245	1235	1240	Buzzard	2	2	1		
09/03/2012	1	RW	0945	1245	1240	1245	Buzzard	1	2	1		
09/03/2012	1	RW	1345	1645	1355	1400	Buzzard	1	2	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
09/03/2012	1	RW	1345	1645	1450	1455	Raven	1	2		1	
09/03/2012	1	RW	1345	1645	1505	1510	Buzzard	1	2	1		
09/03/2012	1	RW	1345	1645	1520	1525	Buzzard	1	2	1		
09/03/2012	4	JN	1010	1310	1010	1015	Raven	1	2			
09/03/2012	4	JN	1010	1310	1150	1155	Buzzard	1	1	1		
09/03/2012	4	JN	1010	1310	1200	1205	Buzzard	1	2	1		
09/03/2012	4	JN	1410	1710	1520	1525	Great black-backed gull	1	3	1	1	
16/03/2012	5	ARC	1015	1315	1145	1150	Buzzard	2	2	1		
22/03/2012	1	ARC	0955	1255	1035	1040	Buzzard	1	2	1		
22/03/2012	1	ARC	0955	1255	1055	1100	Buzzard	1	2	1		
22/03/2012	1	ARC	0955	1255	1112	1117	Buzzard	1	2		1	
22/03/2012	1	ARC	0955	1255	1136	1141	Buzzard	1	1		1	
22/03/2012	1	ARC	0955	1255	1152	1157	Buzzard	1	2	1		
22/03/2012	1	ARC	0955	1255	1235	1240	Buzzard	1	1		1	
22/03/2012	1	ARC	0955	1255	1238	1243	Kestrel	1	1		1	
22/03/2012	2	ARC	1420	1720	1444	1449	Buzzard	2	2		1	
22/03/2012	2	ARC	1420	1720	1500	1505	Buzzard	3	2	1		
22/03/2012	2	ARC	1420	1720	1505	1510	Kestrel	1	1		1	
22/03/2012	2	ARC	1420	1720	1525	1530	Kestrel	1	1		1	
22/03/2012	2	ARC	1420	1720	1645	1650	Buzzard	2	3	1		
23/03/2012	4	ARC	0500	0800	0710	0715	Buzzard	1	1	1		
23/03/2012	4	ARC	0905	1205	0950	0955	Buzzard	2	2	1		
23/03/2012	4	ARC	0905	1205	1005	1010	Buzzard	2	3	1		
23/03/2012	4	ARC	0905	1205	1025	1030	Buzzard	1	1	1		
23/03/2012	4	ARC	0905	1205	1115	1120	Buzzard	2	2	1		
04/04/2012	3	CL	1015	1315	1105	1110	Buzzard	1	2	1	1	

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
04/04/2012	3	CL	1015	1315	1130	1135	Buzzard	1	1		1	1
04/04/2012	3	CL	1015	1315	1155	1200	Buzzard	1	2		1	
04/04/2012	3	CL	1015	1315	1225	1230	Buzzard	1	2		1	1
04/04/2012	3	CL	1345	1645	1352	1357	Kestrel	1	1	1	1	1
04/04/2012	3	CL	1345	1645	1405	1410	Buzzard	1	1	1	1	
04/04/2012	3	CL	1345	1645	1410	1415	Buzzard	1	2	1	1	1
04/04/2012	3	CL	1345	1645	1435	1440	Buzzard	1	1	1		
04/04/2012	3	CL	1345	1645	1550	1555	Kestrel	1	1	1		
04/04/2012	3	CL	1345	1645	1615	1624	Kestrel	1	1	1	1	1
04/04/2012	4	SLR	1030	1330	1130	1135	Buzzard	1	2	1		
04/04/2012	4	SLR	1430	1730	1505	1510	Kestrel	1	2	1		
04/04/2012	4	SLR	1430	1730	1540	1545	Kestrel	1	2	1		
04/04/2012	4	SLR	1430	1730	1600	1605	Buzzard	1	2	1		
04/04/2012	4	SLR	1430	1730	1605	1610	Buzzard	1	2	1		
05/04/2012	1	CL	0945	1245	0945	0950	Buzzard	1	1	1		
05/04/2012	1	CL	0945	1245	0950	0955	Raven	1	1	1		
05/04/2012	1	CL	0945	1245	0955	1000	Buzzard	4	2		1	1
05/04/2012	1	CL	0945	1245	0955	1000	Buzzard	1	1	1		
05/04/2012	1	CL	0945	1245	1000	1005	Raven	2	2	1	1	1
05/04/2012	1	CL	0945	1245	1015	1020	Kestrel	1	2		1	1
05/04/2012	1	CL	0945	1245	1040	1045	Buzzard	1	2	1		
05/04/2012	1	CL	0945	1245	1055	1100	Kestrel	1	1	1	1	1
05/04/2012	1	CL	0945	1245	1120	1125	Raven	3	1		1	1
05/04/2012	1	CL	0945	1245	1215	1220	Buzzard	1	1			1
05/04/2012	1	CL	0945	1245	1215	1220	Raven	1	1			1
05/04/2012	1	CL	0945	1245	1220	1225	Buzzard	1	1	1	1	

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
05/04/2012	1	CL	0945	1245	1225	1230	Raven	1	1	1	1	
05/04/2012	1	CL	0945	1245	1230	1235	Buzzard	1	1	1	1	1
05/04/2012	1	CL	1315	1615	1335	1340	Buzzard	2	2		1	1
05/04/2012	1	CL	1315	1615	1400	1405	Raven	3	1			1
05/04/2012	1	CL	1315	1615	1405	1410	Buzzard	1	1	1	1	1
05/04/2012	1	CL	1315	1615	1415	1420	Kestrel	2	1	1	1	1
05/04/2012	1	CL	1315	1615	1500	1505	Buzzard	1	2		1	1
05/04/2012	1	CL	1315	1615	1545	1550	Raven	1	1	1	1	1
05/04/2012	2	SLR	1000	1300	1240	1245	Buzzard	1	3	1		
05/04/2012	2	SLR	1400	1700	1400	1416	Buzzard	1	2	1	1	
05/04/2012	2	SLR	1400	1700	1526	1531	Buzzard	1	2	1		
05/04/2012	2	SLR	1400	1700	1529	1534	Buzzard	1	3	1		
05/04/2012	2	SLR	1400	1700	1530	1535	Buzzard	2	3	1		
05/04/2012	2	SLR	1400	1700	1604	1609	Buzzard	1	2	1	1	
05/04/2012	2	SLR	1400	1700	1605	1610	Buzzard	1	3	1		
06/04/2012	5	SLR	0715	1015	0815	0820	Buzzard	2	3		1	1
06/04/2012	5	SLR	0715	1015	0855	0900	Buzzard	2	2	1	1	1
06/04/2012	5	SLR	0715	1015	0900	0905	Buzzard	2	2	1		
06/04/2012	5	SLR	0715	1015	0905	0910	Buzzard	1	1	1	1	
06/04/2012	5	SLR	0715	1015	0920	0925	Buzzard	2	3	1	1	
06/04/2012	5	SLR	0715	1015	0931	0936	Buzzard	2	3	1	1	
06/04/2012	5	SLR	0715	1015	0943	0948	Grey heron	1	3		1	
06/04/2012	5	SLR	0715	1015	1000	1005	Buzzard	1	3		1	1
06/04/2012	5	SLR	0715	1015	1005	1010	Buzzard	2	2		1	1
06/04/2012	5	SLR	0715	1015	1010	1015	Buzzard	2	3		1	1
06/04/2012	5	SLR	1115	1415	1115	1120	Buzzard	1	2		1	

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
14/05/2012	2	BA	1900	2100	1900	1905	Buzzard	1	1	1		
14/05/2012	2	BA	1900	2100	1925	1930	Sparrowhawk	1	1	1		
14/05/2012	2	BA	1900	2100	2012	2017	Buzzard	1	2	1		
14/05/2012	2	BA	1900	2100	2026	2031	Mallard	2	1	1		
14/05/2012	3	GT	1915	2115	2040	2045	Buzzard	2	2	1		
15/05/2012	1	BA	1630	1930	1650	1655	Sparrowhawk	1	1		1	
15/05/2012	1	BA	1630	1930	1710	1715	Buzzard	1	1	1		
15/05/2012	1	BA	1630	1930	1740	1745	Buzzard	1	2		1	
15/05/2012	1	BA	1630	1930	1820	1825	Lesser black-backed gull	3	2		1	
15/05/2012	1	BA	1630	1930	1830	1835	Buzzard	2	1	1	1	
15/05/2012	1	BA	1630	1930	1830	1835	Sparrowhawk	1	1		1	
15/05/2012	1	BA	1630	1930	1915	1920	Buzzard	1	2	1		
15/05/2012	2	BA	0630	0930	0735	0740	Lesser black-backed gull	4	2	1		
15/05/2012	2	BA	0630	0930	0755	0800	Buzzard	1	2	1		
15/05/2012	2	BA	0630	0930	0800	0805	Buzzard	1	1	1	1	
15/05/2012	2	BA	0630	0930	0810	0815	Buzzard	1	2		1	
15/05/2012	2	BA	0630	0930	0815	0820	Kestrel	1	2	1		
15/05/2012	2	BA	0630	0930	0825	0830	Buzzard	1	2	1	1	
15/05/2012	2	BA	0630	0930	0835	0840	Buzzard	1	2	1		
15/05/2012	2	BA	0630	0930	0845	0850	Buzzard	1	2			
15/05/2012	2	BA	0630	0930	0850	0855	Lesser black-backed gull	1	3	1		
15/05/2012	2	BA	0630	0930	0925	0930	Buzzard	1	2	1		
15/05/2012	2	BA	0630	0930	0925	0930	Kestrel	1	2	1		
15/05/2012	2	BA	1030	1330	1035	1040	Buzzard	1	1	1		
15/05/2012	2	BA	1030	1330	1050	1055	Buzzard	1	2	1		
15/05/2012	2	BA	1030	1330	1055	1100	Buzzard	1	1	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
15/05/2012	2	BA	1030	1330	1100	1105	Kestrel	1	1	1		
15/05/2012	2	BA	1030	1330	1105	1110	Buzzard	1	2		1	
15/05/2012	2	BA	1030	1330	1115	1120	Buzzard	4	2	1	1	
15/05/2012	2	BA	1030	1330	1130	1135	Buzzard	1	2	1		
15/05/2012	2	BA	1030	1330	1135	1140	Buzzard	1	2	1		
15/05/2012	2	BA	1030	1330	1145	1150	Buzzard	2	2	1	1	
15/05/2012	2	BA	1030	1330	1150	1155	Buzzard	1	1	1	1	
15/05/2012	2	BA	1030	1330	1200	1205	Buzzard	2	2	1	1	
15/05/2012	2	BA	1030	1330	1205	1210	Buzzard	2	2			1
15/05/2012	2	BA	1030	1330	1235	1240	Buzzard	1	2	1		
15/05/2012	2	BA	1030	1330	1250	1255	Buzzard	2	2	1		
15/05/2012	2	BA	1030	1330	1300	1305	Buzzard	2	2	1		
15/05/2012	2	BA	1030	1330	1320	1325	Buzzard	1	2	1	1	
15/05/2012	2	BA	1430	1530	1430	1435	Buzzard	1	2		1	
15/05/2012	2	BA	1430	1530	1435	1440	Kestrel	1	1		1	
15/05/2012	2	BA	1430	1530	1440	1445	Kestrel	1	2	1		
15/05/2012	2	BA	1430	1530	1445	1450	Kestrel	1	1	1		
15/05/2012	2	BA	1430	1530	1450	1455	Buzzard	1	2	1		
15/05/2012	2	BA	1430	1530	1500	1505	Buzzard	1	2	1		
15/05/2012	2	BA	1430	1530	1505	1510	Kestrel	1	1	1	1	
15/05/2012	2	BA	1430	1530	1510	1515	Buzzard	1	2	1	1	
15/05/2012	2	BA	1430	1530	1515	1520	Buzzard	2	2	1		
15/05/2012	3	GT	0630	0730	0905	0910	Sparrowhawk	1	1	1		
15/05/2012	3	GT	0830	1130	0940	0945	Buzzard	1	2	1		
15/05/2012	3	GT	0830	1130	1010	1015	Buzzard	1	1	1	1	
15/05/2012	3	GT	0830	1130	1015	1020	Buzzard	2	1	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
15/05/2012	3	GT	0830	1130	1030	1035	Buzzard	1	2	1		
15/05/2012	3	GT	0830	1130	1105	1110	Buzzard	2	2	1	1	
15/05/2012	3	GT	0830	1130	1120	1125	Buzzard	1	1	1		
15/05/2012	3	GT	1230	1530	1255	1300	Buzzard	1	1			1
15/05/2012	3	GT	1230	1530	1315	1320	Buzzard	1	2		1	
15/05/2012	3	GT	1230	1530	1350	1355	Buzzard	1	2	1		
15/05/2012	3	GT	1230	1530	1355	1400	Buzzard	1	1			1
15/05/2012	3	GT	1230	1530	1415	1420	Buzzard	1	1	1		
15/05/2012	3	GT	1230	1530	1510	1515	Buzzard	1	1		1	
15/05/2012	3	GT	1230	1530	1525	1530	Buzzard	1	2		1	
15/05/2012	4	GT	1630	1930	1700	1705	Buzzard	3	2	1	1	
15/05/2012	4	GT	1630	1930	1900	1905	Sparrowhawk	1	1	1		
15/05/2012	4	GT	1630	1930	1920	1925	Buzzard	1	1	1		
16/05/2012	1	BA	1215	1515	1245	1250	Buzzard	1	2		1	
16/05/2012	1	BA	1215	1515	1300	1305	Buzzard	1	2	1		
16/05/2012	1	BA	1215	1515	1305	1310	Buzzard	1	2	1		
16/05/2012	1	BA	1215	1515	1315	1320	Buzzard	1	2	1		
16/05/2012	1	BA	1215	1515	1350	1355	Buzzard	2	2		1	
16/05/2012	1	BA	1215	1515	1350	1355	Raven	1	2		1	
16/05/2012	1	BA	1215	1515	1425	1430	Buzzard	1	2	1		
16/05/2012	1	BA	1215	1515	1440	1445	Buzzard	2	2	1	1	
16/05/2012	1	BA	1215	1515	1455	1500	Buzzard	1	2	1		
16/05/2012	1	BA	1215	1515	1500	1505	Buzzard	1	2		1	
16/05/2012	1	BA	1615	1915	1625	1630	Buzzard	1	2	1		
16/05/2012	1	BA	1615	1915	1635	1640	Kestrel	1	2	1		
16/05/2012	1	BA	1615	1915	1750	1755	Buzzard	1	1	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
16/05/2012	1	BA	1615	1915	1805	1810	Buzzard	1	2	1	1	
16/05/2012	1	BA	1615	1915	1850	1855	Buzzard	2	2	1	1	
16/05/2012	1	BA	1615	1915	1855	1900	Buzzard	1	2		1	
16/05/2012	4	GT	1230	1530	1250	1255	Buzzard	2	2	1		
16/05/2012	4	GT	1230	1530	1320	1325	Sparrowhawk	1	1	1		
16/05/2012	4	GT	1230	1530	1440	1445	Buzzard	1	1	1		
16/05/2012	4	GT	1230	1530	1450	1455	Buzzard	1	2		1	
16/05/2012	4	GT	1230	1530	1500	1505	Buzzard	1	2			1
16/05/2012	4	GT	1630	1930	1630	1635	Buzzard	1	2	1		
31/05/2012	5	KH	0740	1040	0919	0924	Buzzard	1	2	1		
31/05/2012	5	KH	0740	1040	1027	1032	Buzzard	1	2	1		
02/06/2012	5	CL	0335	0635	0412	0417	Raven	1	3			1
02/06/2012	5	CL	0335	0635	0435	0440	Black-headed gull	2	2	1	1	1
02/06/2012	5	CL	0335	0635	0451	0456	Herring gull	2	2			1
02/06/2012	5	CL	0335	0635	0517	0522	Buzzard	1	1	1	1	1
02/06/2012	5	CL	0335	0635	0622	0627	Raven	1	2			1
02/06/2012	5	CL	0335	0635	0625	0630	Kestrel	1	1	1	1	1
02/06/2012	5	CL	0335	0635	0631	0636	Buzzard	2	2			1
02/06/2012	5	CL	0735	1035	0747	0752	Buzzard	3	2		1	1
02/06/2012	5	CL	0735	1035	0817	0822	Black-headed gull	4	2	1	1	1
02/06/2012	5	CL	0735	1035	0842	0847	Buzzard	1	1	1	1	1
02/06/2012	5	CL	0735	1035	0907	0912	Kestrel	1	2	1	1	
02/06/2012	5	CL	0735	1035	0923	0928	Herring gull	2	2	1	1	1
02/06/2012	5	CL	0735	1035	0937	0942	Buzzard	1	2			
02/06/2012	5	CL	0735	1035	0945	0950	Buzzard	1	2	1	1	
02/06/2012	5	CL	0735	1035	1001	1006	Buzzard	1	2		1	1

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
02/06/2012	5	CL	0735	1035	1010	1015	Kestrel	1	1	1	1	1
25/06/2012	2	CL	1250	1550	1312	1317	Buzzard	1	1	1	1	
25/06/2012	2	CL	1250	1550	1413	1418	Buzzard	2	2	1	1	1
25/06/2012	2	CL	1250	1550	1540	1545	Buzzard	2	2	1	1	1
25/06/2012	2	CL	1650	1950	1655	1660	Sparrowhawk	1	1		1	1
25/06/2012	2	CL	1650	1950	1802	1807	Buzzard	1	1	1		
25/06/2012	3	CL	0845	1145	0938	0943	Buzzard	1	2	1		
25/06/2012	3	CL	0845	1145	1101	1106	Buzzard	1	1	1		
25/06/2012	3	CS	1705	2005	1716	1721	Buzzard	1	2			
25/06/2012	4	CS	0900	1200	1029	1034	Buzzard	2	2			
26/06/2012	1	CL	0620	0920	0744	0749	Buzzard	1	2	1		
26/06/2012	1	CL	0620	0920	0807	0812	Raven	2	2	1	1	1
26/06/2012	1	CL	0620	0920	0903	0908	Lesser black-backed gull	2	3	1		
26/06/2012	1	CL	0620	0920	0912	0917	Buzzard	1	1		1	1
26/06/2012	1	CL	1020	1320	1025	1030	Raven	2	2		1	1
26/06/2012	1	CL	1020	1320	1126	1131	Kestrel	1	1	1	1	
26/06/2012	1	CL	1020	1320	1135	1140	Raven	3	1	1	1	
26/06/2012	1	CL	1020	1320	1301	1306	Buzzard	3	2		1	1
26/06/2012	5	CS	0700	1000	0923	0928	Buzzard	1	2		1	
26/06/2012	5	CS	1100	1400	1200	1205	Raven	3	2	1		
09/07/2012	1	CL	0850	1150	0855	0900	Raven	3	1	1	1	1
09/07/2012	1	CL	0850	1150	0950	0955	Buzzard	1	1		1	1
09/07/2012	1	CL	0850	1150	1005	1010	Raven	2	1	1	1	1
09/07/2012	1	CL	0850	1150	1040	1045	Buzzard	1	3	1	1	
09/07/2012	1	CL	1250	1550	1310	1315	Buzzard	1	1	1	1	1
09/07/2012	1	CL	1250	1550	1340	1345	Buzzard	2	2		1	1

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
09/07/2012	1	CL	1250	1550	1355	1400	Buzzard	1	2	1	1	1
09/07/2012	1	CL	1250	1550	1515	1520	Buzzard	1	2			1
09/07/2012	5	SR	0745	1045	0805	0810	Buzzard	1	2		1	1
09/07/2012	5	SR	1145	1445	1435	1440	Buzzard	1	2		1	1
25/07/2012	2	KS	1040	1340	1040	1045	Buzzard	1	2	1		
25/07/2012	2	KS	1040	1340	1055	1100	Buzzard	1	2	1		
25/07/2012	2	KS	1040	1340	1105	1110	Buzzard	1	2	1		
25/07/2012	2	KS	1040	1340	1110	1115	Raven	2	3	1	1	1
25/07/2012	2	KS	1040	1340	1115	1120	Raven	1	2	1	1	
25/07/2012	2	KS	1040	1340	1235	1240	Buzzard	1	2	1		
25/07/2012	2	KS	1040	1340	1240	1245	Buzzard	1	2	1		
25/07/2012	2	KS	1040	1340	1310	1315	Raven	1	2	1	1	
25/07/2012	2	KS	1440	1740	1445	1450	Buzzard	1	2	1		
25/07/2012	2	KS	1440	1740	1450	1455	Raven	1	2	1		
25/07/2012	2	KS	1440	1740	1525	1530	Buzzard	3	1	1		
25/07/2012	2	KS	1440	1740	1535	1540	Kestrel	1	2	1		
25/07/2012	2	KS	1440	1740	1550	1555	Kestrel	1	2	1		
25/07/2012	2	KS	1440	1740	1600	1605	Buzzard	1	2	1		
25/07/2012	2	KS	1440	1740	1615	1620	Kestrel	1	2	1		
25/07/2012	2	KS	1440	1740	1625	1630	Buzzard	1	2	1		
25/07/2012	2	KS	1440	1740	1640	1645	Raven	1	3	1	1	1
25/07/2012	2	KS	1440	1740	1645	1650	Kestrel	1	2	1		
26/07/2012	3	KS	1325	1625	1325	1330	Buzzard	4	1	1		
22/08/2012	5	ZS	1630	1900	1635	1640	Sparrowhawk	1	3		1	
22/08/2012	5	ZS	1630	1900	1700	1705	Buzzard	1	3	1		
22/08/2012	5	ZS	1630	1900	1710	1715	Lesser black-backed gull	7	3	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
22/08/2012	5	ZS	1630	1900	1737	1742	Lesser black-backed gull	4	3	1	1	
22/08/2012	5	ZS	1915	2145	1918	1923	Lesser black-backed gull	57	2	1		
23/08/2012	3	ZS	0845	1145	0930	0935	Buzzard	1	2	1	1	
23/08/2012	3	ZS	0845	1145	0940	0945	Buzzard	1	2	1		
23/08/2012	3	ZS	0845	1145	1015	1020	Kestrel	1	2	1	1	
13/09/2012	9	ZS	1245	1545	1505	1510	Buzzard	1	2	1		
14/09/2012	7	ZS	1000	1300	1015	1020	Raven	2	2	1	1	
14/09/2012	7	ZS	1000	1300	1115	1120	Buzzard	1	2	1		
14/09/2012	7	ZS	1000	1300	1145	1150	Raven	2	2	1		
01/10/2012	9	GJ	1635	1935	1725	1730	Buzzard	1	2	1		
02/10/2012	6	RC	0915	1115	1040	1045	Canada goose	40	2	1		
02/10/2012	7	SS	0920	1220	0955	1000	Canada goose	50	2	1	1	1
17/10/2012	9	ZS	1245	1515	1245	1250	Buzzard	1	2	1	1	
17/10/2012	6	SS	1520	1750	1540	1545	Raven	2	3	1	1	1
17/10/2012	7	RA	1245	1515	1320	1325	Raven	2	3	1		
17/10/2012	7	RA	1245	1515	1340	1345	Raven	3	2	1	1	1
17/10/2012	7	RA	1245	1515	1515	1520	Buzzard	1	2	1	1	1
17/10/2012	7	RA	1525	1755	1535	1540	Raven	2	2	1	1	1
17/10/2012	7	RA	1525	1755	1710	1715	Raven	5	3	1	1	1
18/10/2012	6	SS	0900	1130	1025	1030	Buzzard	1	2	1		
18/10/2012	6	SS	1140	1410	1235	1240	Buzzard	1	2	1		
18/10/2012	7	RA	0900	1130	1055	1100	Raven	2	2	1	1	
04/12/2012	9	SS	0915	1115	1104	1105	Raven	1	2	1	1	
16/01/2013	7	AR	0805	1005	0925	0930	Raven	2	2	1		
16/01/2013	7	AR	1015	1215	1200	1205	Raven	1	2	1		
16/01/2013	7	AR	1015	1215	1200	1205	Raven	1	2	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
26/02/2013	6	AR	1015	1315	1110	1115	Raven	1	2	1		
26/02/2013	6	AR	1015	1315	1110	1115	Raven	1	2	1		
26/02/2013	6	AR	1015	1315	1135	1140	Buzzard	1	3	1		
26/02/2013	6	AR	1015	1315	1140	1145	Buzzard	2	3	1		
26/02/2013	6	AR	1015	1315	1150	1155	Buzzard	3	3	1	1	
26/02/2013	6	AR	1015	1315	1155	1200	Buzzard	3	3	1	1	
26/02/2013	6	AR	1015	1315	1240	1245	Buzzard	1	2		1	
26/02/2013	6	AR	1015	1315	1240	1245	Raven	2	3	1		
26/02/2013	6	AR	1330	1630	1440	1445	Buzzard	2	3		1	
26/02/2013	6	AR	1330	1630	1450	1455	Buzzard	1	2	1		
26/02/2013	6	AR	1330	1630	1525	1530	Raven	1	2	1		
27/02/2013	9	AR	0815	1215	0930	0935	Raven	1	2	1		
27/02/2013	6	ZS	1250	1450	1345	1350	Buzzard	1	3			1
27/02/2013	7	ZS	0830	1245	0840	0845	Buzzard	1	2	1		
27/02/2013	7	ZS	0830	1245	0850	0855	Raven	1	3	1	1	
28/02/2013	6	ZS	0815	1115	0840	0845	Raven	1	2	1	1	
28/02/2013	6	AR	1130	1430	1340	1345	Buzzard	1	2	1		
26/03/2013	9	RA	1250	1450	1430	1435	Buzzard	1	3	1		
26/03/2013	6	SS/JM	1520	1720	1450	1455	Buzzard	1	2	1		
27/03/2013	9	JM	1010	1210	1200	1205	Buzzard	2	2	1		
27/03/2013	9	JM	1010	1210	1200	1205	Buzzard	1	3	1		
27/03/2013	9	JM	1010	1210	1205	1210	Buzzard	2	2	1		
27/03/2013	9	JM	1010	1210	1205	1210	Buzzard	1	3	1		
27/03/2013	9	JM	1220	1420	1250	1255	Buzzard	1	2	1		
27/03/2013	9	JM	1220	1420	1250	1255	Buzzard	1	2	1		
27/03/2013	9	JM	1220	1420	1250	1255	Buzzard	1	2	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
23/04/2013	6	PR	0700	1100	0945	0950	Buzzard	1	1	1		
22/05/2013	9	RS	1410	1710	1630	1635	Buzzard	2	2	1	1	1
22/05/2013	9	RS	1410	1710	1630	1635	Lesser black-backed gull	1	3	1	1	1
22/05/2013	9	RS	1410	1710	1635	1640	Buzzard	2	2	1	1	1
22/05/2013	7	CS	1400	1700	1505	1510	Buzzard	1	1	1		
23/05/2013	6	CS	0835	1135	0930	0935	Buzzard	1	1	1		
23/05/2013	6	RS	1135	1435	1205	1210	Buzzard	1	2	1		
30/05/2013	7	MO	0500	0800	0735	0740	Buzzard	1	2	1		
30/05/2013	7	MO	0500	0800	0745	0750	Buzzard	1	1	1		
30/05/2013	7	MO	0900	1200	0910	0915	Buzzard	1	2	1	1	
30/05/2013	7	MO	0900	1200	1000	1005	Buzzard	1	2	1	1	
30/05/2013	7	MO	900	1200	1035	1040	Snipe	1	2	1		
30/05/2013	7	MO	0900	1200	1130	1135	Buzzard	1	2	1		
05/06/2013	6	MO	1410	1810	1425	1430	Buzzard	1	2	1	1	
05/06/2013	6	MO	1410	1810	1500	1505	Mallard	2	1		1	
05/06/2013	6	MO	1410	1810	1520	1525	Buzzard	1	3		1	
05/06/2013	6	MO	1410	1810	1525	1530	Buzzard	1	3	1	1	
05/06/2013	6	MO	1410	1810	1610	1615	Buzzard	1	2	1	1	
05/06/2013	6	MO	1410	1810	1640	1645	Buzzard	1	3	1	1	
05/06/2013	6	MO	1410	1810	1645	1650	Buzzard	2	3			1
05/06/2013	6	MO	1410	1810	1645	1650	Buzzard	1	2		1	1
05/06/2013	6	MO	1410	1810	1650	1655	Buzzard	1	2	1	1	
05/06/2013	6	MO	1410	1810	1720	1725	Grey heron	1	2	1	1	1
05/06/2013	6	MO	1410	1810	1730	1735	Buzzard	1	2	1		
05/06/2013	6	MO	1410	1810	1735	1740	Buzzard	1	1	1		
05/06/2013	6	MO	1410	1810	1800	1805	Kestrel	1	2		1	

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
05/06/2013	7	MO	1925	2125	2020	2025	Kestrel	1	2		1	
05/06/2013	7	MO	1925	2125	2105	2110	Buzzard	2	2		1	
06/06/2013	7	MO	1100	1400	1120	1125	Buzzard	1	3		1	
06/06/2013	7	MO	1100	1400	1120	1125	Greylag goose	42	3	1	1	
06/06/2013	7	MO	1100	1400	1205	1210	Buzzard	1	2			1
06/06/2013	7	MO	1100	1400	1335	1340	Buzzard	2	2		1	
06/06/2013	7	MO	1500	1800	1600	1605	Kestrel	1	1	1		
06/06/2013	7	MO	1500	1800	1615	1620	Kestrel	1	2	1	1	
06/06/2013	7	MO	1500	1800	1640	1645	Buzzard	1	2	1	1	
06/06/2013	7	MO	1500	1800	1645	1650	Buzzard	1	2	1	1	
06/06/2013	7	MO	1500	1800	1650	1655	Buzzard	1	2	1		
06/06/2013	7	MO	1500	1800	1650	1655	Lesser black-backed gull	25	2	1	1	
06/06/2013	7	MO	1500	1800	1655	1700	Buzzard	1	2		1	
06/06/2013	7	MO	1500	1800	1700	1705	Buzzard	1	3		1	
18/06/2013	9	MO	0915	1215	0945	0950	Buzzard	1	2		1	1
18/06/2013	9	MO	0915	1215	0950	0955	Buzzard	1	2		1	1
18/06/2013	9	MO	0915	1215	1000	1005	Buzzard	1	2	1	1	
18/06/2013	9	MO	0915	1215	1005	1010	Buzzard	2	3		1	1
18/06/2013	9	MO	0915	1215	1010	1015	Buzzard	2	3			1
18/06/2013	9	MO	0915	1215	1020	1025	Buzzard	2	3	1		
18/06/2013	9	MO	0915	1215	1030	1035	Buzzard	2	3	1		
18/06/2013	9	MO	0915	1215	1030	1035	Buzzard	2	3	1		
18/06/2013	9	MO	0915	1215	1030	1035	Buzzard	1	2	1		
18/06/2013	9	MO	0915	1215	1110	1115	Buzzard	1	3	1		
18/06/2013	9	MO	0915	1215	1130	1135	Buzzard	1	2			1
18/06/2013	9	MO	0915	1215	1150	1155	Buzzard	1	2	1		

Date	VP	Observer	VP Start Time	VP Finish Time	5 Min Rec. Start Time	5 Min Rec. End Time	Species	Min Number	Height	On Site	Within Buffer	Out-with Buffer
18/06/2013	6	RS	0925	1225	1145	1150	Buzzard	2	2	1		
18/06/2013	6	RS	0925	1125	1145	1150	Buzzard	1	3	1		
05/07/2013	7	ND	845	1145	920	925	Snipe	1	2	1	1	
05/07/2013	7	ND	0845	1145	1010	1015	Buzzard	1	2	1	1	1
05/07/2013	7	ND	0845	1145	1125	1130	Buzzard	1	2	1	1	1
25/07/2013	6	JM	1430	1730	1505	1510	Buzzard	1	3	1	1	
25/07/2013	6	JM	1430	1730	1510	1515	Buzzard	1	3	1	1	
25/07/2013	6	JM	1430	1730	1705	1710	Buzzard	1	2	1		
25/07/2013	6	JM	1430	2040	1940	1945	Lesser black-backed gull	1	2	1	1	
01/08/2013	6	JM	905	1205	945	950	Buzzard	1	1	1		
27/08/2013	6	ND	1150	1320	1230	1235	Buzzard	1	2	1		
27/08/2013	6	ND	1150	1320	1300	1305	Buzzard	3	2	1	1	
28/08/2013	9	ND	1700	2000	1755	1800	Buzzard	1	2	1		
29/08/2013	7	ND	1350	1700	1655	1660	Buzzard	1	1		1	

D3. Black Grouse Surveys

Surveys were undertaken for black grouse during April and May in 2012 and 2013 (Table D5). No black grouse or signs of black grouse were recorded.

Table D5. Black grouse observations; 2012 and 2013.

Date	Lek number	No. of males	No. of females	Notes
19/04/2012	0	0	0	no black grouse or signs of black grouse recorded
11/05/2012	0	0	0	no black grouse or signs of black grouse recorded
23/04/2013	0	0	0	no black grouse or signs of black grouse recorded
23/05/2013	0	0	0	no black grouse or signs of black grouse recorded

D4. Scarce Breeding Bird Surveys

Scarce Breeding Bird Surveys were conducted in the 2012 and 2013 (March to July) and 2015 (April to July) breeding seasons. The following tables display records of scarce breeding birds (Table D6) and other raptor sightings (D7) and behaviour (showing their protection status if applicable); activity is also shown on Confidential Figure 6.5. Goshawk and peregrine falcon were confirmed to be breeding within the study area in 2012, 2013 and 2015: full details of their breeding success and territory locations can be found in Confidential Technical Appendix 6.2.

Table D6. 2012, 2013 and 2015 scarce breeding bird records – target raptors.

Date	Protection Status	Species	Individuals	Pairs	Age Class/Sex	Territory Number	Notes
15/03/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	13:21, flying at height band 2 for 17 seconds
27/03/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male (1st year)	-	
27/03/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	brief interaction with 1st year male
28/03/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	
28/03/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	displaying
28/03/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	-	different male displaying - very high, lost in clouds
17/04/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	full display for 4 minutes
17/04/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	-	second male in full display for 4 minutes
17/04/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	carrying large prey, flew into trees near nest, likely carrying prey to female on nest
17/04/2012	*Schedule 1, BoCC Green*	Goshawk	-	1		1	
31/05/2012	*Schedule 1, BoCC Green*	Goshawk	-	1		1	
31/05/2012	*Annex 1,*	Peregrine falcon	-	1	Adult	-	flying around for 7 minutes and interacting with

Date	Protection Status	Species	Individuals	Pairs	Age Class/Sex	Territory Number	Notes
	Schedule 1, BoCC Green						buzzards/hunting
15/06/2012	*Schedule 1, BoCC Green*	Goshawk	-	1		1	pair present at nest
15/06/2012	*Schedule 1, BoCC Green*	Goshawk	-	1		3	pair present at nest
15/06/2012	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	-	1		4	present at quarry
19/07/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Juvenile	1	juvenile in trees
19/07/2012	*Schedule 1, BoCC Green*	Goshawk	-	1		1	pair present at nest
19/07/2012	*Schedule 1, BoCC Green*	Goshawk	-	1		3	pair present at nest
19/07/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	circling high
19/07/2012	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	-	circling
27/03/2013	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	-	-		4	potential peregrine nest site, lots of whitewash under a ledge/crack in a quarry face. Grass and twigs sticking out
27/03/2013	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	1	-	Male	4	peregrine falcon arrived from south west and perched ~20m higher up quarry face on a ledge also covered by whitewash. Gorse partially obscuring view of whole legde, seems to be a well used perch, sat there for 18 minutes
27/03/2013	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	1	-	Male	4	same peregrine falcon flew off headed north west
27/03/2013	*Annex 1,*	Peregrine falcon	-	1	Male/female	4	male and female flying around and then landed in

Date	Protection Status	Species	Individuals	Pairs	Age Class/Sex	Territory Number	Notes
	Schedule 1, BoCC Green						quarry. Male went back to previous perch. Female perched just above potential nest site
16/05/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Male (1st year)	3	15:30, height band 2 for 21 seconds
16/05/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Male (1st year)	3	15:30, height band 2 for 18 seconds
17/05/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	07:16, height band 2 for 24 seconds. carrying small prey
17/05/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	2	12:01, height bands 2 and 3 for 45 seconds. Different male to one seen at 07:16
17/05/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Unsexed	2	12:11, height band 2 for 15 seconds
13/06/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	11:30, height band 2
13/06/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	12:11, height band 2 for 25 seconds. landed on prominent tree with prey
13/06/2013	*Schedule 1, BoCC Green*	Goshawk	1	-		3	14:01, height band 2 for 18 seconds
13/06/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	1st year	3	15:31, height band 2 for 18 seconds. carrying prey
26/07/2013	*Schedule 1, BoCC Green*	Goshawk	1	-		2	
26/07/2013	*Schedule 1, BoCC Green*	Goshawk	2+	-	Juvenile	1	young goshawks
26/07/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Male (1st year)	3	16:40, height band 2 for 18 seconds
26/07/2013	*Schedule 1, BoCC Green*	Goshawk	1	-	Adult	1	17:40, height band 3 for 90 seconds
26/07/2013	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	1	-	Juvenile female	4	15:26, height band 2 for 90 seconds. interaction with buzzard

Date	Protection Status	Species	Individuals	Pairs	Age Class/Sex	Territory Number	Notes
21/04/2015	*Schedule 1, BoCC Green*	Goshawk	-	1		1	pair circling
21/04/2015	*Schedule 1, BoCC Green*	Goshawk	1	-		2	seen flying in and then circling
16/05/2015	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	1	-		4	perched and alarm calling, then flew off from cliff
29/05/2015	*Schedule 1, BoCC Green*	Goshawk	1	-	Male	1	flew south west low over canopy
29/05/2015	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	1	-		4	single individual still present at quarry
15/06/2015	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	1	-		4	two short flights at quarry
27/06/2015	*Annex 1, Schedule 1, BoCC Green*	Peregrine falcon	2	-	Fledged chicks	4	flying around quarry

Table D7. 2012, 2013 and 2015 scarce breeding bird records – secondary raptors.

Date	Protection Status	Species	Individuals	Pairs	Age Class/Sex	Notes
15/03/2012	*BoCC Green*	Buzzard	-	3		spread across site
27/03/2012	*BoCC Green*	Buzzard	-	12		spread across site
17/04/2012	*BoCC Green*	Buzzard	2	-	Adult	hunting
17/04/2012	*BoCC Green*	Sparrowhawk	1	-	Female	
31/05/2012	*BoCC Green*	Buzzard		8		spread across site
15/06/2012	*BoCC Green*	Buzzard		8		spread across site
15/06/2012	*BoCC Green*	Sparrowhawk	1	-		

MacArthur Green

Date	Protection Status	Species	Individuals	Pairs	Age Class/Sex	Notes
19/07/2012	*BoCC Green*	Buzzard	-	8		spread across site, 5 pairs have young
19/07/2012	*BoCC Amber*	Kestrel	1	-	Male	hunting over clearfell on site
19/07/2012	*BoCC Green*	Long-eared owl	2	-	Juvenile	minimum 2 juveniles located
27/03/2013	*BoCC Green*	Buzzard	1	-		
27/03/2013	*BoCC Green*	Buzzard	1	-		
16/05/2013	*BoCC Green*	Buzzard	-	11		spread across site
16/05/2013	*BoCC Amber*	Kestrel	1	-	Male	
16/05/2013	*BoCC Green*	Sparrowhawk	-	2	Male/female	2 pairs, likely to be more
13/06/2013	*BoCC Green*	Buzzard	-	11		
13/06/2013	*BoCC Green*	Long-eared owl	1	-	Adult	flushed from ground
13/06/2013	*BoCC Green*	Sparrowhawk	-	2	Male/female	
13/06/2013	*BoCC Amber*	Tawny owl	-	1	Male/female	
13/06/2013	*BoCC Amber*	Tawny owl	-	1	Male/female	
14/06/2013	*BoCC Amber*	Kestrel	1	-	Male	12:04, height band 2 for 6 seconds
26/07/2013	*BoCC Green*	Buzzard	-	14		14 pairs spread across study area, at least 12 successful
26/07/2013	*BoCC Green*	Long-eared owl	-	2		juveniles in thicket, thought to be 2 pairs with one pair successful
26/07/2013	*BoCC Green*	Sparrowhawk	-	2		one breeding pair definitely successful
26/07/2013	*BoCC Green*	Sparrowhawk	1	-	Female	seen in new area
26/07/2013	*BoCC Amber*	Tawny owl	-	5		spread across study area
21/04/2015	*BoCC Green*	Buzzard	1	-		circling
21/04/2015	*BoCC Green*	Buzzard	1	-		circling
21/04/2015	*BoCC Green*	Buzzard	1	-		circing
21/04/2015	*BoCC Green*	Buzzard	1	-		
16/05/2015	*BoCC Green*	Buzzard	1	-		perched, then seen circling before flying off
16/05/2015	*BoCC Green*	Buzzard	1	-		circling
16/05/2015	*BoCC Amber*	Kestrel	1	-	Male	perched then flying away
29/05/2015	*BoCC Green*	Buzzard	1	-		soaring

MacArthur Green

Date	Protection Status	Species	Individuals	Pairs	Age Class/Sex	Notes
29/05/2015	*BoCC Green*	Buzzard	1	-		soaring
29/05/2015	*BoCC Green*	Buzzard	1	-		soaring
29/05/2015	*BoCC Green*	Buzzard	1	-		soaring
15/06/2015	*BoCC Green*	Buzzard	1	-		soaring
15/06/2015	*BoCC Green*	Buzzard	1	-		soaring, mobbed by carrion crow
15/06/2015	*BoCC Green*	Buzzard	1	-		soaring and drifted north
15/06/2015	*BoCC Green*	Buzzard	1	-		flew in low, drifted west
15/06/2015	*BoCC Green*	Buzzard	1	-		interacting with another buzzard travelling west
15/06/2015	*BoCC Green*	Buzzard	1	-		interacting with another buzzard travelling west
15/06/2015	*BoCC Green*	Buzzard	1	-		soaring high over hill
15/06/2015	*BoCC Green*	Buzzard	1	-		short flight west of black hill
15/06/2015	*BoCC Green*	Buzzard	1	-		soaring behind vantage point
27/06/2015	*BoCC Green*	Buzzard	1	-		
27/06/2015	*BoCC Green*	Buzzard	1	-		soaring to west of hill
27/06/2015	*BoCC Green*	Buzzard	1	-		flew off east
27/06/2015	*BoCC Green*	Buzzard	3	-		three buzzards interacting, flew in from south and flew north
27/06/2015	*BoCC Green*	Buzzard	1	-		seen briefly, flying
05/07/2015	*BoCC Green*	Buzzard	6	-		buzzards spotted throughtout day, some interacting in pairs or threes
23/07/2015	*BoCC Green*	Buzzard	1	-		interacting with kestrel
23/07/2015	*BoCC Green*	Buzzard	1	-		flying
23/07/2015	*BoCC Green*	Buzzard	1	-		flying
23/07/2015	*BoCC Amber*	Kestrel	1	-		interacting with buzzard
23/07/2015	*BoCC Amber*	Kestrel	1	-		single flight

D6. Breeding Bird Surveys

Breeding bird surveys were undertaken in the 2011 (April and June) and 2012 (May) breeding seasons. A further series of four breeding bird surveys were conducted on land outside the original development area following changes to the proposed access route during the 2013 breeding season. Upland breeding bird surveys were undertaken following methodology described by Brown & Shepherd (1993). After each survey visit one overview map was then produced showing all target species. The maps from all four survey visits were then compared, enabling the production of composite breeding territory maps. This was done by grouping the observations into territories using the methodology described by Bibby *et al.* (2000). Due to the cryptic nature of many breeding birds and the necessary assumptions made when plotting territories, a minimum and maximum number of territories was identified for each target species and the results are provided in Table D8, Table D9 and Figure 6.10.

Table D8. 2012 breeding wader territories.

Species	Estimated number of territories (breeding pairs)	
	Minimum Number of Territories	Maximum Number of Territories
Curlew	1	1
Oystercatcher	1	1

Table D9. 2013 breeding wader territories.

Species	Estimated number of territories (breeding pairs)	
	Minimum Number of Territories	Maximum Number of Territories
Curlew	0	2
Lapwing	9	10
Oystercatcher	1	2
Snipe	7	12

D7. Winter Walkovers

A series of three winter walkover surveys were conducted in the 2011/2012 and 2012/2013 non-breeding seasons. A further series of two winter walkover surveys were conducted on land outside the original development area following changes to the proposed access route during the 2013/2014 non-breeding season. Tables D8, D9 and D10 detail all birds recorded during the surveys with target species shown in **bold**.

Table D10. Winter walkover summary (2011/2012), species observed on each visit.

Visit 1		Visit 2		Visit 3	
Species	No.	Species	No.	Species	No.
Blackbird	2	Blackbird	1	Blue tit	3
Blue tit	8	Blue tit	13	Buzzard	3
Buzzard	3	Bullfinch	2	Carrion crow	7
Carrion crow	11	Buzzard	3	Chaffinch	15
Chaffinch	37	Carrion crow	19	Coal tit	14
Coal tit	8	Chaffinch	63	**Common crossbill**	**24**
Common crossbill	**68**	Coal tit	23	Dunnock	1
Dunnock	1	**Common crossbill**	**48**	**Fieldfare**	**14**
Fieldfare	**164**	Dunnock	2	Goldcrest	1

Visit 1		Visit 2		Visit 3	
Species	No.	Species	No.	Species	No.
Great spotted woodpecker	1	**Fieldfare**	**28**	Goldfinch	10
Great tit	1	Goldcrest	1	**Goshawk**	**1**
House sparrow	12	**Goshawk**	**1**	Jackdaw	27
Jackdaw	25	Great tit	3	Mallard	4
Jay	2	Lesser redpoll	7	Mistle thrush	2
Lapwing	**1**	Linnet	2	Raven	1
Linnet	4	Meadow pipit	1	Rook	51
Long-tailed tit	2	Mistle thrush	1	Siskin	5
Raven	3	Pheasant	1	Starling	95
Robin	6	Raven	2	Woodpigeon	2
Rook	36	Robin	3		
Siskin	1	Rook	220		
Snipe	**2**	Siskin	6		
Twite	12	Starling	35		
Woodpigeon	1	Wren	5		
Wren	2				

Table D11. Winter walkover summary (2012/2013), species observed on each visit.

Visit 1		Visit 2		Visit 3	
Species	No.	Species	No.	Species	No.
Buzzard	4	Buzzard	12	Buzzard	17
Kestrel	**1**	Carrion crow	33	Carrion crow	34
Raven	2	**Fieldfare**	**30**	Coal tit	1
		Raven	3	Grey wagtail	1
		Snipe	**2**	Jay	2
		Sparrowhawk	1	Mistle thrush	2
		Woodcock	1	**Peregrine falcon**	**1**
				Raven	1
				Rook	46
				Skylark	1
				Song thrush	1
				Sparrowhawk	1
				Wheatear	1
				Woodpigeon	30
				Wren	2

Table D12. Winter walkover summary (2013/2014), species observed on each visit.

Visit 1		Visit 2	
Species	No.	Species	No.
Blackbird	3	Buzzard	2
Buzzard	2	Carrion crow	133
Carrion crow	8	Coal tit	2
Fieldfare	**50**	**Fieldfare**	**1**
Golden plover	**42**	Meadow pipit	6
Great spotted woodpecker	1	Rook	5
Kestrel	**1**	**Snipe**	**10**
Mistle thrush	1	Starling	5
Redwing	**1**	Woodpigeon	4

Robin	1	Wren	1
Rook	73		
Snipe	**2**		
Sparrowhawk	1		
Woodcock	1		
Woodpigeon	1		

D8. Bird Species Index

A total of 87 bird species, or signs, were recorded at, or adjacent, to the site during the ornithological surveys. The table below comprises a list of all these species.

Table D13. All bird species recorded at Highlee (September 2011 to July 2015).

Species		
Black-headed gull	Grey wagtail	Red kite
Blackbird	Greylag goose	Redwing
Blackcap	Hawfinch	Reed bunting
Blue tit	Hen harrier	Robin
Bullfinch	Herring gull	Rook
Buzzard	House martin	Sedge warbler
Canada goose	House sparrow	Siskin
Carrion crow	Jackdaw	Skylark
Chaffinch	Jay	Snipe
Chiffchaff	Kestrel	Song thrush
Coal tit	Lapwing	Sparrowhawk
Common crossbill	Lesser black-backed gull	Spotted flycatcher
Common gull	Lesser redpoll	Starling
Cuckoo	Linnet	Stonechat
Curlew	Long-tailed tit	Swallow
Dipper	Long-eared owl	Swift
Dunnock	Magpie	Tawny owl
Fieldfare	Mallard	Tree pipit
Goldcrest	Meadow pipit	Treecreeper
Golden plover	Merlin	Twite
Goldfinch	Mistle thrush	Wheatear
Goshawk	Osprey	Whinchat
Grasshopper warbler	Oystercatcher	Whitethroat
Great black-backed gull	Peregrine falcon	Willow warbler
Great grey shrike	Pheasant	Wood warbler
Great spotted woodpecker	Pied flycatcher	Woodcock
Great tit	Pied wagtail	Woodpigeon
Greenfinch	Pink-footed goose	Wren
Grey heron	Raven	Yellowhammer

ANNEX E: COLLISION RISK ASSESSMENTS

Highlee Wind Farm will consist of two turbine types of different hub heights. Two of the turbines (T6 and T7) have been modelled as having an upper tip height of 150 m and a rotor diameter of 117 m (turbine Type A) and the remaining eleven have been modelled as having an upper tip height of 176 m and a rotor diameter of 117 m (turbine Type B). All other turbine specifications are the same. In order to account for this variation the Collision Risk Model (CRM) was undertaken assuming all the turbines to be Type A and then all as Type B. The worst case estimated collision risk from the two CRMs has then been used in the assessment. Table E.1 presents the parameters which apply to each CRM.

Table E1. Wind farm parameters.

Size of wind farm envelope	752.905	hectares
Number of turbines	13	turbines
Rotor diameter	117	metres
Hub height	A: 91.5, B: 117.5	metres
Max. rotor depth	1.08704	metres (at 10° pitch angle)
Max. chord	4.2	metres
Pitch	15	degrees
Rotation period	4.28	seconds
Turbine operation time	85	percent
Risk height highest	A: 150, B: 176	metres
Risk height lowest	A: 33, B: 59	metres

Table E2. Flight activity watch data.

VP	Area (ha)	2011/2012 Non-Breeding Season Time (hrs)	2012 Breeding Season Time (hrs)	2012/2013 Non-Breeding Season Time (hrs)	2013 Breeding Season Time (hrs)
1	3.4638	36.00	30.00	N/A	N/A
2	342.0980	36.00	30.00	N/A	N/A
3	505.2580	39.00	37.00	N/A	N/A
4	273.0790	36.00	30.00	N/A	N/A
5*	0.0000	36.00	35.00	N/A	N/A
6	433.2750	N/A	N/A	36.00	36.00
7	229.5560	N/A	N/A	36.00	36.00
8	443.8420	N/A	N/A	7.00	N/A
9*	260.9860	N/A	N/A	31.00	36.00
Total	2491.5278	182.00	162.00	110.00	108.00

* Note VP5's viewshed did not cover the final turbine layout and so the associated data have been excluded from the CRMs below. VP9 is in close proximity to VP4

Birds are assumed to be active during all the daylight hours and this is estimated by calculating the number of hours per day between sunrise and sunset (adjusting for correct latitude) for the survey seasons as follows:

- General breeding season: from the 15th March to the 31st August; and
- General non-breeding season: from the 1st September to the 14th March.

Table E3. Hours Birds Assumed Present Per Season.

Season	Hours Assumed Present
2011/2012 non-breeding season	1,864
2012 breeding season	2,631
2012/2013 non-breeding season	1,864
2013 breeding season	2,631

Outputs for the CRM for the following species are presented in the following order below:

- Golden plover;
- Goshawk;
- Peregrine falcon;
- Pink-footed goose; and
- Red kite.

E1. GOLDEN PLOVER

Table E4. Bird parameters.

Golden plover		
Length (l)	0.28	metres
Wingspan	0.72	metres
Assumed flight speed (v)	14.0	ms^{-1}
Avoidance rate	98	percent

Non-Breeding Season 2011/2012

Turbine Type A

Table E5. Golden plover flight data.

VP	Seconds at Risk Height
1	0.00
2	1805.76
3	0.00
4	0.00

Table E6. Golden plover flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
1	131.6255	0.0000	0.0000
2	13341.8217	3.7596E-05	1.1062E-05
3	21220.8358	0.0000	0.0000
4	10650.0814	0.0000	0.0000
Totals	45344.3644	3.7596E-05	1.1062E-05
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0283	0.0083

Table E7. Golden plover mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.05625		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	191067		m^3
Bird occupancy	58.3781	17.17678	hrs/season
Bird occupancy of rotor swept volume	45.5840	13.412335	bird-sec
Bird transit time	0.0764	0.076370949	secs
No. of transits through rotors	596.8764	175.6209	per season
Estimated collisions	33.5759	9.8791344	per season
Estimated collisions after correction for operation	28.5395	8.3972643	per season
Estimated collisions after avoidance factor	0.5708	0.16794529	per season
Equivalent to 1 bird every	1.7520	5.9543202	seasons

Turbine Type B

Table E8. Golden plover flight data.

VP	Seconds at Risk Height
1	0.00
2	3676.26
3	0.00
4	0.00

Table E9. Golden plover flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
1	131.62554	0.0000	0.0000
2	13341.82	7.65E-05	2.25E-05
3	21220.83582	0.0000	0.0000
4	10650.08139	0.0000	0.0000
Totals	45344.36	7.65E-05	2.4330E-05
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0576	0.017

Table E10. Golden plover mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.05625		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	191067.22		m^3
Bird occupancy	118.84943	34.96946	hrs/season
Bird occupancy of rotor swept volume	92.802516	27.30559	bird-sec
Bird transit time	0.07637095	0.07637095	secs
No. of transits through rotors	1215.1547	357.53896	per season
Estimated collisions	68.355625	20.112501	per season
Estimated collisions after correction for operation	58.102282	17.095626	per season
Estimated collisions after avoidance factor	1.1620456	0.34191251	per season
Equivalent to 1 bird every	0.8605514	2.9247248	seasons

E2. GOSHAWK

Table E11. Bird parameters.

Goshawk		
Length (l)	0.62	metres
Wingspan	1.65	metres
Assumed flight speed (v)	9.7	ms^{-1}
Avoidance rate	98	percent

Non-Breeding Season 2011/2012

Turbine Type A

Table E12. Goshawk flight data.

VP	Seconds at Risk Height
1	0.00
2	0.00
3	0.00
4	42.11

Table E13. Goshawk flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
1	131.626	0.0000	0.0000
2	13341.822	0.0000	0.0000
3	21220.836	0.0000	0.0000
4	10650.081	1.09843E-06	2.57989E-07
Totals	45344.364	1.09843E-06	2.8780E-07
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0008	0.0002

Table E14. Goshawk mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.1011		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	238588.03		m^3
Bird occupancy	1.7056	0.4006	hrs/season
Bird occupancy of rotor swept volume	1.6631	0.3906	bird-sec
Bird transit time	0.1760	0.1760	secs
No. of transits through rotors	9.4500	2.2195	per season
Estimated collisions	0.9552	0.2244	per season
Estimated collisions after correction for operation	0.8119	0.1907	per season
Estimated collisions after avoidance factor	0.0162	0.0038	per season
Equivalent to 1 bird every	61.5812	262.1916	seasons

Turbine Type B

Table E15. Goshawk flight data.

VP	Seconds at Risk Height
1	0.00
2	0.00
3	0.00
4	30.21

Table E16. Goshawk flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
1	131.626	0.0000	0.0000
2	13341.822	0.0000	0.0000
3	21220.836	0.0000	0.0000
4	10650.081	7.88E-07	1.8508E-07
Totals	45344.364	7.88E-07	1.8508E-07
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0006	0.0001

Table E17. Goshawk mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.1011		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	238588		m^3
Bird occupancy	1.2236	0.2874	hrs/season
Bird occupancy of rotor swept volume	1.1931	0.2802	bird-sec
Bird transit time	0.1760	0.1760	secs
No. of transits through rotors	6.7794	1.5923	per season
Estimated collisions	0.6853	0.1609	per season
Estimated collisions after correction for operation	0.5825	0.1368	per season
Estimated collisions after avoidance factor	0.0116	0.0027	per season
Equivalent to 1 bird every	85.8405	365.4793	seasons

Breeding Season 2012

Turbine Type A

Table E18. Goshawk flight data.

VP	Seconds at Risk Height
1	0.00
2	34.21
3	118.16
4	0.00

Table E19. Goshawk flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
1	93.523	0.0000	0.0000
2	9236.646	1.0288E-06	2.80462E-07
3	17178.772	1.91068E-06	9.68747E-07
4	7373.133	0.0000	0.0000
Totals	33882.074	2.93948E-06	1.24921E-06
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0022	0.0009

Table E20. Goshawk mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.1011		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	238588		m^3
Bird occupancy	5.384	2.288	hrs/season
Bird occupancy of rotor swept volume	5.249	2.231	bird-sec
Bird transit time	0.176	0.176	secs
No. of transits through rotors	29.829	12.677	per season
Estimated collisions	3.015	1.281	per season
Estimated collisions after correction for operation	2.563	1.089	per season
Estimated collisions after avoidance factor	0.051	0.022	per season
Equivalent to 1 bird every	19.509	45.907	seasons

Turbine Type B

Table E21. Goshawk flight data.

VP	Seconds at Risk Height
1	0.00
2	24.54
3	84.77
4	0.00

Table E22. Goshawk flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. Hahr^{-1}) Unweighted	Flying time at Risk Height (secs. Hahr^{-1}) Weighted
1	93.523	0.0000	0.0000
2	9236.646	7.38049E-07	2.01201E-07
3	17178.772	1.37071E-06	6.94971E-07
4	7373.133	0.0000	0.0000
Totals	33882.074	2.10876E-06	8.96172E-07
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0016	0.0007

Table E23. Goshawk mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.1011		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	238588		m^3
Bird occupancy	3.862	1.641	hrs/season
Bird occupancy of rotor swept volume	3.766	1.600	bird-sec
Bird transit time	0.176	0.176	secs
No. of transits through rotors	21.399	9.094	per season
Estimated collisions	2.163	0.919	per season
Estimated collisions after correction for operation	1.839	0.781	per season
Estimated collisions after avoidance factor	0.037	0.016	per season
Equivalent to 1 bird every	27.195	63.991	seasons

E3. PEREGRINE FALCON

Table E24. Bird parameters.

Peregrine falcon		
Length (l)	0.48	metres
Wingspan	1.1	metres
Assumed flight speed (v)	12.1	ms^{-1}
Avoidance rate	98	percent

Non-Breeding Season 2011/2012

Turbine Type A

Table E25. Peregrine falcon flight data.

VP	Seconds at Risk Height
1	0.00
2	11.45
3	77.10
4	0.00

Table E26. Peregrine falcon flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. Hahr^{-1}) Unweighted	Flying time at Risk Height (secs. Hahr^{-1}) Weighted
1	131.626	0.0000	0.0000
2	13341.822	2.38438E-07	7.01565E-08
3	21220.836	1.00929E-06	4.72341E-07
4	10650.081	0.0000	0.0000
Totals	45344.364	1.24773E-06	5.42497E-07
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0009	0.0004

Table E27. Peregrine falcon mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.0776		prop.
Flight risk volume	881000000		m^3
Total Combined Rotor Swept Volume	219021		m^3
Bird occupancy	1.937	0.842	hrs/season
Bird occupancy of rotor swept volume	1.734	0.754	bird-sec
Bird transit time	0.130	0.130	secs
No. of transits through rotors	13.400	5.822	per season
Estimated collisions	1.039	0.452	per season
Estimated collisions after correction for operation	0.883	0.384	per season
Estimated collisions after avoidance factor	0.018	0.008	per season
Equivalent to 1 bird every	56.600	130.000	seasons

Turbine Type B

Table E28. Peregrine falcon flight data.

VP	Seconds at Risk Height
1	0.00
2	8.22
3	55.31
4	0.00

Table E29. Peregrine falcon flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. Hahr^{-1}) Unweighted	Flying time at Risk Height (secs. Hahr^{-1}) Weighted
1	131.626	0.0000	0.0000
2	13341.822	1.71054E-07	5.03297E-08
3	21220.836	7.24056E-07	3.38853E-07
4	10650.081	0.0000	0.0000
Totals	45344.364	8.9511E-07	3.89183E-07
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0007	0.0003

Table E30. Peregrine falcon mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.0776		prop.
Flight risk volume	881000000		m^3
Total Combined Rotor Swept Volume	219021		m^3
Bird occupancy	1.390	0.604	hrs/season
Bird occupancy of rotor swept volume	1.240	0.541	bird-sec
Bird transit time	0.130	0.130	secs
No. of transits through rotors	9.610	4.177	per season
Estimated collisions	0.745	0.324	per season
Estimated collisions after correction for operation	0.633	0.275	per season
Estimated collisions after avoidance factor	0.013	0.006	per season
Equivalent to 1 bird every	78.900	182.000	seasons

Breeding Season 2012

Turbine Type A

Table E31. Peregrine falcon flight data.

VP	Seconds at Risk Height
1	0.00
2	7.36
3	0.00
4	0.00

Table E32. Peregrine falcon flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. Hahr^{-1}) Unweighted	Flying time at Risk Height (secs. Hahr^{-1}) Weighted
1	93.523	0.0000	0.0000
2	9236.646	2.21248E-07	6.03148E-08
3	17178.772	0.0000	0.0000
4	7373.133	0.0000	0.0000
Totals	33882.074	2.21248E-07	6.03148E-08
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0002	0.00004

Table E33. Peregrine falcon mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.0776		prop.
Flight risk volume	881000000		m^3
Total Combined Rotor Swept Volume	219021		m^3
Bird occupancy	0.405	0.110	hrs/season
Bird occupancy of rotor swept volume	0.363	0.099	bird-sec
Bird transit time	0.130	0.130	secs
No. of transits through rotors	2.800	0.763	per season
Estimated collisions	0.217	0.059	per season
Estimated collisions after correction for operation	0.185	0.050	per season
Estimated collisions after avoidance factor	0.004	0.001	per season
Equivalent to 1 bird every	270.800	993.000	seasons

Turbine Type B

Table E34. Peregrine falcon flight data.

VP	Seconds at Risk Height
1	0.00
2	5.28
3	0.00
4	0.00

Table E35. Peregrine falcon flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
1	93.52341	0.0000	0.0000
2	9236.646	1.58722E-07	4.32693E-08
3	17178.77	0.0000	0.0000
4	7373.133	0.0000	0.0000
Totals	33882.07	1.58722E-07	4.32693E-08
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0001	0.00003

Table E36. Peregrine falcon mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.0776		prop.
Flight risk volume	881000000		m^3
Total Combined Rotor Swept Volume	219021		m^3
Bird occupancy	0.291	0.079	hrs/season
Bird occupancy of rotor swept volume	0.260	0.071	bird-sec
Bird transit time	0.130	0.130	secs
No. of transits through rotors	2.010	0.548	per season
Estimated collisions	0.156	0.043	per season
Estimated collisions after correction for operation	0.132	0.036	per season
Estimated collisions after avoidance factor	0.003	0.001	per season
Equivalent to 1 bird every	377.400	1384.000	seasons

E4. PINK-FOOTED GOOSE

Table E37. Bird parameters.

Pink-footed goose		
Length (l)	0.675	metres
Wingspan	1.525	metres
Assumed flight speed (v)	17.3	ms^{-1}
Avoidance rate	99.8	percent

Non-Breeding Season 2011/2012

Turbine Type A

Table E38. Pink-footed goose flight data.

VP	Seconds at Risk Height
1	0.00
2	264.15
3	0.00
4	0.00

Table E39. Pink-footed goose flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
1	131.6255	0.0000	0.0000
2	13341.82	5.49974E-06	1.61821E-06
3	21220.84	0.0000	0.0000
4	10650.08	0.0000	0.0000
Totals	45344.36	5.49974E-06	1.61821E-06
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0041	0.0012

Table E40. Pink-footed goose mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.0747		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	246275		m^3
Bird occupancy	8.540	2.513	hrs/season
Bird occupancy of rotor swept volume	8.595	2.529	bird-sec
Bird transit time	0.102	0.102	secs
No. of transits through rotors	84.387	24.830	per season
Estimated collisions	6.306	1.855	per season
Estimated collisions after correction for operation	5.360	1.577	per season
Estimated collisions after avoidance factor	0.011	0.003	per season
Equivalent to 1 bird every	93.279	317.025	seasons

Turbine Type B

Table E41. Pink-footed goose flight data.

VP	Seconds at Risk Height
1	0.00
2	189.5
3	0.00
4	0.00

Table E42. Pink-footed goose flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
1	131.6255	0.0000	0.0000
2	13341.82	3.94546E-06	1.16089E-06
3	21220.84	0.0000	0.0000
4	10650.08	0.0000	0.0000
Totals	45344.36	3.94546E-06	1.16089E-06
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0030	0.0009

Table E43. Pink-footed goose mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.0747		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	246275		m^3
Bird occupancy	6.126	1.803	hrs/season
Bird occupancy of rotor swept volume	6.166	1.814	bird-sec
Bird transit time	0.102	0.102	secs
No. of transits through rotors	60.539	17.813	per season
Estimated collisions	4.524	1.331	per season
Estimated collisions after correction for operation	3.845	1.131	per season
Estimated collisions after avoidance factor	0.008	0.002	per season
Equivalent to 1 bird every	130.026	441.913	seasons

E5. RED KITE

Table E44. Bird parameters.

Red kite		
Length (l)	0.66	metres
Wingspan	1.95	metres
Assumed flight speed (v)	12	ms^{-1}
Avoidance rate	98	percent

Breeding Season 2013

Turbine Type A

Table E45. Red kite flight data.

VP	Seconds at Risk Height
6	0.00
7	103.27
9	0.00

Table E46. Red kite flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
6	13864.8	0.0000	0.0000
7	7345.792	3.90522E-06	1.00595E-06
9	7306.768	0.0000	0.0000
Totals	28517.36	3.90522E-06	1.00595E-06
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0029	0.008

Table E47. Red kite mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.0914		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	244178		m^3
Bird occupancy	7.153	1.842	hrs/season
Bird occupancy of rotor swept volume	7.138	1.839	bird-sec
Bird transit time	0.146	0.146	secs
No. of transits through rotors	49.026	12.629	per season
Estimated collisions	4.485	1.155	per season
Estimated collisions after correction for operation	3.812	0.982	per season
Estimated collisions after avoidance factor	0.076	0.020	per season
Equivalent to 1 bird every	13.115	50.914	seasons

Turbine Type B

Table E48. Red kite flight data.

VP	Seconds at Risk Height
6	0.00
7	74.09
9	0.00

Table E49. Red kite flight activity.

VP	Observation Effort (HaHr)	Flying Time at Risk Height (secs. $Hahr^{-1}$) Unweighted	Flying time at Risk Height (secs. $Hahr^{-1}$) Weighted
6	13864.8	0.0000	0.0000
7	7345.792	2.80157E-06	7.21658E-07
9	7306.768	0.0000	0.0000
Totals	28517.36	2.80157E-06	7.21658E-07
Mean Activity In Wind Farm (hr^{-1})		**Unweighted**	**Weighted**
Rotor height		0.0021	0.0005

Table E50. Red kite mortality estimates.

Estimate	Unweighted	Weighted	
Probability of collision	0.09148		prop.
Flight risk volume	880898850		m^3
Total Combined Rotor Swept Volume	244178		m^3
Bird occupancy	5.131	1.322	hrs/season
Bird occupancy of rotor swept volume	5.120	1.319	bird-sec
Bird transit time	0.146	0.146	secs
No. of transits through rotors	35.171	9.060	per season
Estimated collisions	3.218	0.829	per season
Estimated collisions after correction for operation	2.735	0.705	per season
Estimated collisions after avoidance factor	0.055	0.014	per season
Equivalent to 1 bird every	18.282	70.972	seasons

TECHNICAL APPENDIX 7.1

HIGHLEE HILL WIND FARM - HISTORIC ENVIRONMENT DESK-BASED ASSESSMENT

NOVEMBER 2015

CULTURAL HERITAGE TECHNICAL REPORT NUMBER: 039

Prepared By:

Arcus Consultancy Services

Suite 1C
Swinegate Court East
York
North Yorkshire
YO1 8AJ

T +44 (0)1904 715 470 l **E** info@arcusconsulting.co.uk
w www.arcusconsulting.co.uk

Registered in England & Wales No. 5644976

Prepared by:	Reviewed by:	Approved by:
J. Barnes/L. Jones	H. Kwiatkowski	M. Turner

DATA ENTRY FORM

PROJECT INFORMATION			
Project Title	Highlee Hill Wind Farm		
Description	A historic environment desk-based assessment (DBA) has been undertaken by Arcus Consultancy Services Ltd. ('Arcus') on behalf of RES ('the client') of land at Highlee Hill, near Chesters, in the Scottish Borders. The purpose of the DBA is to inform the Planning Authority for a proposed wind farm development (herein referred to as 'the Development'), for which a planning application is to be submitted in 2016. The archaeological core study area (Figure 1) is located approximately 11 km south-east of Hawick and immediately south of the village of Chesters. Much of the site is occupied by commercial forestry, the rest being in agricultural use (unimproved and improved pasture). The data collection exercise has identified a total of 114 records within the 1km wider study area, which extends up to 1 km from the archaeological core study area. These features include 9 Scheduled Monuments and 3 Listed Buildings. There are no designated Gardens and Designed Landscapes, Battlefields or World Heritage Sites situated within either the core or 1km wider study area. This DBA has revealed that there is low to moderate potential for further archaeological remains to be encountered within the archaeological core study area (albeit this potential may be higher in the open ground, where commercial forestry activities have not taken place). It is considered that any further archaeological remains likely to be encountered are likely to date from the late prehistoric period through to the post-medieval era and to be of local to regional importance. There is also potential for indirect impacts to affect sites in and beyond both the core and 1km wider study areas. This will be investigated fully in the Environmental Statement, taking into account the way in which the Development will affect the setting of significant sites.		
Report Type	Historic Environment Desk-Based Assessment		
Project Start Date	30/01/2014	**Project End Date**	14/10/2015
Contractor Name	Arcus Consultancy Services Ltd.		
Client	RES		
SITE LOCATION INFORMATION			
Site Address	Highlee Hill, near Chesters, Scottish Borders		
Unitary Authority/District	Scottish Borders		
Grid References	NGR 361868 607518		
Area	14.6 km^2		
PROJECT BIBLIOGRAPHY			
Type of Publication	Grey Literature		
Title	Highlee Hill Wind Farm Historic Environment Desk-Based Assessment		

Author	J Barnes	**Date**	14/10/2015

NON-TECHNICAL SUMMARY

A historic environment desk-based assessment (DBA) (supported by a walkover survey) has been undertaken by Arcus Consultancy Services Ltd. ('Arcus') on behalf of RES ('the client') of land at Highlee Hill, near Chesters, in the Scottish Borders. The purpose of the DBA is to inform the Planning Authority for a proposed wind farm development (herein referred to as 'the Development'), for which a planning application is to be submitted in 2016.

The archaeological core study area is based upon the 2015 Scoping Report redline boundary (Figure 1) and is located approximately 11 km south-east of Hawick and immediately south of the village of Chesters. The core study area is bordered to the north by the A6088, to the west by the B6357 and to the east by Jed Water. The core study area is predominantly commercial forestry to the south (Plate 2) and farmland to the north (Plate 3). The desk-based assessment was supported by a site walkover undertaken to validate the dataset and assess the condition and character of the site.

The data collection exercise has identified a total of 114 features within the 1km wider study area, which extends up to 1 km from the archaeological core study area. These features include 9 Scheduled Monuments and 3 Listed Buildings. There are no designated Gardens and Designed Landscapes, Battlefields or World Heritage Sites situated within either the core or 1km wider study area. Of the 114 features situated within the 1km wider study area, 44 are located within the core study area, of which three are Scheduled Monuments.

This DBA has revealed that there is a low-moderate potential for further archaeological remains to be encountered within the archaeological core study area. This is based on the number of records from the HER and the NMRS as well as observations made during the site walkover, taking into account the presence of commercial forestry across most of the development site. The potential may be locally higher in the vicinity of certain known sites, in open ground not previously disturbed by forestry. Unknown archaeological remains that may be encountered are likely to date from the late prehistoric period through to the post-medieval era and to be of local to regional importance. It is considered that potential direct effects can be mitigated by avoidance through design (preservation *in situ*) and where this is not possible, through the implementation of a programme of archaeological recording leading to preservation by record.

There is also potential for indirect impacts to affect sites in and beyond both the core and 1km wider study areas. This will be investigated fully in the Environmental Statement, taking into account the way in which the Development will affect the setting of significant sites.

TABLE OF CONTENTS

Plates

Figures

1 INTRODUCTION

Arcus Consultancy Services Ltd. ('Arcus') has undertaken a historic environment desk-based assessment (DBA), on behalf of RES ('the client') for land at Highlee Hill, near Chesters, in the Scottish Borders.

For the purposes of this DBA, the archaeological core study area is the Development site, the boundary of which was defined by the Scoping Request issued in November 2015. The archaeological core study area is centred at NGR 361868 607518 and covers an area of approximately 14.6 km^2. This archaeological core study area is predominantly covered by commercial plantation forestry and is shown in Figure 1.

A 1km wider study area, which includes the archaeological core study area and land within a 1 km radius (Figure 1), has been used to aid the assessment of the potential for unknown archaeology to survive within the Development site.

1.1 The Development

The Development would consist of 13 wind turbines with a maximum height of 176 metres (m) to blade tip, with associated infrastructure such as turbine foundations, access roads, cabling and grid connection (as described in Chapter 2 of Volume 2 of the Environmental Statement).

The Development will be operational for up to 25 years and hence will not be considered a permanent feature within the landscape. At the end of the 25 years, the site will be decommissioned. Once decommissioned all above ground equipment would be dismantled and removed. Alternatively, the Developer may apply for planning permission to extend the operational life of the Development; however, this would be subject to planning policy at the time should an application be submitted

During construction and operation, the Development may have direct or indirect impacts upon the archaeological features within the area. The effects of the Development will be fully assessed as part of an environmental impact assessment and reported within the Environmental Statement, and where applicable mitigation measures identified and implemented. This report is an initial stage in the assessment process and will be used to inform the Environmental Statement.

1.2 Legislation, Policy and Guidance

The assessment has been undertaken taking into account relevant heritage legislation and guidance as outlined below.

1.2.1 Legislation

- Statutory protection for archaeology is principally outlined in Ancient Monuments and Archaeological Areas Act (1979)[1], as amended; and
- The Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997[2], as amended.

1.2.2 National Policy

- The National Planning Framework 3 – Scotland's Third National Planning Framework[3] (2014), Section 4;
- Scottish Planning Policy[4] (2014) Section 135-151; and
- The Scottish Historic Environment Policy[5] (SHEP) (December 2011).

[1] Ancient Monuments and Archaeological Areas Act (1979) Available at http://www.legislation.gov.uk/ukpga/1979/46 (Accessed on 10/10/2013)
[2] Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997. Available at http://www.legislation.gov.uk/ukpga/1997/9/contents (Accessed on 10/10/2013)
[3] The Scottish Government, (2014), National Planning Framework 3. Available at: http://www.gov.scot/Topics/Built-Environment/planning/National-Planning-Framework [Accessed on 20/04/2015]
[4] The Scottish Government, (2014), Scottish Planning Policy. Available at: http://www.gov.scot/Topics/Built-Environment/planning/Policy [Accessed 20/04/2015]

1.2.3 Development Plan

- The Scottish Borders Local Plan (2008, amended 2010)[6], Structure Plan Policies N14, N15 and N16 sets out how all heritage assets whether of national importance or not are to be protected in regards to new development.

1.2.4 Relevant Guidance

- The Historic Environment Strategy for Scotland[7];
- Historic Scotland (2010) Managing Change in the Historic Environment: Setting[8];
- Planning Advice Note (PAN) 2/2011: Planning and Archaeology[9]; and
- Standards and Guidance for Archaeological Desk-Based Assessments provided by the Chartered Institute for Archaeologists (CIfA)[10].

2 AIMS, METHODOLOGY AND SOURCES

2.1 Aims

The aim of this DBA is to:

- Establish the baseline information regarding archaeology in the archaeological core and 1km wider study areas;
- To establish the archaeological potential and significance of the archaeological core study area; and
- To assess the potential for the Development to harm archaeological resources, either directly or indirectly, within the archaeological core study area.

2.2 Methodology

The following methodology follows those guidelines as outlined in the Chartered Institute for Archaeologists' Standards and Guidance Paper for Historic Environment Desk-Based Assessment (2014)[11].

The DBA comprises of a written report including a description of the baseline heritage resource and archaeological potential of the study area, a description of the area's historic character, the archaeological and historical baseline's significance, the effect of proposed development upon the outlined archaeological and historical resource, and potential mitigation strategies. The following section outlines the methodology used to fulfil the aims of the assessment stated in 2.1 above.

To inform this DBA, an archive search was undertaken in order to identify records of known archaeological features which have the potential to be affected by the Development. This archive search also collected data falling within 1 km of the Development, to inform the assessment of the physical and ground-based archaeological potential of the site. The following sources were consulted in accordance with the best practice guidelines laid down by the Institute for Archaeologists[12] (CIfA).

- Historic Scotland's datasets of nationally designated historic environment assets, including;

[5] Historic Scotland (2011) Scottish Historic Environment Policy, Available at: http://www.historic-scotland.gov.uk/shep-dec2011.pdf [Accessed 20/04/2015]
[6] Scottish Borders (2008, amended 2010) Local Plan. Available at http://www.scotborders.gov.uk/info/178/development_plans/658/consolidated_local_plan [Accessed on 05/03/2014]
[7] The Scottish Government (2014) Our Place in Time: The Historic Environment Strategy for Scotland. Available at http://www.gov.scot/Publications/2014/03/8522/downloads [Accessed on 20/04/2015]
[8] Historic Scotland (2010) Managing Change in the Historic Environment: Setting. Available at http://www.historic-scotland.gov.uk/setting-2.pdf [Accessed on 20/04/2015]
[9] PAN 2/2011: Planning and Archaeology. Available at http://www.gov.scot/Resource/Doc/355385/0120020.pdf [Accessed 05/03/2014]
[10] Chartered Institute for Archaeologists (December 2014) Standards and Guidance for Historic Environment Desk-Based Assessment. IfA : University of Reading. Available at http://www.archaeologists.net/sites/default/files/node-files/CIfAS&GDBA_2.pdf [Accessed 20/04/2015]
[11] *Ibid*
[12] *Ibid*

- Database of World Heritage Sites, dataset downloaded 25/02/2014;
  - Database of Scheduled Monuments, dataset downloaded 25/02/2014;
  - Database of Listed Buildings, dataset downloaded 25/05/2014;
  - Database of Inventoried Gardens and Designed Landscapes, dataset downloaded 25/02/2014; and
  - Database of Inventoried Battlefields, dataset downloaded 25/02/2014.
- The National Monuments Record Scotland (NMRS) including;
  - National Collection of Aerial Photography (NCAP) - Aerial Photography Collection, consulted 10/02/2014; and
  - Archaeological Records, received 05/02/2014.
- The Scottish Border Historic Environment Record (HER), received 05/02/2014; and
- Cartographic Evidence as held by the National Library of Scotland (NLS), consulted on 10/02/2014.

These resources have been collated and examined alongside the results of any recent fieldwork.

To accompany this consultation, Arcus conducted a site walkover to verify the written records, to assess the character of the site, and to note any archaeological features not previously identified. Any previously unknown sites were recorded by use of digital photography, an appropriate scale, and a hand held GPS.

The results of archival research and walkover survey have informed the archaeological baseline and archaeological potential of the Development. The baseline was cross-referenced with the proposed Development scheme to assess the potential for the Development to harm archaeological resources situated within the Development footprint.

3 RESULTS

The results of the DBA are summarised below. Site number references correlate to Table 1.3 found in Appendix I.

3.1 Archaeological core study area description

The archaeological core study area is the Development site, the boundary of which was defined by the Scoping Request issued in November 2015. The archaeological core study area (Figure 1) is located approximately 11 km south-east of Hawick and immediately south of the village of Chesters. The core study area is bordered to the north by the A6088, to the west by the B6357 and to the east by Jed Water. Due to the large area of the site, the geology varies considerably between the hills and the slope towards the valley. The lowland geology is primarily formed by a Sandstone and Argi of the Strathdeen and Inverclyde Group. This bedrock was formed approximately 345 to 385 million years ago in the Carboniferous and Devonian Periods. The local environment would have previously been dominated by rivers and alluvial fans[13]. The geology of the higher ground is primarily formed by Wacke and Mudstone of the Riccarton Group formed approximately 423 to 428 million years ago in the Silurian Period. The local environment would have previously been preciously dominated by deep seas[14].

Where superficial deposits have been recorded for the site these are primarily Devensian till, formed up to 2 million years ago in the Quaternary Period. The local environment was previously dominated by ice age conditions[15].

The site rises from 68 m AOD in the centre of the site, within the valley, to 140 m to the north and 135 m AOD to the south of the valley.

The majority of the land within the redline boundary is currently utilised as commercial forestry plantation (especially on the higher ground in the southern and eastern part of the development site, see Plate 2). The remainder (on Highlee Hill, and around Dykeraw farmstead, and north towards the valley bottom, is agricultural land (mostly a mix of unimproved and improved pasture, see plates 1 and 3).

The non-scheduled part of the Tamshiel Rig settlement was not forested (although mapping suggests it has been in the recent past), and the immediate vicinity of the former farmstead of Westshiels was clear of commercial plantation. The majority of the closer enclosed fields associated with the farmstead are forested though some of the stone walls may survive in part.

3.2 HER and NMRS Archives results summary

Consultation of the Scottish Borders HER, Historic Scotland datasets and the NMRS has identified a total of 101 features within the 1km wider study area, which extends to 1 km from the archaeological core study area. These features include nine Scheduled Monument and three Listed Buildings. There are no Inventoried Gardens and Designed Landscapes, or Inventoried Battlefields or World Heritage Sites situated within the core or 1km wider study areas.

Of the 101 features identified by the HER and NMRS, 32 are situated within the core study area, including three Scheduled Monuments, Dykeraw Tower (Site 6, Plate 3), Tamshiel, Rig (Site 9, Plate 4) and Wheel Causeway (Site 4, Plate 5). Also within the site boundary is the non-designated Highlee Hill (Site 37, Plate 6) which includes the earthwork remains of a potential Iron Age/Roman settlement.

There is one non-designated designed landscape as recorded by the Scottish Border's HER situated within the 1km wider study area which is protected under Policy BE3 of The Scottish Border's Local Plan[16].

3.3 Cartographic Analysis

The National Library of Scotland's (NLS) collection of maps was consulted throughout this project. The following summarises the findings for the core study area.

- Roy's Military Survey of the Lowlands – 1752-55 – Roy's survey of the lowlands shows various settlements across the core study area. These include Lustruther (Site 19) and Dykeraw (Site 111) as recorded on the HER and the Westshiels farmstead (Site 112). One further settlement, a small farmstead labelled Ever Dykeraw (Site 113) may lie within the core study area.

- OS Six Inch – First Edition – The First Edition OS Map shows various features within the core study area, which have been previously recorded by the HER. These sites include the earthworks surrounding Site 100, Highlee Hill Settlement (Site 37), and the sheepfold at Site 54 and Wheel Causeway (Site 9) is labelled as a Roman Road. Dykeraw Tower (Site 6) is also depicted; however, the ruins appear far more extensive than on subsequent OS maps. In addition, the following sites are shown of the first edition OS map which are not included in the HER; the farmsteads of Lustruther (Site 110) and Dykeraw (111) as well as the farmstead of Westshiels (Site 112) in addition to seven sheepfolds (Site 102 – 109) situated across the core study area.

- OS Six Inch – 1923 – This OS map shows little change since the publication of the First edition OS map. The remains depicted at Dykeraw Tower (Site 6) are less extensive and more representative of what can be seen onsite today. Wheel Causeway (Site 9) is shown but not noted as a Roman Road.
- OS Six– 1954 – This map again show shows very little change from earlier mapping; however, the earthworks surrounding Site 100 are annotated as Old Quarries. The surrounding boundaries

---

13 British Geological Society (2014) *Geology of Britain viewer*. Available at http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html [Accessed on 18/02/2014]

14 *Ibid*

15 *Ibid*

16 Scottish Borders (2008, amended 2010) Local Plan. Policy BE3 – Volume 1, Page 46. Available at http://www.scotborders.gov.uk/info/178/development_plans/658/consolidated_local_plan [Accessed on 05/03/2014]

of the Westshiels farmstead are still annotated but appear to extend over a smaller area (Site 112).

3.4 Aerial Photography and National Mapping Programme

Records held by the National Collection of Aerial Photography (NCAP) were consulted. A full list of aerial photographic records consulted is presented in Table 1.2, Section 7.3. No additional features were located within the core study areas which had not already been identified by the HER, The NMRS or through cartographic analysis.

3.5 Walkover Survey

A walkover survey of the core study area was conducted on the 12th through to the 14th of February 2014 with a brief inspection of the surrounding area being conducted on the 11th. The weather was variable over the three days, with blizzards and high winds on the 12th, rain on the 13th and dry weather on the 14th. With the exception of the 12th, visibility was moderate during the site visit. On the 12th visibility ranged from poor to moderate throughout the day. The sites of any known archaeological features were visited and information from the Scottish Borders HER and the NMRS was confirmed. A general walkover of the archaeological core study area was conducted to assess the site for any potentially undiscovered archaeological features. Two additional features including the Westshiels farmstead (Site 112, Plate 7) and a large rectangular enclosure (Site 114, Plate 8) were identified during this site walkover. It was clear from the site visit that commercial forestry activities have caused substantial impact at ground level (from drainage and ground preparation and harvesting activities).

3.6 Historic Landscape Use Assessment

A programme of Historic Landscape Use Assessment (HLA) has been completed by Historic Scotland and the Royal Commission of Ancient and Historical Monuments of Scotland (RCAHMS), for approximately 65% of Scotland. The HLA project highlights important landscapes and the extent of changes that have occurred to the environment[17]. There are thirteen unique landscape characterisations across the 1km wider study area these include:

- Woodland and Forestry, 18th to 20th century;
- Woodland and Forestry, 20th century to present;
- Agriculture and settlement,18th century to present;
- Agriculture and settlement, 18th century to present;
- Agriculture and settlement, 19th century to present;
- Agriculture and settlement, 20th century to present;
- prehistoric-present to moorland and rough grazing;
- 17th- 20th century designed landscape;
- 19th century quarrying;
- Late 20th century to present opencast mining;
- 19th century recreation area;
- 20th century unenclosed improved pasture; and
- 19th century built-up area.

The location of the landscape use assessment areas are shown in Figure 3. This figure shows that the majority of the site to the south is covered by 20th woodland plantation forestry whilst the north is covered by prehistoric – present rough grazing land and medieval and post- medieval settlement.

[17] Historic Scotland (2014) Historic Landscape use Assessment. Available at http://data.historic-scotland.gov.uk/pls/htmldb/f?p=2100:10:0::NO::: [Accessed on 25/02/2014]

3.7 Statistical Accounts for Scotland

The core study area is covered by the Parish of Southdean, Roxburgh statistical account. The 1854 Account makes mention to tumuli or cairns being formerly prevalent throughout the parish[18], this is also noted in the 1791-99 Statistical Account[19]. The tumuli and cairns are noted as having almost disappeared by the time of publication of the 1854 Account. Both the 1791-99 and 1854 Statistical Accounts note that ruins of ancient strongholds or peels as well as ancient encampments still survive on the hilltops. They also note that there are numerous ruins of tower houses situated across the parish. The 1791-99 Account suggests that each camp is situated within view of Southdean-Law which is thought to have acted as a signalling post[20].

3.8 Previous Archaeological Investigations

There have been a number of archaeological investigations conducted within both the core and 1km wider study areas.

Those highlighted of importance by the HER include;

- Forestry and Archaeology at Tamshiel Rig – This survey was undertaken in 1996 by the Centre for Field Archaeology (CFA). This survey was conducted to investigate the effects of forest planting on the remains of the settlement and field system of Tamshiel Rig (Site 9). The investigation concluded that shallow furrow ploughing prior forestry operations had a minimal effect upon larger upstanding archaeological remains. The soils are shallow, and it is thought that in certain cases, deeper root penetration has been controlled by the availability of moisture. Although damage is considered to be less substantial than previously thought, damage has been caused by tree roots and in one case planting. As a result of this report and further considerations, the monument was re-scheduled in 2003 after it had been de-scheduled in 1990.
- Southdean Borders, An Archaeological Survey – The results of this survey was published in 1994[21]. The survey area was selected by the Afforestable Land Survey (ALS) and recorded in detail all remains within the survey area. The analysis focussed upon medieval and post-medieval landscape due to the quality of the late medieval remains identified during the survey. The survey demonstrated the special character of the medieval and post-medieval archaeological remains of Southdean. The area is considered to have the potential to develop the understanding of medieval rural settlement not only in Southdean but in the Borders as a whole.

4 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

4.1 Overview

The data collection exercise has identified a total of 114 features within the 1km wider study area, which extends up to 1 km from the archaeological core study area. These features include 9 Scheduled Monuments and 3 Listed Buildings. There are no Inventoried Gardens and Designed Landscapes, Inventoried Battlefields or World Heritage Sites situated within either the core or 1km wider study area.

Of the 114 features situated within the 1km wider study area, 44 are located within the core study area, of which three are Scheduled Monuments.

[18] Statistical Account of Scotland (1834-45) Southdean County of Roxburgh. Available at http://stat-acc-scot.edina.ac.uk/link/1834-45/Roxburgh/Southdean/[Accessed on 25/02/2014]
[19] Statistical Account of Scotland (1791-99) Southdean County of Roxburgh. Available at http://stat-acc-scot.edina.ac.uk/link/1791-99/Roxburgh/Southdean/ [Accessed on 25/02/2014]
[20] Statistical Account of Scotland (1791-99) Southdean, County of Roxburgh. Available at http://stat-acc-scot.edina.ac.uk/link/1791-99/Roxburgh/Southdean/12/71/ [Accessed on 25/02/2014]
[21] RCAHMS (1994) *Southdean Borders: An archaeological Survey*. RCAHMS: Edinburgh

4.2 The Prehistoric Period – Mesolithic to Bronze Age

There is extensive evidence of prehistoric archaeological remains throughout both the core and 1km wider study area. The most visible remains relates to the hill fort settlement of Southdean Hill (Site 2). RCAHMS has conducted extensive earthwork studies of the settlement on Southdean which have revealed that archaeological remains are not limited to the hilltop but extend to the surrounding area[22] (Site 45). Similar settlement remains are situated just beyond the 1 km study area, approximately 4 km north-west of the fort at Southdean, upon Bonchester Hill.

Two Bronze Age Cairns have also been noted by the HER as having previously existed within the 1km wider study area. These include Coblaw Plantation (Site 34), destroyed by construction of the road, and Hare Cairn (Site 35), situated on the archaeological core study area boundary though no trace of the cairn was visible in 1859 and no evidence of the cairn was noted during the site walkover. The Wheel Causeway (Site 4) and the Spur Earthwork (Site 5) are situated within the core study area boundary. An isolated findspot of two Bronze-Age socketed axes were also discovered at Southdean Law (Site 26).

Iron Age monuments include earthwork banks and ditches thought to be a possible homestead or a settlement (Site 19), Burns Plantation which is a possible Iron Age stock enclosure (Site 24), and Dykehead homestead (Site 1) which was originally concluded to be a homestead though later studies concluded was a settlement.

Other prehistoric monuments situated within the 1km wider study area include The Black Hill Settlement (Site 3). This earthwork has received some damage as a result of plantation forestry.

The core study area also retains numerous prehistoric findspots and features. These include several Neolithic stone artefacts including axes (Sites 25, 29, 33 and 42) and numerous tumuli near Southdean which included a stone chest and human bones (Site 28).

4.3 Iron Age - Roman

There is also evidence of later Iron Age/Roman occupation within the core study area, as represented by Highlee Hill Settlement (Site 37, Plate 6). Survey was restricted by adverse weather conditions at the time of visiting this feature; however; the earthworks of the settlement were clearly visible and well defined.

Within the 1km wider study area, there are further Iron Age/Roman features including an enclosure and the footprint of some rectangular buildings at Coblaw Plantation (Site 38) and several Roman coins which were found prior to 1858 at Wauchope Rig (Site 13). Any features at Wauchope Rig (Site 13) have been destroyed since the area was quarried, ploughed and then planted with conifers.

4.4 Early Medieval – Medieval

The medieval period is well represented within the 1km wider study area. The HER returned several features including the settlements of Wolfehopelee (Site 17), Wauchope Farm (Site 18), Chesters (Site 71), Mackside (Site 72), Dykeraw (Site 73) and Jedhead (Site 74) all of which are shown on Pont's Map of Scotland.

In addition to this, there is further evidence of medieval buildings at Southdean Law (Site 55), documentary evidence of a tower at Wauchope (Site 14), cultivation terraces at Catllee Burn now obscured by plantation forestry (Site 16) ,and evidence of old roads at Southdean Farm (Site 56), part of Wheel Causeway (Site 39) and at Dykeraw Plantation (Site 47).

Within the core study area is the remains of Dykeraw Tower House (Site 6). The remains of the tower house have been scheduled. Although the date is not confirmed it is thought likely to be medieval in date. The remains of the tower house are situated uphill from the remains Southdean Church (Site 7). This monument consists of the remains of the church, primarily the foundations. The church has an association with the Battle of Otterburn, 1388. Due to the proximity of the church to the former tower house, it is likely that they would have held a historical link.

4.5 Later Medieval – Post medieval

Remains dating to the later medieval/post medieval period include the fragmentary remains in the old churchyard of Southdean Parish Church (Site 10). The church is thought to date to 1690 but incorporates earlier medieval features. There is also evidence of a medieval/post-medieval track called Broomhills (Sites 32). In addition to this, a further tower house is documented as being situated at Lustruther (Site 70) of which there is no visible trace today.

4.6 Post-Medieval

There are numerous post-medieval features situated throughout both the core and 1km wider study areas. These include quarries (Sites 49, 51, 52, 58-63 and 68), sheepfolds (Sites 53-54, 65 and 102-109), and farmsteads (Sites 50 and 110- 112). In addition to these post-medieval sites, there are also the remains of a tower wall recorded in 1859 though no visible remains could be seen in 1967 (Site 22), the remains of the Church and Graveyard at Chesters (Sites 10 and 20), and the new Church at Chesters constructed in 1874 (Site 11). There is also a mill pond marked on the first edition OS Map near Mackside (Site 64), a single arch hump backed bridge at Hyndlee Bridge (Site 75), Category C designated Southdean Bridge (Site 12), and Southdean Mill, an early 19th century bride with a wooden sawmill extension which has since been dismantled (Site 40).

4.7 Unknown

The HER returned 14 features for which a date has not been confirmed. This includes a possible branch of Wheel Causeway (Site 23, 36 and 41), ditches (Site 30-31), linear earthworks (Site 33) a bronze axe (Site 46), old roads or tracks (Site 66-67) and a building which is marked on the first edition OS map but for which no date is given (Site 69).

5 ARCHAEOLOGICAL AND HISTORICAL POTENTIAL

5.1 Overview

The following section summarises the potential for further subsurface archaeological remains to occur within the core study area, outlines the potential threat from the Development to these remains, and suggests appropriate further work as well as potential mitigation strategies.

The review of the data collected and the current site condition indicates that there is low-moderate potential for further archaeological remains across the archaeological core study area. Potential is to be higher in open ground, away from areas in which commercial plantation forestry activity is likely to have caused significant ground disturbance. Where they survive, any remains are considered likely to be prehistoric through to post-medieval in date and relate to either agriculture or settlement.

---

[22] *Ibid*

5.2 Archaeological Potential

Table 1.1: Archaeological Potential

Period	Visibility within 1 km study area	Presence or Absence of sites within 1 km study area	Potential for Discoveries within the Development
Prehistoric	Some remains are highly visible such as the hill top settlements. Others are less visible such as isolated findspots.	The HER records numerous prehistoric sites within the 1 km study area, a number of which have been Scheduled. For a number of these features, the location and condition has been confirmed during the site walkover.	Potential for prehistoric remains is considered to be low generally, but may be higher locally especially in close proximity to Tamshiel Rig (Site 9), Wheel Causeway (Site 4) and Hare Cairn (Site 35) as well as in the un-forested areas to the north. Potential is considered to be reduced in areas of dense plantation forestry where significant ground disturbance has resulted.
Roman	Limited visibility, some potential above ground, Iron Age/Roman remains. Others are less visible such as isolated findspots.	The HER records a number of Iron Age/ Roman present within the 1 km study area.	Potential for Roman remains is considered to be generally low, but may be locally high especially in close proximity to Highlee Hill Settlement (Site 37) and the remaining un-forested areas to the north within the core study area. Potential is considered to be reduced in areas of dense plantation forestry where significant ground disturbance has resulted.
Early Medieval - Medieval	Visible, extensive remains across Southdean as recorded by the 1994 RCAHMS survey.	There are numerous medieval remains throughout the 1km wider study area including several scheduled sites, such as Steel Knowe (Site 8).	Potential for medieval remains is considered low-moderate especially in the un-forested area within the north of the core study area.
Post-Medieval	Visible, extensive remains across Southdean as recorded by the 1994 RCAHMS survey. There is also good cartographic and documentary evidence.	There are numerous post-medieval remains throughout the 1km wider study area including several scheduled sites such and Dykeraw Tower (Site 6), which is located within the core study area.	Potential for post-medieval remains is considered generally low to moderate. However, it may be higher especially in the un-forested area within the north of the core study area, in the immediate vicinity of Dykeraw Tower. Although potential is considered to be reduced in the forested area where there are high levels of ground disturbance, it is noted that the remains of the Westshiels farmstead are extant and there is potential for associated and similar remains throughout the core study area.
Modern	Visible – good cartographic and documentary evidence.	There are few modern features of archaeological relevance situated within the 1km wider study area. These are largely linked to established villages, such as Southdean.	Cartographic evidence suggests that there is limited to potential to discovery additional modern archaeology within the Development.

5.3 Potential Impact

Impacts associate with the Development are likely to fall into two types, direct and indirect. Direct impacts are likely to from construction related activities, where these involve ground disturbance, such as excavation to form turbine bases and laydown areas, drainage and cable runs etc. Whilst a final infrastructure layout was not available during the preparation of this DBA, all of the turbines except one will be located within the southern part of the site (i.e., within the commercial forestry), but access will be taken from the north (from the A6088). This will use existing track where possible, but a construction compound will be required at the northern end of the site.

Indirect impacts may occur due to visual (primarily) intrusion into the settings of heritage assets resulting from the erection and operation of the turbines.

5.4 Potential Mitigation

Preservation *in-situ* is the preferred method of mitigation for known archaeological remains. To achieve this is recommended that the following buffers are applied in order to inform the Development design.

- A topple height plus 10% buffer to be applied to all Scheduled Monuments situated within the core study area. This buffer will also cover the non-designated remains of Tamshiel Rig, the Highlee Hill Settlement and the remains of Westshiels Farmstead;
- A 50 m buffer of all other known archaeological sites situated within the core study area (as appropriate); and
- A 10 m buffer of all historical tracks which cross the core study area.

However where this is not possible, or where there is a likelihood of encountering locally important unknown subsurface archaeological remains, a programme of archaeological works leading to preservation by record is considered appropriate.

Due to there being potential for further unknown archaeology within the archaeological core study area, it is proposed that a phased programme of archaeological investigation is undertaken, as outlined below.

- Consultation with the Scottish Borders County Archaeologist to establish appropriate mitigation for potential on-site archaeology;
- fencing features that can be avoided to mitigate accidental incursion and an appropriate level of recording and/or excavation of any features that cannot be avoided;
- Watching Brief on all ground breaking works in areas not previously disturbed by forestry and where known sites are recorded or identified as having higher potential for the survival of associated archaeological remains such as around Dykeraw Tower, Tamshiel Rig Highlee Hill and Westshiels Farmstead.

This programme of archaeological work would be agreed in advance by means of the approval of Written Schemes of Investigation (WSI) by the Local Planning Authority. Implementation of any agreed scheme of works can be secured by an appropriately worded planning condition.

6 CONCLUSION

This DBA has revealed that there is generally a low to moderate potential for further archaeological remains to be encountered within the archaeological core study area. This is based on the number of return of records from the HER and the NMRS as well as observations made during the site walkover. The RCAHMS survey of Southdean also indicates that the potential for archaeological remains on this side of the valley is also likely to be high.

The walkover survey confirmed the data recorded by the HER and the NMRS and noted that the condition of some of the more substantial known features, such as Highlee Hill (Site 37) and Wheel Causeway (Site 4) in the open un-forested ground, is good. The walkover survey also noted that there is potential for post-medieval remains, such as Westshiels farmstead and associated boundaries (Site 112), even within the forested areas. Conversely, many of the sheepfolds noted on the First Edition OS map where no longer identifiable.

However, the commercial forestry is considered likely to have caused damage or destruction of archaeological features (if they existed) across much of the site). The potential that significant undiscovered remains survive within the forested areas is likely to be low (notwithstanding the preservation at Tamshiel Rig and the results of the surveys conducted in the 1990s).

It is considered that any unknown archaeological remains encountered are likely to date from the late prehistoric period through to the post-medieval era and to be of local to regional importance.

In conclusion, any work undertaken within the core study area has the potential to have a direct impact upon both known and previously undiscovered remains, and as such, appropriate mitigation should be agreed in order to reduce this impact. This impact is typically low, but may be higher in specific parts of the site (in the vicinity of Highlee Hill enclosure, Tamshiel Rig, Dykeraw Tower and Westshiels Farmstead).

There is also potential for indirect impacts to affect sites in and beyond both the core and 1km wider study areas. This will be investigated fully in the Environmental Statement, taking into account the way in which the proposed Development will affect the setting of significant sites.

7 SOURCES

7.1 Bibliography

Ancient Monuments and Archaeological Areas Act (1979) Available at http://www.legislation.gov.uk/ukpga/1979/46 (Accessed on 10/10/2013)

Archaeology Data Service, *http:ads.ahds.ac.uk*

British Geological Society (2014) *Geology of Britain viewer*. Available at http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html [Accessed on 18/02/2014]

Chartered Institute for Archaeologists (2015) Standards and Guidance for Historic Environment Desk-Based Assessment. CIfA: University of Reading.

Google (2014) Google Earth Satellite Imagery.

Historic Scotland (1998) Memorandum of Guidance on Listed Buildings and Conservation Areas. Historic Scotland: Edinburgh

Historic Environment (Amendment) (Scotland) Act 2011. Available at http://www.legislation.giv.uk/asp/2011/3/contents/enacted (Accessed on 10/10/2013)

Historic Scotland (2014) Historic Landscape use Assessment. Available at http://data.historic-scotland.gov.uk/pls/htmldb/f?p=2100:10:0::NO: [Accessed on 25/02/2014]

Historic Scotland (2011) Scottish Historic Environment Policy, Available at: http://www.historic-scotland.gov.uk/shep-dec2011.pdf [Accessed 20/04/2015]

Panning (Listed Buildings and Conservation Areas) (Scotland) Act 1997. Available at http://www.legislation.gov.uk/ukpga/1997/9/contents (Accessed on 10/10/2013)

RCAHMS (1994) *Southdean Borders: An archaeological Survey.* RCAHMS: Edinburgh

Scottish Borders (2008, amended 2010) Local Plan. Available at http://www.scotborders.gov.uk/info/178/development_plans/658/consolidated_local_plan [Accessed on 05/03/2014]

Statistical Account of Scotland (1791-99) Southdean County of Roxburgh. Available at http://stat-acc-scot.edina.ac.uk/link/1791-99/Roxburgh/Southdean/ [Accessed on 25/02/2014]

Statistical Account of Scotland (1834-45) Southdean County of Roxburgh. Available at http://stat-acc-scot.edina.ac.uk/link/1834-45/Roxburgh/Southdean/[Accessed on 25/02/2014]

The Scottish Government, (2014), National Planning Framework 3. Available at: http://www.gov.scot/Topics/Built-Environment/planning/National-Planning-Framework [Accessed on 20/04/2015]

The Scottish Government, (2014), Scottish Planning Policy. Available at: http://www.gov.scot/Topics/Built-Environment/planning/Policy [Accessed 20/04/2015]

7.2 Maps

- Pont's Map of Scotland 1583-1614
- Roy's Military Survey of the Lowlands – 1752-55
- First edition 6" OS map – 1863
- 6" OS map – 1923
- 6" OS map – 1954

7.3 Aerial Photography

Table 1.2: Aerial Photographs Consulted

Sortie	Frame	Date	Scale
ASS/51788	132	18/06/1988	24000
ASS/61089	32	05/05/1989	24000
ASS/62/51788	133	18/06/1988	24000
ASS/62888	52	23/06/1988	24000
MER/014/82	38	30/05/1982	12000
MER/014/82	39	30/05/1982	12000
MER/014/82	64	30/05/1982	12000
MER/014/82	65	30/05/1982	12000
MER/014/82	66	30/05/1982	12000
MER/014/82	67	30/05/1982	12000
MER/014/82	67	30/05/1982	12000
MER/014/82	71	30/05/1982	12000
MER/014/82	72	30/05/1982	12000
MER/014/82	73	30/05/1982	12000
MER/014/82	74	30/05/1982	12000
MER/014/82	75	30/05/1982	12000
MER/014/82	76	30/05/1982	12000
MER/014/82	90	30/05/1982	12000
MER/014/82	92	30/05/1982	12000
MER/068/72	5	18/07/1972	11000

8 COPYRIGHT

9 ACKNOWLEDGEMENTS

The author would like to thank the occupants of Charlies Hill for the guided tour of Steel Knowe medieval and later settlements and the Land Owners for permitting access to site.

10 FIGURES

Figure 1 - Archaeological Core and 1km wider study areas

Figure 2 – Archaeological Feature Locations

Figure 3 – Historic Land Use Assessment

Figure 4 – First edition 6” OS map 1863

11 APPENDIX 1 – ARCHIVE AND WALKOVER RESULTS

11.1 Catalogue of archaeological sites and historic buildings

The following catalogue summarises the records for the core and 1km wider study area as held by the Scottish Borders HER and the NMRS. Thirteen additional sites were identified during the walkover survey, aerial photographic and cartographic analysis. The Site ID number relates to the sites location in Figure 7.2. Those highlighted in grey are situated within the core study area.

Table 1.3: Highlee Hill Heritage Assets situated within the archaeological core and 1km wider study areas.

Site ID	Name	Period	Description	Type	Reference Number/ Source	Grid Reference	
						X	Y
1	Dykeheads, homestead moat	Iron Age	This monument is described by RCAHMS as a homestead moat in 1949. Later investigations agreed with this interpretation however in 1979 it was concluded that the feature is an Iron Age Settlement. The monument is rectangular in plan with rounded corners and consists of a steep sided ditch, with an entrance situated to the north-east.	Scheduled Monument Iron Age Settlement	SM number 2116 HER 3090033	358200	607300
2	Southdean Law, fort and settlement	Iron Age	A complex group of remains consisting of an early Iron Age fort. The hill and slopes around the site and the surrounding area are covered with fragmentary remains of a field system. The remains of 11 houses and several enclosures are scattered across the north-east part of the fort.	Scheduled Monument Iron Age Settlement	SM number 2211 HER 3220048	363500	609380
3	Black Hill, Settlement	Prehistoric	An earthwork situated on the western side of Black Hill. The earthwork has been broken and destroyed by forestry cultivation on its north-west side although the interior of the feature remains clear.	Scheduled Monument Earthwork	SM number 2319 3220003	359617	606575
4	Wheel Causeway, section 640m long on south slope of Wardmoor Hill	Prehistoric	The scheduled area of wheel causeway exists as two hollow tracks either side of a demolished turf dyke. This turf dyke was identified during the site walkover (Plate 5). The causeway survives as a Holloway north of the Scheduled area, often ill-defined but also identified during the site walkover (Plate 5).	Scheduled Monument Earthwork	SM number 3423	360881	605713
5	Spur earthwork 1550 m south-west of Westshiels	Prehistoric		Scheduled Monument Earthwork	SM number 3425	360998	605432
6	Dykeraw Tower, Southdean	Medieval	The remains of Dykeraw tower, no confirmed date. Only a portion of the south gable stands (Plate 3).	Scheduled Monument Tower House	SM number 3848 HER number 3220046	362830	609050
7	Southdean Church	13th century	This monument comprises the remains, primarily the foundations of a medieval church of Southdean. The church has associations with the Battle of Otterburn 1388.	Scheduled Monument and Category B Listed Building Church	SM number 7034 HB 15456 HER numbers 3220041	363100	609100
8	Steel Knowe, medieval and later settlements and field systems	Medieval – Post medieval	An extensive group of farmsteads, field systems and enclosures. The remains survive as substantial earthworks.	Scheduled Monument Settlement and field systems	SM number 7144	365173	608725
9	Tamshiel Rig, fort, settlement and field system	Prehistoric	This monument consists of the remains of a settlement which overlies an earlier fort. There are remains of an associated field system to the west and north sides of the monument (Plate 4).	Scheduled Monument Settlement	SM number 10605 HER 3220045	364303	606342
10	Chesters Church	1690	Fragmentary remains in the Old Churchyard of Southdean Parish church. The church is thought to date to 1690 and incorporates mediaeval features. Related sites, Site 20.	Category B Listed Building	HB number 19748	362647	310704
11	Chesters, Southdean Parish Church	1874	An Early English, rectangular-plan buttressed church with gabled porch and single storey, square-plan vestry to rear.	Category C Listed Building	HB number 49195	362415	610896
12	Southdean Bridge	Early 19th century	A single segmental arch spanning Jed Water. Constructed in sandstone rubble with an ashlar coping to the parapet. Also recorded Site 79.	Category C Listed Building	HB number 15461 HER 3223001	362977	609237

Site ID	Name	Period	Description	Type	Reference Number/ Source	Grid Reference	
						X	Y
13	Wauchope Rig	Iron age/roman period	Has been used as quarry, ploughed & planted with conifers, all distinct features have been obliterated. Several roman coins were found prior to 1858.	Homestead	3090004 55128	358570	607100
14	Wauchope Tower	Medieval	No structural remains of the tower are visible; however a tower at the site was noted as being in the possession of Turnbull from 1530 - 1600.	Tower	3090029	357930	608360
15	Route way	Medieval	Linear feature	Linear Feature	3220020	362361 361330	605001 602260
16	Catlee Burn	Medieval	In 1937, nine very visible and four less visible terraces could be seen. They have since been obscured by forestry plantation.	Cultivation terrace	3090030	358800	607200
17	Wolfehopelee	Medieval	Farm buildings shown on Pont's Map as Wolfehopelee.	Farm buildings	3092007	358800	608100
18	Wauchope Farm	Medieval	Farm buildings shown on Pont's Map as Wachope.	Farm buildings	3092008	358000	608400
19	Wolflee Hill	Iron age	Earthwork banks & ditches damaged by cultivation. Early suggestion of Homestead Moat to South (1965). Later (1979) described as a settlement.	Homestead	3220002	359190	608950
20	Chesters	Post-medieval	The remains of the church and graveyard.	Church ruins	3220013 96327	362630	610700
21	Doorpool Hill	Unclassified	Possible circular fort? The fort has double concentric ramparts.	Enclosure	3220014	362270	611350
22	Tower	Post-medieval	Remains of a possible Tower Wall were recorded in 1859. No visible remains could be seen by 1967.	Tower	3220016	362810	610620
23	Wheel Causeway	Unclassified	Two branches off Wheel Causeway?	Road	3220022	362350	604990
24	Burns Plantation	Iron age	Surrounded by ruined wall. Entrance gap at the north end. No defensive quality – possibly a stock enclosure. The feature was recorded as badly mutilated (1973).	Enclosure	3220030	365080	606840
25	West Shiel Farm	Neolithic	Part of axe found 1974. Butt end missing. Retained by finder.	Axe	3220031 3220102	362600	608700
26	Southdean Law	Bronze age	Two socketed axes - one rectangular, other possibly related to rectangular type.	Axe	3220032	363700	609400
27	The Burns	Post-medieval	A possible Roman paved way. Abutment of large squared stones of four courses on side of ravine. Similar stones reported in burn.	Bridge	3220033	364900	606000
28	Southdean	Bronze age	Numerous Tumuli near Southdean. Stone chest and Human Bones discovered. No visible evidence. See cards 322/0036 and 322/0038.	Cairn	3220034	363100	609000
29	Southdean	Neolithic	A number of finds including a Polished greenstone axe, hammer head and whorls.	Not applicable	3220035	363100	609000
30	Wolfhopelee	Unclassified	A ditch with a spread bank was noted in 1945. The ditch was destroyed by road construction and afforestation by 1976. The eastern portion remains.	Boundary	3220036	360580	607190
31	Burnhead Sike	Unclassified	Traces of a ditch with the remains of spread banks (1960).	Boundary	3220037	360170	607960

Site ID	Name	Period	Description	Type	Reference Number/ Source	Grid Reference	
						X	Y
32	Broomhills	Medieval/ Post-medieval	Old track or road marked on 1st edition OS map. Related to Site 52.	Road	3220040 3220112	363090	610930
33	Westshiels	Unclassified	Linear earthwork noted in 1964. A description of the feature in 1976 records the features as a “narrow insignificant ditch”.	Ditch	3220042	360890	605370
34	Coblaw Plantation	Bronze age	Reduced to shapeless mound 0.9m high. There was a cavity in centre mound with large stones. This feature is recorded in 1976 as destroyed by road construction.	Cairn	3220043	362580	605370
35	Hare Cairn	Bronze age	No trace in 1859, but was considerable heap of stones and two cists found beneath it.	Cairn	3220044	360870	605410
36	Wheel Causeway	Unclassified	A branch of Wheel Causeway. Lustruther to Battling Burn/ Wolfhopelee Burn head	Road	3220047	362390	609170
37	Highlee Hill	Iron age/ Roman period	Ditch with earthen bank on either side. The feature is best preserved on its south side. There is an entrance in the east and south-west. Observed during the site visit (Plate 6).	Enclosure	3220050	361580	607980
38	Coblaw Plantation	Iron age/Roman period	Rectangular buildings and an enclosure. Noted as mutilated by afforestation in 1973.	Not applicable	3220051	362930	605360
39	Wheel Causeway	Medieval	A hollow track 2 m deep with numerous branches.	Road	3220067	360000	609200
40	Southdean Mill	Early Modern	An early 19th century mill 2 and 3 storeys in height. The building has a paddle-wheel drive.	Mill	3220071	363430	610460
41	Wardmoor Hill	Unclassified	Wheel causeway, section 640m long on south slope of Wardmoor Hill.	Road	3220072	360840	606110
42	West Shiel Farm	Neolithic	Polished stone. Butt end missing. Facet on one side: White Patine.	Axe	3220073	362000	608700
43	Southdean Law	Multi-period	Cultivation terraces and field-systems cover most of Southdean Law. These include two probable prehistoric field-systems, as well as numerous lynchets, some of which are demonstrably part of the field-systems themselves.	Cultivation terrace	3220075	363650	609360
44	Wolfhopelee Burn	Unclassified	Visible on AP`s.	Enclosure	3220100	360000	607500
45	Black Hill	Unclassified	Cord Rig	Cord rig	3220105	360000	606900
46	Jed Water	Unclassified	Flanged bronze axe.	Axe	3220107	362428	605110
47	Dykeraw Plantation	Medieval	Earthwork road.	Road	3220109	362440	605130
48	Highlee Hill	Unclassified	A cropmark showing a farmstead.	Farmstead	3220110	361300	607900
49	Broomhills	Post-medieval	Quarry marked on 1st edition OS map.	Quarry	3220113	363130	610770
50	Roadside	Post-medieval	A farmstead or set of cottages called ""Roadside"" is marked on the 1st Edition OS map.	Farmstead	3220116	362430	610420
51	Highlee Hill	Post-medieval	Old Quarries"" marked on the 1st Edition OS map.	Quarry	3220117	361800	608600
52	Dykeraw	Post-medieval	Old Quarry"" marked on the 1st Edition OS map.	Quarry	3220118	363260	608550
53	Battling Sike	Post-medieval	Sheepfold"" marked on the 1st Edition OS map.	Stock enclosure	3220119	361460	607330

Site ID	Name	Period	Description	Type	Reference Number / Source	Grid Reference	
						X	Y
54	Highlee Hill	Post-medieval	Stock enclosure	Stock enclosure	3220120	361750	607990
55	Southdean Law	Medieval	A single building is built along the inside chord of a D-shaped enclosure some 475m SW of Slack's Tower; it is situated on the east side of a sike amongst rigged ground. The building measures 12.5m from NE to SW by 6.5m over low grassy banks spread to 2m.	Farmstead	3220121 74663	364000	609660
56	Southdean Farm	Medieval	An old road, from Southdean Mill is marked on the 1st Edition OS map. The road joins the so-called "Drove Road" and continues SE past Slack's Tower.	Road	3220122	363410	610420
57	Old Road	Post-medieval	Old road marked on the 1st Edition OS map.	Road	3220123	363320	609070
58	Southdean Cottages	Post-medieval	Quarry"" marked on the 1st Edition OS map.	Quarry	3220124	363000	609260
59	Southdean Law	Post-medieval	Quarry"" marked on the 1st Edition OS map.	Quarry	3220125	363820	609400
60	Mackside Strips	Post-medieval	Old quarry, marked on the 1st edition OS map.	Quarry	3220153	360640	610120
61	Mackside Strips	Post-medieval	Old quarry, marked on the 1st edition OS map.	Quarry	3220154	360660	610150
62	Back Plantation	Post-medieval	Old quarry, marked on the 1st edition OS map.	Quarry	3220155	360980	610370
63	Mackside Hill	Post-medieval	Old quarry, marked on the 1st edition OS map.	Quarry	3220156	360360	609320
64	Mackside	Post-medieval	Mill pond, marked on the 1st edition OS map.	Mill pond	3220158	360350	610020
65	Mackside Strips	Post-medieval	Sheepfold, marked on the 1st edition OS map.	Stock enclosure	3220160	361220	609860
66	Chesters	Unclassified	Old road or track, marked on the 1st edition OS map.	Road	3220161	362490	611460
67	Chesters	Unclassified	Old road or track, marked on the 1st edition OS map.	Road	3220162	362680	611180
68	Doorpool	Post-medieval	Old quarry, marked on the 1st edition OS map.	Quarry	3220164	361380	611200
69	Doorpool	Unclassified	Building, marked on the 1st edition OS map.	Building	3220167	361290	610830
70	Lustruther	Post-medieval	Taken and burned by Sir John Ratcliffe 1513.Protected a Hamlet ? No trace (1967). Shown on Pont's Map as Lustruther.	Tower	3222001	362400	609200
71	Chesters	Medieval	Shown on Pont's Map as Chesterr.	Village	3222002	362400	610700
72	Mackside	Medieval	Shown on Pont's Map as Maxsyide.	Farmstead	3222003	360400	610100
73	Dykeraw	Medieval	Shown on Pont's Map as O. Dykra.	Farmstead	3222006	363200	608700
74	Jedhead	Medieval	Shown on Pont's Map as Jedd R. Head in Teviotdail.	Village	3222011	362440	605010
75	Hyndlee Bridge	Post-medieval	Single arch, hump backed	Bridge	3223002	359150	606270
76	Lustruther	Medieval – Post Medieval	Possible tower house burned in 1513. No trace of a tower was found at the farm.	Tower House (Possible)	56818	362410	609210

Site ID	Name	Period	Description	Type	Reference Number/ Source	Grid Reference	
						X	Y
77	Wolfelee	Unknown	Cropmarks of cultivation remains, plantation bank centred on NT 5925 0875	Cultivation Remains, Plantation Bank	179475	359200	608700
78	White Burn	Unknown	The site of a former building and rig furrow.	Building, Rig And Furrow	179595	361570	609700
79	Highlee Hill	Post-medieval	Quarry and a possible sheepfold	Quarry(s) (Possible), Sheepfold(S)	179529	361730	608040
80	Highlee Hill	Post-medieval	An enclosure, lazy beds and Rig and furrow	Enclosure(s), Lazy Beds, Rig And Furrow	179592	361020	608080
81	Whiteburn, Manse	Post-medieval	A roofed building with two outshots annotated Manse is depicted on the first edition OS map.	Manse	179761	362860	609760
82	White Burn	Post-medieval	A field shown on the first edition OS map.	Field System	180358	360900	608500
83	Dykeraw Tower	Post-medieval	A potential farmstead is depicted on the first edition OS map as a partially roofed long building.	Farmstead (Possible)	180359	362880	609030
84	Southdean	Bronze-Age	Bronze Age artefacts discovered at Southdean, including a Bronze Age flat axe, two Middle Bronze Age flanged axes, art of Middle Bronze Age rapier blade, and a Late Bronze Age ribbed socketed axe as well as a Bronze Age blade.	Flanged Axehead(s) (Bronze), Flat Axehead (Bronze), Rapier, Socketed Axehead(s) (Bronze)	56821	363000	609000
85	Southdean Mill	Post Medieval	A saw mill situated north of Southdean on a mill race channelled off the Jed Water.	Saw Mill, Watermill	97469	363360	610420
86	Dykeheads	Post Medieval	Field Boundary(s) (Possible), Rig And Furrow	Field Boundary(s) (Possible), Rig And Furrow	179482	358100	607430
87	Carter Burn	Unknown	A turf enclosure to the south of the Carter Burn. A rectilinear structure is depicted on the first edition OS map.	Enclosure	119059	364700	608190
88	Spar Plantation Sheepfold	Post Medieval	Rig and furrow at Spar Plantation	Rig And Furrow	179521	360050	608600
89	White Burn	Post Medieval	Farmstead, Lazy Beds, Rig And Furrow at White Burn	Farmstead, Lazy Beds, Rig And Furrow	179599	361860	609840
90	Wolfelee	Romano-British	Metal finds including a Romano-British copper-alloy trumpet brooch and a Roman-style iron axehead.	Axehead (Iron), Brooch (Roman)	169499	359100	608900
91	Burnhead Sike	Unknown	Bank, earthworks and enclosures	Bank (Earthwork)(s), Enclosure(s) (Possible), Sheepfold	179512	360100	607640
92	Spar Sike	Unknown	Enclosure and rig and furrow	Enclosure, Rig And Furrow	179525	360720	608830
93	Slack's Tower	Unknown	Extensive but patchy remains of rig, partly reduced by recent cultivation and a rectilinear turf-walled enclosure are also depicted on the First Edition OS map.	Boundary Bank(s), Plantation Bank, Rig And Furrow, Stock Enclosure(s)	74662	364100	609700
94	Wolfehopelee Burn	Unknown	The east portion of an earthwork remains at this location. It is thought possible to be part of an old land boundary.	Linear Earthwork	56819	360690	607250
95	Carter Burn	Unknown	A rectangular turf-walled enclosure is situated to the south of the Carter Burn. It is divided roughly into two compartments.	Enclosure	119058	364530	608330
96	Spar Plantation	Unknown	Possible remains of buildings, field boundaries and rig and furrow at Spar Plantation	Building(s) (Possible), Field Boundary(s), Rig And Furrow	179524	360440	608820

Site ID	Name	Period	Description	Type	Reference Number/ Source	Grid Reference	
						X	Y
97	Highlee Hill	Post Medieval	Sheepfold on Highlee Hill	Sheepfold(s)	179589	361240	608190
98	Burnhead Sike	Unknown	Track at Burnhead Sike	Track	179958	360100	607650
99	Lustruther Strip	Unknown	Earthwork bank, field boundaries, plantation banks, quarry and rig and furrow	Bank (Earthwork)(s), Field Boundary(s), Plantation Bank(s), Quarry(s), Rig And Furrow	179594	361900	608750
100	Lustruther Strip	Unknown	Track at Lustruther Strip	Track	180021	361940	608750
101	Wauchope/Wolflee	Unknown	Designed Landscape	Designed Landscape	SBC 113	358242	608413
102	Sheepfold	Post Medieval	A sheepfold depicted on the first edition OS Map	Sheepfold	Cartographic analysis	363095	607454
103	Sheepfold	Post Medieval	A sheepfold depicted on the first edition OS Map	Sheepfold	Cartographic analysis	363598	607972
104	Sheepfold	Post Medieval	A sheepfold depicted on the first edition OS Map	Sheepfold	Cartographic analysis	363413	606975
105	Sheepfold	Post Medieval	A sheepfold depicted on the first edition OS Map	Sheepfold	Cartographic analysis	362837	606848
106	Sheepfold	Post Medieval	A sheepfold depicted on the first edition OS Map	Sheepfold	Cartographic analysis	362651	606705
107	Sheepfold	Post Medieval	A sheepfold depicted on the first edition OS Map	Sheepfold	Cartographic analysis	361884	606371
108	Sheepfold	Post Medieval	A sheepfold depicted on the first edition OS Map	Sheepfold	Cartographic analysis	361646	605726
109	Sheepfold	Post Medieval	A sheepfold depicted on the first edition OS Map	Sheepfold	Cartographic analysis	359467	607244
110	Lustruther	Post Medieval	Lustruther Farmstead, still extant	Farmstead	Cartographic analysis	362368	609241
111	Dykeraw Farmstead	Post Medieval	Dykeraw Farmstead identified on cartographic survey	Farmstead	Cartographic analysis	363233	608587
112	Westshiels Farmstead	Post Medieval	Westshiels Farmstead identified on cartographic survey and walkover survey	Farmstead	Walkover Survey	362417	606433
113	Ever Dykeraw	Post Medieval	Ever Dykeraw identified on cartographic survey	Farmstead	Cartographic analysis	363558	608015
114	Highlee	Post Medieval	Large rectangular enclosure	Enclosure	Walkover Survey	361097	607526

12 APPENDIX II – PLATES

Plate 1 – General view of the archaeological core study area facing north-east across the farmland of the north

Plate 2 – General view of plantation forestry

Plate 3 – Detail of Dykeraw Tower (Site 6)

Plate 4 – General view of Tamshiel Rig (Site 9)

Plate 5 – Detail view along the Scheduled Section of Wheel Causeway (Site 4)

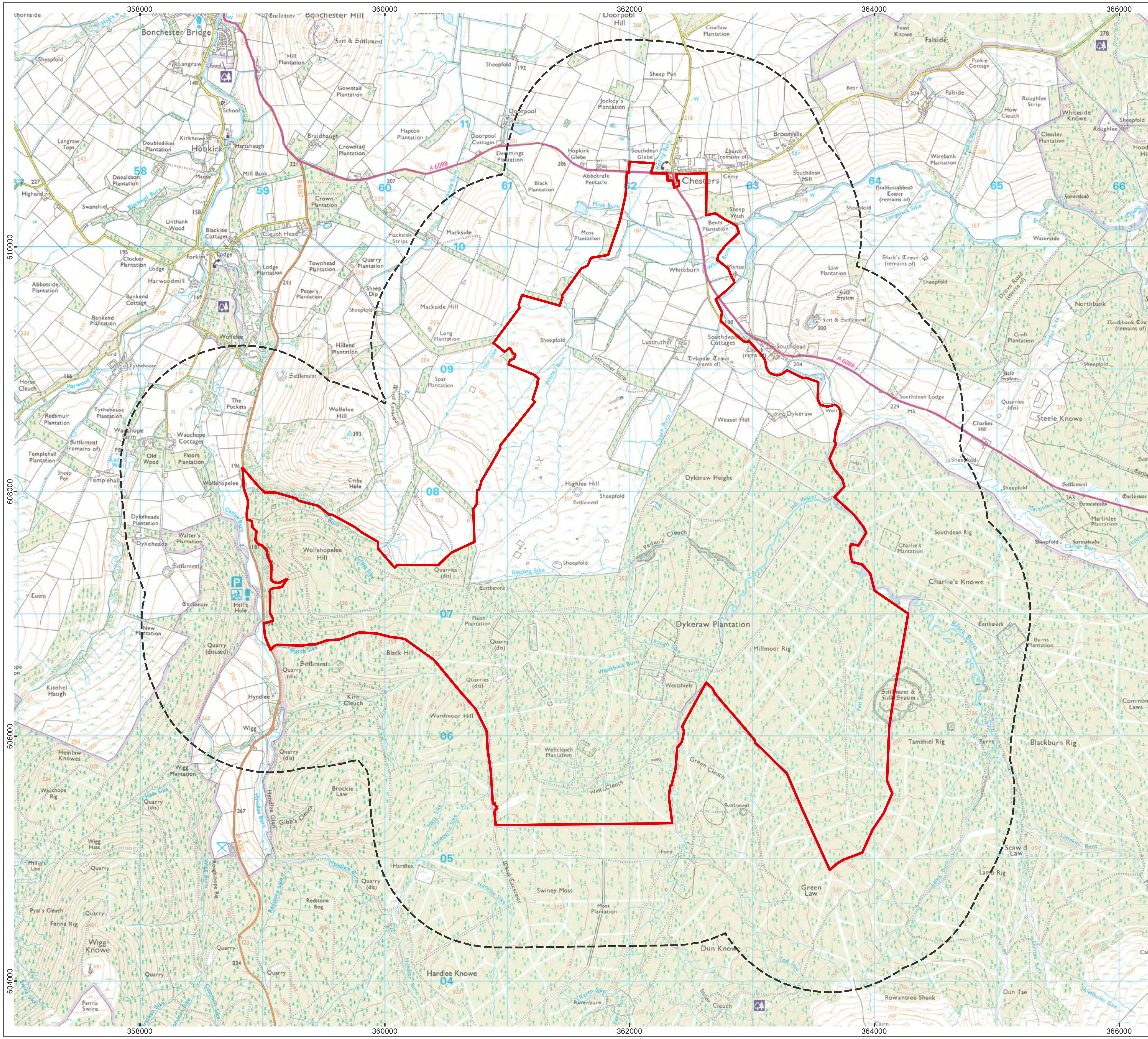
Plate 6a – Detail of Highlee Hill Settlement (Site 37)

Plate 6b – Detail of Highlee Hill Settlement (Site 37)

Plate 7a – Detail of the ruins of Westshiels Farmstead (Site 112)

Plate 7b - Detail of the ruins of Westshiels Farmstead (Site 112)

Plate 8 – Detail of rectangular enclosure (Site 114)



Core Study Area

Wider Study Area

1:30,000 Scale @ A3

0 0.5 1 km

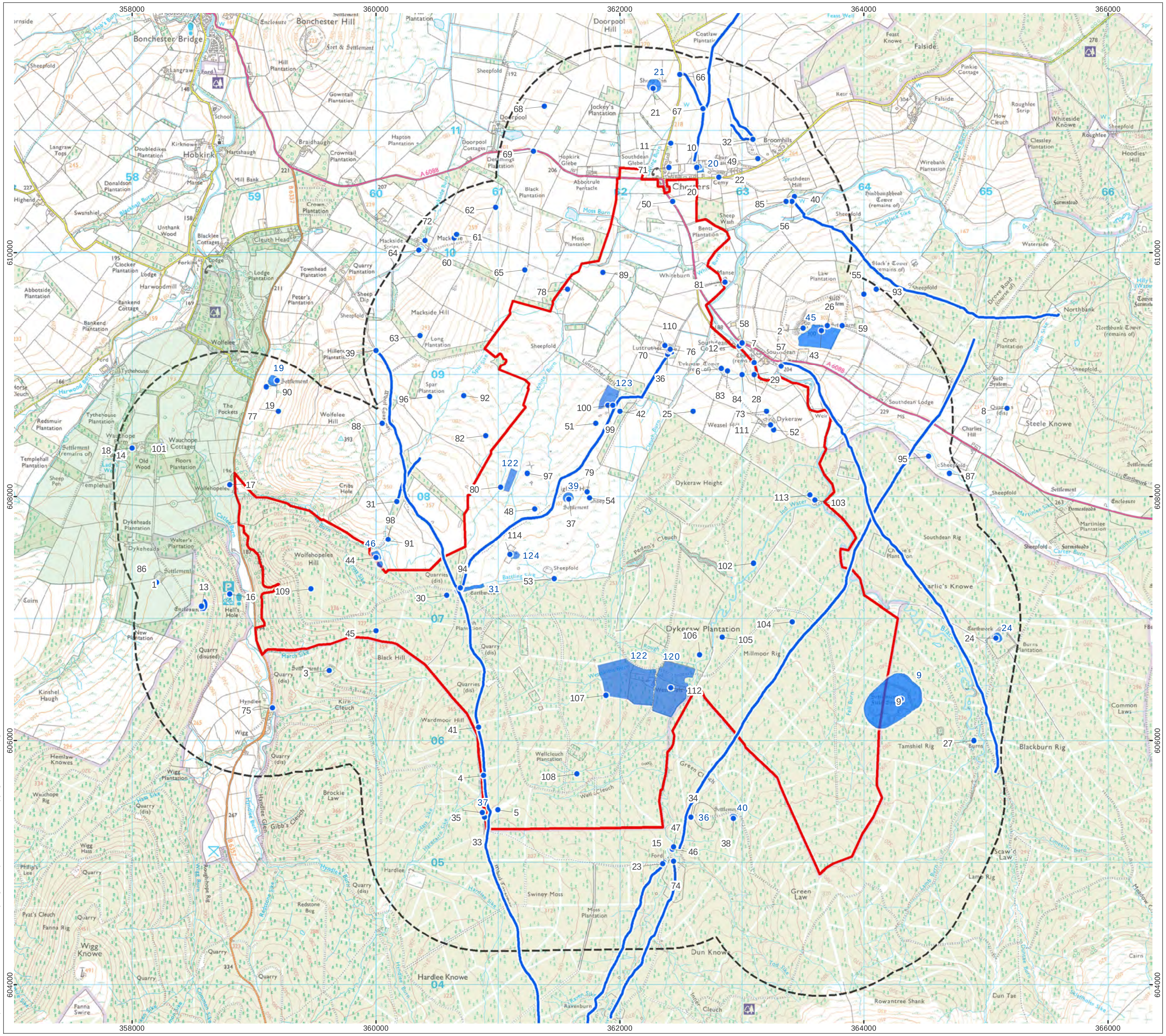
N

Produced: LJ Reviewed: SC Approved: MT	Ref: 2053/REP/001 Date: 15/10/2015

Archaeological
Core and Wider Study Areas
Figure 1

Highlee Hill Wind Farm
Historic Environment
Desk-Based Assessment

N:\Projects\2053 Highlee Hill Wind Farm Technical Services\GIS\Document Files\Reports\Historic Environment Desk-Based Assessment\2053_Figure 1_Core and Wider Study Areas.mxd



res

ARCUS

Core Study Area
Wider Study Area
Undesignated Designed Landscape
Heritage Feature Area
Linear Heritage Feature

1:30,000 Scale @ A3

0 0.5 1 km

N

Produced: LJ
Reviewed: SC
Approved: MT

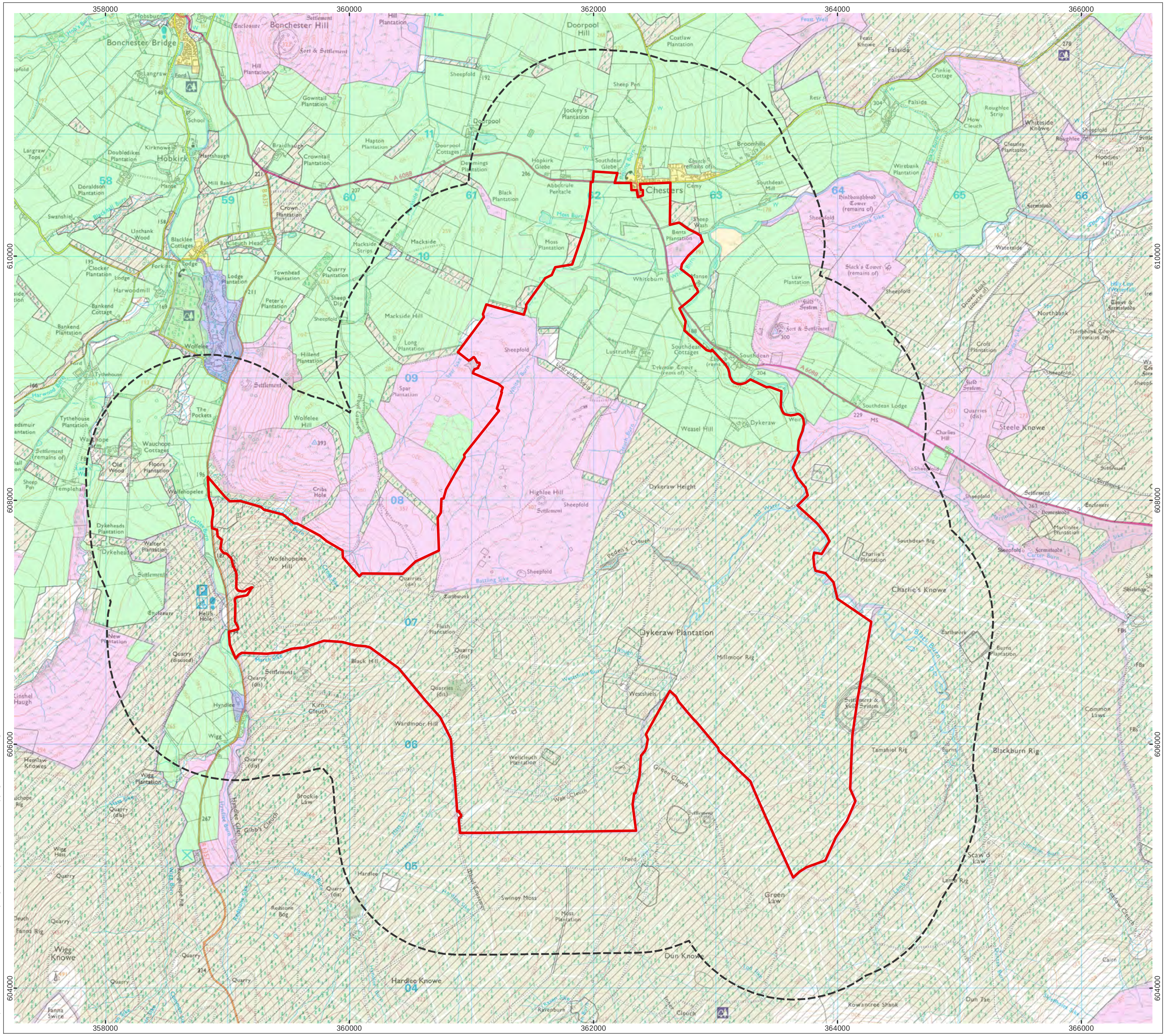
Ref: 2053/REP/002

Date: 23/05/2016

Heritage Features
Figure 2

Highlee Hill Wind Farm
Historic Environment
Desk-Based Assessment

P:\Projects\2053 Highlee Hill Wind Farm Technical Services\GIS\Document Files\Reports\Historic Environment Desk-Based Assessment\2053_Figure 2_Heritage Features.mxd



Core Study Area
Wider Study Area
Agriculture and Settlement
Built-up Area
Designed Landscape
Energy, Extraction and Waste
Leisure and Recreation
Moorland and Rough Grazing
Woodland and Forestry

1:30,000 Scale @ A3
0 0.5 1 km

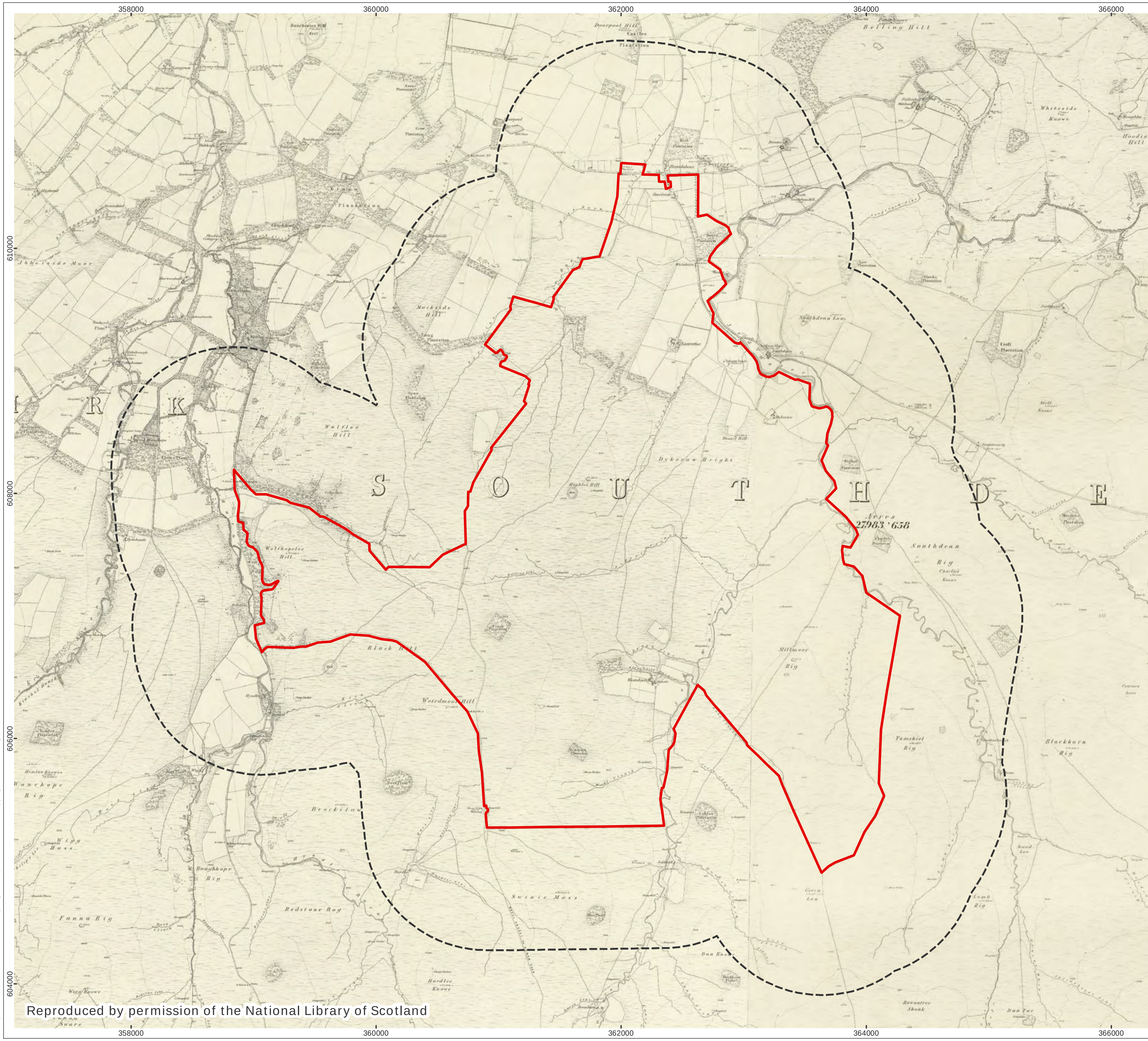
Produced: LJ
Reviewed: SC
Approved: MT

Ref: 2053/REP/003
Date: 15/10/2015

Historic Landscape Use Assessment
Figure 3

Highlee Hill Wind Farm
Historic Environment
Desk-Based Assessment

N:\Projects\2053 Highlee Hill Wind Farm Technical Services\GIS\Document Files\Reports\Historic Environment Desk-Based Assessment\2053_Figure 3_Historic Landscape Use Assessment.mxd



res

ARCUS

Core Study Area

Wider Study Area

1:30,000 Scale @ A3

0 0.5 1 km

N

Produced: LJ
Reviewed: SC
Approved: MT

Ref: 2053/REP/004

Date: 15/10/2015

1863 Six Inch OS Mapping
Figure 4

Highlee Hill Wind Farm
Historic Environment
Desk-Based Assessment

N:\Projects\2053 Highlee Hill Wind Farm Technical Services\GIS\Document Files\Reports\Historic Environment Desk-Based Assessment\2053_Figure 4_1863 Six Inch OS Mapping.mxd

TECHNICAL APPENDIX 8.1

DRAFT CONSTRUCTION METHOD STATEMENT
FOR HIGHLEE HILL WIND FARM

RES

Prepared By:

Arcus Consultancy Services Ltd.

Suite 1C
Swinegate Court East
York
North Yorkshire
YO1 8AJ

T +44 (0)1904 715 470 l **E** info@arcusconsulting.co.uk
w www.arcusconsulting.co.uk

Registered in England & Wales No. 5644976

June 2016

TABLE OF CONTENTS

1 INTRODUCTION

This Construction Method Statement (CMS) forms an appendix to the Environmental Statement (ES) for Highlee Hill Wind Farm ("the Development"). The CMS presented in this document is intended to demonstrate measures that could be used across the Development site to adequately protect hydrological and related resources. Detailed proposals for such measures will be documented prior to construction, and will provide the same or greater protection for the water environment as those described in this document. The measures are proportionate to the risk and, where greater risk is highlighted at specific locations prior to construction, specific measures would be agreed for those locations.

The methods set out in the CMS are based on good practice, measures agreed with the Scottish Environment Protection Agency (SEPA) for several constructed wind farms and the following guidance:

- Forestry Commission, 'Forest and Water Guidelines, 5th Edition[1]';
- Scottish Renewables (SR) and SEPA. Guidance on the Assessment of Peat volumes, Reuse of Excavated Peat and the Minimisation of Waste (2012)[2];
- Scottish Natural Heritage, Good Practice During Wind Farm Construction, (2013)[3];
- The Construction Industry Research and Information Association (CIRIA), 'Environmental Good Practice On Site (C741)' (2015)[4]; and
- CIRIA, 'Control of Water Pollution from Construction Sites (C532)' (2001)[5].

The CMS takes into account specific activities during the construction and operational phases of the Development, including:

- Access roads;
- Borrow pits;
- Turbine foundations; and
- Hardstanding areas and buildings (including crane hardstandings, construction compounds and associated infrastructure).

The appropriate methodologies to cover water control and the means of drainage from all hard surfaces and structures within the site are described in the following sections.

2 THE MANAGEMENT OF SEDIMENT AND SURFACE WATERS

This section addresses the management of sediment and surface water run-off generated during the construction phase of the Development, through good practice construction techniques.

Major construction works will minimised during heavy precipitation events.

Drainage from the site will include elements of Sustainable Urban Drainage Systems (SUDS) design, where appropriate. SUDS replicate natural drainage patterns and have a number of benefits:

- SUDS will attenuate run-off, thus reducing peak flow and any flooding issues that might arise downstream;
- SUDS will treat run-off, which can reduce sediment and pollutant volumes in run-off before discharging back into natural drainage network; and
- SUDS measures, such as lagoons or retention ponds, correctly implemented will produce suitable environments for wildlife.

[1] The UK Forestry Standard: Forests and Water [online] Available at: http://www.forestry.gov.uk/forestry/infd-8bvgx9 [Accessed 27/08/2014].
[2] SR and SEPA (2012). Guidance on the Assessment of Peat volumes, Reuse of Excavated Peat and the Minimisation of Waste [online] Available at: http://www.scottishrenewables.com/media/uploads/publications/a4_developments_on_peatland.pdf [Accessed 21/08/2014].
[3] SNH (2013) Good Practice During Windfarm Construction, [online] Available at: http://www.snh.gov.uk/docs/A1168678.pdf [Accessed 27/08/2014].
[4] The Construction Industry Research and Information Association (CIRIA), (2015), Environmental Good Practice on Site Guide (C741), CIRIA: London
[5] CIRIA, (2001), Control of Water Pollution from Construction Sites (C532), CIRIA: London.

2.1 LOCATION OF SILT TRAPS AND SILT MATTING

Silt traps maybe utilised to trap and filter sediment-laden run-off from excavation works at the Development, including turbine bases and access roads. They will be installed in drainage ditches but will be sited to avoid slopes with a gradient greater than 1 in 20

Good practice will be followed prior to placement of silt traps adjacent to watercourses. Silt matting may be placed at the outfall of settlement lagoons to filter sediment during times of heavy rainfall.

The silt traps and silt matting will be monitored by the Ecological Clerk of Works (ECoW) and replaced when necessary.

Plates 1, 2 and 3 of this document display typical silt fencing, silt traps and silt matting.

Plate 1: Typical silt fencing

Plate 2: Typical silt traps

Plate 3: Typical silt mat to be placed at lagoon outfalls

2.2 LOCATION OF CHECK DAMS

Check dams will be installed within drainage ditches at regular intervals, where appropriate. Check dams will facilitate the settlement of suspended solids by slowing the flow of water within the drainage ditches. Appropriately sized stone pitching will be used within the dam in order to provide a rough surface for water within the drainage ditch to pass over.

Plate 4 of this document displays a typical check dam.

Plate 4: Typical check dams - to be installed in drainage ditches adjacent to the access track

2.3 LOCATION OF SETTLEMENT LAGOONS

Settlement lagoons will be implemented, where appropriate, at turbine excavations. The location and management of settlement lagoons is essential and will not be sited within vulnerable wetland areas where they may cause drying out and direct loss of habitat.

All settlement lagoons will be actively managed to control water levels and ensure that any runoff is contained, especially during times of rainfall. If required to achieve the necessary quality of the final run-off, further measures may include the use of flocculent to further facilitate the settlement of suspended solids.

Plate 5 of this document displays a typical settlement lagoon and flocculent station.

Plate 5: Typical lagoon and flocculent station

2.4 OUTFLOW MONITORING FROM SETTLEMENT LAGOONS

Settlement lagoon outflow will be regularly inspected and discharge may be pumped, when required, for maintenance purposes. Any pumping activities will be supervised and authorised by the Infrastructure Contractor's Project Manager.

Treated water will be discharged onto vegetated surfaces and directed away from surface watercourses. Within all the catchments, irrigation techniques, which may include the use of perforated discharge hoses, or similar, will be employed to rapidly distribute discharge across a vegetated slope. This will be carried out in consultation with the ECoW.

Plate 6 of this document displays typical pumping operations.

Plate 6: Typical 'Siltbuster' and settlement lagoon

2.5 PROVISION FOR STORM EVENTS

The site itself is not considered to be at risk from flooding. In extreme storm events, there would be elevated levels of run-off from the hardstanding elements of the Development relative to green-field flow rates, which has the potential to contribute to down-stream, off-site, flood risk. This area of new hardstanding, in terms of the percentage of the relevant catchments that may be affected, is small (approximately 0.06 %[6]).

In the baseline scenario, the water table is not at the ground surface, and hence some infiltration would be expected. The Development proposals would raise the water table, and therefore infiltration would reduce. Notwithstanding this, measures are proposed here that would reduce run-off further.

Temporary storage volume for storm run-off from the turbine foundations and crane hardstanding areas would be provided via settlement lagoons.

Along the access tracks, drainage channels on the down-slope would shed track run-off to adjacent rough ground approximately every 30 m, to attenuate flow and allow natural filtration to remove sediments. In areas within 50 m of a watercourse marked on an Ordnance Survey 1:50,000 scale map or where cross-slopes exceed 1 in 20, drainage channels will be bunded and outflow will be monitored daily in areas with on-going construction activity.

Appropriate licensing and discharge consents will be sought (under Water Environment (Controlled Activities) (Scotland) Amended Regulations 2013 (CAR)[7]) before the construction phase of the Development.

2.6 FOUL DRAINAGE

The substation building may house a single toilet facility and / or hand basin for visiting maintenance staff during the operational phase. Should this facility be required rainwater will be collected from the roof of the building via a gutter and inlet pipe to fill a rain water harvesting tank. Waste will be held in a closed system or a septic tank and pumped out as necessary via a tanker. The system shall be designed and approved by SEPA prior to construction.

Effluent and waste from onsite construction personnel will be treated at a package sewage treatment plant or a septic tank and discharged into a properly designed and sized drainage field, in accordance with PPG4. The system will be designed prior to the construction phase of the Development.

3 THE MANAGEMENT AND MOVEMENT OF FRESH CONCRETE

Concrete will be imported to the site ready-mixed, the following management measures are proposed.

3.1 ACCIDENTAL SPILLAGE

Speed limits for vehicles transporting concrete will be set at a maximum of 15 miles per hour (mph) and will be continually monitored. Maximum vehicle load capacities will not be exceeded. Although tracks will be maintained in good condition, vehicle loads will be reduced when a rougher surface is identified prior to track maintenance.

Spill kits will also be located at strategic points across the site, as displayed in Plate 7.

Plate 7: Spill Kits to be located across the Development

Measures to manage fresh concrete during pouring operations are described in Section 3.4: *Concrete Pouring for Turbine Foundations*.

3.2 VEHICLE WASHING

There will be a wash-out facility within the construction area consisting of a sump overlain with an impermeable geosynthetic membrane. The geosynthetic membrane will filter out the concrete fines leaving clean water to pass through to the sump. The sump water will be pumped to a licenced carrier and taken off-site for approved disposal.

No washing of concrete-associated vehicles will be undertaken outside the wash out facilities, and the area will be signposted, with all site contractors informed of the locations.

The frequency of concrete plant washout may also be reduced through the use of retarders.

Plate 8 displays a typical concrete wash-out facility.

[6] Approximately 5.5 ha area of new hardstanding (of all proposed infrastructure) in 13,900 ha catchment area (catchment of Jed Water).
[7] The Water Environment (Controlled Activities) (Scotland) Amendment Regulations 2013 [online] Available at: http://www.legislation.gov.uk/ssi/2013/176/pdfs/ssi_20130176_en.pdf [Accessed 17/05/2016].

Plate 8: Typical concrete washout facility

In the event that plant and wheel washing is required, dry wheel wash facilities and road sweepers will be provided to prevent (as far as is practicable) mud and debris being carried from within the site onto the public road.

Signage will be put in place to direct all vehicles to use wheel wash facilities. The track section between the wash facility and the public road will be surfaced with tarmac or clean hardcore and the area surrounding the facilities will be kept clean and in good condition.

The wheel wash facility, which will work on a closed cycle, shall be operated throughout the construction period. Wheel wash facilities will be located within a designated area of hardstanding at least 50 m from the nearest watercourse or 20 m from the nearest surface drain. It is expected that these facilities shall be sited adjacent to the site entrance, as shown in Plate 9.

Should debris be spread onto the site access or public road adjacent to the wind farm, then road sweepers will be quickly utilised to clean affected areas. Loose debris will also be periodically removed from on-site tracks. Also, all HGVs taking construction materials to and from the site will be sheeted to prevent the spillage or deposit of material on the highway.

Plate 9: Example of a dry ramp wheel wash facility

3.3 CONCRETE POURING FOR TURBINE FOUNDATIONS

Methods to protect surface and groundwater from the batching and transportation of concrete are considered above.

To prevent pollution it is important that all concrete pours are planned and that specific procedures are adopted where there may be a risk of surface water or groundwater contamination, in accordance with CIRIA C532. These procedures will include:

- Ensuring that all excavations are sufficiently dewatered before concrete pours begin and that dewatering continues while the concrete cures. However, construction good practice will be followed to ensure that fresh concrete is isolated from the dewatering system; and
    - Ensuring that covers are available for freshly placed concrete to avoid the surface of the concrete washing away during heavy precipitation.

Typical foundation shuttering is shown in Plate 10 of this document.

Plate 10: Typical wooden shuttering – to be deployed around the turbine foundations during concrete pours

The excavated area will be back-filled with compacted layers of graded material from the original excavation, where this is suitable, and capped with peat or soil. Locally, around the turbines, the finished surface will be capped with crushed aggregate to allow for safe personnel access around the base of the turbine. The management of run-off from these areas is described in Section 2: *The Management of Sediment and Surface Waters*.

4 HYDROCARBON CONTAMINATION

4.1 VEHICLE MAINTENANCE

During the operation of the excavations, excavation machinery will be regularly maintained to ensure that there is minimal potential for fuel or oil leaks / spillages to occur. All maintenance will be conducted on suitable absorbent spill pads to minimise the potential for groundwater and surface water pollution. All machinery will be equipped with drip pans to contain minor fuel spillage or equipment leakages.

Appointed refuelling personnel will be trained in the correct methods of refuelling on site to ensure that pollution incidents are prevented and a quick response plan is implemented, should a spill occur, to minimise the impact of spills.

Plates 11 and 12 of this document display examples of dip pans and bunds.

Plates 11 and 12: examples of drip trays and bunds

4.2 CHEMICAL STORAGE

Potentially contaminating chemicals stored on site will be kept within a secure bunded area to prevent any accidental spills from affecting hydrological resources. The bunded area will be within the construction compound and will be underlain by an impermeable ground membrane layer to reduce the potential pathways for contaminants to enter watercourses and groundwater.

Oil storage areas will be covered in order to prevent rainwater collecting within the bunded area.

Further detail is presented in Section 3.1: *Accidental Spillage within Construction Compounds*.

The chemicals storage area would be kept secure to prevent theft of vandalism. A safe system for accessing the storage area would be implemented by the Construction Contractor.

5 BORROW PIT DRAINAGE

Existing borrow pits used for the operational forestry may be used for the Development, while new borrow pits may be opened. The following drainage measures will adequately protect the hydrological and hydrogeological resource.

5.1 PRE EARTHWORKS DRAINAGE

Temporary interception bunds and cut-off drainage ditches ('clean water drains') will be constructed upslope of the borrow pits and cuts to prevent surface water runoff entering the excavation.

SUDS measures, such as swales or retention ponds, will be implemented to convey and attenuate excess surface water flow away from borrow pits and excavations. Swales will be kept to a minimum length, depth and gradient with check dams, silt traps and buffer strips also utilised to minimise erosion, sedimentation at peak flows, where appropriate.

Swales to collect runoff will be placed on the downslope of borrow pits and overburden / stockpiles and will be designed to treat potentially silty runoff before discharging back into the drainage system.

The use of peat and soil stockpiles will be minimised by earthworks planning. However, where stockpiles are used, silt fences and straw bales wrapped in hessian or semi-permeable lining can be used to intercept sediment laden surface runoff in addition to swales and infiltration trenches.

5.2 EARTHWORKS DRAINAGE

Due to the low permeability of the overlying peaty soil deposits, it is unlikely that groundwater ingress from peat will be significant in borrow pit or earthworks areas. However, the bases of borrow pits and earthworks will have a gravity drainage system and all water will drain to an adequately sized sump.

If dewatering of borrow pits or excavations is necessary, waste water will be treated by designed settlement lagoons and retention ponds. 'Siltbusters' will be used to treat pumped/surplus water from lagoons or retention ponds during periods of heavy or persistent rainfall.

Organic flocculent could be employed in settlement lagoons and retention ponds to further facilitate the settlement of fine suspended solids before waste water is discharged to rough vegetation.

Waste water discharge onto vegetated surfaces from borrow pits and earthworks areas will be directed away from watercourses and drainage ditches to avoid direct and extended the treatment phases. Any sediment suspended within the treated water will be deposited amongst the rough surface vegetation. The Contractor's site manager will ensure that excessive sediment on vegetated surfaces does not accumulate.

Silt mats may be used at the outfalls of settlement lagoons and retention ponds to further aid the settlement of sediment from earthworks drainage.

During the operation of the borrow pits and during earthworks operations, excavation machinery will be regularly maintained to ensure that there is minimal potential for fuel or oil leaks / spillages to occur. All maintenance will be conducted on a bunded geotextile layer to reduce the potential for groundwater and surface water pollution.

5.3 MANAGEMENT OF DRAINAGE FROM OF SURPLUS MATERIALS

Careful consideration will be given to the location of topsoil and subsoil storage areas for all areas of the Development during construction. Storage areas will be either in a flat dry area away from watercourses, or be protected by the addition of cut off drains above the storage areas to minimise the ingress of water.

Mineral soils will not be allowed to dry out and silt fences and mats will be employed to minimise sediment levels in run-off.

All stockpiled material will be stored at least 50 m from watercourses in order to reduce the potential from sediment to be transferred into the wider surface water system and will be regularly inspected to ensure that erosion of the material is not taking place.

5.4 DUST SUPPRESSION AND CONTROL

Water needed for dust suppression on the haul roads during periods of dry weather and the compound vehicle wash will be clean water. Clean water may be obtained from re-circulated clean or treated drainage waters.

Where required, water may be extracted from local watercourses or groundwater. In these instances, the Contractor will liaise with SEPA beforehand to agree abstraction locations, rates and CAR authorisation requirements.

Good practice measures will be adopted during construction to control the generation and dispersion of dust such that significant impacts on neighbouring habitats will not occur. The hierarchy for mitigation will be prevention, suppression then containment.

The following mitigation measures will be implemented to control the movement of dust within the Development site:

- Excavation and earthworks areas will be stripped as required in order to minimise exposed areas;
- During excavation works, drop heights from buckets will be minimised to control the fall of materials reducing dust escape;
- completed earthworks and other exposed areas will be covered with topsoil and re-vegetated as soon as it is practical in order to stabilise surfaces.
- During stockpiling of loose materials, stockpiles shall exist for the shortest possible time;
- Material stockpiles will be low mounds without steep sides or sharp changes in shape;
- Material stockpiles will be located away from the site boundary, sensitive receptors, watercourses and surface drains;
- Material stockpiles will be sited to account for the predominant wind direction and the location of sensitive receptors;
- Water bowsers will be available on site and utilised for dust suppression during roadworks/ vehicle movements when and where required;
- Daily visual inspections will be undertaken to assess need for use of water bowsers; and

- Daily visual inspections will be undertaken to assess the condition of the junction of the site track with the A6088 and its approaches.

6 ACCESS TRACK CONSTRUCTION AND USE

Prior to access track construction, site operatives will identify flush areas, depressions or zones which may concentrate water flow so that site drainage design will maintain hydrological connectivity. Site drainage design will be produced in advance of construction.

Floating roads are unlikely to be used, as peat depth is rarely greater than 0.5 m. Set out below are measures that will be incorporated into the design and installation of the access tracks.

6.1 MANAGEMENT OF SURFACE WATER

Access tracks will be designed to have adequate cross fall to avoid ponding of rainwater and surface run-off. Run-off from the access tracks and existing drainage ditches will be directed into swales that will be designed to intercept, filtrate and convey the runoff.

Check dams will be installed within the swales and existing drainage ditches in order to increase the attenuation of run-off.

Permanent swales and drainage ditches adjacent to access tracks will have outlets at specified intervals to reduce the volume of water collected in a single channel and, therefore, reduce the potential for erosion. Further measures could include the use of settlement ponds or possibly flocculent to further facilitate the settlement of suspended solids.

The Infrastructure Contractor would be responsible for the management of all surface water run-off, including the design and management of a drainage scheme compliant with SUDS principles. This may include settlement lagoons and retention ponds, incorporating natural or assisted attenuation.

6.2 LOOSE TRACK MATERIAL

Loose material from the use of access tracks will be prevented from entering watercourses by utilising the following measures:

- Silt fences will be erected between areas at risk of erosion and watercourses;
- Silt fences and swales will be inspected daily and cleaned out as required to ensure their continued effectiveness;
- Silt matting if required will be checked daily and replaced as required;
- Excess silt will be disposed of in designated areas at least 50 m away from any watercourses or drainage ditches;
- Cut off ditches will be implemented on slopes greater than 1 in 20;
- Swales and drains will be checked after periods of heavy precipitation;
- The inlets and outlets of settlement lagoons and retention basins will be checked on a daily basis for blockages; and
- The access tracks will be inspected on a daily basis for areas where water collects and ponds.

An example of a semi-permeable geotextile layer is shown in Plate 13 of this document.

Plate 13: semi-permeable geotextile layer

6.3 MATERIAL EXCAVATED DURING TRACK CONSTRUCTION

Material excavated during track construction will be either be stored adjacent to the track or within agreed spoil deposition areas and compacted in order to limit instability and erosion potential. Peat will not be allowed to dry out and silt fences will be employed if required to minimise sediment levels in run-off. Material will be stored at least 50 m from watercourses in order to reduce the potential from sediment to be transferred into the wider hydrological system.

Typical overburden stockpile measures are shown in Plate 14 of this document.

Plate 14: Typical overburden stockpile measures

6.4 WATERCOURSE CROSSINGS

The use of in-situ fresh concrete in the construction of watercourse crossings will be avoided where possible by the use of pre-cast elements. Existing culverts may be upgraded and anticipated to be replaced with suitable pre-cast culvert designs. Ready-made concrete 'box style' or wide, circular concrete or plastic culverts will be used. Existing culverts requiring an ugrade and will be replaced using ready-made culverts, outlined in Section 14 of this CMS.

Prior to access track construction, site operatives will identify flush areas, depressions or zones which may concentrate water flow. These sections may be spanned with plastic pipes if required to ensure hydraulic conductivity under the road, and reduce water flow over the road surface during heavy precipitation.

Culverts will be designed based on best practice[8],[9],[10] in order to minimise effects of developments on the natural integrity and continuity of water courses. The design will incorporate the following criteria:

- Culverts will be well bedded to avoid settlement and protected by an adequate cover of road material;
- The substrate and side/ head walls will be reinforced in order to prevent erosion;
- The culverts will be designed such that it does not cause a barrier to movement of fish or other aquatic fauna;
- Culvert floors will have the same gradient (not exceeding a slope of 3 %) and level, and carry similar bed material and flow, as the original steam;
- There shall be no hydraulic drop at the culvert inlet or outlet;
- The width of the culvert will be greater than the active channel width of the watercourse;
- Culverts will be used to conduct water under the wind farm tracks; and
- Any fences or screens fitted on the inlet or outlet of the culvert will be designed to allow at least 230 mm of space between the bars of the screen of fence, up to the high water level.

7 FELLING MEASURES

The following measures will be implemented during tree felling as part of the Development to ensure that harvesting methods are in accordance with good practice:

- Timber will be stacked on drier slopes at least 50 m from watercourses and not blocking roadside drains. ;
- Brash will not be stockpiled within 50 m of a watercourse;
- The area within 50 m of watercourses shall be regarded as a “sensitive area”;
- The area within 100 m of Jed Water shall be regarded as a “sensitive area”;
- During felling operations within “sensitive areas”, silt traps or temporary dams will be used in local ditches to prevent sediment entering watercourses, and silt fences will be constructed locally between working areas and watercourses;
- Any work in ”sensitive areas” to be approved by the Infrastructure Contractor’s Project Manager and the Ecological Clerk of Works;
- If felling is to occur in the riparian zone (the interface between land and a flowing surface water body) of a watercourse, trees will be felled away from the watercourse;
- Brash mats will be used for vehicle trafficking to protect bare soils;
- Silt traps will be installed in existing and new drainage ditches downstream of felling areas and construction activities but will be sited to avoid slopes with a gradient greater than 1 in 20;
- Silt fences and traps will be cleaned out on a regular basis and following heavy precipitation; and
- Silt matting if used to be checked on a daily basis and replaced as required.

8 HANDLING OF MINERAL SOILS

8.1 GENERAL GOOD PRACTICE MEASURES

The excavation of each turbine foundation will generate excess material, the majority of which will typically be mineral soils. Excess material from other infrastructure will also be predominantly mineral soils.

As mentioned in Section 6: *Access Track Construction and Use* of this CMS, floating roads are unlikely to be used at the Development, as peat depth is generally less than 0.5 m.

At turbine foundations topsoil will be stripped separately to sub soils, where possible aiming to keep the top layer of turf intact. This material will be stored adjacent to the base working area and will be limited in height to 2 m to minimise the risk of overheating. Subsoil will then be stripped and stored, keeping this material separate from the topsoil in accordance with guidance by SNH and SEPA.

In accordance with BS 3882 ‘Specification for Topsoil and Requirements for Use’, any long term stockpiling of topsoil should not exceed 2.0 m in height with a maximum side slope of 1 in 2. In its dry non plastic state, topsoil can be stockpiled in a ‘loose tipped’ manner and tracked in a compactive method reducing water ingress. Wetter soils can be stored in windrows for drying and later stockpiled for re-use. The re-wetting of peat will be carried out, if there is a potential risk of the peat drying out.

8.2 MEASURES TO PROTECT GROUNDWATER DEPENDENT TERRESTRIAL ECOSYSTEMS

The following measures will ensure that water quality and the flow supply of groundwater and near-surface water are maintained during the construction and operational phase of the Development. Key measures include:

- Silt traps may be deployed to trap and filter sediment-laden run-off throughout the construction phase of the Development;
- Settlement lagoons may be constructed and actively managed to control water levels and ensure that any runoff is contained, especially during times of rainfall. The location and management of the settlement lagoons is essential and will not be sited within vulnerable wetland areas where they may cause drying out and direct loss of habitat;
- Flush areas, depressions or zones which may concentrate water flow, will be identified in advance of construction and a suitable drainage design shall be developed to address each location, to ensure hydraulic connectivity
- Site drainage design will avoid any severance of saturated areas to ensure hydrological connectivity is maintained. Site drainage design will be produced in advance of construction
- Turbine foundations are constructed in holes in the ground that will be de-watered, and hence water flow is typically into the foundation area. This will prevent concrete leaching into groundwater or surface water in the event of shutter collapse;
- All excavations will be sufficiently dewatered before concrete pours begin and that dewatering continues while the concrete cures. However, construction good practice will be followed to ensure that fresh concrete is isolated from the dewatering system; and
- Water from dewatering activities are generally treated by settlement lagoons and will be discharged onto vegetated surfaces, ensuring no net loss of water from the hydrological system. If ponding of water is observed during the discharge onto vegetated surfaces, additional measures may be employed.

9 DISPOSAL OF WASTE MATERIALS

Waste such as timber, metal, general waste etc will be segregated on site, and disposed of, off site in a licenced waste facility.

10 MONITORING PROGRAMME

A surface water and groundwater monitoring programme will be established prior to the construction phase of the Development. An indicative monitoring programme is set out below.

10.1 SURFACE WATER MONITORING

Surface water monitoring would be undertaken at locations on the principal watercourses downstream of the Development infrastructure and upstream of other non-natural influences, where possible.

Regular visual inspections of surface watercourses are proposed, especially during major excavation works, as these allow rapid identification of changes in levels of suspended solids that could indicate construction related effects are occurring upstream. Potential effects can then be investigated and remedial action taken to prevent further effects, if necessary.

To supplement the visual inspections, it is anticipated that there would be up to six surface water monitoring points for extractive sampling and analysis, Details will be agreed in advance of construction.

The following sampling frequency is proposed in order to establish baseline hydrochemical conditions of surface water constituents:

- once every month for six months prior to the construction phase.

[8] *Forest and Water Guidelines, 5th Edition,* Forestry Commission, 2011. [online] Available at: http://www.forestry.gov.uk/website/forestry.nsf/byunique/infd-8bvgx9 [Accessed 17/05/2015].
[9] *Construction of River Crossings,* SEPA, 2008. [online] Available at: http://www.sepa.org.uk/planning.aspx [Accessed 17/05/2016].
[10] Culverting of Water courses: Position Statement, SEPA, 2006. [online] Available at: http://www.sepa.org.uk/planning/engineering-water_environments.aspx [Accessed 17/05/2016].

The following sampling frequencies are proposed in order to monitor surface water conditions against baseline conditions:

- once a month during ground breaking works and concrete works, e.g., access track construction, turbine foundations; (once a week on tributaries leading to the SAC downstream) and
- once, one month after the construction phase.

Establishing baseline conditions for surface waters will enable any trends in levels of critical parameters to be assessed and deviations from the norm identified and rectified through water management measures,. Monitoring will not take place within catchments or sub-catchments where no construction activity has occurred for a period of two weeks or more, during the on-going construction phase.

10.2 MONITORING REPORTING

The results of all laboratory analysis of water samples will be tabulated and recorded.

10.3 OPERATIONAL PHASE MONITORING

Sampling and testing will be carried out during the operational phase when any major maintenance or construction works are undertaken that may give rise to pollution of surface water.

10.4 MONITORING PROGRAMME SUMMARY

Any activity proving detrimental to water quality will be detected at the earliest opportunity during the construction and operational phases of the Development. This will allow action to be taken to prevent any further effect on water quality.

11 DECOMMISSIONING

During the decommissioning phase of the Development it is anticipated that access tracks would be removed and the area allowed to naturally re-vegetate. A full drainage reinstatement plan would be developed in advance of decommissioning the wind farm. Decommissioning activities will be undertaken in accordance with good practice at the time, and agreed with the relevant consultees in advance of the works commencing.

12 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this CMS is to detail appropriate water management measures to control surface water run-off, and drain infrastructure during the construction and operation of Highlee Hill Wind Farm. The measures detailed throughout this report would ensure that any effects on the surface and groundwater environment are minimised.

This document would be adapted to meet the additional requirements of the construction contractor and Ecological Clerk of Works, when appointed, to ensure that all measures implemented are effective and site-specific. Consultation with bodies including SNH and SEPA would be carried out to confirm agreement with the measures proposed prior to construction commencement.

The CMS is considered to be a live document, such that modifications can be made following additional information and advice from consultees.

13 NEW WATERCOURSE CROSSING INVENTORY

Watercourse description	**Is it an existing watercourse crossing?**	**Is the watercourse displayed on 1:50,000 OS Basemap?**	**Width of watercourse > 2 m? (CAR Registration)**	**Ecological constraints**	**If channel width >2 m, what is the total length of bank to be affected?**	**New proposed watercourse crossing type**	**Proposed level of CAR authorisation**
Crossing of Rough Sike Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	No	Yes	No 1.5 m	None	N/A	Culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

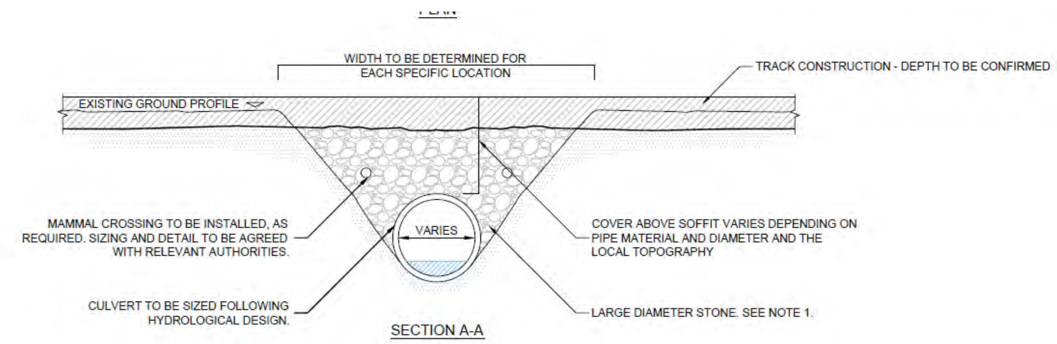
Crossing Location Upstream

Photograph taken approximately 80 m west of crossing location

Crossing Location Downstream

Photograph taken approximately 80 m west of crossing location

Type of Crossing



Map

Watercourse description	**Is it an existing watercourse crossing?**	**Is the watercourse displayed on 1:50,000 OS Basemap?**	**Width of watercourse > 2 m? (CAR Registration)**	**Ecological constraints**	**If channel width >2 m, what is the total length of bank to be affected?**	**New proposed watercourse crossing type**	**Proposed level of CAR authorisation***
Crossing of Well Cleuch Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and small stones Surrounding land use: Forestry	No	Yes	No 1.0 m	None	N/A	Possible arched culvert or piped (TBC)	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

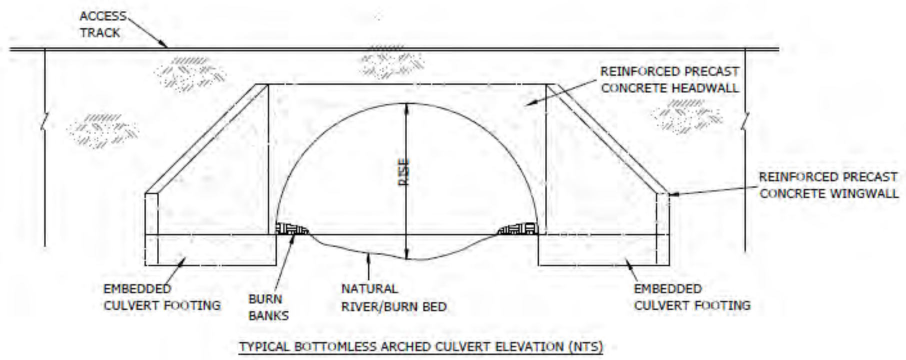
Crossing Location Upstream

Photograph taken approximately 140 m east (downstream) of crossing location

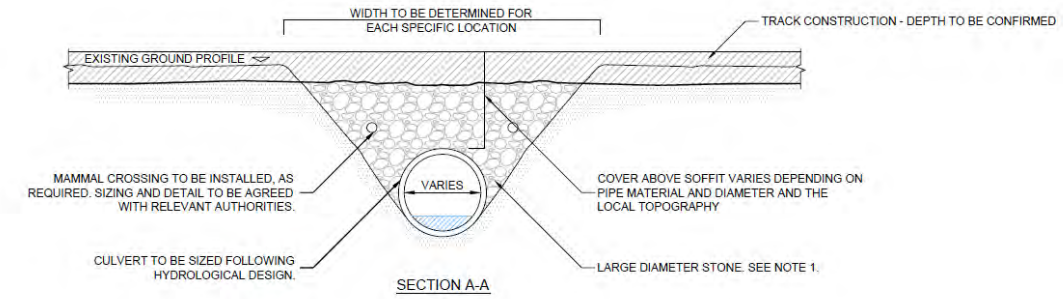
Crossing Location Downstream

Photograph taken approximately 140 m east (downstream) of crossing location

Type of Crossing



or



Map

14 EXISTING WATERCOURSE CROSSINGS INVENTORY

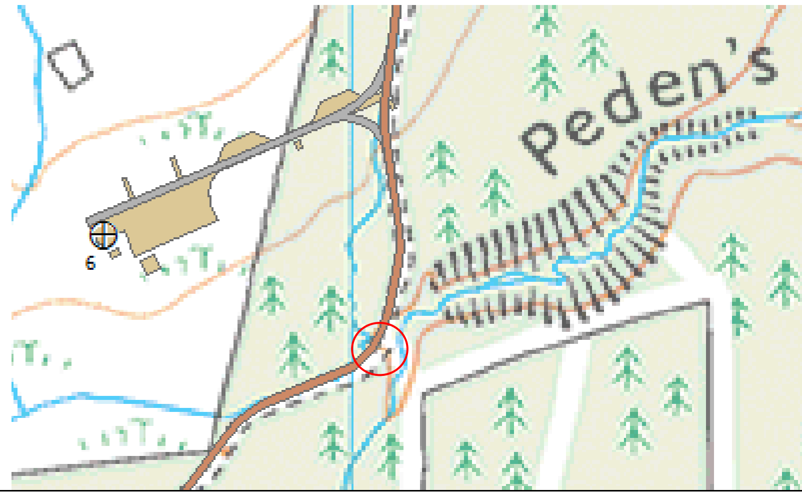
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of Pedens Cleuch Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – box culvert	Yes	No 1.0 m	None	N/A	Possible - Culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



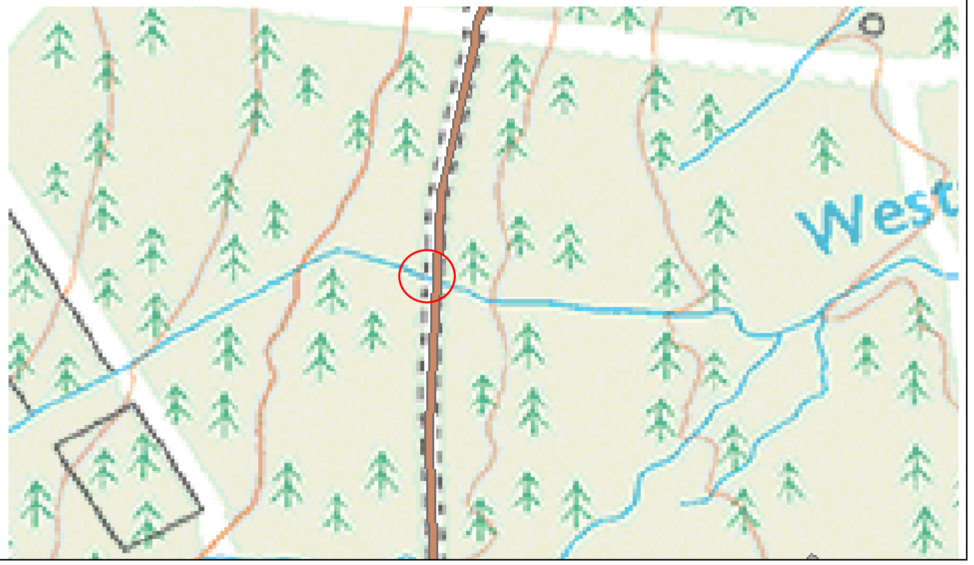
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of Westshiels Burn Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	No 1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



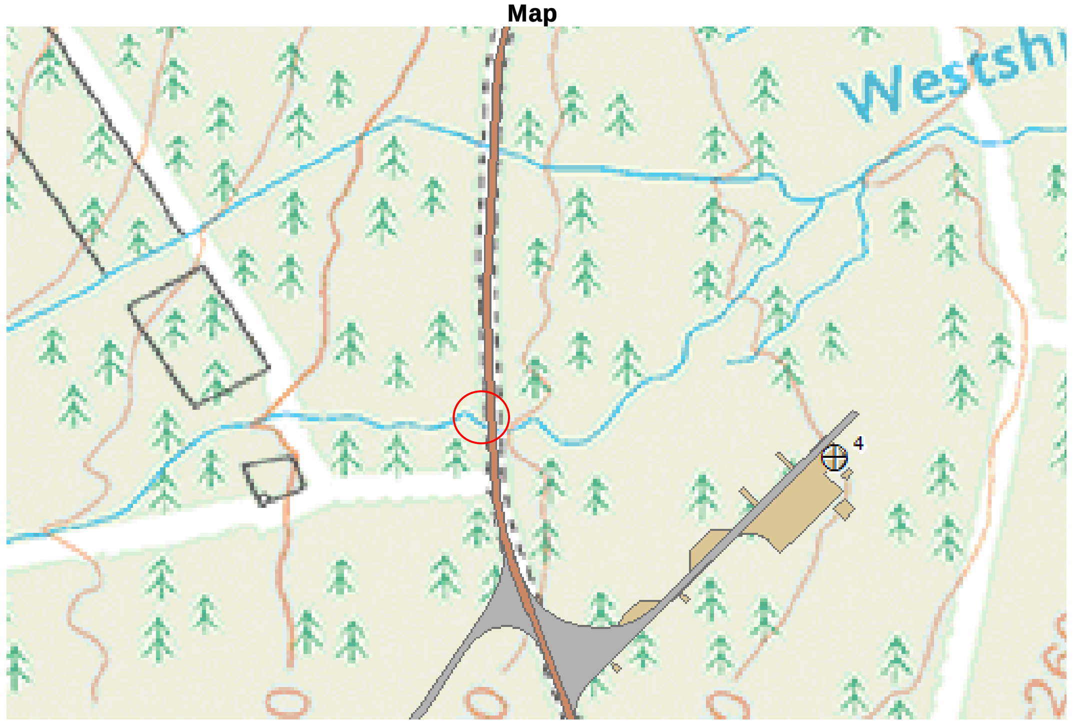
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of Westshiels Burn Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	No 1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



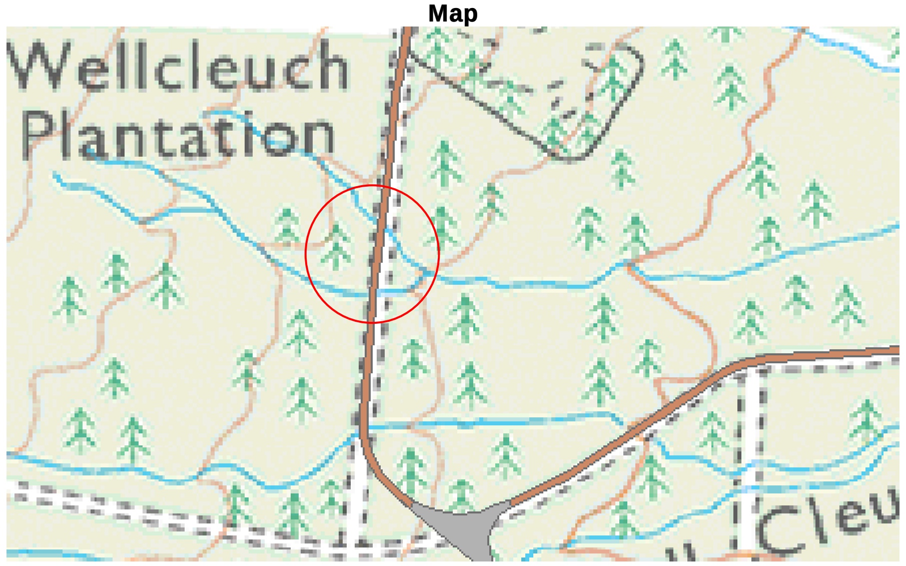
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of Well Cleuch Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	No <1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



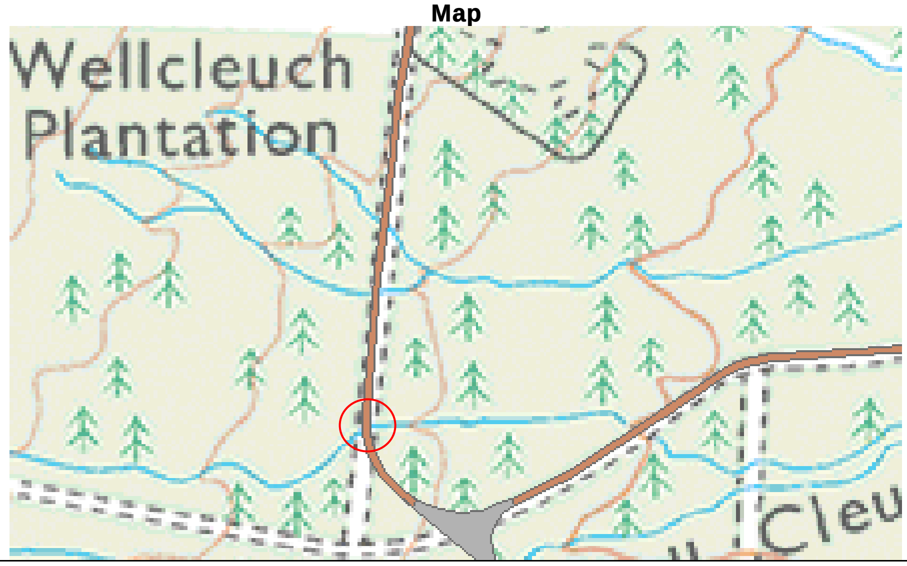
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of Well Cleuch Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – twin piped culvert	Yes	No 1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of Well Cleuch Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	No 1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream	Crossing Location Downstream	Existing forestry track
No photograph available	No photograph available	No photograph available **Map** 

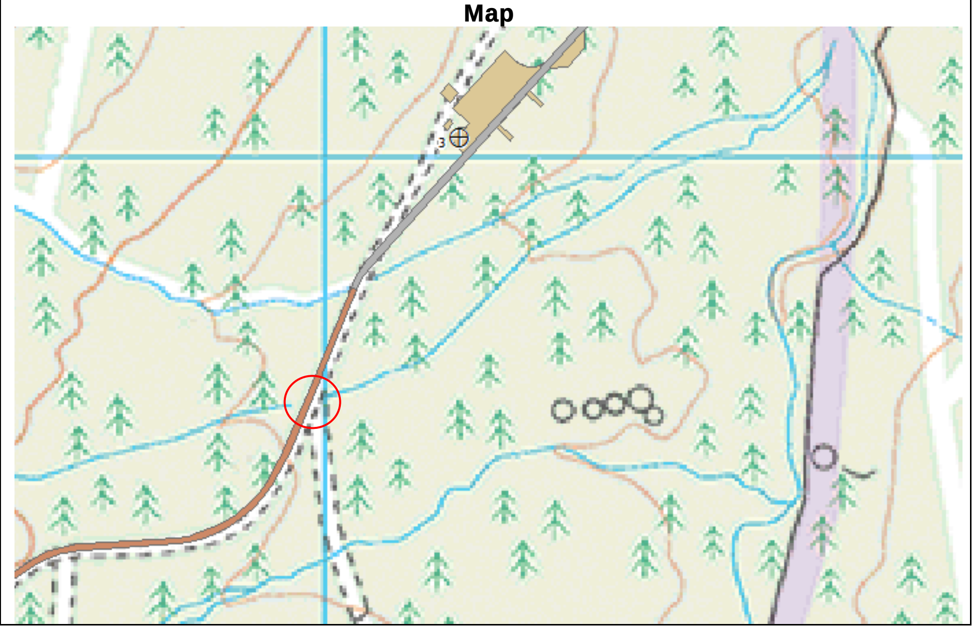
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation*
Existing crossing of Well Cleuch Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	No <1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



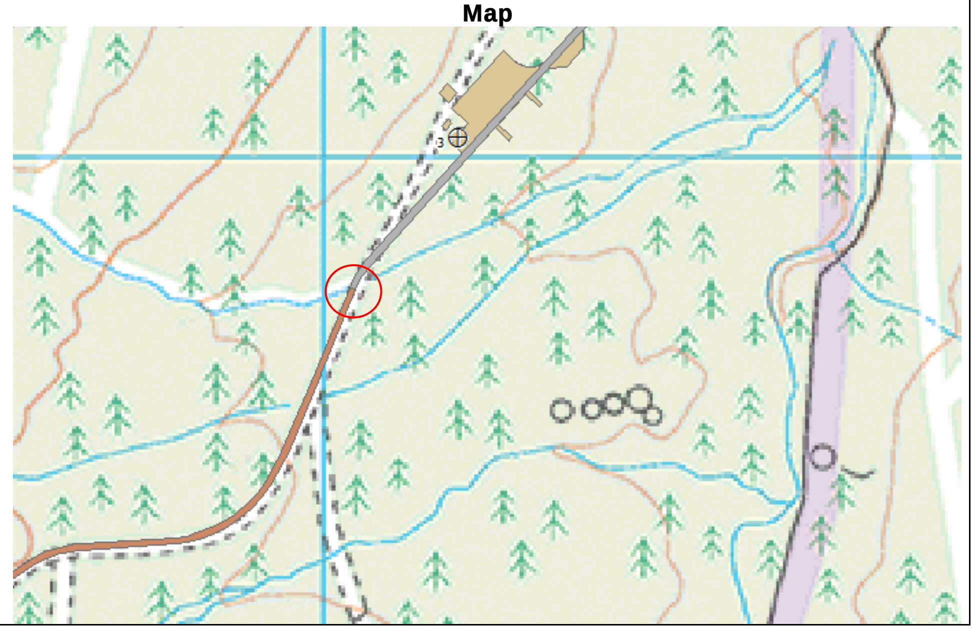
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of Well Cleuch Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	No 1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation*
Existing crossing of Peden's Cleuch Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	No 1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

No photograph available

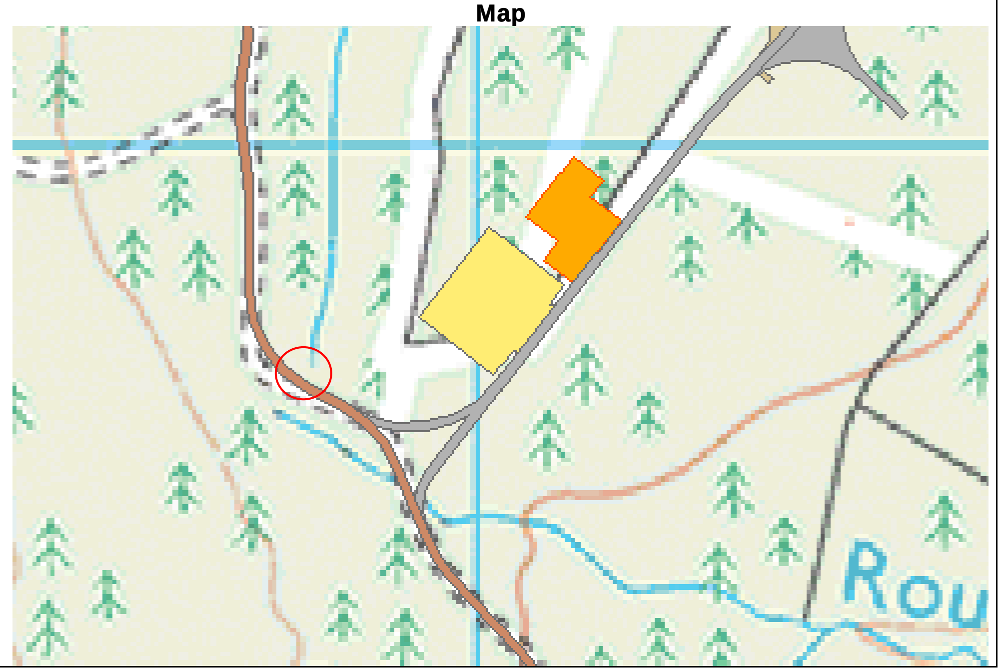
Crossing Location Downstream

No photograph available

Existing forestry track

No photograph available

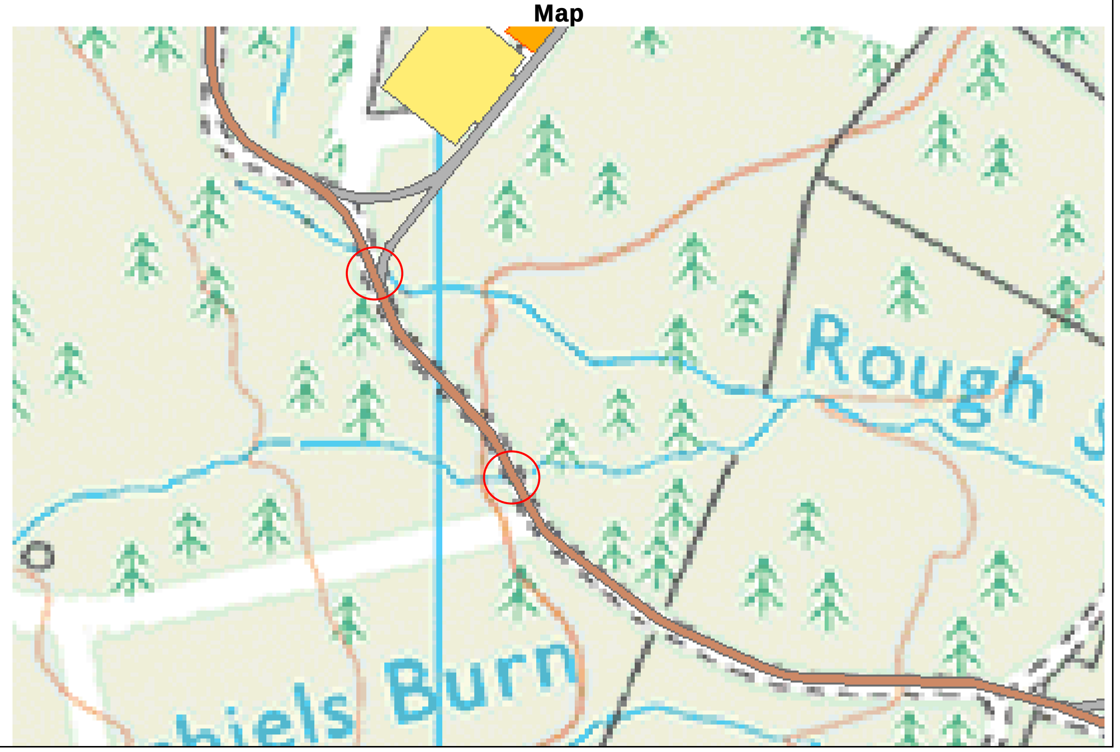
Map



Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossings of Rough Sike (x2) Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	No <1.0 m	None	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream	Crossing Location Downstream	Existing forestry track
		

Map



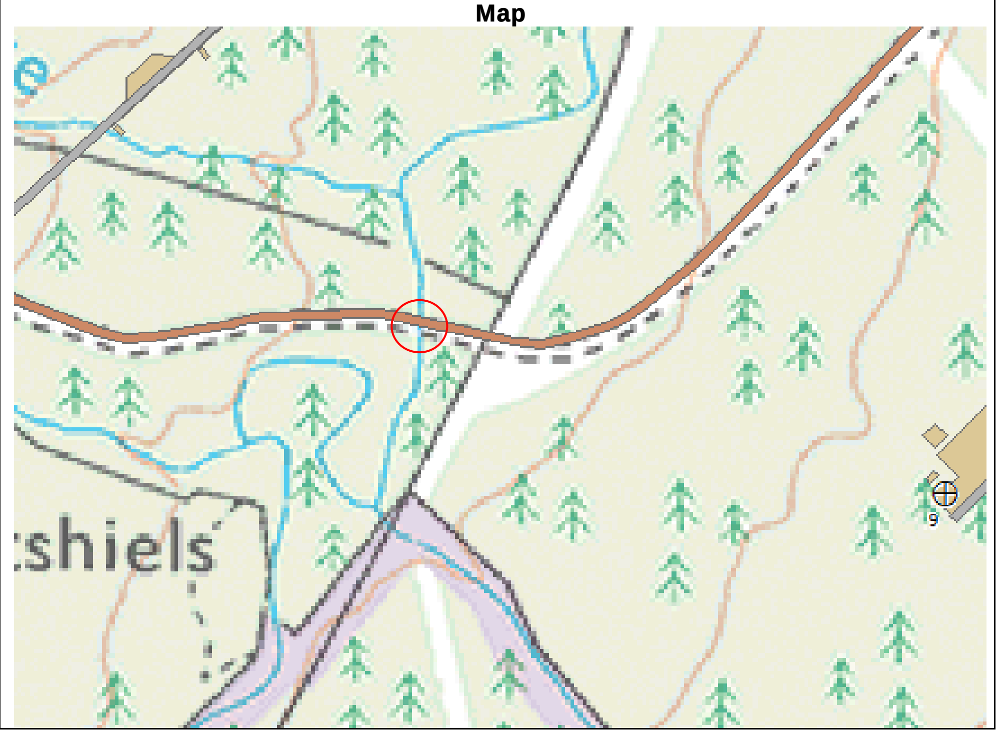
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of Jed Water Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	Yes 3 m	None (River Tweed SAC downstream)	Unlikely to be affected	Possible – existing piped metal culvert may have load bearing capacity.	Simple licence - *All other closed culverts used for crossings*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of unnamed tributary of Black Burn Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	Yes <1 m	None (River Tweed SAC downstream)	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map

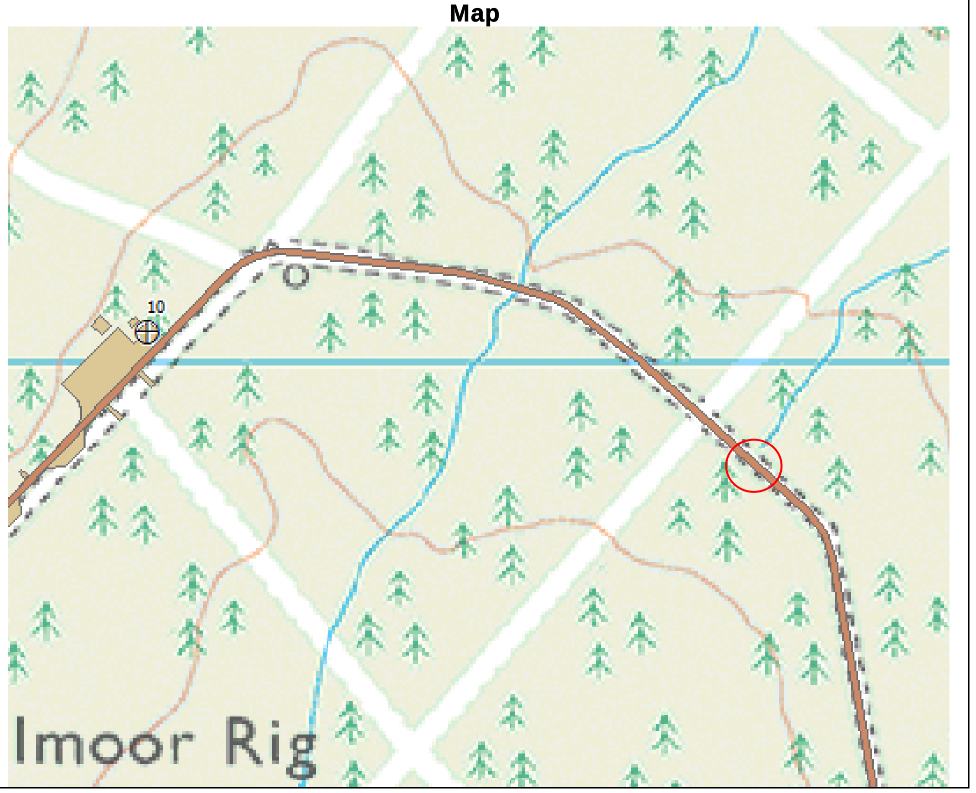
Watercourse description	Is it an existing watercourse crossing?	Is the watercourse displayed on 1:50,000 OS Basemap?	Width of watercourse > 2 m? (CAR Registration)	Ecological constraints	If channel width >2 m, what is the total length of bank to be affected?	Upgrade required?	Proposed level of CAR authorisation
Existing crossing of unnamed tributary of Black Burn Flow: Slow Level: Low Gradient: Low Watercourse bed substrate: Silt and stones Surrounding land use: Forestry	Yes – piped culvert	Yes	Yes <1 m	None (River Tweed SAC downstream)	N/A	Possible – piped culvert	Registration - *Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide*

Crossing Location Upstream

Crossing Location Downstream

Existing forestry track

Map



15 PLATES

Plate 15: Acidification and brash build up in tributaries of Well Cleuch and upper catchment of Jed Water

Plate 16: Rough vegetation and forestry ditches between areas to be worked at T10 and Jed Water

Noise – Technical Appendices

Technical Appendix 9.1: Scope of Assessment

Low Frequency Noise

9.111 The frequency range of 'audible noise' is generally taken to be 20 Hz to 20,000 Hz, with the greatest sensitivity to sound typically in the central 500 Hz to 4,000 Hz region. The range from 10 Hz to 200 Hz is generally used to describe 'low frequency noise', and noise with frequencies below 20 Hz used to describe 'infrasound'[1], although there is sometimes a lack of consistency regarding the definition of these terms in both common usage and the literature.

9.112 Low frequency noise is always present, even in an ambient 'quiet' background[1]. It is generated by natural sources, including the sea, earthquakes, the rumble of thunder and wind. It is additionally an emission from many artificial sources found in modern life, such as household appliances (e.g. washing machines, dishwashers) and all forms of transport.

9.113 Noise emitted from wind turbines covers a broad spectrum from low to high frequencies. In relation to human perception of the broadband noise produced by wind turbines, the dominant frequency range is not the low frequency or infrasonic ranges[2]. The reason for this is that the perception threshold for hearing in these ranges is much higher than for speech frequencies of between 250 Hz and 4000 Hz. As a result of this decreased sensitivity, wind turbine noise at the lowest frequencies of the range described as 'low frequency noise' would be below the average hearing threshold.

9.114 A comprehensive literature review of 'Low Frequency Noise and Infrasound Associated with Wind Turbine Generator Systems', undertaken for the Ontario Ministry for the Environment in 2010, indicated that low frequency noise from wind turbines crosses the threshold boundary, and thus would be considered to become audible, above frequencies of around 40-50 Hz[2]. The degree of audibility depends upon the wind conditions, the degree of masking from background noise sources and the distance from the wind turbines[2].

9.115 Although audible under some conditions, a paper; 'Infrasound and low frequency noise from wind turbines: exposure and health effects'[3], published by the authors of a literature review on the subject prepared for the Swedish Environmental Protection Agency in 2011[4], concludes that the level of low frequency noise produced by wind turbines does not exceed levels from other common sources, such as road traffic noise[3].

9.116 In response to an article published in the national press in 2004, alleging that low frequency noise from wind turbines may give rise to adverse health effects, the Department of Trade and Industry (DTI) commissioned the Hayes McKenzie Partnership to perform an independent study to investigate these claims[5]. The Government released the following advice based on the report's findings[6]:

"The report concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines."

9.117 This is re-iterated in the review undertaken for the Ontario Ministry for the Environment, which concludes that publications by medical professionals indicate that; at typical setback distances, the noise levels produced by wind turbines, including noise at low and infrasound frequencies, do not represent a direct health risk.

9.118 The Oregon Health Authority's Public Health Division conducted a strategic Health Impact Assessment in response to a convergence of questions about potential health impacts from wind energy facilities in Oregon. The report, titled 'Strategic Health Impact Assessment on Wind Energy Development in Oregon[7]' states that:

"Some field studies have found that in some locations near wind turbine facilities, low frequency noise (frequencies between 10 and 200 Hz) may be near or at levels that can be heard by humans. However, there is insufficient evidence to determine if low frequency noise from wind turbines is associated with increased annoyance, disturbance or other health effects".

9.119 Whilst low frequency content of the noise from wind farms shall be considered through the use of octave band specific noise emission and propagation modelling within the assessment presented here, it is considered that specific and targeted assessment on low frequency content of noise emissions from the proposed wind farm is unjustified.

Infrasound

9.120 In relation to infrasound in general, frequencies below 20 Hz may be audible, although tonality is lost below 16 - 18 Hz, thus losing a key element of perception[1]. In relation to modern, upwind turbines; there is strong evidence that the levels of infrasound produced will be well below the average threshold of human hearing[2]. The aforementioned DTI report extended this conclusion to more sensitive members of the population[5]:

"Even assuming the most sensitive members of the population have a hearing threshold which is 12 dB lower than the median hearing threshold, measured infrasound levels are well below this criterion".

9.121 As such[3]:

"infrasound from wind turbines is not audible at close range and even less so at distances where residents are living".

9.122 In February 2005, the BWEA[8] published background information on low frequency noise from wind farms[9]. The conclusion states that:

"It has been repeatedly shown, by measurements of wind turbine noise undertaken in the UK, Denmark, Germany and the USA over the past decade, and accepted by experienced noise professionals, that the levels of infrasonic noise and vibration radiated from modern upwind configuration wind turbines are at a very low level; so low that they lie below the threshold of perception, even for those people who are particularly sensitive to such noise, and even on an actual wind turbine site".

9.123 The BWEA report goes on to quote Dr Geoff Leventhall, author of the DEFRA report on 'Low Frequency Noise and its Effects', as saying:

1 'A Review of Published Research on Low Frequency Noise and Its Effects', Leventhall, Report for DEFRA, 2003

2 'Low Frequency Noise and Infrasound Associated with Wind Turbine Generator Systems, a Literature Review', Ontario Ministry of the Environment, OSS078696, December 2010

3 'Infrasound and low frequency noise from wind turbines: exposure and health effects', Bolin et al, Environmental Research Letters Volume 6, September 2011

4 'A literature review of infra and low frequency noise from wind turbines: exposure and health effects', prepared for Swedish Environmental Protection Agency, November 2011

5 'The Measurement of Low Frequency Noise at Three UK Wind Farms', Hayes, Contract Number W/45/00656/00/00, URN 06/1412, 2006, www.berr.gov.uk/files/file31270.pdf

6 'Advice on findings of the Hayes McKenzie report on noise arising from Wind Farms', DTI, URN 06/2162, November 2006, www.berr.gov.uk/files/file35592.pdf

7 'Strategic Health Impact Assessment on Wind Energy Development in Oregon', Sujata Joshi et al, Prepared By: Public Health Division Oregon Health Authority, March 2013, www.healthimpactproject.org

8 BWEA is now known as RenewableUK, a group representing the concerns of companies in the Renewable Energy Industry

9 'Low Frequency Noise and Wind Turbines', The British Wind Energy Association, 2005, www.bwea.com/ref/lowfrequencynoise.html & Technical Annex www.bwea.com/pdf/lfn-annex.pdf

"I can state, quite categorically, that there is no significant infrasound from current designs of wind turbines".

9.124 With regard to health effects, the DTI report quotes the document 'Community Noise', prepared for the World Health Organisation (WHO), which states that[5]:

"there is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects".

9.125 The DTI report goes on to conclude that:

"infrasound associated with modern wind turbines is not a source which will result in noise levels which may be injurious to the health of a wind farm neighbour".

9.126 Furthermore, researchers at Keele University explain that:

"The infrasound generated by wind turbines can only be detected by the most sensitive equipment, and again this is at levels far below that at which humans will detect the low frequency sound. There is no scientific evidence to suggest that infrasound has an impact on human health."[10]

9.127 In January 2013 the Environment Protection Authority, South Australia, presented their findings of a study into the level of infrasound within typical environments with a particular focus on comparing wind farm environments to urban and rural environments away from wind farms[11]. The report states:

"This study concludes that the level of infrasound at houses near the wind turbines assessed is no greater than that experienced in other urban and rural environments, and is also significantly below the human perception threshold. Also, that the contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment."

9.128 The Australian Medical Association[12] in March 2014 issued a position statement which detailed their findings on the health impacts due to the generation of infrasound from wind turbines. The findings concluded that:

"The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity. The infrasound and low frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur, and there is no accepted physiological mechanism where sub audible infrasound could cause health effects".

9.129 In April 2015, at the International Conference on Wind Turbine Noise in Glasgow[13], a number of papers were presented on Low Frequency Noise and Infrasound. The findings of the research work undertaken were as follows.

9.130 A paper by Berger et al[14], investigates whether current audible noise-based guidelines for wind turbines account for the protection of human health, given the levels of infrasound and low frequency noise typically produced by wind turbines. New field measurements of indoor infrasound and outdoor low frequency noise at locations between 400m and 900m from the nearest turbine, which were previously underrepresented in the scientific literature, are reported and put into context with existing published work. The findings concluded that:

"The analysis showed that indoor IS (infrasound) levels were below auditory threshold levels while LFN (low frequency noise) levels at distances >500m were similar to background LFN levels. Overall, the available data from this and other studies suggest that health-based audible noise wind turbine siting guidelines provide an effective means to evaluate, monitor, and protect potential receptors from audible noise as well as IS and LFN".

9.131 Research by Hansen et al[15] proposed to examine the effect of infrasound tonal components on perceived low frequency noise annoyance for short exposure durations. The investigated spectra were synthesized based on measured wind turbine noise, which consisted of amplitude modulated tonal components. Listening test were developed, based on data measured outside a residence, 1.3 km from a wind farm in South Australia. The research concluded that:

"For evaluation times of 5 minutes, it has been shown that for the persons tested, the presence of infrasound at realistic levels does not influence audibility, annoyance or ability to fall asleep."

9.132 Leventhall[16] presented a paper which assesses the scientific basis of the "Plympton-Wyoming bylaw". This is a bylaw which has recently introduced limits on infrasound from wind turbines. The author concludes:

"Science does not support the conditions of the bylaw, which is largely aimed at restricting blade pass tones. There is no evidence that the very low level of blade pass tones affects humans, whilst there is evidence that it does not."

9.133 The work carried out by Tonin et al[17] was an investigation into the effect on the reported pathological symptoms of simulated infrasound produced by wind turbines. The infrasound waveform was generated using a custom-made headphone apparatus. Volunteers were manipulated into states of either high or low expectancy of negative effects from infrasound and their reactions to either infrasound or a sham noise were recorded in a double blind experiment. The findings of the investigation state that:

"It was found, at least for the short-term exposure times conducted here-in, that the simulated infrasound has no statistically significant effect on the symptoms reported by volunteers, however the state of prior concern that volunteers had about the effect of infrasound has a statistically significant influence."

9.134 A study by Walker & Celano[18] considered the subjective effects of wind turbine noise in a controlled environment and how to faithfully generate acoustic signatures produced by actual turbines. Field measurements indicate that theses signatures encompass a wide frequency range, extending from below 1Hz to several kHz. The authors present conceptual descriptions and preliminary demonstrations of an infrasound synthesizer that is capable of producing turbine-faithful signals at least 10 dB greater than experienced in the field. The authors concluded from their research:

"It has been demonstrated that simulation of wind turbine noise and infrasound levels representative of those observed at distances of 100 meters can be accomplished in a typical residential-sized room with a modest array of electro-acoustic actuators. To date, subjective

[10] 'Wind farm noise', Styles, & Toon, printed in the Scotsman newspaper as a rebuttal of claims made by the Renewable Energy Foundation, August 2005

[11] 'Infrasound Levels Near Windfarms and in Other Environments' Environment Protection Authority & Resonate Acoustics, January 2013, www.epa.sa.gov.au

[12] "AMA Position – Wind Farms and Health 2014", Australian Medical Association, March 2014

[13] International Conference on Wind Turbine Noise, An INCE Series of International Conferences on Wind Turbine Noise Held Biennially, Wind Turbine Noise 2015, 20th – 23rd April 2015, Glasgow

[14] "Health-based Audible Noise Guidelines Account for Infrasound and Low Frequency Noise Produced by Wind Turbines", Berger et al, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015, Frontiers in Public Health, 24 February 2015

[15] "Perception and annoyance of low frequency noise versus infrasound in the context of wind turbine noise", Hansen et al, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015

[16] "On the overlap region between wind turbine infrasound and infrasound from other sources and its relation to criteria", G Leventhall, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015

[17] "Response to Stimulated Wind Farm Infrasound Including Effect of Expectation", Tonin et al, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015

[18] "Progress Report on Synthesis of Wind Turbine Noise and Infrasound", Walker & Celano, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015

reactions to the synthesized signals are not conclusive due to the small number of test subjects and constrained exposure times. However, no individual thus far has reported and sensation when exposed to infrasound alone at peak levels up to 97dB."

9.135 Therefore, in accordance with literature, it is not considered appropriate or relevant to undertake specific assessment in relation to infrasound for the proposed wind farm.

Sleep Disturbance

9.136 ETSU-R-97 states that different limits should be applied during daytime and night-time periods. The daytime limits are intended to preserve outdoor amenity, while the night-time limits are intended to prevent sleep disturbance. The night-time criterion is derived from the 35 dB(A) sleep disturbance criterion referred to in ETSU-R-97, with an allowance of 10 dB(A) for attenuation through an open window (which is conservative) and a correction of 2 dB(A) to allow for the use of L_{A90}, rather than L_{Aeq}.

9.137 A report entitled 'Sleep Disturbance and Wind Turbine Noise' by Dr Christopher Hanning reviewed the potential consequences of wind turbine noise and its effect on sleep and health, and made recommendations on setback distances[19]. The report was created on behalf of 'Stop Swinford Wind Farm Action Group' (SSWFAG).

9.138 Dr Hanning states that:

"There can be no doubt, that groups of industrial wind turbines ("wind farms") generate sufficient noise to disturb the sleep and impair the health of those living nearby."

9.139 Dr Hanning's paper fails to acknowledge the link between noise level and sleep disturbance. This link is acknowledged in the most recent advice published by the World Health Organisation Night Noise Guidelines for Europe[20]. This report recommends acceptable levels of night time noise below which no appreciable adverse effects on sleep can reasonably be identified and levels above which sleep effects may be expected. The levels identified in these guidelines indicate an outdoor annualised free field noise level of 40 dB(A). Such averaging would allow short term levels in excess of this. In comparison to the likely noise limits to be imposed upon the wind farm, based upon ETSU-R-97 recommendations, this 40 dB(A) annualised limit is much more lenient. There will be significant portions of time that the noise levels shown in this report, due to wind direction, wind speed or conservatism in modelling, are not realised.

9.140 In another article published by Dr Hanning and Professor Alun Evans, in the British Medical Journal[21] it states:

"A large body of evidence now exists to suggest that wind turbines disturb sleep and impair health at distances and external noise levels that are permitted in most jurisdictions, including the United Kingdom."

9.141 Research evidence supports the conclusion that noise from any source will result in measurable effects on sleep when it reaches a certain level. Such effects may comprise changes in sleep state without those exposed actually awakening, or they may comprise complete awakenings. Either of these responses may or may not have a consequential long term effect on wellbeing depending on the subjects concerned and the extent of the effects being considered.

9.142 There is no reason why wind turbine noise should be any different to other forms of noise, in that there will be a certain level at which wind turbine noise would impact on the sleep of those exposed to it. As with other forms of noise, some variability in response across the exposed population would be expected, with some people being more noise sensitive and others more noise tolerant.

9.143 In a report by the Chief Medical Officer of Health of Ontario[22], in response to public health concerns about wind turbine noise, the review concluded that:

"...while some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects. The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct health effects..."

9.144 A report published the Massachusetts Department of Environmental Protection concludes that[23]:

"Evidence regarding wind turbine noise and human health is limited. There is limited evidence of an association between wind turbine noise and both annoyance and sleep disruption, depending on the sound pressure level at the location of concern".

9.145 Since ETSU-R-97 accounts for sleep disturbance when setting night time noise limits it is therefore concluded that protection from sleep disturbance is considered within this acoustic impact for the proposed wind farm.

Vibration

9.146 Structure borne noise, originating in vibration, is also low frequency, as is neighbour noise heard through a wall, since walls generally block higher frequencies more than lower frequencies.

9.147 In 2004/2005, researchers at Keele University investigated the effects of the extremely low levels of vibration resulting from wind farms on the operation of the seismic array at Eskdalemuir, one of the most sensitive installations in the world10. The results of this study have frequently been misinterpreted and, to clarify the position, the authors have explained that:

"The levels of vibration from wind turbines are so small that only the most sophisticated instrumentation and data processing can reveal their presence, and they are almost impossible to detect."

9.148 They go on to say:

"Vibrations at this level and in this frequency range will be available from all kinds of sources such as traffic and background noise - they are not confined to wind turbines. To put the level of vibration into context, they are ground vibrations with amplitudes of about one millionth of a millimetre. There is no possibility of humans sensing the vibration and absolutely no risk to human health."

9.149 The Ministry of Defence's approach to safeguarding the Eskdalemuir seismic array is to allocate a budget in terms of the cumulative level of seismic vibration from wind turbines. This restricts the number of wind farms that can be located within a certain distance of the Eskdalemuir seismic array (EKA) without adversely impacting upon its operation. In June 2014, a report was prepared by Xi Engineering Consultants with the full cooperation and significant input from the Ministry of

[19] 'Sleep Disturbance and Wind Turbine Noise', Hanning, on behalf of Stop Swinford Wind Farm Action Group (SSWFAG), June 2009

[20] 'Night Noise Guidelines for Europe', World Health Organisation, 2009

[21] 'Wind Turbine Noise', Hanning et al, British Medical Journal, March 2012

[22] 'The Potential Health Impact of Wind Turbines', Chief Medical Officer of Health (CMOH) Report, May 2010

[23] 'Wind Turbine Health Impact Study: Report of Independent Expert Panel'" Jeffrey M. Ellenbogen et al, Prepared for: Massachusetts Department of Environmental Protection Massachusetts Department of Public Health, January 2012

Defence24. The report builds on initial Phase 0 work which identified that the current budget over estimates the seismic vibration produced by wind turbines and that there is a likelihood of significant prospective head room that would allow the building of wind farms without breaching the 0.336 nm threshold. The goal of the research was to produce an algorithm that will better predict the amplitude of seismic vibrations produced by wind turbines in the 0.5 to 0.8 Hz passband, which might allow the exploitation of wind resource in the Southern Uplands while maintaining protection of the detection capabilities of EKA. The work of the research allows for the determination of how close to EKA wind turbines can be built while optimising the generating capacity within the consultation zone. The application of a physics based algorithm allowed for the calculation of cumulative seismic vibration at EKA. From these calculations they were able to predict that:

"The cumulative amplitude of all turbines currently allocated budget and currently subject to objection with a utilisation factor of unity and minimum hub height of 40 m is 0.193833 nm."

This value falls well below the 0.336 nm threshold as set by the MOD.

9.150 A scientific advisory panel comprising independent experts in acoustics, audiology, medicine and public health conducted a comprehensive review of the available literature on the issue of perceived health effects of wind turbines, titled 'Wind Turbine Sound and Health Effects - An Expert Panel Review', and prepared a report for the American and Canadian Wind Energy Associations in December 200925. The authors explain that:

"Vibration of the body by sound at one of its resonant frequencies occurs only at very high sound levels and is not a factor in the perception of wind turbine noise".

9.151 The authors further state that:

"Airborne sound can cause detectable body vibration, but this occurs only at very high levels — usually above sound pressure levels of 100 dB. There is no scientific evidence to suggest that modern wind turbines cause perceptible vibration in homes or that there is an associated health risk".

9.152 Therefore, in accordance with literature, it is not considered appropriate or relevant to undertake specific assessment in relation to vibration caused by the operation of the proposed wind farm.

Aerodynamic Modulation

9.153 A noise sometimes associated with wind turbines and commonly referred to as 'blade swish' is the modulation of aerodynamic noise produced at blade passing frequency (the frequency at which a blade passes a fixed point). This noise character is acknowledged by, and accounted for, in the recommendations of ETSU-R-97**Error! Bookmark not defined.**. However the aforementioned DTI report[5] noted that 'Aerodynamic Modulation', alternatively referred to as 'Amplitude Modulation' (AM) was, in some isolated circumstances, occurring in ways not anticipated by ETSU-R-97. AM above and beyond that considered by ETSU-R-97 is often referred to as Excess, or Other, Amplitude Modulation (EAM/OAM).

9.154 In December 2013, the wind industry trade association, RenewableUK, published detailed new scientific research[26] into causes and effects of wind turbine AM. The work was carried out by a group of independent experts, including academics from the Universities of Salford and Southampton, the National Aerospace Laboratory of the Netherlands, Hoare Lea Acoustics, Robert Davies Associates and DTU Riso in Denmark.

9.155 The Chairman of the IOA Noise Working Group said of the study:

"This research is a significant step forward in understanding what causes amplitude modulation from a wind turbine, and how people react to it."

9.156 The RenewableUK work encouraged further research in the area, which has led to the identification of suitable mitigation methods. At the EWEA Technology Workshop on Wind Turbine Sound in 2014, Hoare Lea Acoustics presented a paper entitled: "Measurements to assess the effectiveness of turbine modifications to reduce the occurrence of AM in the far-field"[27]. The paper concludes that turbine blade modifications can result in significant reductions in AM in the far-field and that similar effects can also be achieved through blade pitch modification.

9.157 The authors state that:

"This shows that effective mitigation of AM on operational turbines is technically feasible."

9.158 The other notable outcome of the RenewableUK research was a proposed planning condition informed by listening tests and work undertaken to determine how AM should be measured. The IOA recommended a period of testing and validation before the condition was adopted such that the work again proved valuable as a catalyst for further research.

9.159 The IOA created an AM Working Group which published a discussion document[28] on methods for rating amplitude modulation in wind turbine noise in April 2015. The document proposed a definition of AM and provided a literature review of the available metrics before selecting three for detailed discussion. The intention was to obtain feedback from the acoustic community, allowing a preferred rating method to be selected following the consultation period.

9.160 A separate, government funded, study has been commissioned by the Department of Energy and Climate Change (DECC) with a view to recommending how an appropriate AM threshold should be defined.

9.161 Given the ongoing research detailed above, it is not currently considered appropriate to impose a planning condition specific to AM. It should also be acknowledged that the likelihood of OAM occurring and the frequency of its occurrence vary depending upon the characteristics of the site in question such that a planning condition relating to AM may not satisfy the tests of being necessary, relevant to the development to be permitted or reasonable in all cases.

9.162 Given that occurrences of OAM depend upon the detailed characteristics of the installed turbine type as well as the site, it is not considered appropriate to undertake a specific assessment in relation to AM above and beyond that considered by ETSU-R-97 that may potentially be produced by the operation of the proposed wind farm development based on a candidate machine. It should also be noted that the aforementioned identification of effective AM mitigation methods may mean

[24] "Seismic vibration produced by wind turbines in the Eskdalemuir region. Release 2.0 of Substantial Research project" prepared by Xi Engineering Consultants Ltd, Document Number FMB_203_FINAL_V5R, 15th June 2014

[25] 'Wind Turbine Sound and Health Effects - An Expert Panel Review' W.D. Colby et al, 2009

[26] 'Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effects', RenewableUK, 2013, www.renewableuk.com

[27] "Measurements to assess the effectiveness of turbine modifications to reduce the occurrence of AM in the far-field", Bullmore & Cand, Hoare Lea Acoustics, EWEA Technology Workshop: Wind Turbine Sound 2014, Malmo, Sweden, 9-10 December 2014

[28] Institute of Acoustics, IOA Noise Working Group (Wind Turbine Noise), Amplitude Modulation Working Group, Discussion Document, "Methods for Rating Amplitude Modulation in Wind Turbine Noise", April 2015

that, should planning permission be granted, such options are available as standard by the time the proposed site comes to be built.

Wind Turbine Syndrome

9.163 The condition proposed by paediatrician Dr Nina Pierpont in her report 'Wind Turbine Syndrome: A Report on a Natural Experiment' cites a range of physical sensations and effects as being caused by living near a wind farm[29]. This study is based on a series of interviews comprising a study group of 10 families. It is a self-published report with none of the research being published in any peer reviewed medical journal.

9.164 In a NHS response to the Pierpont report, a report titled 'Are wind farms a health risk?' states that there is no conclusive evidence that wind turbines have an effect on health or are causing the set of symptoms described as 'wind turbine syndrome'[30]. It was noted that the group study by Pierpont was not sufficient to grant the claims stated.

9.165 The aforementioned report 'Wind Turbine Sound and Health Effects - An Expert Panel Review'[25], prepared by a scientific advisory panel for the American and Canadian Wind Energy Associations, concludes that Wind Turbine Syndrome is:

"not a recognized medical diagnosis, is essentially reflective of symptoms associated with noise annoyance and is an unnecessary and confusing addition to the vocabulary on noise".

9.166 The report went on to say:

"There are no unique symptoms or combinations of symptoms that would lead to a specific pattern of this hypothesized disorder."

9.167 An independent review of the state of knowledge about the alleged health condition was carried out[31]. This report includes three expert opinions provided by: Richard J.Q. McNally - Reader in Epidemiology at the Institute of Health and Society Newcastle University; Geoff Leventhall – an independent consultant specialising in low frequency noise, infrasound and vibration; and Mark E. Lutman - Professor of Audiology at the University of Southampton. Their critique of Pierpont's study concludes that the reported symptoms are the effects mediated by stress and anxiety when exposed to an adverse element in their environment. There is no evidence that they are patho-physiological effects of wind turbine noise.

9.168 A paper by Pedersen explores data from three cross-sectional studies comprising A-weighted sound pressure levels of wind turbine noise, and subjectively measured responses from 1,755 people, to find the relationships between sound levels and aspects of health and well-being[32]. It was concluded that there is no consistent association between wind turbine noise exposure and the symptoms associated with Wind Turbine Syndrome.

9.169 A study conducted by Simon Chapman, Professor of Public Health at Sydney University, provides evidence that noise and health complaints about wind turbines are psychogenic[33]. The authors conclude that:

"In view of scientific consensus that the evidence for wind turbine noise and infrasound causing health problems is poor, the reported spatio-temporal variations in complaints are consistent with psychogenic hypotheses that health problems arising are communicated diseases with nocebo effects likely to play an important role in the aetiology of complaints".

9.170 Therefore, in accordance with literature, it is not considered appropriate or relevant to undertake specific assessment in relation to Wind Turbine Syndrome potentially caused by the operation of the proposed wind farm.

Wind Turbine Noise and Associated Health Effects Studies

9.171 In 2014 Health Canada released its findings from the "Wind Turbine Noise and Health Study"[34]. Health Canada, in partnership with Statistics Canada, conducted the study between residents of southern Ontario and Prince Edward Island where there were a sufficient number of homes within the vicinity of wind turbine installations. Twelve and six wind turbine developments were sampled in Ontario and PEI, representing 315 and 84 wind turbines, respectively. All potential homes within approximately 600 m of a wind turbine were selected, as well as a random selection of homes between 600 m and 10 km. A total of 1,238 households participated out of a possible 1,570.

9.172 The study was comprised of three parts: an in-person questionnaire given to randomly selected participants living at various distances from wind turbines; a collection of physical health measures that assessed stress levels using hair cortisol, blood pressure and resting heart rate as well as measures of sleep quality; and more than 4,000 hours of wind turbine noise measurements conducted by Health Canada to support calculations of wind turbine noise levels (WTN) in all homes in the study.

9.173 Health Canada broke the findings into five parts: illness and chronic disease, stress, sleep, annoyance and quality of life and noise.

9.174 Under Self-reported Illnesses and Chronic Diseases, Health Canada states:

"Self-reports of having been diagnosed with a number of health conditions were not found to be associated with exposure to WTN levels. These conditions included, but were not limited to chronic pain, high blood pressure, diabetes, heart disease, dizziness, migraines, ringing, buzzing or whistling sounds in the ear (i.e., tinnitus)".

9.175 Under the heading of Self-reported Stress, Health Canada states no association was found between the multiple measures of stress (such as hair cortisol, blood pressure, heart rate, self-reported stress) and exposure to wind turbine noise.

"Self-reported stress, as measured by scores on the Perceived Stress Scale, was not found to be related to exposure to WTN levels".

9.176 For Self-reported Sleep:

"Results of self-reported measures of sleep, that relate to aspects including, but not limited to general disturbance, use of sleep medication, diagnosed sleep disorders and scores on the Pittsburgh Sleep Quality Index (PSQI), did not support an association between sleep quality and WTN levels".

9.177 However, the study states, while some people reported some of the aforementioned health conditions, their existence was not found to change in relation to exposure to wind turbine noise.

9.178 An association was found, however, between increasing levels of wind turbine noise and individuals reporting to be very or extremely annoyed. No association was found with any significant changes

[29] 'Wind Turbine Syndrome - A Report on a Natural Experiment', Pierpont, K-Selected Books, 2009

[30] 'Are wind farms a health risk?', NHS, 2009, www.nhs.uk

[31] 'Wind Turbine Syndrome (WTS) - An independent review of the state of knowledge about the alleged health condition', RenewableUK, 2010, www.bwea.com

[32] 'Health aspects associated with wind turbine noise—results from three field studies' Pedersen, Noise Control Engineering Journal, Volume 59, Issue 1, 2011

[33] 'Spatio temporal differences in the history of health and noise complaints about Australian wind farms: evidence for the psychogenic, communicated disease hypothesis', Chapman et al, University of Sydney, 2013

[34] "Wind Turbine Noise and Health Study: Summary of Results", Health Canada, November 2014, http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php

in reported quality of life or with overall quality of life and satisfaction with health. This was assessed using the abbreviated version of the World Health Organization's Quality of Life Scale.

"The overall conclusion to emerge from the study findings is that the study found no evidence of an association between exposure to WTN and the prevalence of self-reported or measured health effects beyond annoyance. Collectively, the findings related to annoyance suggest that health and well-being effects may be partially related to activities that influence community annoyance, over and above exposure to WTN. Therefore, efforts that aim to identify and mitigate high levels of annoyance with wind turbines may have benefits that go beyond annoyance".

9.179 Lastly, under noise, calculated noise levels were found to be below levels that would be expected to directly affect health, according to the World health Organization Community Noise Guidelines, 1999.

9.180 A review conducted by McCunney et al in[35] November 2014, examines the literature related to health effects of wind turbines. The review was intended to assess the peer-reviewed literature regarding evaluations of potential health effects among people living in the vicinity of wind turbines. It included analysis and commentary of the scientific evidence regarding potential links to health effects, such as stress, annoyance, and sleep disturbance, among others, that have been raised in association with living in proximity to wind turbines. Also addressed were specific components of noise associated with wind turbines such as infrasound and low-frequency sound and their potential health effects.

9.181 The review attempts to address the following questions regarding wind turbines and health:

- Is there sufficient scientific evidence to conclude that wind turbines adversely affect human health? If so, what are the circumstances associated with such effects and how might they be prevented?
- Is there sufficient scientific evidence to conclude that psychological stress, annoyance, and sleep disturbance can occur as a result of living in proximity to wind turbines? Do these effects lead to adverse health effects? If so, what are the circumstances associated with such effects and how might they be prevented?
- Is there evidence to suggest that specific aspects of wind turbine sound such as infrasound and low-frequency sound have unique potential health effects not associated with other sources of environmental noise?

9.182 The co-authors represent professional experience and training in occupational and environmental medicine, acoustics, epidemiology, otolaryngology, psychology, and public health.

9.183 The findings of the review are summarised thus:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.
- No cohort or case–control studies were located in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low-frequency sound have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

35 "Wind Turbines and Health: A Critical Review of the Scientific Literature" McCunney et al, Journal of Occupational & Environmental Medicine, November 2014

Technical Appendix 9.2: Calculating Standardised Wind Speed

9.184 In order to derive appropriate noise limits the ETSU-R-97 guidance requires the correlation of background noise survey data with wind speed data referenced to 10 m height. In contrast to this, acoustic emission measurements on wind turbines are undertaken in accordance with international standard IEC 61400-11, 'Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques'[36], which specifies that the turbine noise emission should be reported as a function of 'standardised' wind speed at 10 m height. In practice this translates as extrapolation of wind speed at hub height down to 10 m height using a specified, and fixed, relationship.

9.185 The use of a fixed relationship between hub height and 10 m wind speed means that potential exists for the background noise data and acoustic emission data to be misaligned i.e. a wind speed measured at 10 m height is not necessarily equivalent to a 'standardised' 10 m wind speed of the same magnitude, with the difference depending upon the site specific shear exponent (the rate of change of wind speed with height). To account for the effects of wind shear, the background noise data is referenced to the same wind speed as the acoustic emission data. This approach is defined as appropriate, both by a group of independent acoustic consultants who have undertaken work on behalf of wind farm developers, local planning authorities and third parties in the IoA Bulletin, and in the subsequent IoA GPG. The methodology outlined below is followed to covert the wind speed measured concurrently with the background noise data to 'standardised' 10 m height:

- Extrapolate the wind speed from the measurement height to the proposed hub height by use of a calculated wind shear exponent. The wind shear exponent is a commonly used, empirically based, engineering description of the rate of change of wind speed with height and may vary according to atmospheric conditions and be affected by interactions between ground features and the wind flow. The hub height wind speed for each 10 minute period may be calculated from the measured wind speed and the calculated wind shear exponent as follows:

$$v_{hub} = v_{H1}\left(\frac{h_{hub}}{h_{H1}}\right)^{\alpha}$$

Where: v_{H1} = measured wind speed
v_{hub} = wind speed at proposed hub height
h_{H1} = measurement height
h_{hub} = proposed hub height
α = calculated wind shear exponent from measured site data

- The 'standardised' 10 m wind speed is determined from the measured hub height wind speed according to the procedure specified in IEC 61400-11. The 'standardised' wind speed is essentially a proxy for hub height wind speed (the primary driver of noise emission from the turbine) and is found by extrapolating the hub height wind speed to 10 m height according to the following formula:

$$v_S = v_Z\left[\frac{\ln\frac{z_{ref}}{z_{0ref}}}{\ln\frac{z}{z_{0ref}}}\right]$$

Where: v_s is the 'standardised' wind speed
v_z is the wind speed at height z (the hub height wind speed)
z_{0ref} is the reference roughness length (0.05 m)
z_{ref} is the reference height, 10 m
z is the proposed hub height

- The resulting 'standardised' 10 m wind speed is correlated with the measured background noise survey data.

[36] 'Wind turbine generator systems – Part 11: Acoustic noise measurement techniques', IEC 61400-11:2003 (Amendment 1: 2006)

Technical Appendix 9.3: Propagation Height & Valley Effect

9.186 To model the propagation of noise between each proposed turbine and residential property in accordance with the IoA GPG the mean propagation height has to be calculated in order to determine whether the correction specified by the guidance for situations where propagation over a concave ground profile, or where the ground falls away significantly between the source and receiver, is applicable.

9.187 The mean propagation height between each turbine and considered property are detailed in the table below. Instances where the threshold specified by the IoA GPG is exceeded, and 3 dB(A) has therefore been added to the noise level predicted by the ISO 9313-2 model for that specific turbine and property, are highlighted.

Table of Mean Propagation Heights

House ID	Propagation Height (h_m) for each Turbine (m)												
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13
H1	43.7	39.8	33.3	35.3	31.1	37.5	34.7	41.5	51.0	55.6	61.7	62.3	73.4
H2	39.2	34.9	33.9	34.3	26.7	33.5	31.2	38.5	52.7	54.2	64.1	64.4	69.0
H3	38.9	34.4	34.0	34.3	26.9	33.6	31.3	38.7	52.7	54.3	64.1	64.6	69.1
H4	36.7	35.6	40.1	36.6	26.1	37.4	29.1	33.0	53.6	47.1	64.0	70.6	78.4
H5	80.1	107.0	76.5	100.9	102.8	85.4	78.5	73.2	75.0	77.3	81.5	82.8	80.1
H6	35.8	35.9	33.7	36.7	47.7	41.8	48.0	43.5	49.1	61.6	62.3	58.7	64.6
H7	29.3	33.4	20.5	28.3	30.1	27.8	36.7	39.3	47.4	55.3	61.3	57.1	62.4
H8	37.0	37.1	32.6	43.4	44.5	34.4	38.0	39.2	48.2	52.5	56.3	65.8	73.3
H9	37.0	37.1	32.6	43.4	44.5	34.4	38.0	39.2	48.2	52.5	56.3	65.8	73.3
H11	43.0	48.2	39.5	43.3	59.4	45.4	46.3	48.7	60.0	56.6	65.0	59.9	64.0
H12	44.2	50.0	40.0	44.0	60.3	46.5	47.3	49.8	60.1	57.4	65.9	60.3	64.3
H14	37.0	40.5	36.9	40.4	54.5	40.9	42.3	43.1	57.6	53.4	58.9	59.6	62.9
H16	36.4	39.8	36.9	40.9	53.0	41.3	42.6	42.3	56.6	54.0	55.9	62.5	64.0
H17	38.7	45.3	29.4	37.0	38.8	30.7	38.9	44.5	51.6	53.9	63.1	58.9	62.1
H18	39.7	47.4	32.8	40.6	40.9	32.5	40.7	45.4	52.9	54.9	63.5	57.6	59.6
H19	75.9	92.1	70.2	89.8	88.5	67.3	70.0	66.9	65.7	70.5	72.3	76.5	80.9
H20	37.9	43.9	26.3	32.8	35.9	31.6	37.7	42.1	51.8	53.6	60.8	59.8	65.1
H21	58.4	62.0	55.6	61.8	58.4	34.7	39.7	52.7	64.8	65.7	70.2	72.7	78.6
H22	58.6	62.5	55.5	62.1	59.4	35.6	40.0	52.5	65.2	65.8	70.8	73.7	79.4
H23	84.9	86.8	80.9	87.6	79.9	57.4	64.5	77.8	73.4	78.0	79.5	81.3	88.9
H24	83.4	83.2	79.9	83.9	76.9	54.8	61.8	76.7	73.6	78.4	79.8	81.4	88.7
H25	38.8	43.6	22.7	27.9	38.7	43.4	43.5	46.3	52.3	61.9	64.2	59.0	64.1
H26	34.6	36.7	26.0	33.9	44.8	45.8	47.1	47.3	55.2	66.8	70.2	63.5	69.4
H29	51.1	54.4	47.3	51.6	50.1	30.0	31.6	42.5	53.9	56.2	61.9	63.8	71.2
H31	49.2	59.0	45.0	52.8	49.5	37.7	42.6	48.4	63.5	63.8	73.5	81.8	91.4
H32	50.4	60.5	45.9	53.1	49.9	38.3	43.2	48.2	63.1	64.2	74.0	81.7	91.2
H33	48.0	51.8	43.9	49.5	45.2	27.7	27.1	38.4	51.0	50.6	56.7	60.4	66.2
H35	44.6	49.0	44.8	53.3	50.8	34.8	36.1	39.5	51.8	51.4	58.1	63.3	68.0
H36	51.7	61.0	45.8	52.8	49.1	39.0	43.4	47.6	62.0	63.6	73.6	79.4	88.9
H37	48.0	49.4	42.4	48.9	44.7	29.3	26.2	36.1	49.0	47.3	53.9	59.1	64.1
H38	51.6	61.0	45.8	52.7	48.9	38.9	43.4	47.5	61.7	63.4	73.2	79.4	88.8
H40	42.8	49.6	51.1	58.6	59.2	48.6	51.4	56.4	69.9	68.0	76.2	84.5	92.7
H41	44.1	52.7	38.0	44.9	43.0	32.2	34.7	39.3	52.2	51.9	60.8	68.9	77.3
H42	33.5	36.0	34.5	37.8	40.7	32.5	33.5	35.4	47.1	53.2	58.7	62.1	69.9
H43	55.1	63.9	50.5	57.3	52.1	42.2	45.0	49.1	61.7	58.9	69.4	77.9	86.3
H44	62.9	74.7	58.1	80.7	73.6	80.1	77.0	71.2	72.5	90.5	88.9	74.2	78.6
H45	60.9	72.8	56.3	78.7	67.9	79.7	78.7	74.0	76.6	89.9	91.9	78.2	81.8
H46	40.2	45.0	41.3	50.0	48.1	34.2	34.8	34.3	46.6	49.2	55.2	59.3	64.7
H47	62.2	76.5	59.3	81.5	70.3	81.5	81.2	77.0	79.4	91.1	94.5	81.5	85.0
H48	45.9	54.7	37.8	44.6	41.4	29.0	31.2	35.1	47.6	45.3	55.0	64.5	72.0

House ID	Propagation Height (h_m) for each Turbine (m)												
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13
H49	53.9	61.5	44.5	51.1	47.7	34.0	36.4	41.0	53.3	49.3	59.1	69.9	77.8
H50	45.6	54.3	37.2	44.0	40.8	28.2	30.2	33.7	45.8	44.0	53.1	62.5	69.6
H53	49.2	56.9	39.8	46.7	42.9	29.4	31.3	35.6	48.0	44.2	53.9	64.3	71.8
H55	47.0	55.4	38.1	44.9	41.3	28.0	29.7	33.4	45.2	43.0	51.8	61.6	68.6
H63	41.1	45.3	48.2	57.8	59.9	50.4	49.1	50.2	62.1	65.5	74.1	77.6	84.9
H65	39.8	48.6	33.1	40.2	37.8	26.0	27.5	30.5	41.8	42.9	49.3	57.3	64.3
H69	30.6	40.1	31.0	35.4	35.5	27.3	29.2	31.2	41.8	50.7	54.5	55.6	63.1
H71	33.5	42.3	31.1	37.0	35.1	26.3	28.3	30.3	40.8	48.7	52.8	54.4	61.8
H73	35.9	37.8	44.8	52.8	55.6	49.1	49.1	50.4	61.9	65.0	73.2	76.7	83.7
H74	64.4	71.5	67.8	74.2	69.5	57.2	57.5	61.1	71.6	62.9	74.2	85.9	92.3
H75	53.7	65.5	69.4	76.2	78.8	66.1	66.4	69.1	78.4	72.4	82.8	91.0	97.2
H76	55.6	70.1	71.7	78.5	81.0	67.7	67.6	70.6	79.5	72.0	82.9	91.9	98.0
H77	43.7	59.2	41.0	56.9	61.1	49.8	38.1	43.2	61.6	62.4	79.3	77.8	95.5
H78	46.8	54.6	48.5	60.2	59.2	47.1	50.3	49.3	61.0	64.4	70.3	74.2	79.9
H79	45.4	53.9	47.3	58.9	58.3	46.2	49.5	48.8	60.4	63.9	69.8	73.7	79.4
H80	31.5	33.6	40.5	46.2	49.6	44.9	46.0	47.5	58.3	61.0	69.1	72.2	79.5
H91	60.1	68.3	59.3	73.2	72.1	59.4	60.0	58.5	69.9	73.7	80.3	83.2	90.5
H96	42.4	51.5	32.8	39.7	35.8	23.5	25.2	27.4	37.2	44.1	47.5	50.6	57.0
H97	44.3	56.5	39.4	54.8	57.9	44.1	41.8	42.7	53.9	58.8	65.2	68.4	74.9
H101	47.3	60.2	41.5	58.0	61.8	47.3	43.8	44.3	55.3	59.8	66.3	69.7	76.0
H108	50.0	58.6	51.7	63.6	62.9	50.8	53.8	52.9	64.4	67.8	73.7	77.7	83.6
H109	42.2	56.5	43.3	56.8	59.0	45.7	46.0	47.2	58.6	63.2	69.3	72.7	79.0
H111	31.3	32.7	29.7	34.0	42.2	38.4	40.1	41.7	51.8	58.0	64.1	64.9	72.4
H114	65.7	73.9	64.8	78.7	77.6	64.8	65.3	63.9	75.2	79.0	85.8	88.7	96.2
H115	42.5	51.0	44.6	57.4	59.8	48.2	44.7	44.1	55.1	54.3	61.5	69.4	74.3
H117	86.1	101.8	81.9	100.3	103.6	90.0	81.1	80.6	91.2	91.8	96.8	102.0	108.3
H118	39.6	51.1	43.5	55.0	57.7	45.5	40.9	40.2	51.8	51.8	58.5	66.0	70.1
H120	32.5	41.1	27.0	32.1	29.7	24.0	27.2	28.7	38.2	48.4	53.4	50.2	58.1
H121	34.6	35.4	32.5	41.3	48.5	42.3	43.7	45.0	55.0	60.1	67.6	68.0	75.5
H130	37.9	49.5	43.3	54.0	58.2	46.4	40.7	39.3	50.7	53.2	59.7	65.0	70.5
H132	90.9	105.6	87.0	100.7	102.9	88.5	78.5	82.8	95.9	96.7	104.8	109.6	116.8
H135	92.0	107.2	87.8	102.3	104.5	90.3	79.8	83.4	96.5	97.1	105.5	110.6	118.0

Cells highlighted grey for turbine and house locations where correction applied

Technical Appendix 9.4: Background Noise Survey Equipment and Photos

Noise Instrumentation Records

Survey Location ID	Meter Type	Meter S/N	Calibration Certificate No.	Date of Issue	Microphone S/N	Preamp S/N	Calibrator Type	Calibrator S/N	Calibrator Certificate No.	Date of Issue
H4	Rion NL52	00610207	2013 Cert No. UCRT13/1171	24/10/13	02549	10201	Rion NC-74	34315132	2013 Cert No. UCRT13/1170	23/10/13
H21	Rion NL52	00732144	2013 Cert No. UCRT13/1173	24/10/13	05336	32172	Rion NC-74	34315132	2013 Cert No. UCRT13/1170	23/10/13
H35	Rion NL52	00732145	2013 Cert No. UCRT13/1174	24/10/13	5337	32173	Rion NC-74	34315132	2013 Cert No. UCRT13/1170	23/10/13
H63	Rion NL52	00732143	2013 Cert No. UCRT13/1172	24/10/13	05335	32171	Rion NC-74	34315132	2013 Cert No. UCRT13/1170	23/10/13

Photo 1: Noise Apparatus in Relation to H4 (Initial Survey Location)

Photo 2: Noise Apparatus in Relation to H4 (Relocated)

Photo 3: Noise Apparatus in Relation to H21

Photo 4: Noise Apparatus in Relation to H35

Photo 5: Noise Apparatus in Relation to H63 (Initial Survey Location)

Photo 6: Noise Apparatus in Relation to H63 (Relocated)

Technical Appendix 9.5: Charts

Chart 1: Wind Speed and Direction during the Background Noise Survey

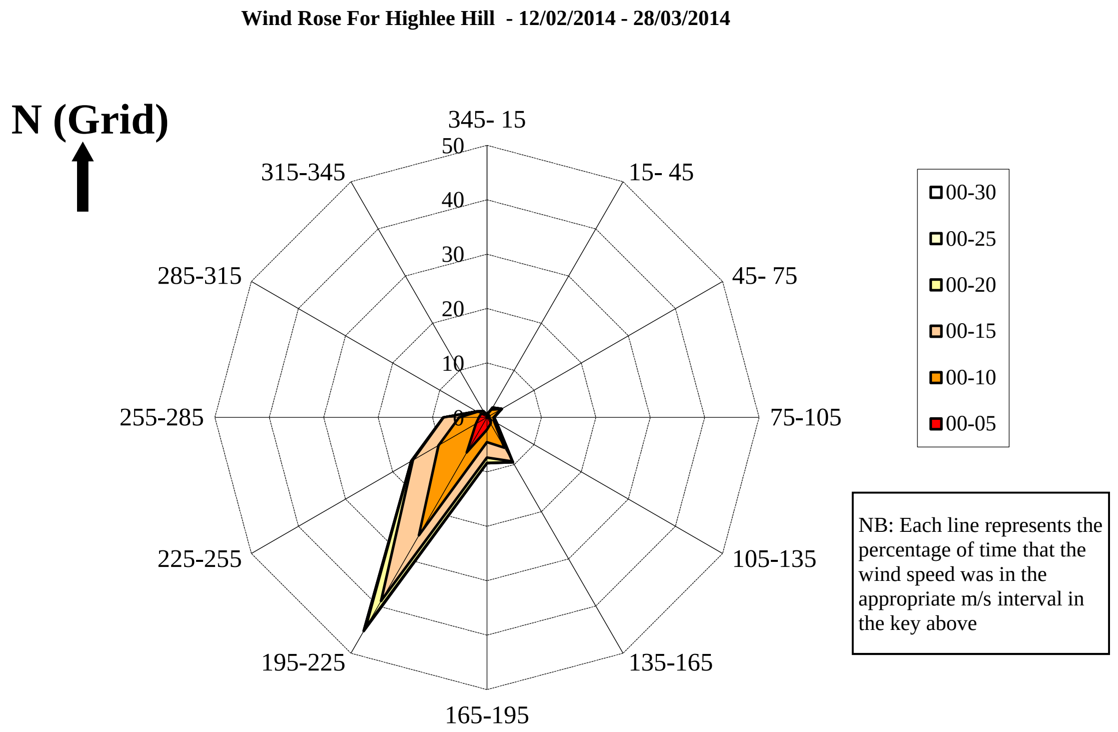


Chart 2: Wind Speed and Direction during the Background Noise Survey including the period of relocation at H4 & H63

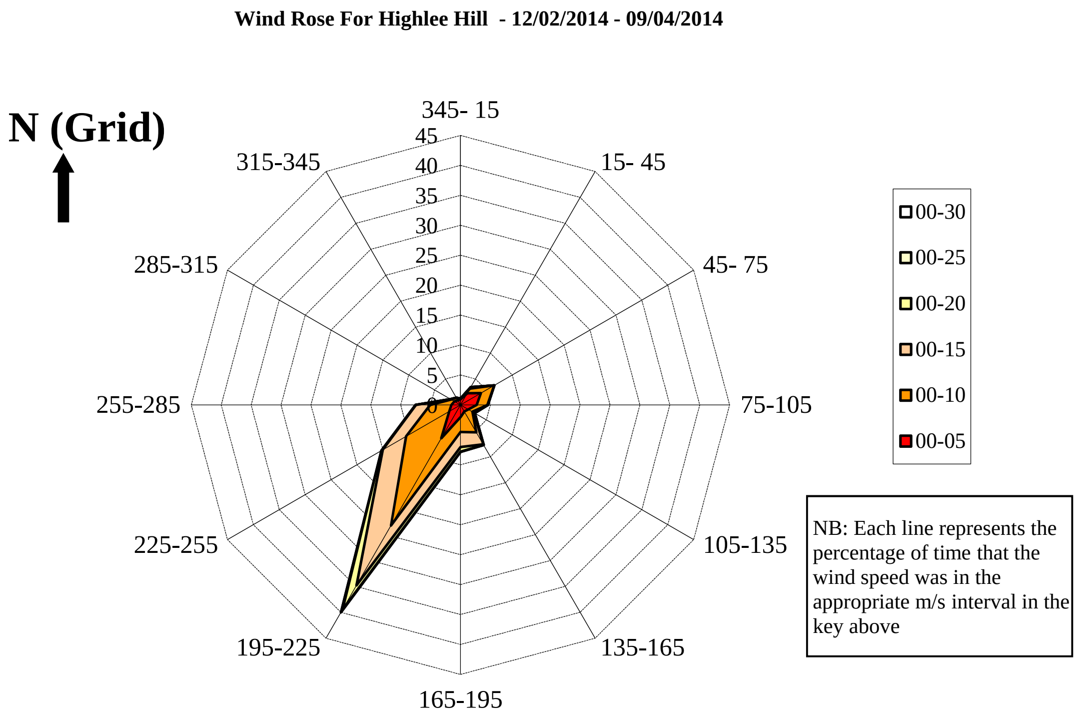


Chart 3: Measured Wind Rose over an Extended Period

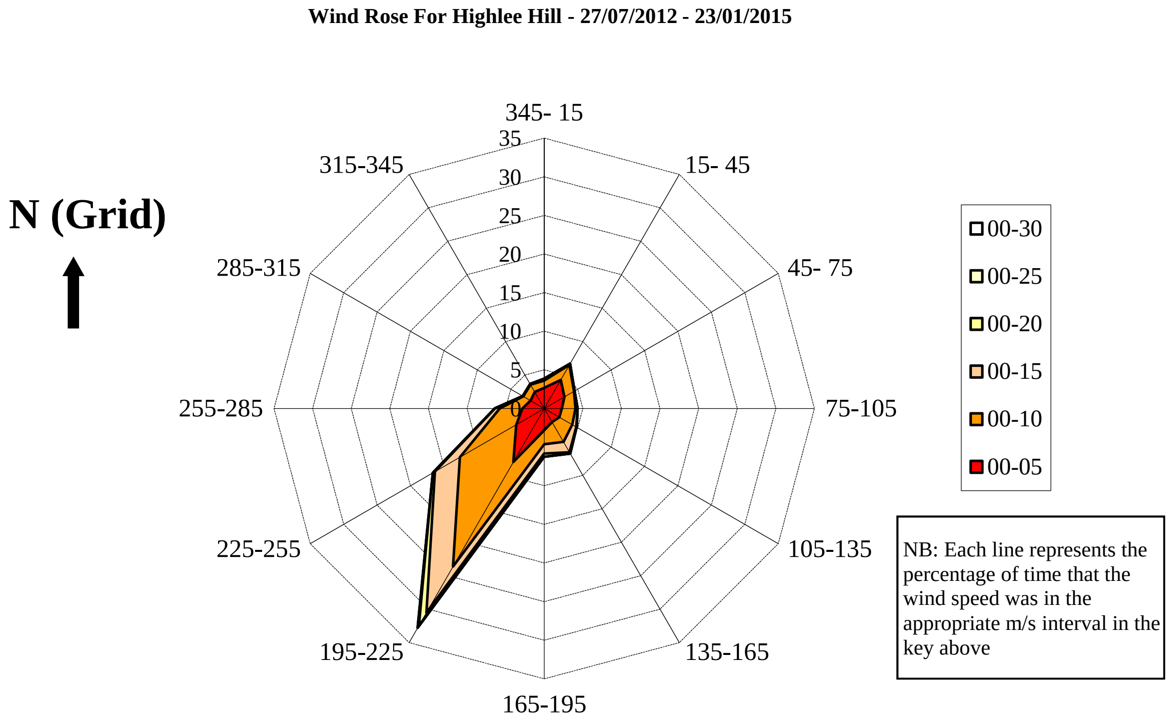


Chart 4: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Quiet Daytime Periods at H4

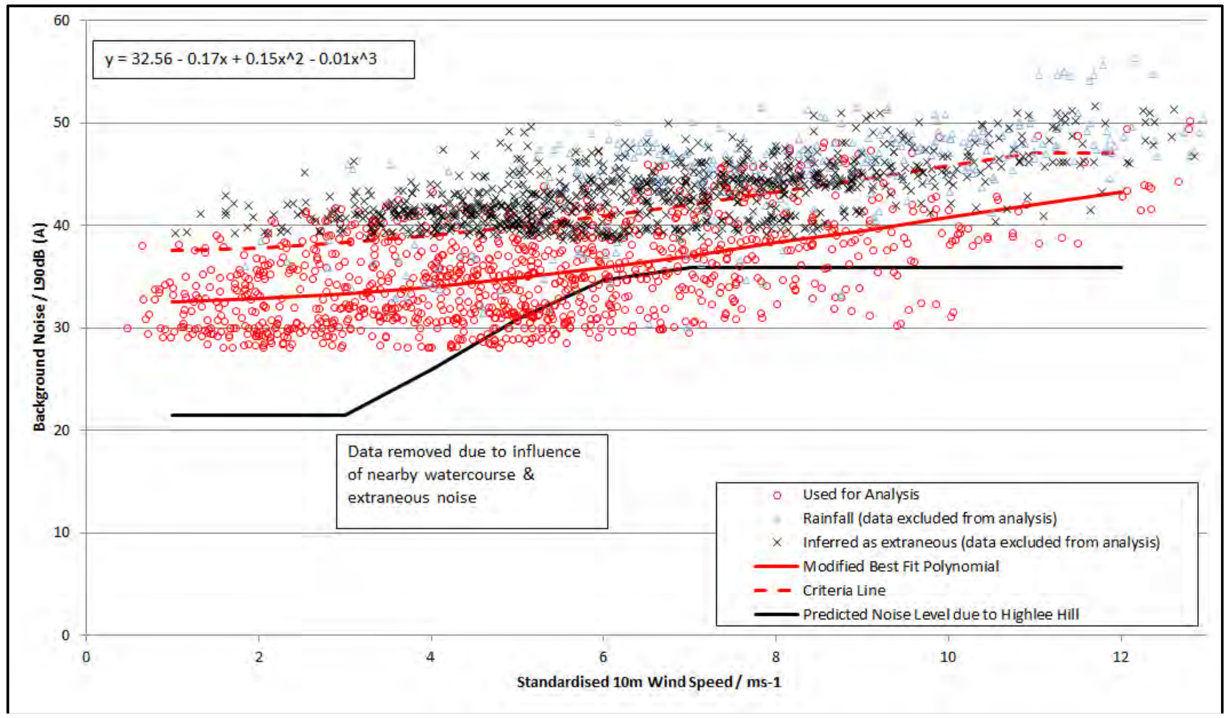


Chart 5: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Quiet Daytime Periods at H21

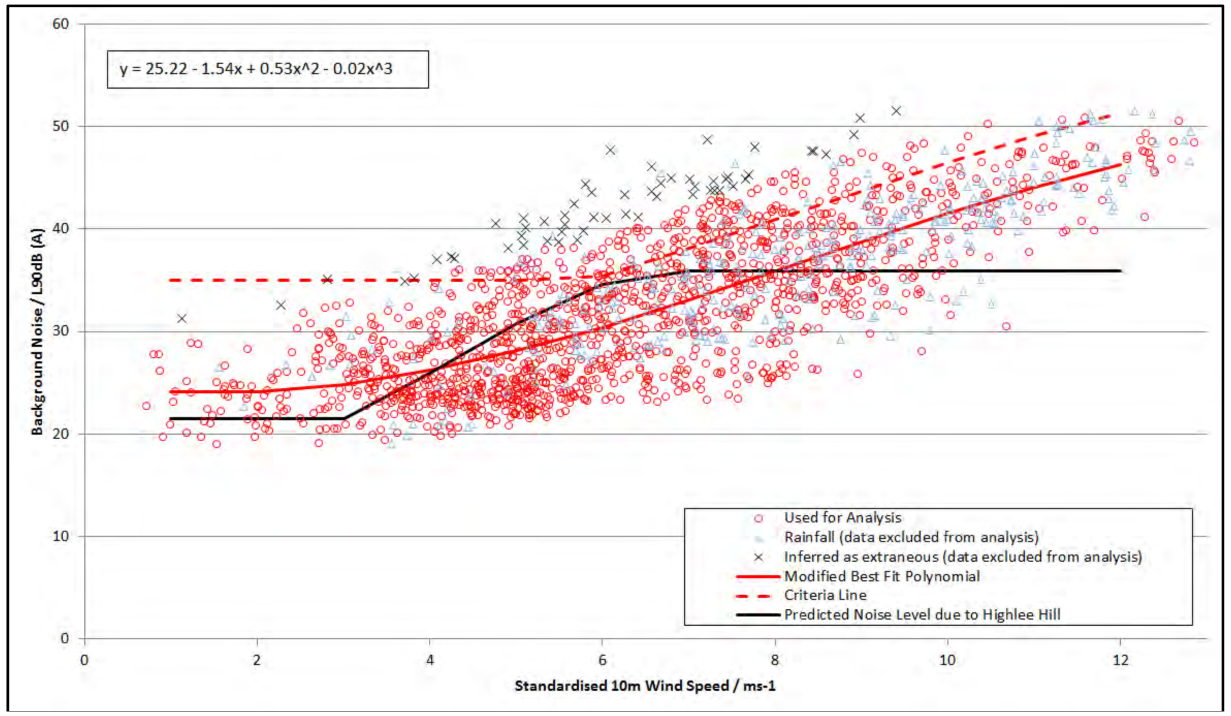


Chart 6: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Quiet Daytime Periods at H35

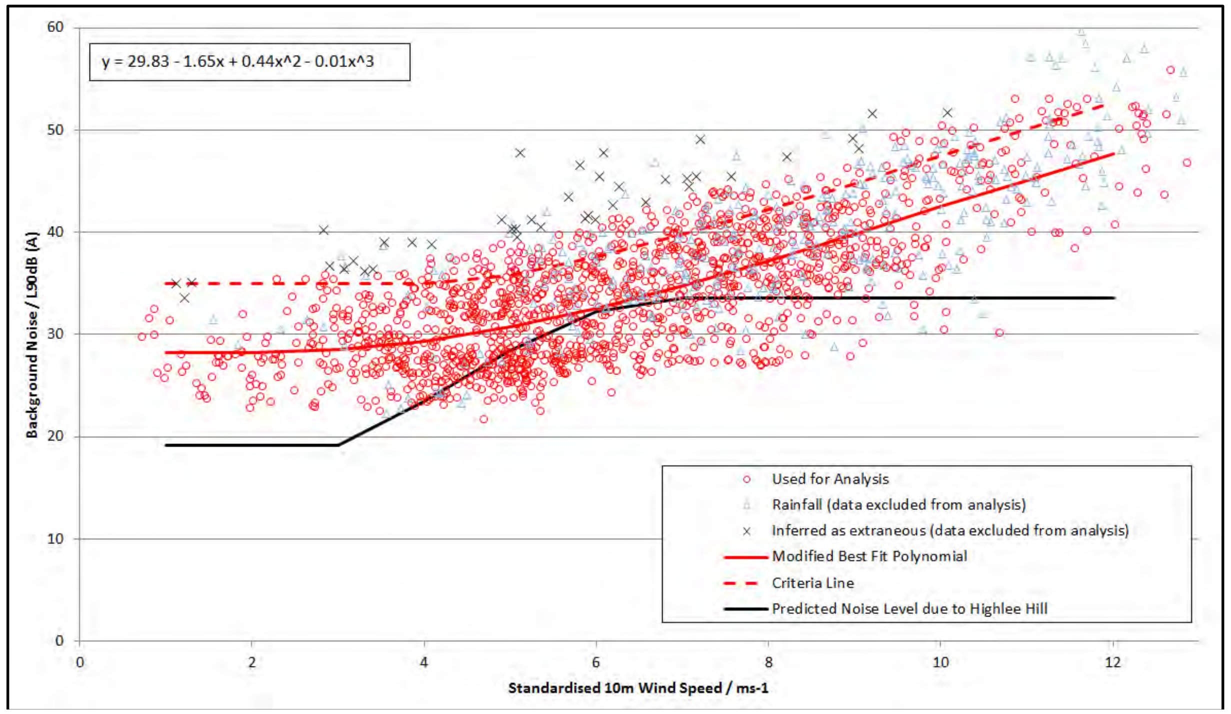


Chart 7: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Quiet Daytime Periods at H63

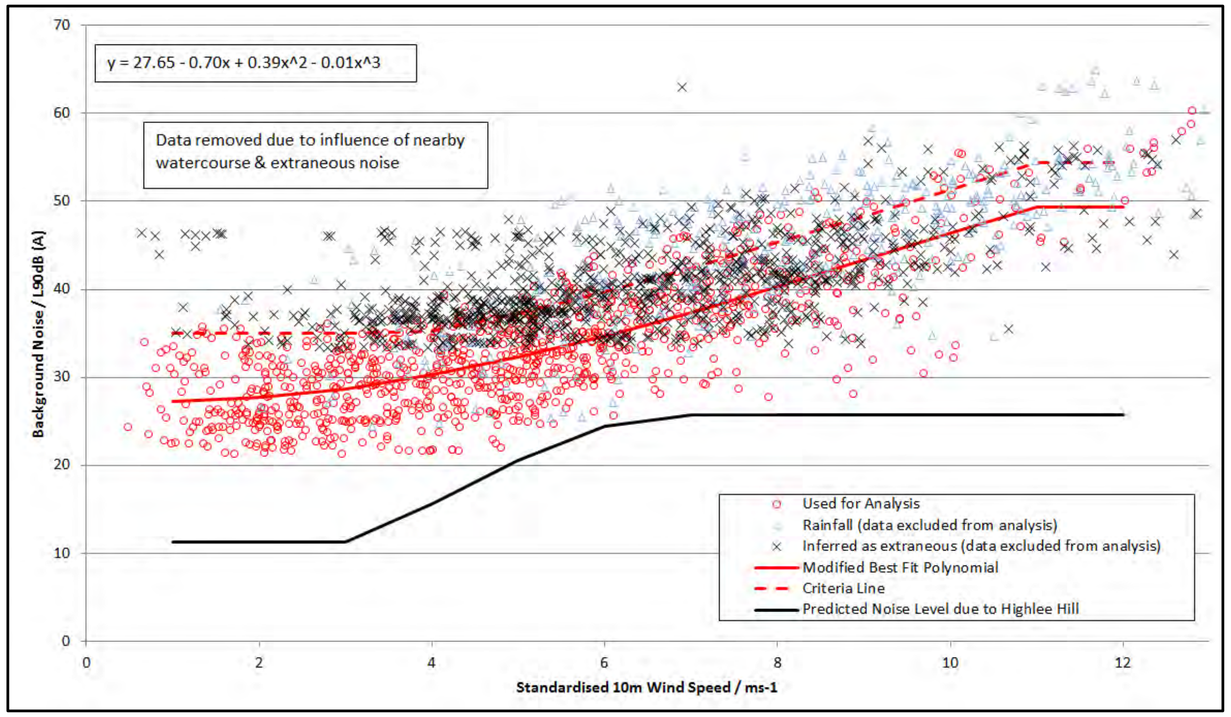


Chart 8: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Night-Time Periods at H4

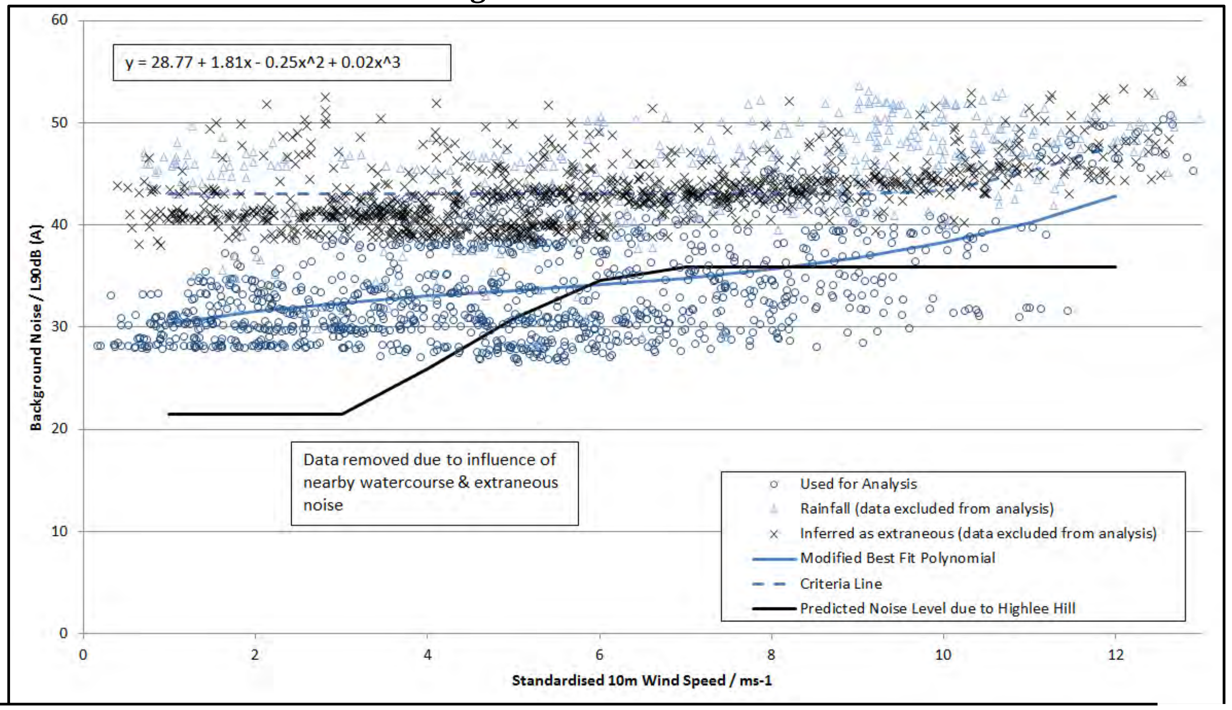


Chart 9: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Night-Time Periods at H21

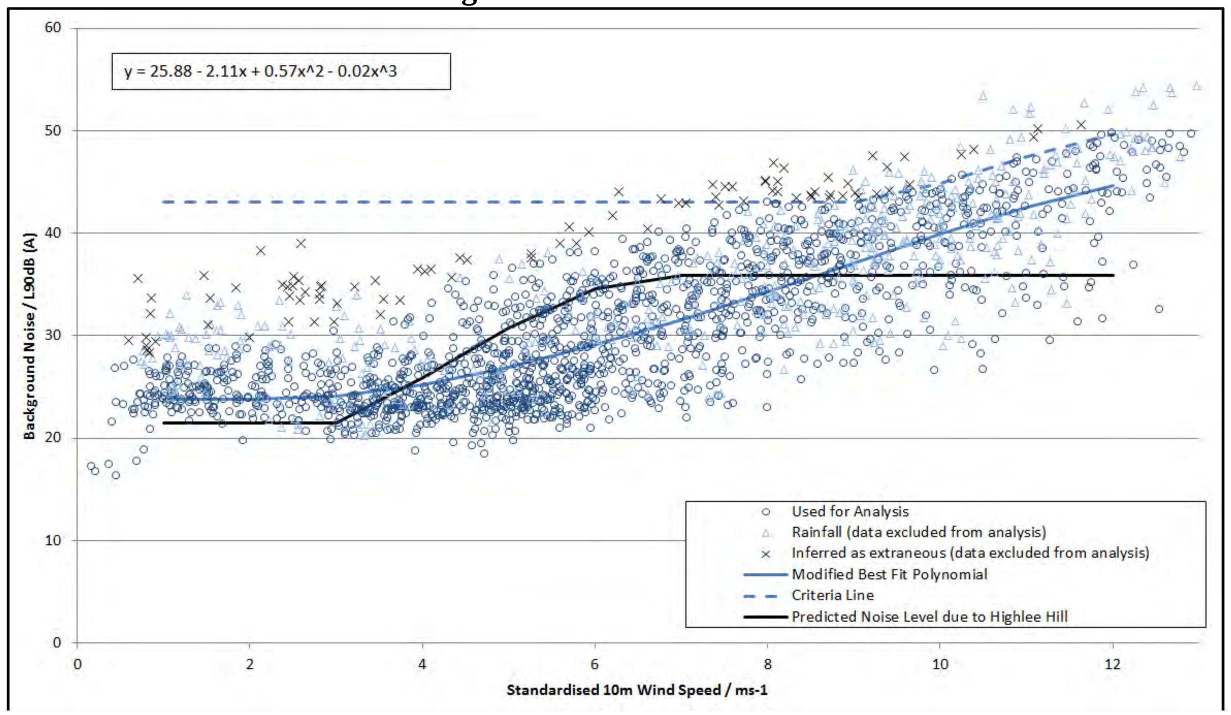


Chart 10: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Night-Time Periods at H35

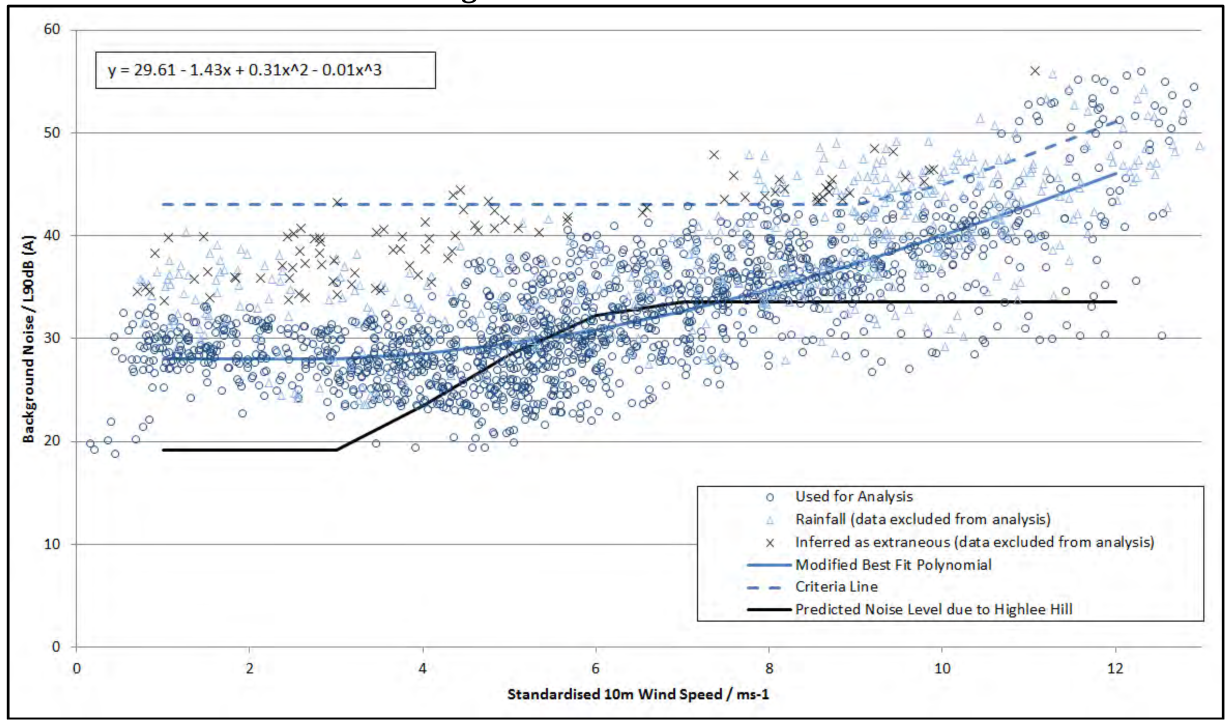
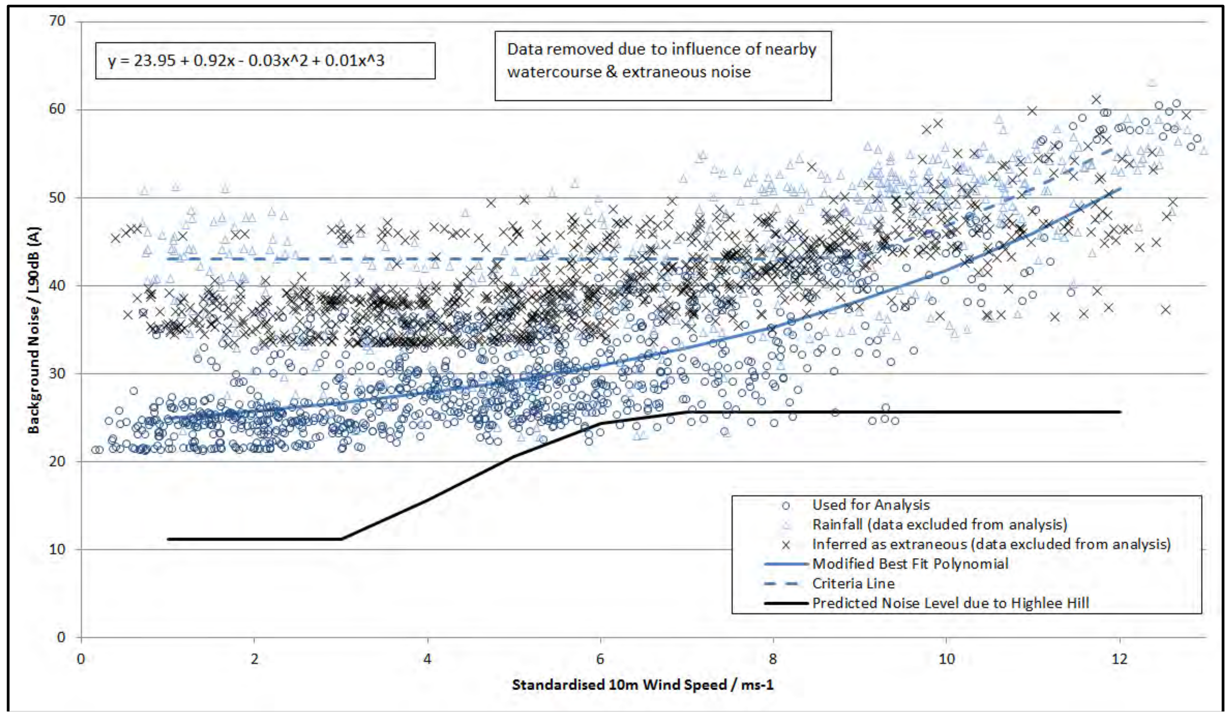


Chart 11: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Night-Time Periods at H63



Technical Appendix 9.6: Suggested Planning Conditions: Noise

9.188 If the wind farm was successful in its application for planning permission any resulting decision notice would likely contain appropriately worded noise conditions, written so as to be in accordance with Circular 4/1998 The Use of Conditions in Planning Permissions[37].

9.189 Such conditions would provide a degree of protection to nearby residents in the event that noise from the wind farm causes disturbance. To that end, presented below are a set of relevant, precise and enforceable conditions that RES suggest may be considered as appropriate. The form of condition wording suggested has been adopted at sites such as Freasdail[38], Minnygap[39], Roos[40], Solwaybank[41] and Wryde Croft[42]. Any final conditions attached to the proposal would be according to the discretion of the decision maker.

1. The level of noise immissions from the combined effects of the wind turbines (including the application of any tonal penalty) when calculated in accordance with the attached Guidance Notes, shall not exceed the values set out in the attached Table 1 or Table 2 (as appropriate). Noise limits for dwellings which lawfully exist or have planning permission for construction at the date of this consent but are not listed in the Tables attached shall be those of the physically closest location listed in the Tables unless otherwise agreed with the Local Planning Authority. The coordinate locations to be used in determining the location of each of the dwellings listed in Tables 1 and 2 shall be those listed in Table 3.

2. Within 21 days from the receipt of a written request from the Local Planning Authority and following a complaint to the Local Planning Authority from the occupant of a dwelling which lawfully exists or has planning permission at the date of this consent, the wind farm operator shall, at the wind farm operators expense, employ an independent consultant approved by the Local Planning Authority to assess the level of noise immissions from the wind farm at the complainant's property following the procedures described in the attached Guidance Notes.

3. The wind farm operator shall provide to the Local Planning Authority the independent consultant's assessment and conclusions regarding the said noise complaint, including all calculations, audio recordings and the raw data upon which those assessments and conclusions are based. Such information shall be provided within 2 months of the date of the written request of the Local Planning Authority, with an additional 3 weeks allowed should further investigation pursuant to Guidance Note 4 be required, unless otherwise extended in writing by the Local Planning Authority.

4. Wind speed, wind direction and power generation data shall be continuously logged and provided to the Local Planning Authority at its request and in accordance with the attached Guidance Notes within 14 days of such request. Such data shall be retained for a period of not less than 24 months.

5. No development shall commence until there has been submitted to the Local Planning Authority details of a nominated representative for the development to act as a point of contact for local residents (in connection with conditions 1 - 4) together with the arrangements for notifying and approving any subsequent change in the nominated representative. The nominated representative shall have responsibility for liaison with the Local Planning Authority in connection with any noise complaints made during the construction, operation and decommissioning of the wind farm.

SCHEDULE OF NOISE GUIDANCE NOTES

These notes form part of conditions 1-5. They further explain these conditions and specify the methods to be deployed in the assessment of complaints about noise immissions from the wind farm.
Reference to ETSU-R-97 refers to the publication entitled "The Assessment and Rating of Noise from Wind Farm" (1997) published by the Energy Technology Support unit (ETSU) for the Department of Trade and Industry (DTI).

NOTE 1

a) Values of the $L_{A90,10min}$ noise statistic shall be measured at the complainant's property using a sound level meter of EN 60651/BS EN 60804 Type 1, or EN 61672 Class 1 quality (or the replacement thereof) set to measure using a fast time weighted response as specified in BS EN 60651/BS EN 60804 or BS EN 61672-1 (or the equivalent UK adopted standard in force at the time of the measurements). This shall be calibrated in accordance with the procedure specified in BS 4142: 1997 (or the replacement thereof). These measurements shall be made in such a way that the requirements of Note 3 shall also be satisfied.

b) The microphone should be mounted at 1.2 - 1.5 m above ground level, fitted with a two layer windshield (or suitable alternative approved in writing from the Local Planning Authority), and placed outside the complainant's dwelling. Measurements should be made in "free-field" conditions. To achieve this, the microphone should be placed at least 3.5m away from the building facade or any reflecting surface except the ground at a location agreed with the Local Planning Authority.

c) The $L_{A90,10min}$ measurements shall be synchronised with measurements of the 10-minute arithmetic mean wind speed and with operational data, including power generation information for each wind turbine, from the turbine control systems of the wind farm.

d) The wind farm operator shall continuously log arithmetic mean wind speed and arithmetic mean wind direction data in 10 minute periods on the wind farm site to enable compliance with the conditions to be evaluated. The mean wind speed at hub height shall be 'standardised' to a reference height of 10 metres as described in ETSU-R-97 at page 120 using a reference roughness length of 0.05 metres. It is this standardised 10m height wind speed data which is correlated with the noise measurements of Note 2(a) in the manner described in Note 2(c).

[37] Circular 4/1998, "The Use of Conditions in Planning Permissions", Scottish Government, February 1998

[38] Directorate for Planning and Environmental Appeals, Appeal Decision Notice, Appeal Reference PPA-130-2036, Decision Date: 15 April 2014

[39] Directorate for Planning and Environmental Appeals, Appeal Decision Notice, Appeal Reference PPA-170-2055, Decision Date: 19 June 2014

[40] The Planning Inspectorate, Appeal Decision, Appeal Reference: APP/E2001/A/09/2113076, Decision Date: 21 June 2010

[41] Directorate for Planning and Environmental Appeals, Appeal Decision Notice, Appeal Reference PPA-170-2091, Decision Date: 23 September 2014

[42] The Planning Inspectorate, Appeal Decisions for Appeal References: APP/J0540/A/08/2083801 and APP/J0540/A/08/2090541, Decision Date: 1 April 2010

NOTE 2

a) The noise measurements shall be made so as to provide not less than 20 valid data points as defined in Note 2 paragraph (b). Such measurements shall provide valid data points for the range of wind speeds, wind directions, times of day and power generation requested by the Local Planning Authority. In specifying such conditions the Local Planning Authority shall have regard to those conditions which were most likely to have prevailed during times when the complainant alleges there was disturbance due to noise.

b) Valid data points are those that remain after all periods during rainfall have been excluded. Rainfall shall be assessed by use of a rain gauge that shall log the occurrence of rainfall in each 10 minute period concurrent with the measurement periods set out in Note 1(c) and is situated in the vicinity of the sound level meter.

c) A least squares, "best fit" curve of a maximum 2nd order polynomial or otherwise as may be agreed with the local planning authority shall be fitted between the standardised mean wind speed (as defined in Note 1 paragraph (d)) plotted against the measured $L_{A90,10min}$ noise levels. The noise level at each integer speed shall be derived from this best-fit curve.

NOTE 3

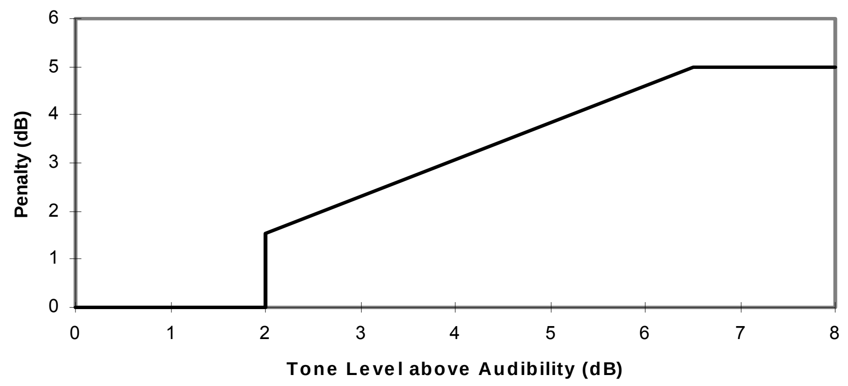
Where, in the opinion of the Local Planning Authority, noise immissions at the location or locations where assessment measurements are being undertaken contain a tonal component, the following rating procedure shall be used.

a) For each 10-minute interval for which $L_{A90,10min}$ data have been obtained as provided for in Notes 1 and 2, a tonal assessment shall be performed on noise immissions during 2-minutes of each 10-minute period. The 2-minute periods shall be regularly spaced at 10-minute intervals provided that uninterrupted clean data are available. Where clean data are not available, the first available uninterrupted clean 2 minute period out of the affected overall 10 minute period shall be selected. Any such deviations from standard procedure, as described in Section 2.1 on pages 104-109 of ETSU-R-97, shall be reported.

b) For each of the 2-minute samples the margin above or below the audibility criterion of the tone level difference, ΔL_{tm} (Delta L_{tm}), shall be calculated by comparison with the audibility criterion, given in Section 2.1 on pages 104-109 of ETSU-R-97.

c) The arithmetic average margin above audibility shall be calculated for each wind speed bin where data is available, each bin being 1 metre per second wide and centred on integer wind speeds. For samples for which the tones were below the audibility criterion or no tone was identified, a value of zero audibility shall be substituted.

d) The tonal penalty shall be derived from the margin above audibility of the tone according to the figure below. The rating level at each wind speed shall be calculated as the arithmetic sum of the wind farm noise level, as determined from the best-fit curve described in Note 2, and the penalty for tonal noise.



NOTE 4

If the wind farm noise level (including the application of any tonal penalty as per Note 3) is above the limit set out in the conditions, measurements of the influence of background noise shall be made to determine whether or not there is a breach of condition. This may be achieved by repeating the steps in Notes 1 & 2 with the wind farm switched off in order to determine the background noise, L_3, at the assessed wind speed. The wind farm noise at this wind speed, L_1, is then calculated as follows, where L_2 is the measured wind farm noise level at the assessed wind speed with turbines running but without the addition of any tonal penalty:

$$L_1 = 10 \log\left[10^{L_2/10} - 10^{L_3/10}\right]$$

The wind farm noise level is re-calculated by adding the tonal penalty (if any) to the wind farm noise.

TABLE OF NOISE LIMITS RELATING TO CONDITION 1
Table 1: The $L_{A90,10min}$ dB Wind Farm Noise Level Between 23:00 and 07:00 hours:

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H2	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H4	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.8	47.4
H5	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H6	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H7	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H8	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H9	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H11	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H12	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H14	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H16	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H17	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H18	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H19	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H20	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H21	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H22	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H23	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H24	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H25	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H26	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H29	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H31	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H32	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H33	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H35	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H36	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H37	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H38	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H40	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H41	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H42	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H43	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H44	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H45	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H46	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H47	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H48	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H49	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H50	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H53	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H55	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H63	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	46.8	51.0	56.0
H65	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H69	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H71	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H73	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H74	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H75	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H76	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H77	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H78	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H79	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H80	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H91	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H96	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H97	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H101	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H108	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H109	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H111	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H114	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H115	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H117	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H118	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H120	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H121	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H130	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.5	49.7
H132	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1
H135	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.0	47.9	51.1

Table 2: $L_{A90,10min}$ dB Wind Farm Noise Level at all other times:

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H2	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H3	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H4	37.3	37.8	38.3	39.0	39.7	40.5	41.4	42.4	43.5	44.7	46.1	46.1
H5	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H6	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H7	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H8	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H9	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H11	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H12	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H14	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H16	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H17	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H18	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H19	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H20	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H21	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H22	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H23	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H24	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H25	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H26	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H29	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H31	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H32	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H33	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H35	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H36	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H37	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H38	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H40	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H41	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H42	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H43	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H44	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H45	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H46	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H47	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H48	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H49	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H50	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H53	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H55	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H63	35.0	35.0	35.0	35.3	37.3	39.7	42.4	45.3	48.3	51.4	54.4	54.4
H65	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H69	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H71	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H73	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H74	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H75	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H76	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H77	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H78	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H79	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H80	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H91	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H96	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H97	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H101	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H108	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H109	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H111	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H114	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H115	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H117	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H118	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H120	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H121	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H130	35.0	35.0	35.0	35.0	35.0	35.4	38.1	40.9	43.7	46.5	49.1	51.3
H132	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7
H135	35.0	35.0	35.0	35.0	35.8	37.6	39.8	42.2	44.8	47.5	50.1	52.7

TABLE OF COORDINATE LOCATIONS OF PROPERTIES

Note to Table 3: The geographical co-ordinates references are provided for the purpose of identifying the general location of dwellings to which a given set of noise limits applies

Table 3: Coordinate locations of the properties listed in Table 1 & 2.

House ID	Co-ordinates	
	X (m)	Y (m)
H1	358581	605736
H2	358922	605900
H3	358930	605911
H4	359083	606332
H5	367191	607237
H6	357967	607618
H7	358848	608065
H8	357747	608142
H9	357747	608142
H11	356322	608304
H12	356272	608305
H14	356536	608325
H16	356592	608359
H17	358240	608360
H18	358074	608401
H19	364915	608404
H20	358224	608453
H21	363265	608616
H22	363203	608628
H23	364149	608789
H24	364052	608803
H25	357752	608921
H26	357888	609019
H29	363282	609076
H31	358820	609109
H32	358870	609122
H33	363078	609192
H35	362459	609209
H36	358927	609230
H37	362938	609237
H38	358936	609246
H40	358106	609511
H41	359098	609628
H42	359650	609696
H43	358440	609721

House ID	Co-ordinates	
	X (m)	Y (m)
H44	356456	609723
H45	356597	609781
H46	362607	609796
H47	356540	609861
H48	358855	609891
H49	358572	609920
H50	358836	609955
H53	358687	610008
H55	358741	610048
H63	360336	610105
H65	358917	610110
H69	359205	610173
H71	359089	610247
H73	360074	610265
H74	357739	610304
H75	357329	610343
H76	357234	610455
H77	363424	610462
H78	362381	610534
H79	362328	610569
H80	359790	610594
H91	362673	610621
H96	358592	610637
H97	361743	610655
H101	361610	610664
H108	362356	610692
H109	361961	610711
H111	359308	610716
H114	362691	610749
H115	360774	610773
H117	363273	610815
H118	360934	610830
H120	358734	610837
H121	359408	610839
H130	361037	611028
H132	364371	611176
H135	364384	611288

Technical Appendix 11.1 – Phase 1 Access Study (Halcrow)

Phase 1 Access Study

Highlea Hill Wind Farm

RES UK & Ireland Limited

30 September 2011

Halcrow

Document history

Phase 1 Access Study

Highlea Hill Wind Farm

RES UK & Ireland Limited

This document has been issued and amended as follows:

Version	Date	Description	Created by	Verified by	Approved by
001	27.09.11	Draft – excluding swept path summary and drawings	Alan Kerr	-	-
002	30.09.11	Draft – including swept path summary and drawings	Alan Kerr	-	-

Contents

1 Introduction

1.1 Introduction

Following submission of the Phase 0 Access Study Halcrow Group Limited (hereinafter referred to as Halcrow) have been commissioned by RES UK & Ireland Limited (hereinafter referred to as RES) to undertake the Phase 1 Access Study for a wind farm development, located south of Jedburgh and southeast of Hawick in the Scottish Borders. The overall aims of the Access Study are to identify all areas of highway and third-party land take along the route, and minimise this where possible; to quantify the level of structural upgrades required for the delivery of wind farm equipment (turbines, cranes and substation equipment such as grid transformers); and to clearly identify all outstanding risks for access to the project. Halcrow have been requested to review the route for abnormal loads from two potential 'Ports of Entry (POE)' to the proposed site access, from the B6357.

This report has been prepared in accordance with instructions from RES. No liability is accepted for the use of all or part of this report by third parties. This report is copyright of RES and Halcrow. No section of this report may be reproduced without prior written approval.

To assist the wind farm developer to fulfil their responsibilities, Halcrow have been commissioned to prepare this Access Study as a source of guidance. The report identifies the key points and issues associated with the route that may require remedial works to accommodate the predicted loads. The designs of these remedial works, however, are beyond the agreed scope of works.

This report should be read in conjunction with the Phase 0 report.

1.2 Report Structure

The remainder of the report is structured as follows:

- the proposed wind farm development and the criteria used for assessment are described in Chapter 2
- the detailed assessment of the route options from the POE through to the site access is described in Chapter 3
- a review of the proposed site entrance location and the guidance used to inform the arrangement of the proposed access junction is provided in Chapter 4
- Chapter 5 presents the recommendations for the preferred route
- the risks associated with the delivery of the abnormal loads are introduced in Chapter 6
- the conclusions of the report are included as Chapter 7

2 Criteria Used for Assessment

2.1 Site Description and Location

The proposal is for the development of a Wind Farm near Bonchester Bridge south of Jedburgh and southeast of Hawick in the Scottish Borders. The location of the site is displayed on Figure 2-1. The site is located entirely within the Scottish Borders Council region. The B6357 and the A6088 link the site with the A68 to the east.

2.2 Abnormal Load Route

A route review was undertaken from the potential POE to the site access junction on 28 June 2011 by video survey. This method allows a full record of the route to be undertaken, with notes recorded during and following completion of the survey. As summarised in the Phase 0 Access Study various Points of Interest (POI) were recorded using a Global Positioning System (GPS) tracker to accompany the video survey, logging the locations of points on the route to Ordnance Survey (OS) co-ordinates.

Two routes to the site were considered, which overlap at at the A68/A6088 junction just north of the Scotland/England border. A description of the routes are provided below and illustrated on Figure 2-1:

- Route Option 1 – depart Port of Blyth and proceed south on the B1329, Links Road to the roundabout junction with the A193 and A1061 → continue on the A1061 to the next roundabout junction and continue straight-ahead → continue on the A1061 through the next roundabout junction and join the A189 at the following interchange → continue southbound on the A189 to its junction with the A19 and turn right → proceed on the A19 to the roundabout prior to the A1 interchange before joining the A1 to head southbound → proceed southbound on the A1 to the interchange with the A696 and turn right to continue on the A696 → continue northwest on the A696, continuing as it becomes the A68 to the junction with the A6088 → head westbound on the A6088 to its junction with the B6357 at the Braidhaugh Cottages → turn right and continue southbound on the B6357 to the site entrance
- Route Option 2 – depart Grangemouth Port and continue on the A904 via Timber Basin Roundabout to Earl's Gate Roundabout → proceed eastbound on the A905 to Junction 5 of the M9 → merge with the M9 and continue eastbound to Junction 2 where the load will depart and join the M8 eastbound for Edinburgh → continue to Junction 1 at Hermiston → join the A720 City of Edinburgh Bypass and continue eastbound to the intersection with the A68 → continue southbound on the A68 to the junction with the A6088 → head westbound on the A6088 to its junction with the B6357 at the Braidhaugh Cottages → turn right and continue southbound on the B6357 to the site entrance

2.3 Port of Entry

As introduced in the Phase 0 Access Study, the Port of Blyth and Grangemouth Port are considered the most advantageous POE due to their facilities, location in relation to the development site and their proximity to the major road network, allowing quick and efficient access for any abnormal loads.

The Port of Blyth is located on the UK east coast and can support the delivery of wind farm cargo and accommodate it on-site. The port's 'location, handling expertise, heavy lift craneage, extensive storage facilities and excellent access to the distribution network', as expressed on it's online literature, is what designates it as a key facility for the movement and mobilisation of cargo associated with renewable energy sector.

Grangemouth Port is located on the Firth of Forth in central Scotland and is also experienced in the handling of imported wind farm cargo with extensive storage facilities. As with the Port of Blyth, Grangemouth Port is close to the major road network allowing easy access for abnormal loads associated with the type of development being considered.

2.4 Phase 0 Recommendations

The Phase 0 Access Study recommends that both routes are suitable for the movement of the anticipated loads, although careful manoeuvring will be required at several key locations with mitigation required to accommodate the anticipated abnormal load movements at some.

2.5 ESDAL Review

Halcrow have undertaken an Electronic Service Delivery for Abnormal Loads (ESDAL) review for the proposed loads using details from the Highways Agency website, www.esdal.com. The review identified the key organisations among the various highways agencies and authorities along the proposed routes. The key organisations were informed that the transportation of the most onerous of the turbine components were to be modelled from the preferred POE and that a review of the existing structures and overhead/underground services was to be undertaken. It was advised that:

- the maximum axle weight for the abnormal loads would be 12 tonnes
- the maximum height of the load on the trailer will be no greater than 4.90 metres
- the maximum width of the loads will be no greater than 4.50 metres
- the longest component to be transported will be the blade anticipated at being no longer than 45 metres long (length including vehicle approximately 51m)

Load tables were attached to the correspondence estimating the combined component and vehicle dimensions and providing the anticipated maximum axle loadings. These details are provided in Table 2-1 to Table 2-5.

Table 2-1: Siemens 2.3MW Base Tower Load Table

Axle	1	2	3	4	5	6	7	8	9	10	11	12
Wheels	2	2	4	4	4	4	4	4	4	4	4	-
Weight	7	7	11	11	10	10	10	12	12	12	12	-
Spacing		2.00	2.00	1.36	1.50	1.36	1.36	24.10	1.50	1.50	1.50	-
Rigid Length	31.00m											
Overall Length	46.00m											

Overall Width	4.50m
Maximum Height	4.70m
Gross Weight	114T

Table 2-2: Siemens 2.3MW Mid Tower Load Table

Axle	1	2	3	4	5	6	7	8	9	10	11	12
Wheels	2	2	4	4	4	4	4	4	4	4	4	-
Weight	7	7	10	10	10	10	8	8	8	8	8	-
Spacing		2.00	2.00	1.36	1.50	1.36	27.00	1.80	1.73	1.41	1.41	-

Rigid Length	35.00m
Overall Length	46.00m
Overall Width	3.50m
Maximum Height	3.80m
Gross Weight	94T

Table 2-3: Siemens 2.3MW Top Tower Load Table

Axle	1	2	3	4	5	6	7	8	9	10	11	12
Wheels	2	2	4	4	4	4	4	4	-	-	-	-
Weight	7	7	11	11	9	9	9	9	-	-	-	-
Spacing		2.00	2.00	1.36	27.50	1.40	1.40	1.40	-	-	-	-

Rigid Length	35.00
Overall Length	41.00m
Overall Width	3.50m
Maximum Height	3.80m
Gross Weight	72T

Table 2-4: Siemens 2.3MW Nacelle Load Table

Axle	1	2	3	4	5	6	7	8	9	10	11	12
Wheels	2	2	4	4	4	4	4	4	4	4	4	4
Weight	9	9	12	12	12	12	12	12	12	12	12	12

Spacing		2.00	2.00	1.36	2.66	1.50	1.50	10.60	1.50	1.50	1.50	1.50

Rigid Length	25.00m
Overall Length	31.00m
Overall Width	3.50m
Maximum Height	4.70m
Gross Weight	138T

Table 2-5: Siemens 2.3MW Blades Load Table

Axle	1	2	3	4	5	6	7	8	9	10	11	12
Wheels	2	2	4	4	4	4	4	-	-	-	-	-
Weight	8	8	10	10	6	6	6	-	-	-	-	-
Spacing		2.00	2.00	1.36	33.50	1.81	1.81	-	-	-	-	-

Rigid Length	45.00m
Overall Length	51.00m
Overall Width	2.50m
Maximum Height	4.90m
Gross Weight	54T

The organisations and their responses are summarised in Table 2-6. The full responses are attached as Appendix A.

Table 2-6: ESDAL Contacts and Responses

Organisation	Response
Lothian and Borders Police	No response to date.
A-one+	The response from A-one+ stated that 'should the proposed port of entry be Blyth, then I am responsible for the A19, A1 and A696 as far as Newcastle Airport, the remainder of the route, together with the first section, would come under Northumberland County Council. I have had nearly 200 wind turbine loads out of Blyth, all travelling in various directions to different sites, and all of similar dimensions without any incidents. Blyth has become one of the main entry ports for wind turbine equipment and the routes have become well tried and tested. The A696 dual carriageway ends at Newcastle airport, so from there the A696 – A68 become two-way

Organisation	Response
	roads and tailbacks of traffic can become a problem, especially with limited pull-in passing places. On the Blyth port of entry there are no issues with the dimensions illustrated along the proposed route. If you contact me nearer the movement dates, I can advise of any impending roadworks that may interfere with the moves, but if you require any further information please contact me.'
Northumberland Council	No response to date.
Scottish Borders Council	No response to date.
Network Rail	The response stated that the proposed routes 'do not affect any Network Rail owned road over rail bridges, therefore we have no objections to your proposed route'. The response also clarified that Network Rail only check the load carrying capacity of road over rail bridges affected and do not check anything else including load carrying capacity of level crossings; clearance to bridge parapets; clearance under a rail bridge; and clearance to overhead wires at level crossings.
North Tyneside Council	The response informed Halcrow that the 'two proposed routes do not affect us as a Bridge Authority. The trunk roads (A1 and A19) are administered by AOne and the connecting roads (B1329 to A189) are administered by Northumberland County Council'. It was added that as 'the transporting of such long loads on the trunk road network at certain times may affect traffic movements in the Borough so I've asked Kevin Ridpath (Network Manager) and Paul Fleming (Team Leader Traffic) to comment directly if they perceive any potential problems'. No further comments have yet been received.
Northumbria Police	The police response focused on the route from Blyth as this is the only route that falls within the Northumbria Police area (as far as the Scottish Border at Carter Bar on the A68). It was stated that 'it is not the policy of Northumbria Police to comment on the viability of proposed routes'. It was expressed that any route should be considered 'in consultation with the local authority responsible for the roads the route follows and also physically surveyed by the haulier'. The response also confirmed that the dimensions and weight of abnormal loads that Northumbria Police consider should be escorted are over 6.1 metres wide; and/or over 30 metres rigid length; and/or over 150,000 kilograms. It was confirmed that escort of abnormal loads under these dimensions and weight will only be considered if requested by the haulier on the grounds of public safety or where it may be necessary for a driver to breach road traffic regulations, requiring traffic control in order to do so i.e. travelling on the wrong side of

Organisation	Response
	the road to avoid street furniture. It was requested that note be taken of, if an abnormal load driver breaches road traffic regulations without being directed to do so by police or a private escort driver attempts to control traffic, they leave themselves open to prosecution. It was established that any escort will attract a charge for police services. From the information provided by Halcrow that some of the loads will be 45 metres rigid length and therefore 'these loads should be escorted by police if they travel anywhere within the Northumbria Police area, so if it is decided to use the first described route Northumbria Police, Operations Command, Planning and Coordination Unit should be contacted at least 14 days before the movement in order to arrange suitable escort'.
Nexus	No response to date.
BEAR Scotland Limited	No response to date.
City of Edinburgh Council	No response to date.
West Lothian Council	No response to date.
Midlothian Council	The Midlothian response confirmed that 'neither of your proposed routes affects Midlothian Council roads so I have no comments to make'.
Jacobs	No response to date.

2.6 Proposed Turbine Details

The details of the nominated turbine have subsequently been provided by the applicant based on the overall height to blade tip of 125m with 80m hub height. The nominated turbine is the Siemens 2.3MW wind turbine assuming the use of a three section 80m tubular steel tower (80m hub height). The component details are provided in Table 2-7.

Table 2-7: Siemens 2.3MW Component Details (125m to blade tip and 80m hub height)

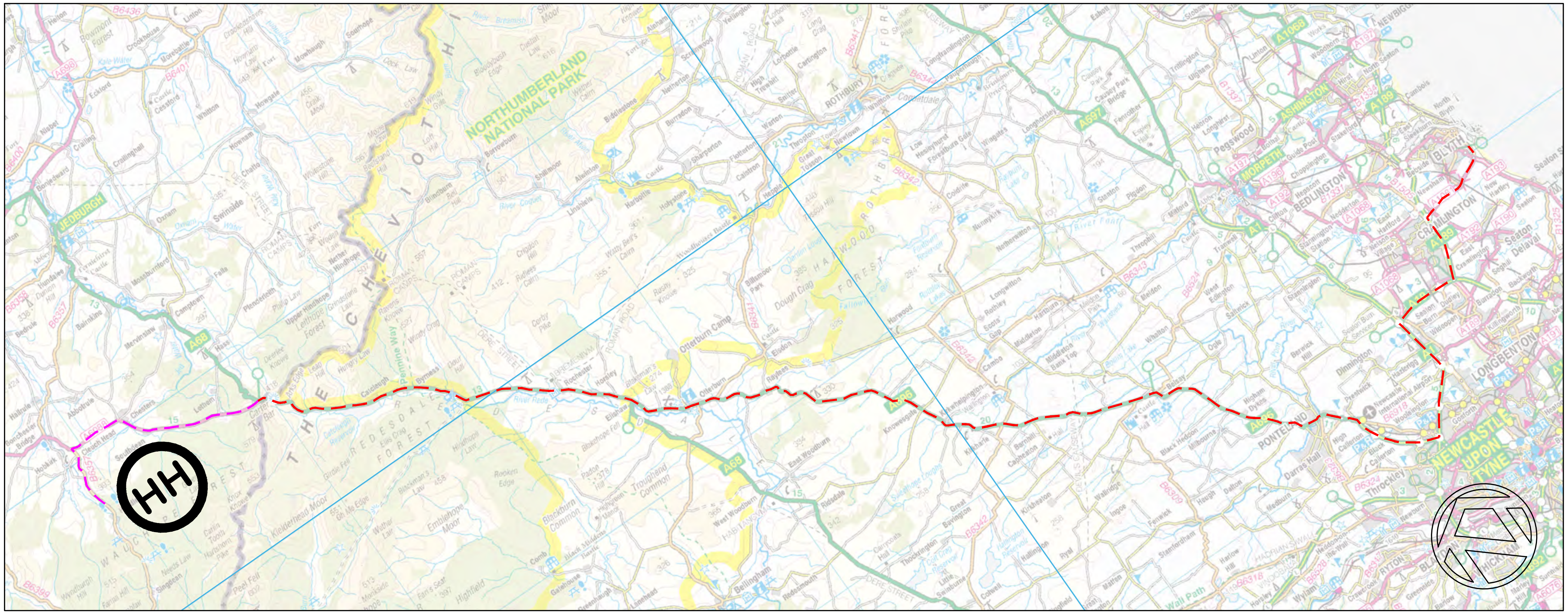
Component	Approx. Length (m)	Approx. Width (m)	Approx. Height (m)	Approx. Weight (t)	Approx. Weight (t)*
Nacelle	11.40	3.50	3.80	87.00	92.00
Hub	4.20	3.65	2.70	26.00	26.00**
Blades (single)	45.00	1.95	3.50	11.00	11.50

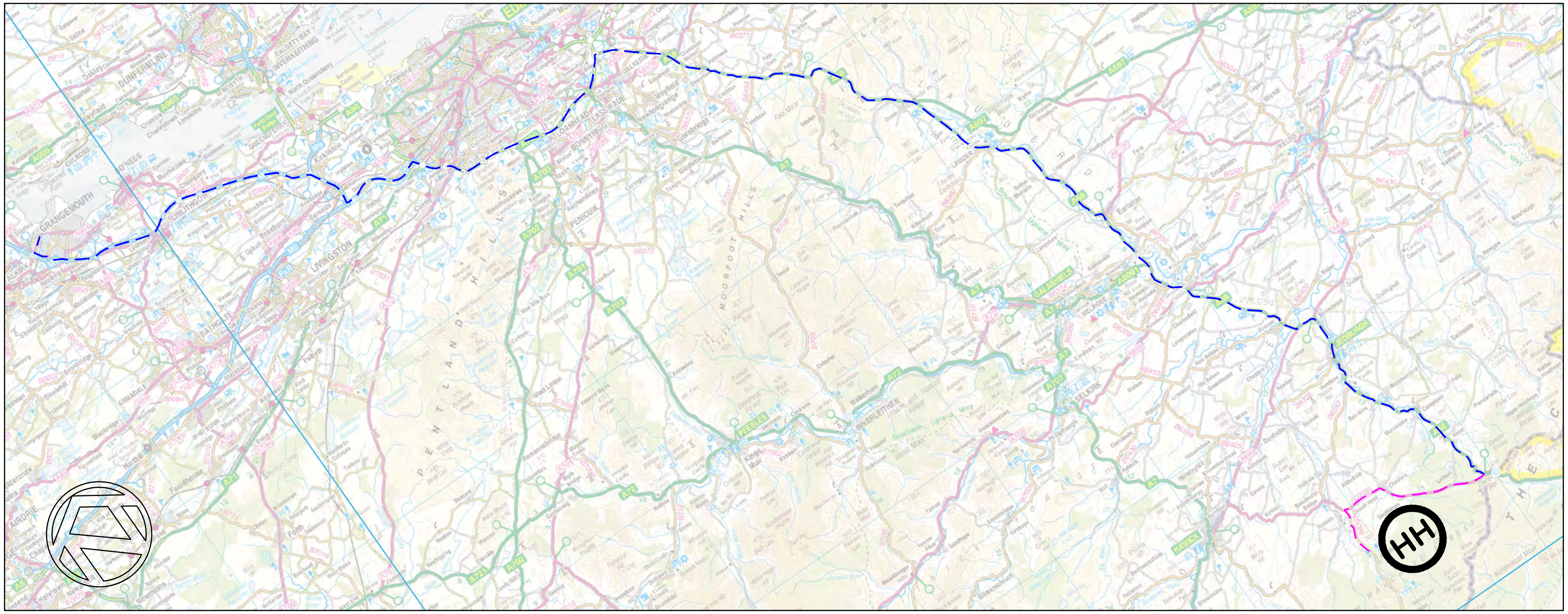
Component	Approx. Length (m)	Approx. Width (m)	Approx. Height (m)	Approx. Weight (t)	Approx. Weight (t)*
Tower – top section (80m Tower)	36.00	3.90 (max)	3.90 (max)	46.00	46.50
Tower – mid section (80m Tower)	24.00	4.20 (max)	4.20 (max)	49.00	49.50
Tower – base section (80m Tower)	18.50	4.50 (max)	4.50 (max)	63.00	63.50

* - including transport frame, ** - for vertical standing hub

These confirmed turbine components do not prejudice the ESDAL assessment undertaken, which used the load tables provided above as Table 2-1 to Table 2-5. The load tables provided to the key organisations 'cover' the confirmed turbine details.

Using the component details provided, Table 2-7, a model of each delivery vehicle was built, including their loads (blade, top tower and base tower sections only).





Key Plan:

- Grangemouth Route
- Blyth Route
- Combined Route
- HH Development Site

Notes:

Rev	By	Chkd	Apprvd	Date	Description
-	-	-	-	-	-

Client

RES

Halcrow Group Limited
16 Abercromby Place, Edinburgh, EH3 6LB
Tel +44 (0)131 272 3300 Fax +44 (0)131 272 3301
www.halcrow.com

Halcrow

Project

Cairn Duhie Wind Farm

Drawing

Site Location
and Routes

Drawn by: AK		Date: 13/07/11	
Checked by: -		Date: -	
Approved by: -		Date: -	

Figure No.	Revision
2-1	-

Drawing Scale: NTS

Drawing file path & name:
Xreference file path
User and Plot Date

3 Detailed Assessment of Route Options

3.1 Swept Path Assessment Results

As summarised in the Phase 0 Access Study, it was determined that a detailed swept path analysis was required at a number of the POI recorded. Using the vehicle/load models created an assessment has been undertaken using the swept path assessment software, AutoTrack. A description of the swept path analysis results is provided in Table 3-1 to Table 3-3, and the illustrated outputs are provided in Appendix B for review. Where mitigation works are required, these are illustrated on the swept path drawings. The works required are also summarised in Table 3-1 to Table 3-3.

It should be noted that both sides of the carriageway will be required along a significant proportion of the proposed delivery route due to the load and vehicle dimensions and the configuration of the loads on the vehicles. This will be particularly true at bends in the road, and appropriate traffic management will be required.

The drawings in Appendix B illustrate the blade and base tower sections. The drawings are for information only and should not be scaled from. The colours provided on the swept paths are:

- green – vehicle/trailer outline (body swept path)
- red – wheel tracked pathway (wheel swept path)
- magenta – load over-sail tracked path (load swept path)

Please note that any alterations to the load or vehicle details will invalidate the assessment results.

Table 3-1: Summary of Swept Path Assessment (Route from Blyth Port to A68/A6088 Junction)

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
2	431975,580134	The port exit intersects the B1329 and a tracking exercise is recommended to determine the potential land that may be required to accommodate the abnormal load delivery vehicles and their loads. Any impact is likely only to affect land and street furniture in the highway boundary, and possibly the temporary removal of the Port boundary fence.	The tracking assessment, see Drawing SK-HH-01, highlights that there would be oversail which would involve the temporary removal of adjacent fencing and street lighting within the Port area. Also there will be load and body oversail within the highway boundary with no associated impacts on any existing adjacent street furniture.	4, Medium	3, Low
4	431856,579549	The A193/A1061/B1329 roundabout should be easily navigable although a swept path assessment is recommended. Any impact is likely only to affect land and street furniture in the highway boundary, although this is unlikely.	The tracking assessment is illustrated on Drawing SK-HH-02 and this highlights that the delivery vehicles and the loads would oversail within the highway boundary involving the temporary removal of adjacent street furniture, signs and potentially street lighting, which would have to be temporarily removed or relocated.	2, Low	2, Low
10	430355,578804	The A1061/B1523 roundabout should be easily navigable although a swept path assessment is recommended. Any impact, although unlikely, would only affect land and street furniture in the highway boundary.	The tracking assessment undertaken (see Drawing SK-HH-03) highlights that the delivery vehicles and the loads would oversail within the highway boundary involving the temporary removal of adjacent street furniture, signs, which would have to be temporarily removed or relocated.	2, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
13	428193,578458	The A1061/A192 roundabout should be easily navigable although a swept path assessment is recommended. Any impact, although unlikely, would only affect land and street furniture in the highway boundary.	The tracking assessment at this junction, shown on Drawing SK-HH-04, illustrates that the delivery vehicles and the loads would oversail within the highway boundary involving the temporary removal of adjacent street furniture, signs, which would have to be temporarily removed or relocated.	2, Low	2, Low
14	427993,578449	Immediately after the A1061/A192 roundabout there is the on-slip for the A189, which the abnormal load delivery vehicles will use. A tracking assessment is recommended but no impact, other than minor over-sail into the highway boundary, is expected.	Drawing SK-HH-05 shows the results of the tracking assessment highlighting that there is likely to be no impact beyond the carriageway edge.	1, Low	1, Low
15	427050,574688	The delivery vehicles will traverse Moor Farm Roundabout making a right-turn manoeuvre to proceed westbound on the A19. A tracking assessment is recommended but no impact is expected, considering the size of the roundabout and the width of the circulatory carriageway. Arrangements may have to be made to accommodate slow moving vehicles through the junction, ensuring the traffic signal operation does not impede movement.	As anticipated the tracking assessment, see Drawing SK-HH-06, shows that the proposed delivery vehicles and loads can continue westbound at Moor Farm Roundabout without any impacts beyond the carriageway edge.	1, Low	0, No risk

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
16	423604,574550	As the abnormal load delivery vehicles advance they will have to navigate, straight-ahead, at the A19/B1318/A1/A1068 roundabout. A tracking assessment is recommended but minimal impact is expected. There may be some over-sail into the highway boundary with potential impact on street furniture although this is not expected.	The tracking assessment, see Drawing SK-HH-07, shows that the proposed delivery vehicles and loads can continue without any impacts beyond the carriageway edge.	1, Low	1, Low
17	421369,567986	A tracking exercise at the Ponteland interchange is recommended to determine the impact on the highway boundary and adjacent street furniture. Considering the size of the roundabout and the width of the circulatory carriageway any land take is expected to be minimal.	As anticipated the tracking assessment, see Drawing SK-HH-08, illustrated that the proposed delivery vehicles and loads can progress northbound though the Ponteland Interchange without any impacts beyond the carriageway edge.	1, Low	0, Low
18	418161,571662	The abnormal load delivery vehicles will likely use multiple lanes on the approach to the Newcastle Airport Roundabout to prepare for negotiating the roundabout. The vehicle and/or load may over-run or over-sail the roundabout central island to navigate the junction, although this is unlikely. The manoeuvre may also involve the temporary removal/relocation of street furniture.	The tracking assessment, see Drawing SK-HH-09, highlights that there would be oversail within the highway boundary which would involve the temporary removal of adjacent street furniture, signs, within the highway boundary. The street furniture would have to be temporarily removed or relocated.	1, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
18	418161,571662	The abnormal load delivery vehicles will use multiple lanes on the approach to the Prestwick Road End Roundabout to prepare for crossing the roundabout. The vehicle and/or load may over-run or over-sail the roundabout central island to navigate the junction. The manoeuvre may also involve the temporary removal/relocation of street furniture.	The tracking assessment, see Drawing SK-HH-10, highlights that there would be oversail which would involve the temporary removal of adjacent street furniture, signs and potentially street lighting, within the highway boundary. The street furniture would have to be temporarily removed or relocated.	2, Low	2, Low
20	417697,572029	The A696/B6545/Garden Centre roundabout should be navigable by the delivery vehicles but may involve some over-sail of the opposite lane of the carriageway and the highway boundary. The manoeuvre may also involve the temporary removal/relocation of street furniture.	Similar to the tracking assessments at POI 18, see Drawing SK-HH-11, this assessment highlights that there would be oversail which would involve the temporary removal of adjacent street furniture, signs and potentially street lighting, within the highway boundary. The street furniture would have to be temporarily removed or relocated.	2, Low	2, Low
47	410246,578607	A swept path assessment at the tight right-hand bend at Belsay will need to be undertaken to determine any over-run and over-sail requirements. The proximity of dwellings, and associated construction, will have to be evaluated which may influence the need to over-run, potentially using third-party land, on the inside of the bend. The swept path assessment will determine if the carriageway width and presence of footways can preclude the need to use third-party land.	The tracking assessment, see Drawing SK-HH-12, illustrates that there would be vehicle body and load oversail but all within the highway boundary. This would also require the temporary removal of adjacent street furniture, signs and street lighting, which would have to be temporarily removed or relocated.	5, Medium	3, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
66	400642,583238	A swept path assessment at the right-hand bend will need to be undertaken to determine the potential impact on the highway boundary and the street furniture within it. It will be important to consider the presence of the tree canopy at this location to ensure that this does not foul the loads. It may need to be trimmed back to allow passage and should be assessed for summer conditions.	The tracking assessment illustrated on Drawing SK-HH-13 shows that there would be no extension of the vehicle or load beyond the carriageway edge.	3, Low	0, No risk
70	399366,584789	A swept path assessment at the left-hand bend will need to be undertaken to determine the potential impact on the highway boundary and the street furniture within it.	The tracking assessment, see Drawing SK-HH-14, shows that there would be no extension of the vehicle or load beyond the carriageway edge.	3, Low	0, No risk
71	399132,585077	A swept path assessment at the right-hand bend will need to be undertaken to determine the potential impact on the highway boundary and the street furniture within it.	The tracking assessment, see Drawing SK-HH-15, shows that there would be no extension of the vehicle or load beyond the carriageway edge.	3, Low	0, No risk
82	393486,590439	A swept path assessment at the right-hand bend will need to be undertaken to determine the potential impact on the highway boundary and the street furniture within it. It will be important to consider the presence of the adjacent signs which may have to be temporarily removed or relocated. Any impact is not likely to extend beyond the highway boundary.	The tracking assessment, see Drawing SK-HH-16, highlights that there would be vehicle body and load oversail within the highway boundary with no impact on adjacent street furniture.	3, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
83	393322,590795	A swept path assessment at the following left-hand bend (following POI 82) will need to be undertaken to determine the potential impact on the highway boundary and the street furniture within it. It will be important to consider the presence of the adjacent signs which may have to be temporarily removed or relocated. Any impact is not likely to extend beyond the highway boundary.	The tracking assessment, see Drawing SK-HH-17, highlights that there would be load oversail within the highway boundary which may involve the temporary removal/relocation of adjacent marker posts.	3, Low	1, Low
84	393072,590941	A swept path assessment at the following right-hand bend (following POI 82 and 83) will need to be undertaken to determine the potential impact on the highway boundary and the street furniture within it. It will be important to consider the presence of the adjacent signs which may have to be temporarily removed or relocated. Any impact is not likely to extend beyond the highway boundary.	The tracking assessment, see Drawing SK-HH-18, highlights that there would be vehicle body and load oversail within the highway boundary which may involve the temporary removal/relocation of adjacent marker posts.	3, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
85	393173,591231	A swept path assessment at the following right-hand bend (following POI 82, 83 and 84) will need to be undertaken to determine the potential impact on the highway boundary and the street furniture within it. It will be important to consider the presence of the adjacent signs which may have to be temporarily removed or relocated. Any impact is not likely to extend beyond the highway boundary.	The tracking assessment, see Drawing SK-HH-19, highlights that there would be vehicle body and load oversail within the highway boundary, which would involve the temporary removal/relocation of adjacent signs and marker posts.	3, Low	3, Low
86	392901,591307	A swept path assessment at the following right-hand bend (following POI 82, 83, 84 and 85) will need to be undertaken to determine the potential impact on the highway boundary and the street furniture within it. It will be important to consider the presence of the adjacent signs which may have to be temporarily removed or relocated. Any impact is likely to be limited to the highway boundary.	The tracking assessment, see Drawing SK-HH-20, highlights that there would be load oversail, limited to the highway boundary, which may require the temporary removal/relocation of adjacent marker posts.	3, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
92	390224,592370	A swept path assessment at the right-hand bend will need to be undertaken to determine the potential impact on third-party land and the highway boundary at this bend. The impact on the adjacent street furniture will also have to be considered. It will be important to consider the proximity of the tree canopy at this location to ensure that this does not foul the loads. It may need to be trimmed back to allow passage and should be assessed for summer conditions.	The tracking assessment highlights, see Drawing SK-HH-21, that there would be over-run and associated over-sail within third-party land requiring the removal of walls and street furniture, including signs and marker posts.	5, Medium	7, High
93	390131,592548	A swept path assessment at the left-hand bend will need to be undertaken to determine the impact on the highway boundary and adjacent street furniture. There is a possibility that the vehicles and loads may extend into third-party land. The adjacent street furniture may have to be temporarily removed or relocated.	The tracking assessment, see Drawing SK-HH-22, highlights that there would be load oversail, limited to the highway boundary, which may require the temporary removal/relocation of adjacent crash barrier.	4, Medium	3, Low
94	389925,592699	A swept path assessment at the left-hand bend will need to be undertaken to determine the impact on the highway boundary and adjacent street furniture. There is a possibility that the vehicles and loads may extend into third-party land although this is expected to be minimal. The adjacent street furniture may have to be temporarily removed or relocated.	The tracking assessment, see Drawing SK-HH-23, highlights that there would be load oversail, limited to the highway boundary, which may require the temporary removal/relocation of adjacent signs.	4, Medium	3, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
97	389300,592824	The abnormal load delivery vehicles would continue northbound on the A696 potentially having to straddle the centre line. The tree canopy at this location will have to be assessed to ensure that it does not foul the loads. They may need to be trimmed back to allow passage and should be assessed for summer conditions. A check of the gradient and sudden change in vertical alignment will need to be undertaken.	Consideration of the vertical alignment at this location is advised and a topographical survey will be required.	2, Low	2, Low
105	386727,594079	A swept path assessment at the right-hand bend will need to be undertaken to determine the impact on the highway boundary and adjacent street furniture. There is a possibility that the vehicle (probably over-sail only) although this is expected to be minimal. The adjacent street furniture may have to be temporarily removed or relocated.	The tracking assessment, see Drawing SK-HH-24, highlights that there would be load oversail, limited to the highway boundary, with no impact on adjacent street furniture.	3, Low	2, Low
112	384696,596631	The sudden change in vertical alignment needs to be checked for its compatibility with the abnormal load delivery vehicles and due cognisance of the proximity of the side vegetation to ensure it does not foul the loads. It may need to be trimmed back to allow passage and should be assessed for summer conditions.	Consideration of the vertical alignment at this location is advised and a topographical survey will be required.	2, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
113	384267,596990	A swept path assessment at the right-hand bend will need to be undertaken to determine the potential impact on the highway boundary at this bend. The impact on the adjacent street furniture will also have to be considered. It will be important to consider the presence of the tree canopy at this location to ensure that this does not foul the loads. It may need to be trimmed back to allow passage and should be assessed for summer conditions.	The tracking assessment, see Drawing SK-HH-25, highlights that there would be load oversail, limited to the highway boundary, which may have an impact on adjacent marker posts. Consideration of the vertical alignment at this location is advised and a topographical survey will be required.	2, Low	2, Low
148	370659,605910	A swept path assessment at the left-hand bend will need to be undertaken to determine the impact on the highway boundary and adjacent street furniture. There is a possibility that the vehicles and loads may extend into third-party land (likely only over-sail) although this is expected to be minimal. The adjacent street furniture may have to be temporarily removed or relocated.	The tracking assessment, see Drawing SK-HH-26, highlights that there would be no impact beyond the carriageway edge at this location.	3, Low	0, No impact

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
150	369926,606509	A swept path assessment at the left-hand bend will need to be undertaken to determine the impact on the highway boundary and adjacent street furniture. There is a possibility that the vehicles and loads may extend into third-party land (likely only over-sail) although this is expected to be minimal. The adjacent street furniture may have to be temporarily removed or relocated.	The tracking assessment, see Drawing SK-HH-27, highlights that there would be no impact beyond the carriageway edge at this location. However, the available mapping may over-estimate the available carriageway width. It is unlikely, however, that the vehicle or loads will extend beyond the highway boundary.	3, Low	3, Low
150	369926,606509	A swept path assessment at the right-hand bend that immediately follows a left-hand bend (described above) will need to be undertaken to determine the impact on the highway boundary and adjacent street furniture. There is a possibility that the vehicles and loads may extend into third-party land (likely only over-sail) although this is expected to be minimal. The adjacent street furniture may have to be temporarily removed or relocated.	The tracking assessment, see Drawing SK-HH-27, highlights that there would be no impact beyond the carriageway edge at this location. However, the available mapping may over-estimate the available carriageway width. It is unlikely, however, that the vehicle or loads will extend beyond the highway boundary.	3, Low	3, Low

Table 3-2: Summary of Swept Path Assessment (Route from Grangemouth Port to A68/A6088 Junction)

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
A	292436,682162	A tracking exercise is advised at the Timber Basin Roundabout which would likely show that the vehicle/load would over-sail the central island and splitter island and potentially over-run the central island.	The tracking assessment is illustrated on Drawing SK-HH-28 and this highlights that the delivery vehicles and the loads would oversail within the highway boundary with no impact on the surrounding street furniture.	2, Low	2, Low
B	291430,681304	The abnormal load delivery vehicles would continue on the A904, Earl's Road to Earl's Gate Roundabout. A swept path assessment is recommended to determine the impact on the highway boundary and associated street furniture. The loads/vehicles would likely over-sail the central island and splitter island with potentially minor over-run. Street furniture will potentially need to be temporarily removed or relocated.	The tracking assessment is illustrated on Drawing SK-HH-29 and this highlights that the delivery vehicles and the loads would oversail within the highway boundary potentially impacting on adjacent street lighting which would have to be temporarily removed or relocated.	2, Low	3, Low
C	291490,681106	From Earl's Gate Roundabout the delivery vehicles would continue eastbound on the A905 via Bancross Road/Caledon Green Roundabout. A swept path assessment will highlight the over-sail/over-run requirements and potential temporary removal or relocation of street furniture.	Drawing SK-HH-30 illustrates that to navigate this junction it will be necessary to contraflow the roundabout. The tracking assessment highlights that the delivery vehicles and the loads would oversail within the highway boundary and would require the temporarily removal/relocation of the adjacent signage and bollards.	2, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
D	292970,679652	The delivery vehicles will join the M9 at Cadgers Brae Roundabout. The impact at this location is expected to be limited to over-sail within the highway boundary, considering the available road width.	Drawing SK-HH-31 illustrates the delivery vehicles and the loads would oversail, only slightly, beyond the carriageway edge, but within the highway boundary. It may be necessary to remove the adjacent bollards at this location.	1, Low	1, Low
E	318060,670947	A tracking exercise at the Hermiston Gait Interchange is recommended to determine the impact on the highway boundary and adjacent street furniture. Considering the size of the roundabout and the width of the circulatory carriageway it is unlikely that there would be any impact.	As anticipated the tracking assessment, see Drawing SK-HH-32, shows that the proposed delivery vehicles and loads can continue onto the City of Edinburgh Bypass with no impact beyond the carriageway edge.	1, Low	0, No impact
F	331760,667999	A tracking exercise at the Sherriffhall Roundabout is recommended to determine the impact on the highway boundary and adjacent street furniture. Considering the size of the roundabout and the width of the circulatory carriageway any land take is expected to be minimal.	As anticipated the tracking assessment, see Drawing SK-HH-33, shows that the proposed delivery vehicles and loads can continue on the City of Edinburgh Bypass with no impact beyond the carriageway edge.	1, Low	0, No impact

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
G	-	-	A decision was made to continue the route to the Old Craighall Roundabout and perform a u-turn to continue westbound on the City of Edinburgh Bypass to approach the Millerhill Junction from the east. The tracking assessment is illustrated on Drawing SK-HH-34 and this highlights that the delivery vehicles and the loads would oversail within the highway boundary potentially impacting on adjacent street lighting and signs that would have to be temporarily removed or relocated.	-	3, Low
339	333539,669449	A swept path assessment at the A720, Millerhill Junction will need to be undertaken to determine the impact on the highway boundary and adjacent street furniture. Some of the street furniture will have to be temporarily removed or relocated. The delivery vehicles will likely over-sail the highway boundary and potentially over-run the roundabout central island as they exit the City of Edinburgh Bypass. Some of the street furniture at this location will have to be temporarily removed or relocated.	Approaching Millerhill Junction from the east means that the impacts at the Millerhill Junction are limited to vehicle body and load oversail contained within the highway boundary, see Drawing SK-HH-35. There would be an impact on adjacent street lighting and signs. Approaching the Millerhill Junction from the west as proposed would mean a significant amount of over-run, although still contained within the highway boundary.	4, Medium	3, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
317	350692,653319	In exiting the A68/A697 roundabout it is likely that the vehicles will over-sail the highway boundary, including the roundabout central island. Some of the street furniture at this location may have to be temporarily removed or relocated.	Drawing SK-HH-36 illustrates that to navigate this junction it will be necessary for the delivery vehicles and the loads to oversail beyond the carriageway edge. This will however be contained within the highway boundary. The temporarily removal/relocation of the surrounding street furniture, including signs, street lighting and bollards, is required.	2, Low	3, Low
294	357796,633750	In exiting the A68/A6091 roundabout it is likely that the vehicles will over-sail the highway boundary, including the roundabout central island. Some of the street furniture at this location may have to be temporarily removed or relocated.	Drawing SK-HH-37 illustrates that to navigate this junction it will be necessary for the delivery vehicles and the loads to oversail beyond the carriageway edge. This will however be contained within the highway boundary. Little impact is expected on surrounding street furniture.	2, Low	2, Low
277	364105,623569	The abnormal load delivery vehicles would continue southbound on the A68, adjacent to the junction with the A698, potentially having to over-run the central island. The over-run of the central island would also impact on the street furniture.	Drawing SK-HH-38 illustrates that to navigate this junction it will be necessary for the delivery vehicles and the loads to oversail beyond the carriageway edge. This will however be contained within the highway boundary. The temporarily removal/relocation of the surrounding street furniture, including street lighting, signs and a safety barrier, is required.	2, Low	3, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
257	365001,619468	A swept path assessment at the bridge over the Jed Water and the subsequent left-hand bend will need to be undertaken to determine any impact on the bridge structure and any requirements to over-run or over-sail the highway boundary.	The swept path assessment, see Drawing SK-HH-39, highlights that there would be no impact on the bridge structure, from a vehicle or load collision, although it is estimated that the load would oversail beyond the carriageway edge, but within the highway boundary.	3, Low	2, Low
256	365142,618880	A swept path assessment at a second bridge over the Jed Water and a subsequent right-hand bend will need to be undertaken to determine any impact on the bridge structure and any requirements to over-run or over-sail the highway boundary. There is a slight possibility that the loads may over-sail beyond the highway boundary into third-party land.	The swept path assessment, see Drawing SK-HH-40, highlights that there would also be no impact on the bridge structure, from a vehicle or load collision, although it is estimated that the vehicle body and load would oversail beyond the carriageway edge, but within the highway boundary.	4, Medium	2, Low
253	364778,618365	A swept path assessment at a third bridge over the Jed Water and a subsequent left-hand bend will need to be undertaken to determine any impact on the bridge structure and any requirements to over-run or over-sail the highway boundary.	The swept path assessment shown on Drawing SK-HH-41 illustrates that there would also be no impact on the bridge structure, from a vehicle or load collision. Again it is estimated that the vehicle body and load would oversail beyond the carriageway edge, but within the highway boundary. There is a potential impact on adjacent signs which would have to be temporarily removed/relocated.	3, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
242	367252,614091	A swept path assessment at the left-hand bend will need to be undertaken to determine any impact on third-party land or the highway boundary.	The swept path assessment shown on Drawing SK-HH-42 illustrates that it is estimated that the vehicle body and load would oversail within the highway boundary. There is a potential impact on adjacent marker posts which would have to be temporarily removed/relocated.	4, Medium	3, Low
229	368610,607980	The abnormal load delivery vehicles would continue southbound on the A68 potentially having to over-run the adjacent highway boundary. The over-run and any associated over-sail of the highway boundary would also likely impact on street furniture.	Drawing SK-HH-43 illustrates the swept path assessment at this bend showing that the vehicle body and load would oversail beyond the carriageway edge into the highway boundary. The highway boundary at this location is extensive. There is no predicted impact on any existing street furniture.	4, Medium	3, Low
228	368776,607871	The abnormal load delivery vehicles would continue southbound on the A68 potentially having to over-run the adjacent highway boundary. The over-run and any associated over-sail of the highway boundary would also likely impact on street furniture.	Drawing SK-HH-44 illustrates the swept path assessment at this bend showing that the vehicle body and load would oversail beyond the carriageway edge into the highway boundary. The amount of oversail is significant. However, the highway boundary at this location is extensive. There is no predicted impact on any existing street furniture.	4, Medium	3, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
227	368554,607669	The abnormal load delivery vehicles would continue southbound on the A68 potentially having to over-run the adjacent highway boundary. The over-run and any associated over-sail of the highway boundary would also likely impact on street furniture.	Drawing SK-HH-45 illustrates the swept path assessment at this bend showing that the vehicle body and load would oversail beyond the carriageway edge into the highway boundary. The amount of oversail is significant. However, the highway boundary at this location is extensive. There is no predicted impact on any existing street furniture.	4, Medium	3, Low

Table 3-3: Summary of Swept Path Assessment (Route from A68/A6088 Junction to Proposed Site Access)

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
153/151	369412,606965/ 369828,606760	A swept path assessment at the junction with the A6088 is required to determine the impact on the highway boundary and adjacent street furniture. The adjacent street furniture may have to be temporarily removed or relocated. The impact at this location, with vehicles travelling northbound from Blyth Port, is likely to be minimal. From the north the manoeuvre is significantly more difficult and may exclude the route from being viable.	The swept path assessment, see Drawing SK-HH-46, at this location showing vehicles travelling northbound from Blyth Port highlights that there would be no impact beyond the carriageway edge. On the other hand the swept path assessment, see Drawing SK-HH-47, at this location showing vehicles travelling southbound from Grangemouth Port highlights that the delivery vehicles would have to undertake a manoeuvre that would involve a significant amount of over-run through third-party land. An alternative option for vehicles travelling southbound has also been considered; see Drawing SK-HH-48. This would require the vehicle from Grangemouth Port continuing southbound past the A68/A6088 priority junction to the stop-off area at the border to perform a u-turn manoeuvre. Again this will require significant works, although it is anticipated that this would require less impact on third-party land. Consultation with the roads authority will have to be undertaken to determine the possibility of undertaking this manoeuvre.	1, Low from south, 7, High from north	0, No impact from south 8, High from north (right turn) 5, Medium from north (u-turn)

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
175	362359,610545	A swept path assessment at the left-hand bend, and the preceding bend, will need to be undertaken to determine the impact on the highway boundary and adjacent street furniture. There is a possibility that the vehicles and loads may extend into third-party land. The adjacent street furniture will have to be temporarily removed or relocated.	The swept path assessment, see Drawing SK-HH-49, highlights that there would be over-run that extends beyond the highway boundary requiring significant works, particularly in regarding the land to the east of the A6088. Associated with the over-run would be oversail which will also extend beyond the highway boundary into third-party land.	4, Medium	5, Medium
176	361671,610625	A swept path at two successive bends on the A6088 is required to determine the impact on the highway boundary and adjacent street furniture. The adjacent street furniture may have to be temporarily removed or relocated. The impact at this location is likely to be within the highway boundary.	The tracking assessment, see Drawing SK-HH-50, highlights that there would be vehicle body and load oversail, limited to the highway boundary, which will require the temporary removal/relocation of adjacent marker posts.	2, Low	2, Low
177	361396,610801	A swept path is required to determine the impact on the highway boundary and adjacent street furniture. The adjacent street furniture may have to be temporarily removed or relocated. The impact at this location is likely to be within the highway boundary.	The tracking assessment, see Drawing SK-HH-51, highlights that there would be vehicle body and load oversail, limited to the highway boundary.	2, Low	2, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
178	361261,610844	A swept path is required to determine the impact on the highway boundary and adjacent street furniture. The adjacent street furniture may have to be temporarily removed or relocated. The impact at this location is likely to be within the highway boundary.	The tracking assessment, see Drawing SK-HH-52, highlights that there would be vehicle body and load oversail, limited to the highway boundary.	2, Low	2, Low
182	360166,610628	A swept path is required to determine the impact on the highway boundary and adjacent street furniture. The adjacent street furniture may have to be temporarily removed or relocated. The impact at this location is likely to be within the highway boundary. It will be important to consider the presence of the tree canopy at this location to ensure that it does not foul the loads. It may need to be trimmed back to allow passage and should be assessed for summer conditions.	The tracking assessment, see Drawing SK-HH-53, highlights that there would be vehicle body and load oversail, limited to the highway boundary. Consideration should be given to the impact on the adjacent vegetation.	3, Low	3, Low
185	359302,610697	A swept path assessment is required at the A6088/B6357 priority junction where the abnormal load delivery vehicles will undertake a left-turn manoeuvre. The adjacent street furniture will need to be temporarily removed or relocated. The impact at this location will be outside the highway boundary into third-party land.	As anticipated the tracking assessment, see Drawing SK-HH-54, illustrates that there would be significant works associated with the left-turn manoeuvre required to be undertaken within third-party land. In addition, the temporary removal/relocation of street furniture and boundary fences will be required.	5, Medium	5, Medium

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
187	359384,610120	A swept path assessment is required to determine the impact on the highway boundary and adjacent third-party land and street furniture. The adjacent street furniture may have to be temporarily removed or relocated. The impact at this location may be outside the highway boundary. It will be important to consider the presence of the tree canopy and side vegetation at this location to ensure that they do not foul the loads. They may need to be trimmed back to allow passage and should be assessed for summer conditions.	The tracking assessment, see Drawing SK-HH-55, illustrates that there would be vehicle body and load oversail extending beyond the highway boundary into third-party land. In addition, the temporary removal/relocation of boundary fences will be required.	4, Medium	4, Medium
188	359289,609901	A swept path assessment is required to determine the impact on the highway boundary and adjacent street furniture. The adjacent street furniture may have to be temporarily removed or relocated. The impact at this location may be outside the highway boundary. It will be important to consider the presence of the side vegetation at this location to ensure that it does not foul the loads. It may need to be trimmed back to allow passage and should be assessed for summer conditions.	The tracking assessment, see Drawing SK-HH-56, illustrates that there would be vehicle body and load oversail within the highway boundary. Consideration should be given to the impact on the adjacent vegetation.	3, Low	3, Low

POI	OSGR	Phase 0 Recommendation	Phase 1 Recommendation	Phase 0 Risk	Phase 1 Risk
191	359109,609281	A swept path assessment is required to determine the impact on the highway boundary and adjacent street furniture. The adjacent street furniture may have to be temporarily removed or relocated. The impact at this location may be outside the highway boundary. It will be important to consider the presence of the tree canopy and side vegetation at this location to ensure that they do not foul the loads. They may need to be trimmed back to allow passage and should be assessed for summer conditions.	The tracking assessment, see Drawing SK-HH-57 illustrates that there would be vehicle body and load oversail extending beyond the highway boundary into third-party land. In addition, the temporary removal/relocation of boundary walls will be required.	4, Medium	4, Medium
Site Access	-	A swept path assessment at the existing site access is required to determine the impact on the surrounding area and any adjacent street furniture. Adjacent street furniture may have to be temporarily removed or relocated.	The tracking assessment at the proposed site access (assumed to be using the existing access to the site from the B6357), see Drawing SK-HH-58, illustrates that there would be works required to accommodate the delivery vehicles. However, these works are proposed to be within the site boundary.	2, Low	2, Low

4 Site Entrance

4.1 Proposed Site Entrance Location

Entrance to the site for construction vehicles, including abnormal load delivery vehicles, is proposed to be taken from the B6357, which forms the western boundary of the wind farm site, via a single priority junction arrangement. The proposed site entrance could be located at different points along the western boundary of the site however it has been assumed that the existing site access will be used and an indicative layout is provided on Drawing SK-CD-58 in Appendix B. This does not meet the visibility requirements to the right, as shown on Drawing SK-CD-58, with a visibility of 102.5m, however, considering the low traffic volumes on the B6357 it may be possible to relax this requirement. Discussions with Scottish Borders Council to confirm this will be required and it may be necessary to undertake a volumetric count and speed survey to determine if this relaxation would be possible.

4.2 Design Manual for Roads and Bridges (DMRB) Guidance

4.2.1 Visibility

It is proposed that the proposed site entrance take the form of a simple priority junction designed to accommodate the movement of all development related traffic, including the abnormal load vehicles. It is essential that drivers approaching the priority junction, from both the major road and the minor road, shall have unobstructed visibility to permit them to make their manoeuvre safely.

Drivers approaching the junction along the major road shall be able to see the entry from a distance corresponding to the desirable minimum stopping sight distance (SSD) for the design speed of the major road. The speed limit on the B6357 is 60mph (96kph), which corresponds to a design speed of 100kph. Therefore a SSD of 215m is required, as defined in DMRB. This visibility allows drivers on the major road to be aware of traffic entering from the minor road in time for them to be able to slow down and stop safely if necessary.

The distance back along the minor road from which the full visibility is measured is desirably 9.0m, however a relaxation from 9.0m to 4.5m for lightly trafficked simple junctions can be made. The distance from which the full visibility distance is provided, shall not be more than 9.0m, as this induces high minor road approach speeds into the junction, and leads to excessive land take. A distance of 4.5m has been assumed in this case.

Drivers approaching the priority junction along the minor road shall have unobstructed visibility of the junction from a distance corresponding to the SSD for the design speed of the minor road. A speed limit on the minor road of 30mph (48kph) has been assumed, which corresponds to a design speed of 60kph. As defined in DMRB, a SSD of 90m is required allowing drivers time to slow down safely at the junction, or stop, if necessary.

From a point 15m back along the centreline of the minor road measured from the continuation of the line of the nearside edge of the running carriageway of the major road an approaching driver shall be able to see clearly the junction form, and those peripheral

elements of the junction layout. This provides the driver with an idea of the junction form, possible movements and conflicts, and possible required action before reaching the major road.

5 Recommendations for Preferred Route

5.1 Proposed Management Measures

This chapter introduces a number of traffic management measures that could help reduce the impact of the abnormal load convoys. These measures are currently presented as indicative to be confirmed with the various highways agencies and constabularies closer to the construction date.

5.2 Convoy System

A police escort will be required to facilitate the delivery of the predicted loads (see responses in Chapter 2 associated with the ESDAL review). The police escort would be further supplemented by a civilian pilot car to assist with the escort duty. It is proposed that an advanced escort would warn oncoming vehicles ahead of the convoy, with one escort staying with the convoy at all times. The escorts and convoy would remain in radio contact at all times where possible.

The abnormal load convoys should be no more than three HGV's long, to permit safe transit along the delivery route and to allow limited overtaking opportunities for following traffic where it is safe to do so. Where designated passing bays are provided to allow oncoming vehicles to pass the convoy, these would be controlled by one of the escort vehicles. The passing bays would also be marked to discourage people parking in them. The passing bays are predominantly required for the delivery of turbine tower and nacelle components.

The times in which the convoys would travel will need to be agreed with the local constabularies. Typical delivery times for similar projects has seen the early morning periods used in constrained sections, as traffic levels are generally lighter than those found in the afternoon.

A full convoy operation plan will be developed in consultation with the various highways and constabulary agencies along the route and agreed before deliveries commence to the site.

5.3 Advance Warning Signage

Advance warning signs would be installed on the approaches to the affected roads network. Temporary signage advising drivers that abnormal loads will be operating could be erected on the route to help assist drivers, such as the example shown in Figure 5-1.

The purpose of the advance warning signage is to help improve driver information and allow drivers of oncoming traffic to consider proceeding to the nearest convenient passing bay, or breaking their journey until the convoy has moved on.

To further improve driver information, it is suggested that Variable Message Signs (VMS), operated by Transport Scotland, are used to warn drivers of abnormal loads operating on the trunk road sections of the route. This would display warnings of possible delays and would allow drivers to consider alternative routes if possible.

Figure 5-1: Indicative Information Sign

5.4 Public Information

Information on the movement of abnormal load convoys should be provided to local media outlets to help assist the public. Information could be provided to local newspapers and radio stations.

Information would relate to expected vehicle movements from the POE through to the site access. It is hoped that this level of information will make residents aware of convoy movements and help reduce any potential conflicts.

Halcrow also suggest that the developer considers producing a local newsletter for distribution to properties along the most affected sections of the proposed access route, advising of convoy movements and the measures put in place to ensure the safe and efficient operation of the road network.

6 Risks

6.1 Significance of Required Improvements

The significance of the required improvements and land take was estimated in the Phase 0 Report and a revised assessmenr has been provided above in Table 3-1, based on the risk index that follows:

- 0: No risk
- 1 – 3: Low risk, some highways land take with limited modifications to street furniture
- 4 – 6: Medium risk with some limited third party land and further investigation required on bridges and other structures
- 7 – 9: High risk with extensive third party land, single track roads or major investigation required on structures
- 10: Route not feasible – show stopper

6.2 Swept Path Comments

It is important to note that the swept path assessments undertaken have been based on OS data. There can be measurement errors associated with the use of this data and therefore, to define the exact swept path, site specific topographical survey data should be recorded and the swept path reassessed.

The swept path assessment builds in a degree of safety margin that tends to over-predict the required area. Consequently, Halcrow recommend that a trial run is undertaken before the delivery of actual components to confirm the findings of this study.

6.3 General Comments

Halcrow has undertaken a high level review of the access route from the POE to the proposed site access. Halcrow would strongly suggest that a review of the following is undertaken prior to the delivery of the abnormal loads, to ensure load and road user safety:

- a further review of maximum axle loading on structures along the proposed route in consultation with the relevant roads agencies
- a review of clear heights with utility providers and the transport agencies along the route
- ensure any vegetation which may foul the loads is trimmed back to allow passage (this is of concern once the load is on the local road network and should be assessed for summer conditions)
- confirm there are no roadworks or closures that could affect the passage of the loads
- check no new or diverted underground services on the proposed route are at risk from the abnormal loads

- confirm the various Police constabularies are satisfied with the route being used and the local roads authorities have been contacted regarding the proposed loads and suggested route
- the developer contacts the appropriate agencies to ensure that the above points are reviewed before the transport of the components commences

6.4 Utility Impact

In order to review any impact on underground or overhead services, Halcrow contacted the following utility firms to ascertain if the maximum height and axle loading would have a detrimental impact that may require mitigation. Table 6-1 also summarises the various responses. Their full responses are attached as Appendix C.

Table 6-1: Utility Firm Contacts and Responses

Utility Firm	Response
Verizon UK Limited	The response confirmed that Verizon 'have reviewed your plans and have determined that Verizon Business (Formally known as MCI WorldCom, MFS) has no apparatus in the areas concerned'.
Scottish Power Data Management	No response as of Report date.
British Telecom	No response as of Report date.
Scottish & Southern Energy	No response as of Report date.
Geo Networks Limited	No response as of Report date.
Scotland Gas Networks (SGN)	It was stated in the response that, with regard to the transport of abnormal loads from either Port that 'we (SGN) don't anticipate any problem with the transportation of these loads to our apparatus, we have a minimum depth of 750mm of cover in highways and a minimum depth 600mm of cover in footpaths/verges, I must state that SGN have adopted the network of gas mains and these depths can not be guaranteed'.
Cable & Wireless	No response as of Report date.
Thus PLC	No response as of Report date.
Virgin Media	No response as of Report date.
National Grid	The response stated that they had carried out detailed checks in respect to their operational transmission networks. Based on the information we provided it was advised that 'Option 1 is affected by Overhead Transmission Lines and should this route be used you

	would need to provide the height of the abnormal load before the journey takes place to enable us to calculate the risk'. With regard to Option 2 the response confirmed that 'based on the information you have provided and the proximity and sensitivity of these networks we have concluded that the risk is negligible'. It was also recommended that 'when passing beneath an overhead transmission line that the vehicle does not stop for a distance of six metres either side of the outermost conductors. In the event of a breakdown beneath an overhead transmission line under no circumstances allow anyone to climb on top of the vehicle or load'.

The responses to the utility search have been provided as a source of guidance for the client group's utility engineers to review for engineering feasibility and for RES civil engineers to examine and approve. Halcrow have not undertaken any service impact assessments and these remain the responsibility of the wind farm developer.

7 Conclusions

7.1 Conclusions

Halcrow have been commissioned by RES to undertake an access assessment for a wind farm development, located south of Jedburgh and southeast of Hawick in the Scottish Borders.

Halcrow has undertaken a route review and swept path assessment where necessary for abnormal loads from the POE through to the site access junction.

This report identifies the potential remedial works to accommodate the predicted loads. The designs of these remedial works, however, are beyond the agreed scope of works. Generally, the assessment has highlighted that the vehicles and the associated loads can be accommodated within the highway boundary, although there are locations where this is not the case. There are locations where the vehicle body and loads will over-run or oversail into third-party land and these locations and the anticipated outlines of the areas affected are provided in Appendix B (Drawing SK-CD-59 and Drawing SK-CD-66). The POI that need to be investigated further are:

- POI 92 – over-run and oversail into third party land is expected at this bend and it may be worthwhile investigating the implications of using the third-party land here. An alternative solution may be to use the third-party land on the outside of the bend to avoid the nearby residential property. The topography at this location will have to be investigated to determine the most suitable solution.
- POI 97 – consideration of the vertical alignment at this location is advised and a topographical survey will be required.
- POI 112 – consideration of the vertical alignment at this location is advised and a topographical survey will be required.
- POI 113 – consideration of the vertical alignment at this location is advised and a topographical survey will be required.
- POI 151 – over-run and oversail into third-party land is expected to make the required u-turn manoeuvre. The topography of the land at this location will have to be investigated further. Regrading will be necessary to enable the vehicles and loads to proceed safely.
- POI 153 – the manoeuvre form the north will require a significant amount of over-run, and associated oversail, into third party land. The swept path assessment has assumed a path to avoid the most significant topographical issues; however, it is recommended that this is investigated further.
- POI 175 – the swept path assessment highlighted the requirement to oversail beyond the highway boundary into third-party land. Although not particularly significant, a regarding of the land adjacent to the carriageway will be necessary to allow the necessary manoeuvre.
- POI 185 - the left-turn manoeuvre onto the B6357 will require a significant amount of over-run, and associated oversail, into third party land. The swept path assessment

has assumed the most direct path with no knowledge of the topography beyond the highway boundary. A topographical survey at this location may be required.

- POI 187 and 191 – the swept path assessment at these locations has highlighted the need to oversail into third-party land. Considering the width of the B6357, between POI 185 to the site access, it may be worthwhile undertaking a topographical survey to determine the third-party land requirements and available highway boundary.

Prior to moving any abnormal loads along either route it is advised that a dry run be undertaken.

Appendix A – ESDAL Responses

Kerr, Alan

From: greg.houghton.3890@northumbria.pnn.police.uk
Sent: 05 August 2011 14:47
To: Kerr, Alan
Cc: sarah.pitt.7012@northumbria.pnn.police.uk
Subject: Re: Highlea Hill Wind Farm - Traffic and Transport Issues [NOT PROTECTIVELY MARKED]

Dear Mr. Kerr,

In response to your e-mail of 03/08/11, concerning routes to Highlea Hill Wind Farm.

Only the first route i.e. the one from Port of Blyth falls within the Northumbria Police area (as far as the Scottish Border at Carter Bar on the A68).

It is not the policy of Northumbria Police to comment on the viability of proposed routes. Any route should be considered in consultation with the local authority responsible for the roads the route follows and also physically surveyed by the haulier.

The dimensions and weight of abnormal loads that Northumbria Police consider should be escorted are: -

Over 6.1 metres wide; and/or
Over 30 metres rigid length; and/or
Over 150,000 kgs.

Escort of abnormal loads under these dimensions and weight will only be considered if requested by the haulier on the grounds of public safety or where it may be necessary for a driver to breech road traffic regulations, requiring traffic control in order to do so i.e. travelling on the wrong side of the road to avoid street furniture. Please note, if an abnormal load driver breeches road traffic regulations without being directed to do so by police or a private escort driver attempts to control traffic, they leave themselves open to prosecution.

Any escort will attract a charge for police services.

It would appear from your e-mail that at least some of your loads will be 45 metres rigid length. These loads should be escorted by police if they travel anywhere within the Northumbria Police area, so if it is decided to use the first described route Northumbria Police, Operations Command, Planning and Co-ordination Unit should be contacted at least 14 days before the movement in order to arrange suitable escort. (E-mail: pcu@northumbria.pnn.police.uk)

Northumbria Police policy with regard to abnormal loads can be found at: -
http://www.northumbria.police.uk/about_us/policies_plans_and_strategy/policies/details.asp?id=16343

Greg Houghton
Planning and Co-ordination Sergeant
Operations Command, Northumbria Police
Tel 01661 868626
greg.houghton.3890@northumbria.pnn.police.uk

Kerr, Alan

From: David Moat [David.Moat@northtyneside.gov.uk] on behalf of abormal loads [abloads@northtyneside.gov.uk]
Sent: 04 August 2011 11:23
To: Kerr, Alan
Cc: Kevin Ridpath; Paul Fleming
Subject: RE: Highlea Hill Wind Farm - Traffic and Transport Issues [Scanned]

Thank you for your enquiry.

The two proposed routes do not affect us as a Bridge Authority. The trunk roads (A1 and A19) are administered by AOne. and the connecting roads (B1329 to A189) are administered by Northumberland County Council. The transporting of such long loads on the trunk road network at certain times may affect traffic movements in the Borough so I've asked Kevin Ridpath (Network Manager) and Paul Fleming (Team Leader Traffic) to comment directly if they perceive any potential problems.

Regards,

David.

David Moat.
Project Engineer Infrastructure,
Regeneration, Development and Regulatory Services,
Quadrant,
Cobalt 16,
The Silverlink North,
Cobalt Business Park,
Newcastle upon Tyne,
NE27 0BY.

T: (0191) 643 6142
F: (0191) 643 2420

Kerr, Alan

From: Lambley Lucy [Lucy.Lambley@networkrail.co.uk] on behalf of Abnormal Loads Contact [AbnormalLoadsContact@networkrail.co.uk]
Sent: 04 August 2011 10:41
To: Kerr, Alan
Subject: RE: Highlea Hill Wind Farm - Traffic and Transport Issues [Route 1 NBA] [Route 2 OCL/B/7]

Your proposed route does not affect any Network Rail owned road over rail bridges, therefore we have no objections to your proposed route.

We check the load carrying capacity of road over rail bridges affected we do not check anything else including:

- Load carrying capacity of level crossings
- Clearance to bridge parapets
- Clearance under a rail bridge
- Clearance to overhead wires at level crossings

Regards

Lucy

Lucy Lambley | Highways Interface Manager [Abnormal Loads] | Asset Management

---

Network Rail | Floor 2B Desk 71 | George Stephenson House | Toft Green | York YO1 6JT

External (Direct): +44 (0)1904383107

External (Abnormal Loads General): +44 (0)1904389732

Mobile: +44 (0)7515619752

Internal 085 33107

lucy.lambley@networkrail.co.uk

Kerr, Alan

From: brown, alan [alan.brown@aone.uk.com]
Sent: 03 August 2011 14:24
To: Kerr, Alan
Subject: RE: Highlea Hill Wind Farm - Traffic and Transport Issues

Alan

In reply to your enquiry, should the the proposed port of entry be Blyth, then I am responsible for the A.19, A.1 and A.696 as far as Newcastle Airport, the remainder of the route, together with the first section, would come under Northumberland County Council.

I have had nearly 200 wind turbine loads out of Blyth, all travelling in various directions to different sites, and all of similar dimmensions without any incidents. Blyth has become one of the main entry ports for wind turbine equipment and the routes have become well tried and tested.

The A.696 dual carrriageway ends at Newcastle airport, so from there the A.696 - A.68 become two-way roads and tailbacks of traffic can become a problem, especially with limited pull-in passing places.

On the Blyth port of entry there are no issues with the dimmensions illustrated along the proposed route.

If you contact me nearer the movement dates, I can advise of any impending roadworks that may interfere with the moves, but if you require any further information please contact me .

Kind Regards

Alan Brown

Abnormal Loads Officer

A-one+, Valley House, Valley Street North, Darlington DL1 1TJ.

DDI: 01325 341635

Fax: 01325 385701

E-mail: alan.brown@aone.uk.com

Kerr, Alan

From: David Slammon [David.Slammon@midlothian.gov.uk]
Sent: 03 August 2011 13:04
To: Kerr, Alan
Subject: RE: Highlea Hill Wind Farm - Traffic and Transport Issues

Alan,

Neither of your proposed routes affects Midlothian Council roads so I have no comments to make.

Regards,

David Slammon
Structures Engineer
Midlothian Council Road Services
62A Polton Street
Bonnyrigg
Midlothian EH19 3YD
Tel 0131 561 5317
Fax 0131 561 5312
david.slammon@midlothian.gov.uk

Appendix C – Utility Impact Responses

Kerr, Alan

From: Tighe, Bryan
Sent: 20 September 2011 08:52
To: 'richard.macleod@sgn.co.uk'
Subject: RE: Cairn Duhie Wind Farm (Ref GGRRAA001/BT/040811)

Bryan

In regards to impact of abnormal loads and the options that i have recieved we (SGN) dont anticpate any problem with the transportation of these loads to our apparatus, we have a minimum depth of 750mm of cover in highways and a minimum depth 600mm of cover in footpaths/verges,i must state that SGN have adopted the network of gas mains and these depths can not be guaranteed.

Regards

Richard MacLeod
Plant Protection
Inverness

Tele: 01463 234106
Mobile:07970 674366
Fax: 01463 711773

Kerr, Alan

From: Tighe, Bryan
Sent: 18 August 2011 16:35
To: Kerr, Alan
Subject: FW: GGRRAA001/BT/040811

Please find no response for Highlea Hill & Carin Duhie wind farm abnormal loads

Dear Sirs

Verizon Business is a licensed Statutory Undertaker.

We have reviewed your plans and have determined that Verizon Business (Formally known as MCI WorldCom, MFS) has no apparatus in the areas concerned.

If you have any further queries please do not hesitate to call.

Yours faithfully

Chris Pile

Plant Protection Officer E.mail osp-team@uk.verizonbusiness.com

Chris Pile
Plant Protection Officer - OSP & Infrastructure.
UK Field Operations
01293 611736
Mobile 07990 774438
Verizon Global Network Field Operations
www.Verizon.com

nationalgrid

Plant Protection
Block 1 Floor 2
Brick Kiln Street
Hinckley
Leicestershire
LE10 0NA

Halcrow Group Ltd Abercromby Place Edinburgh EH3 6LB	Direct 0800 688 588 E-mail plantprotection@uk.ngrid.com
Date: 16.08.11	www.nationalgrid.com
Your Ref: GGRRAA001/BT/040811	
Our Ref: XX_XX_H_00046	

F.A.O. Bryan Tighe – Re Option 1 & 2 Highlea Hill Wind Farm Abnormal Loads Review

Thank you for your recent letter received on 4th August 2011.

We have carried out detailed checks in respect to our operational transmission networks. Please note that Option 1 is effected by Overhead Transmission Lines and should this route be used you would need to provide the height of the abnormal load before the journey takes place to enable us to calculate the risk.

Option 2 - Based on the information you have provided and the proximity and sensitivity of these networks we have concluded that the risk is negligible.

It is recommended that when passing beneath an overhead transmission line that the vehicle does not stop for a distance of six metres either side of the outermost conductors. In the event of a breakdown beneath an overhead transmission line under no circumstances allow anyone to climb on top of the vehicle or load.

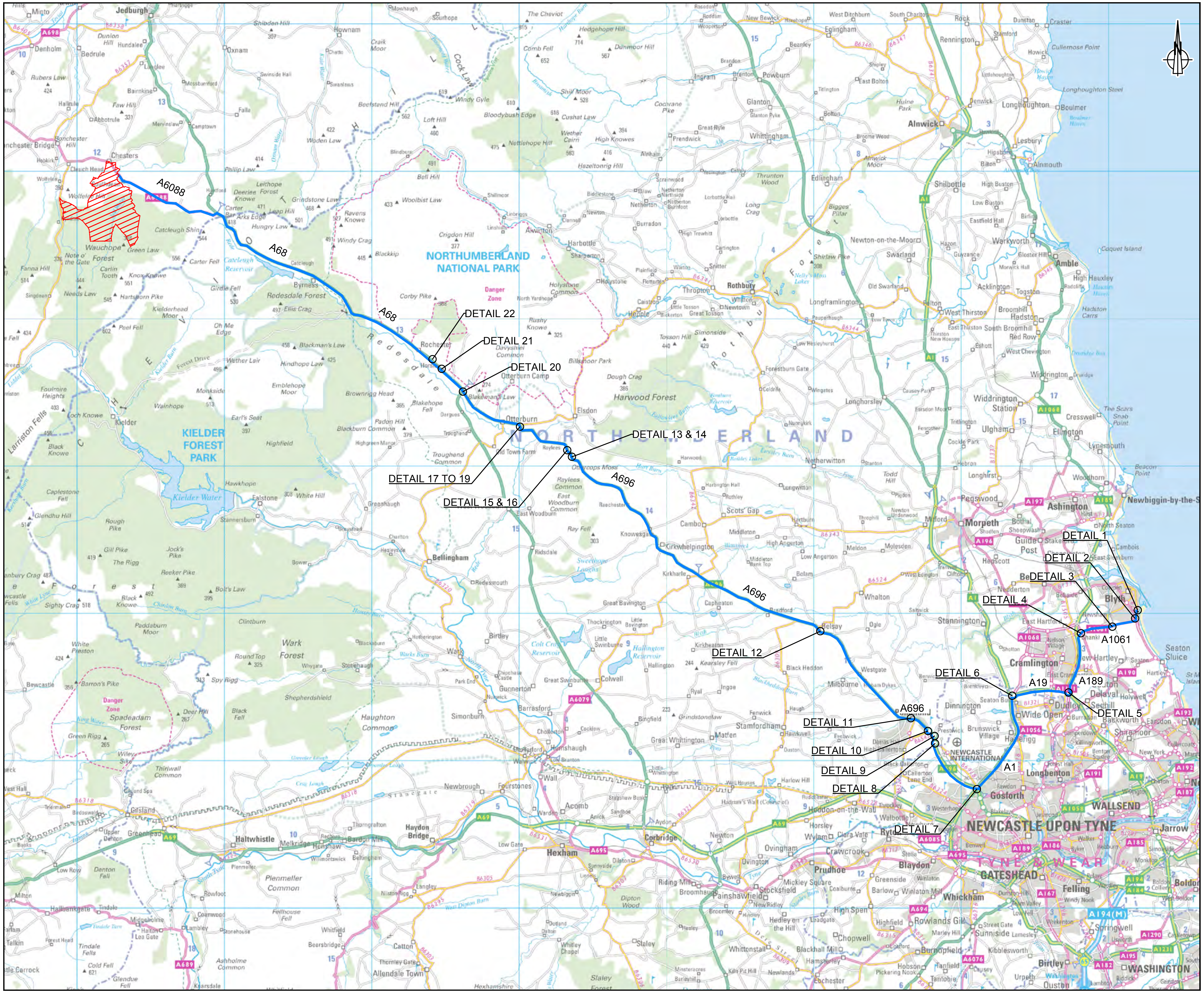
Yours faithfully

Plant Protection

National Grid

0800 688 588

Technical Appendix 11.2 – Additional Swept Path Analysis (57.3m)



KEY

SITE BOUNDARY (TAKEN FROM RES DRAWING 02836D2203-03)

PROPOSED DELIVERY ROUTE

OVERVIEW
SHEET 1 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A

T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

PURPOSE FOR DESIGN

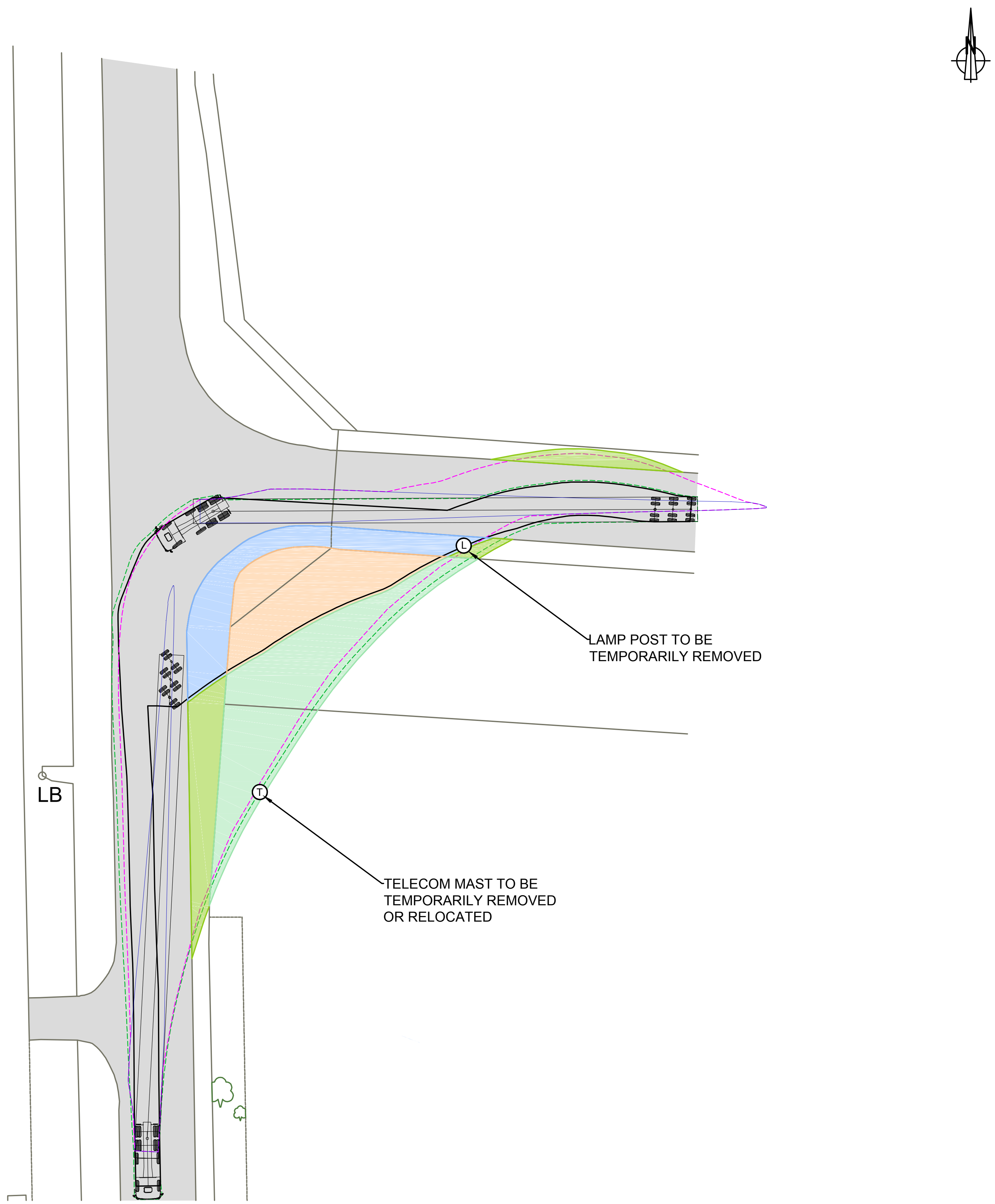
SCALE 1:250,000

ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS -
PORT OF BLYTH

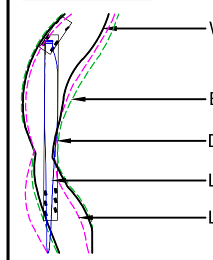
BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299



KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- TELECOMMUNICATIONS MAST
- BOLLARD
- WALL

VEHICLE PATH



NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAIL 1
SHEET 2 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

PURPOSE FOR DESIGN

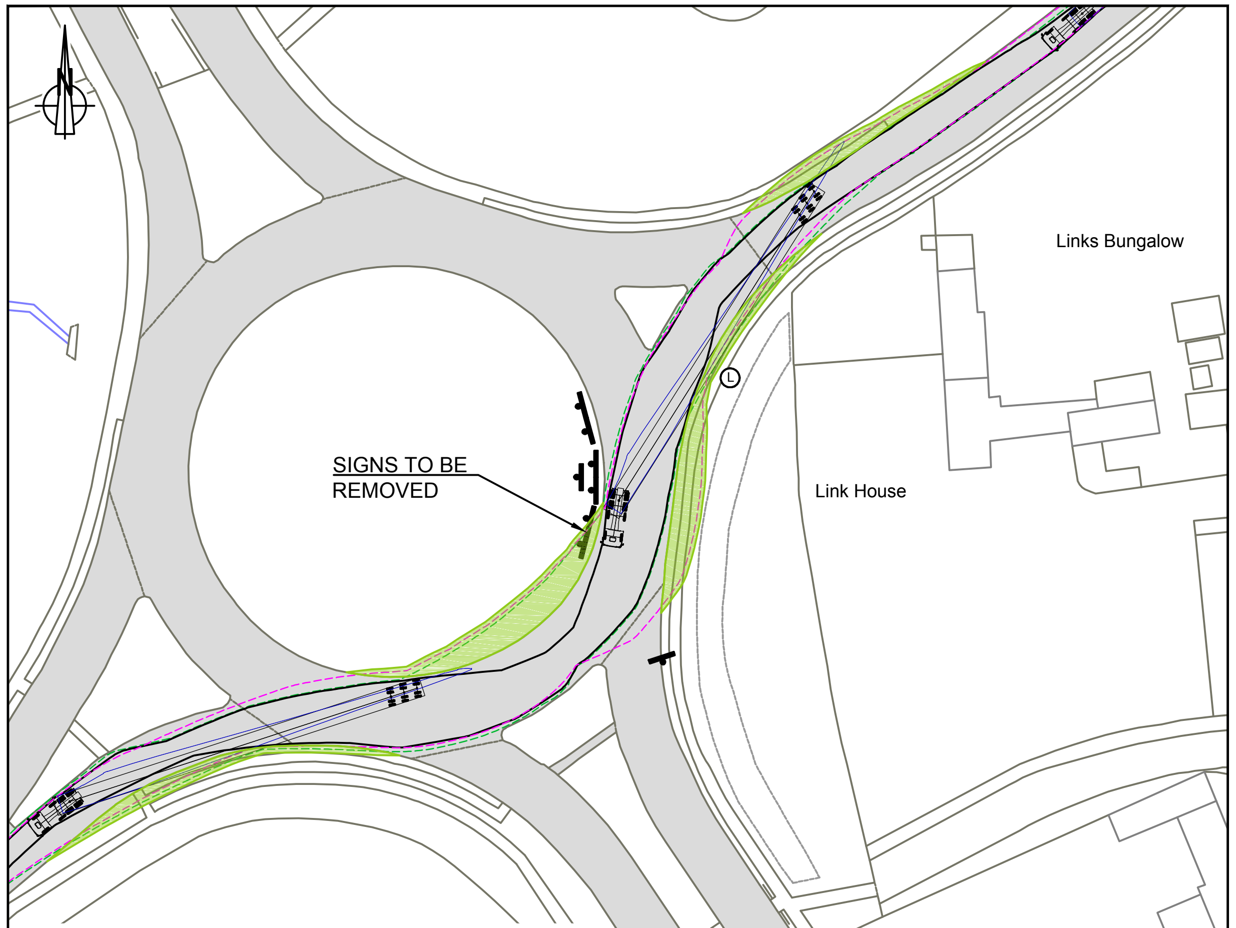
SCALE 1:500
ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL
WIND FARM

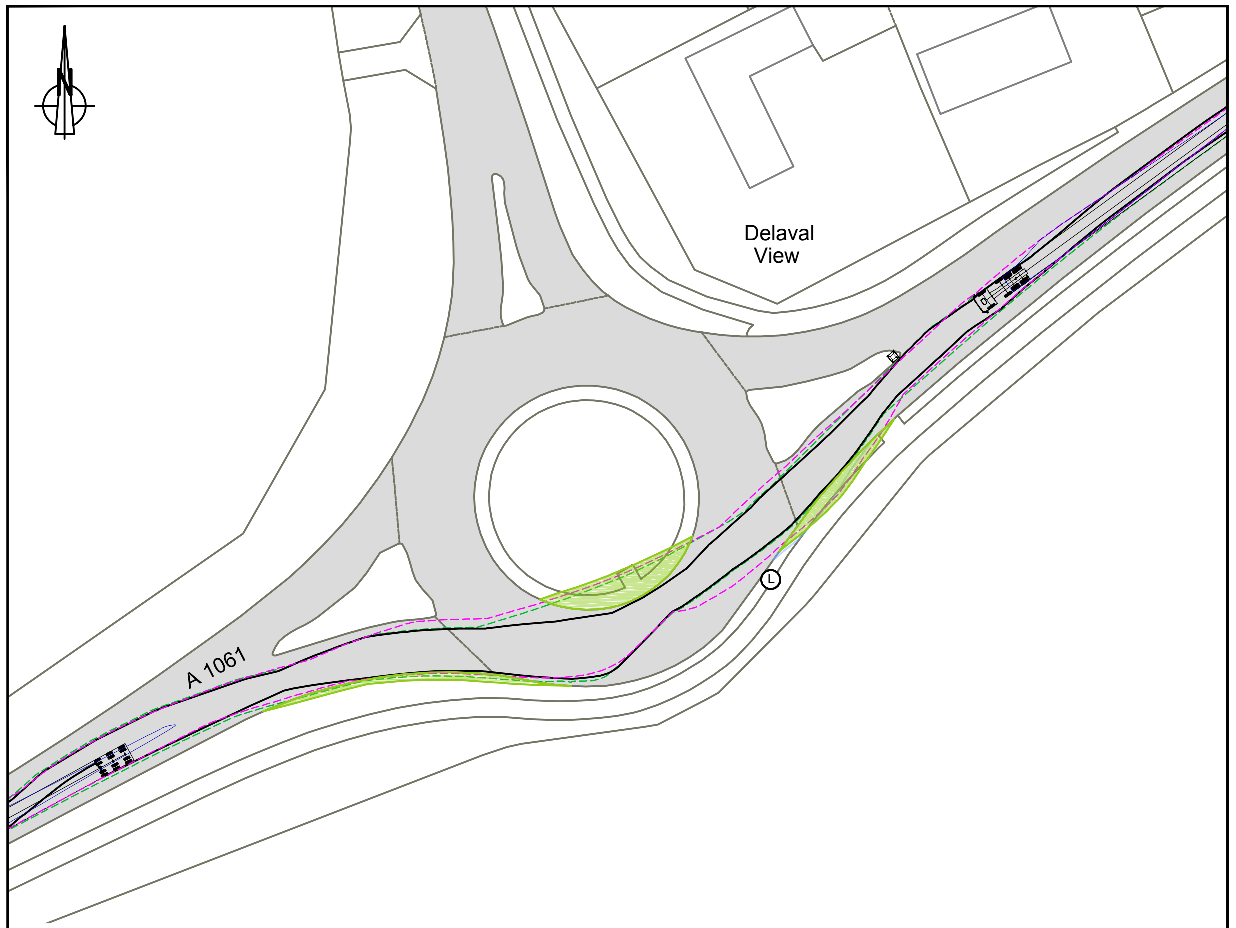
DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS -
PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

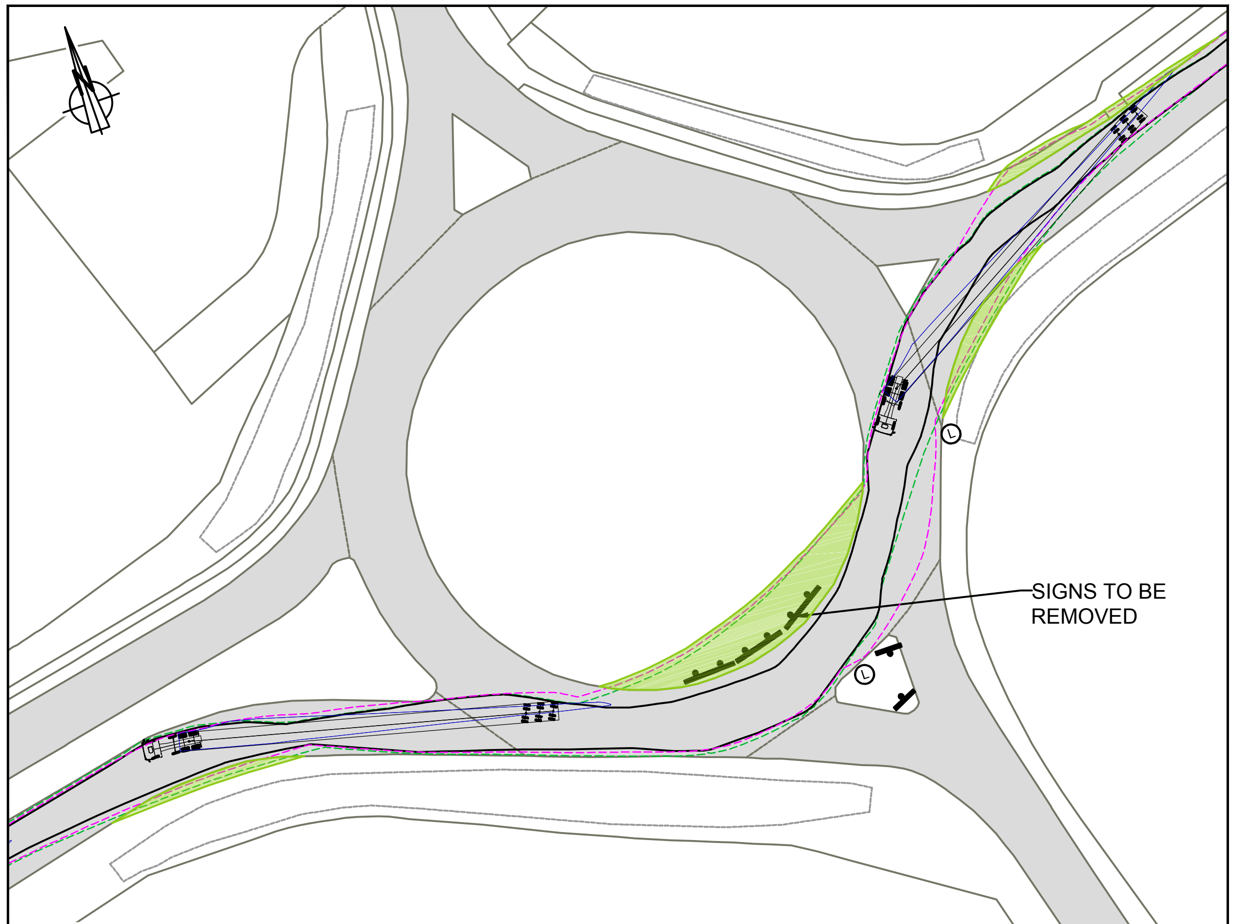
DETAIL 1
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



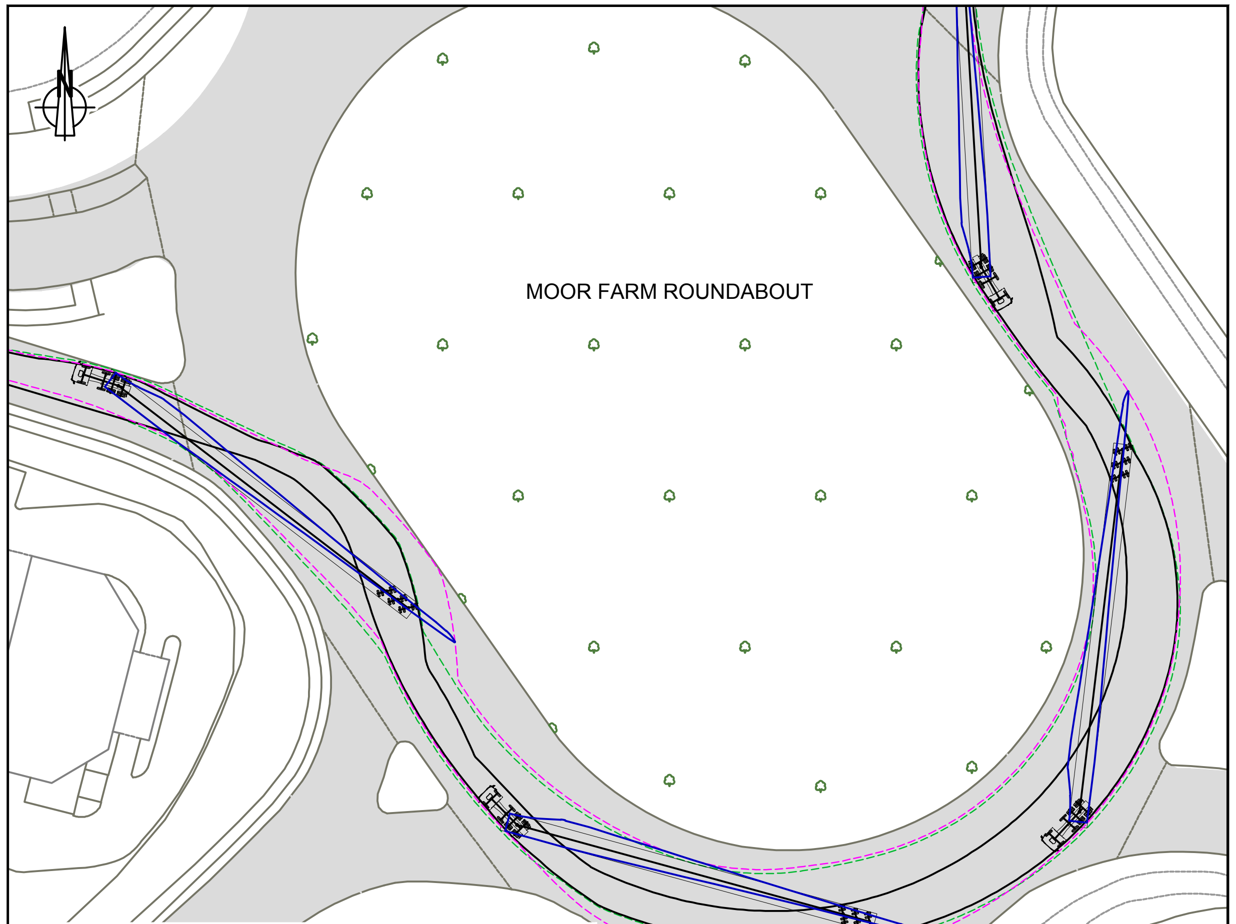
DETAIL 2
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 3
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 4
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 5
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH

NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAILS 2 - 5
SHEET 3 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

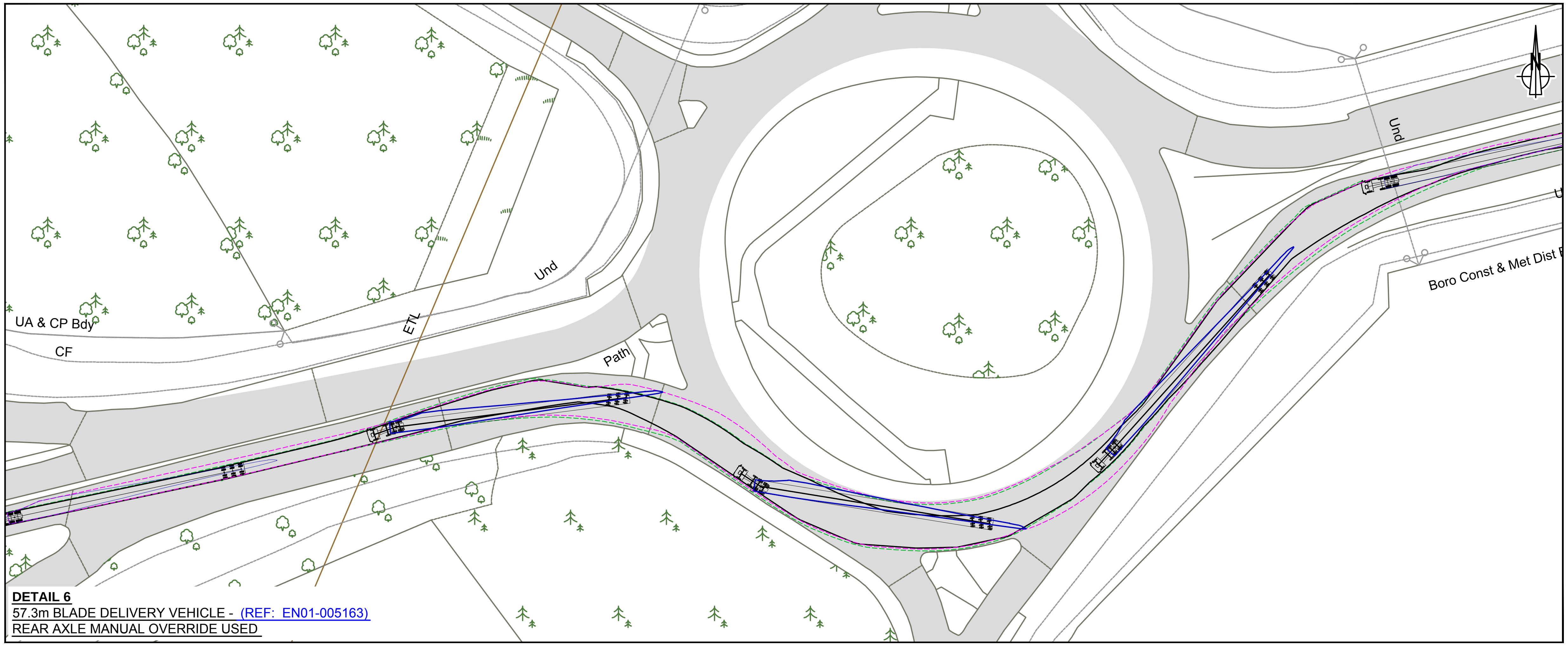
PURPOSE FOR DESIGN

SCALE 1:1000
ORIGINAL PLOT SIZE A3

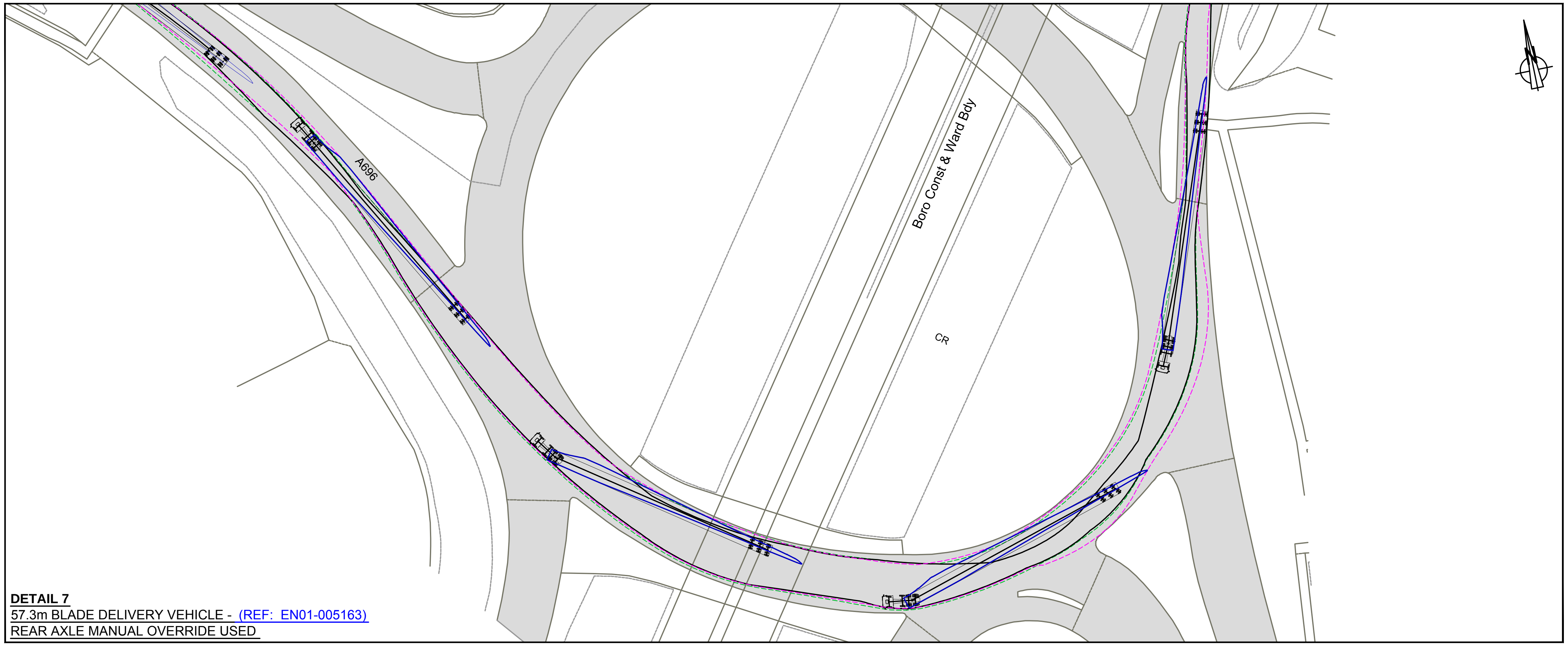
PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS -
PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299



DETAIL 6
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 7
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH

- WHEEL EXTENTS (BLACK)
- BODY EXTENTS (GREEN)
- DELIVERY VEHICLE (BLACK)
- LOAD (BLUE)
- LOAD EXTENTS (MAGENTA)

NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAILS 6 -7
SHEET 4 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A | T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

PURPOSE FOR DESIGN

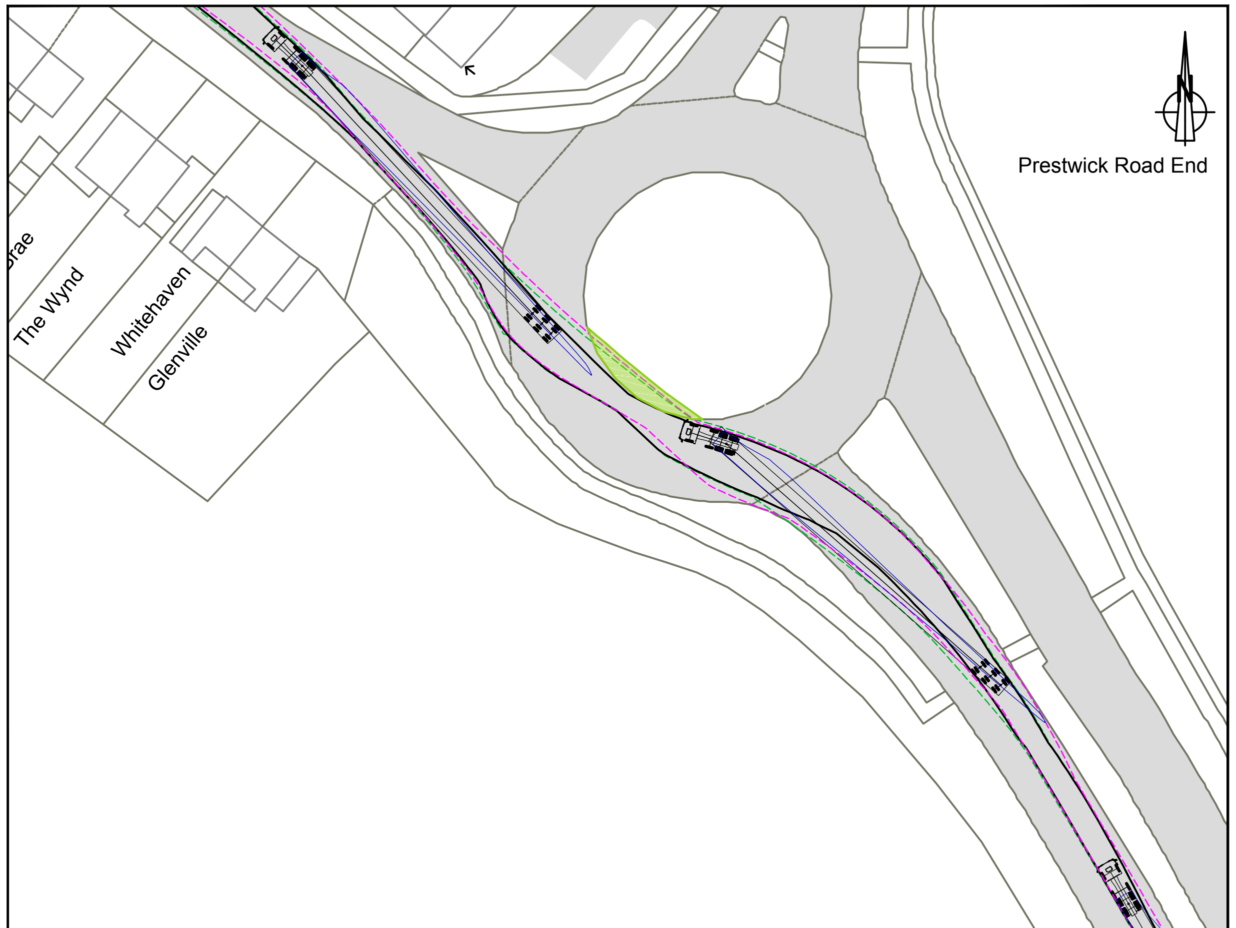
SCALE 1:1000 | ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL
WIND FARM

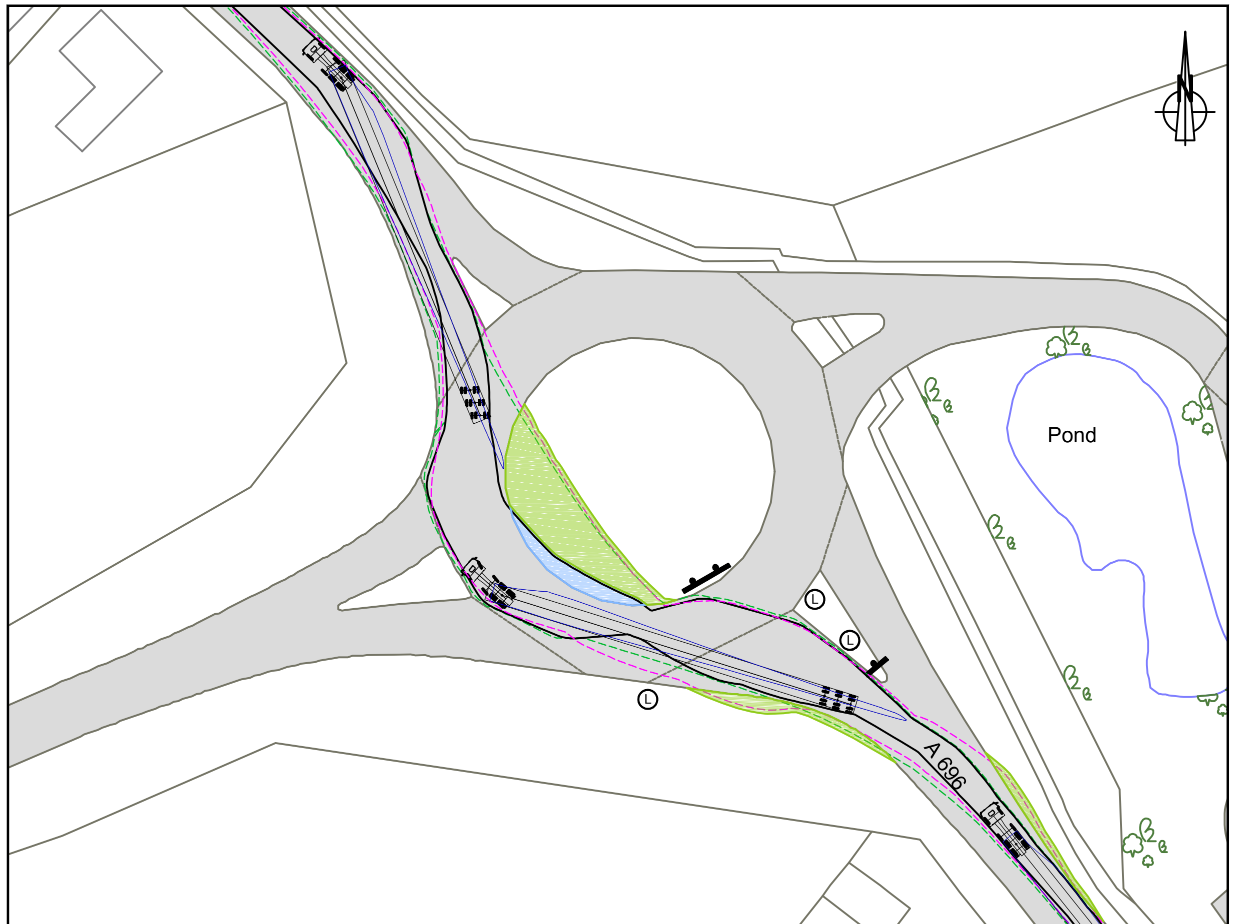
DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS -
PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

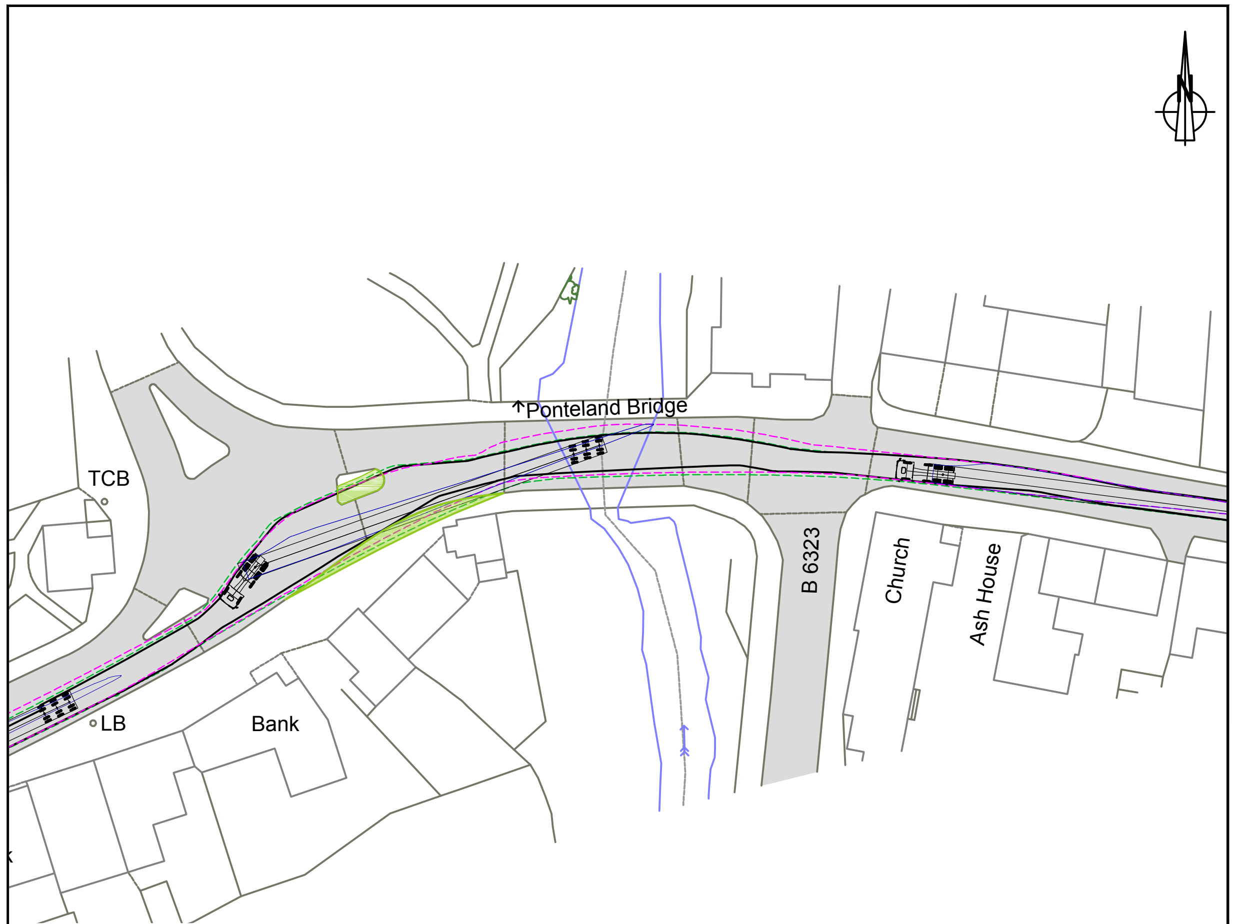
DETAIL 8
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 9
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 10
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

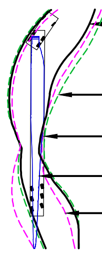


DETAIL 11
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH



NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAILS 8 - 11
SHEET 5 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

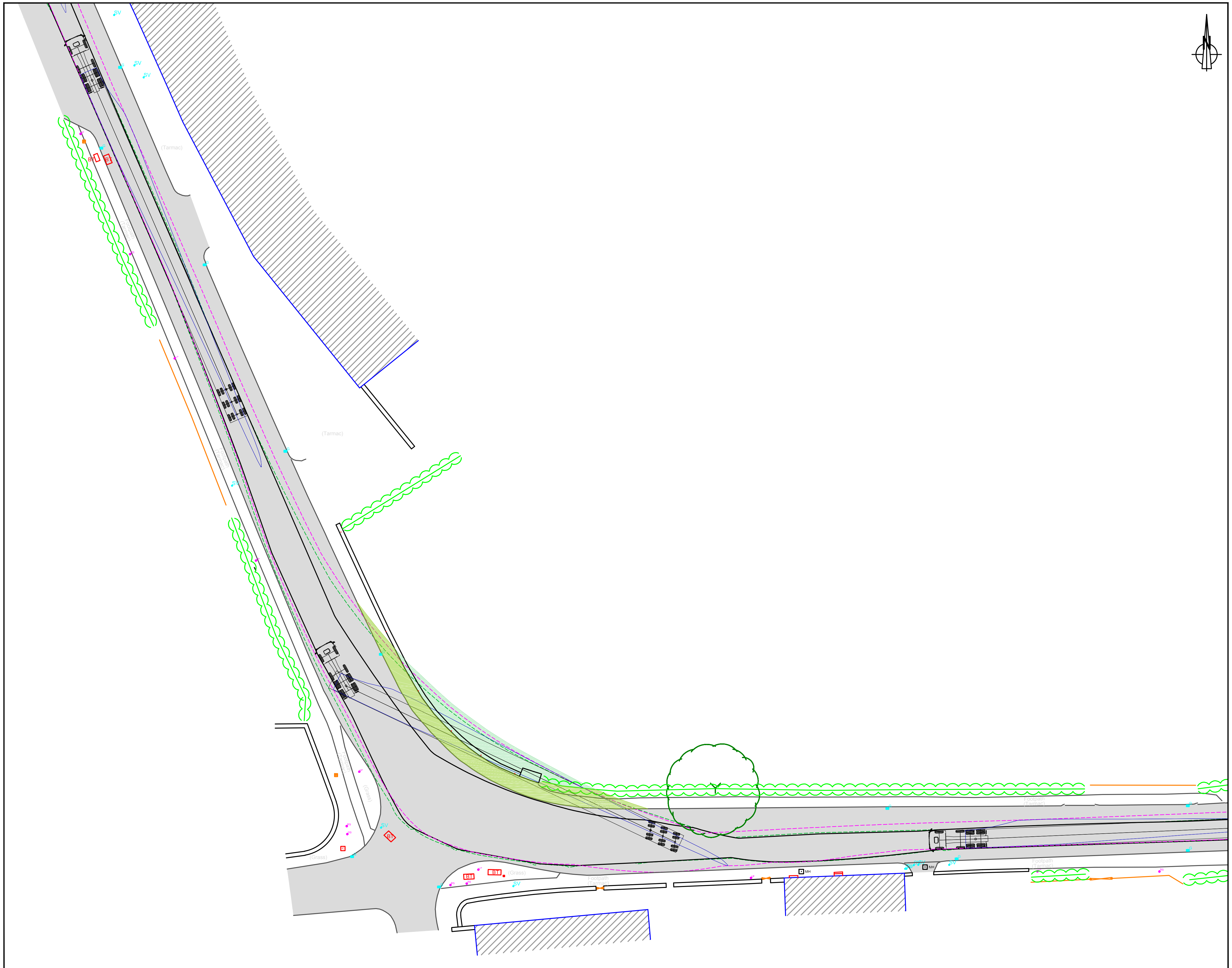
DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID
PURPOSE FOR DESIGN
SCALE 1:1000
ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS - PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299



DETAIL 12
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

TOPOGRAPHICAL DATA SUPPLIED BY
360 SURVEYS - DATE JAN 2016

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH

NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAIL 12
SHEET 6 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

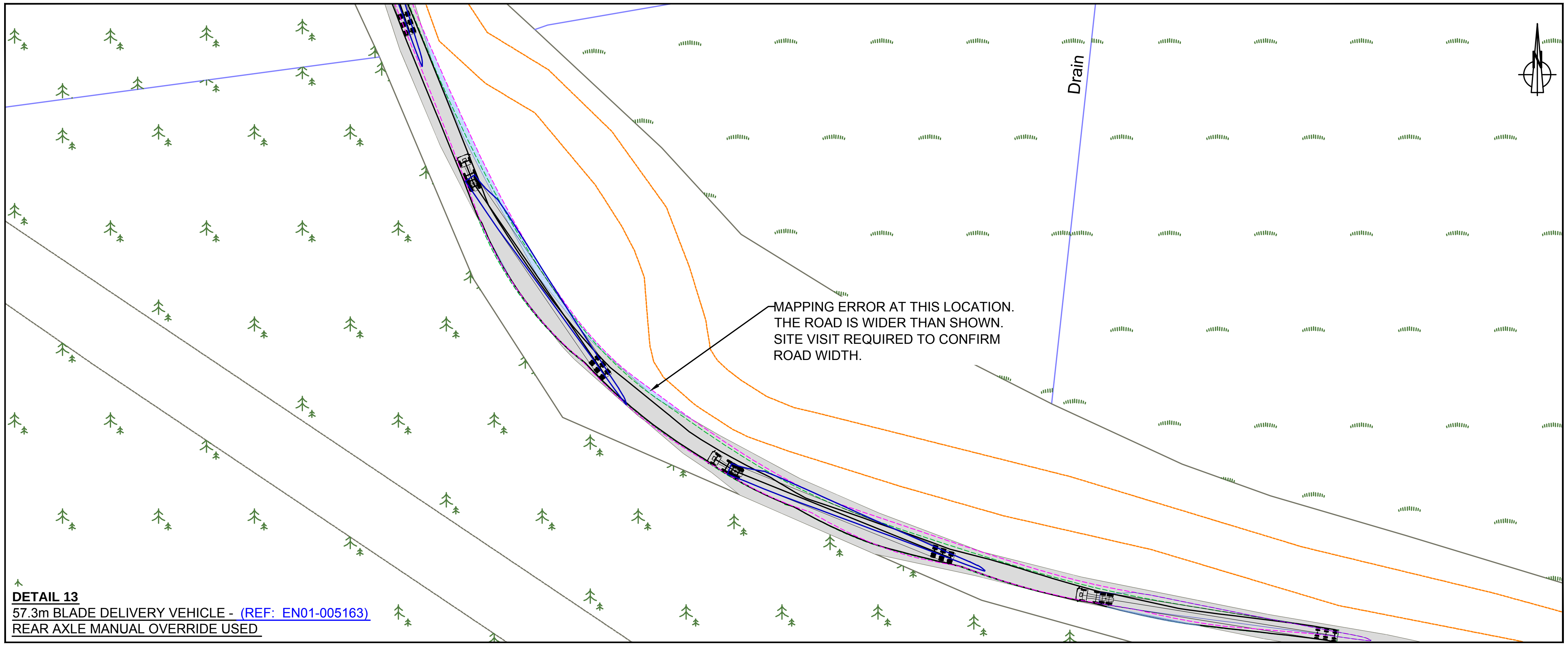
DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID
PURPOSE FOR DESIGN
SCALE 1:500
ORIGINAL PLOT SIZE A3

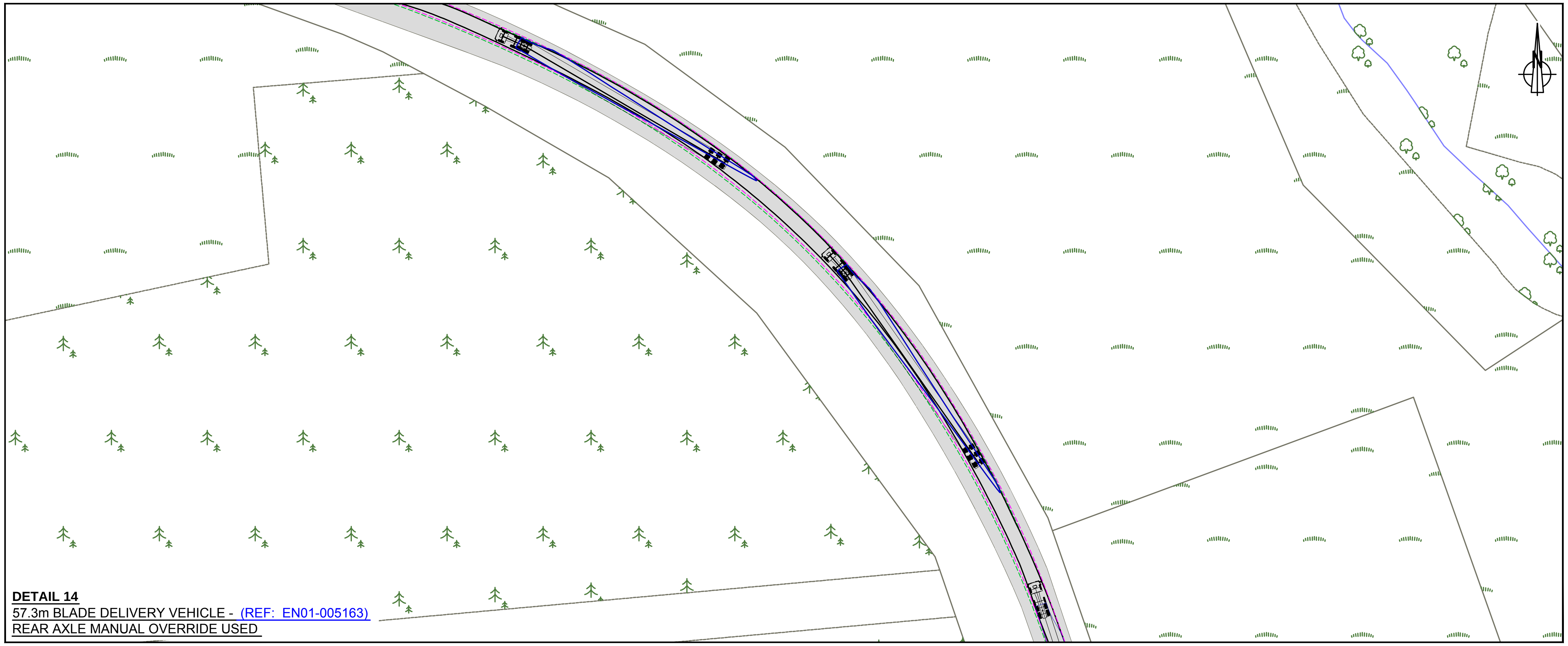
PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS - PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299



DETAIL 13
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 14
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH

- WHEEL EXTENTS (BLACK)
- BODY EXTENTS (GREEN)
- DELIVERY VEHICLE (BLACK)
- LOAD (BLUE)
- LOAD EXTENTS (MAGENTA)

NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAILS 13 - 14
SHEET 7 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A | T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

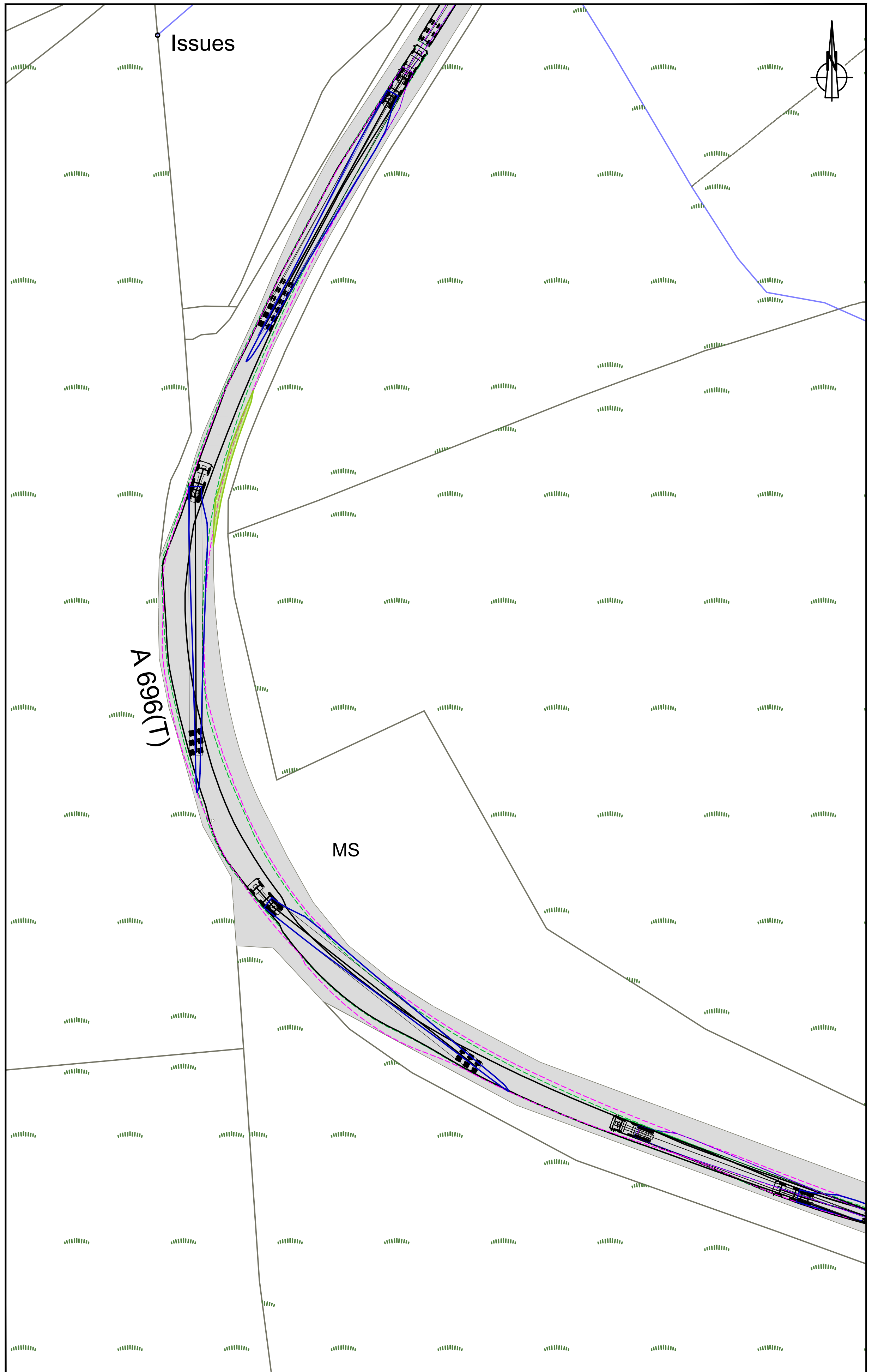
PURPOSE FOR DESIGN

SCALE 1:1000 | ORIGINAL PLOT SIZE A3

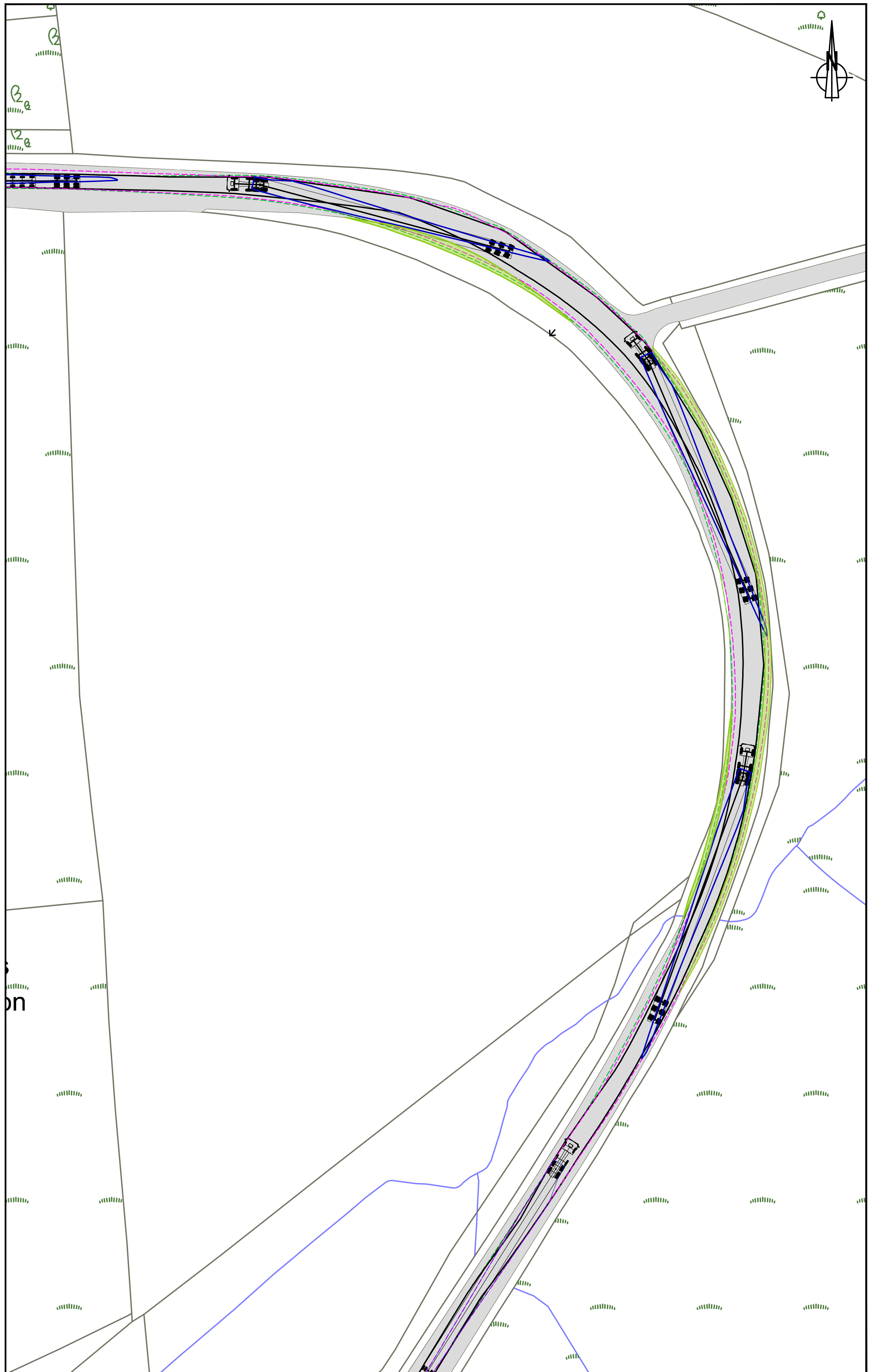
PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS - PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299



DETAIL 15
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 16
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH

- WHEEL EXTENTS (BLACK)
- BODY EXTENTS (GREEN)
- DELIVERY VEHICLE (BLACK)
- LOAD (BLUE)
- LOAD EXTENTS (MAGENTA)

NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAILS 15 - 16
SHEET 8 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

PURPOSE FOR DESIGN

SCALE 1:1000
ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS - PORT OF BLYTH

res
BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

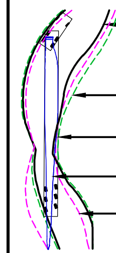
KEY - SURVEY

- CRASH BARRIER
- WALL
- BOLLARD
- STREET SIGN
- SEWER
- BT
- ELECTRIC (UNDERGROUND)

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND

VEHICLE PATH



NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAIL 17
SHEET 9 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG: N/A
T-LAYOUT NO.: N/A

DRAWING NUMBER: 02836D2402-02

COORDS: BRITISH NATIONAL GRID

PURPOSE: FOR DESIGN

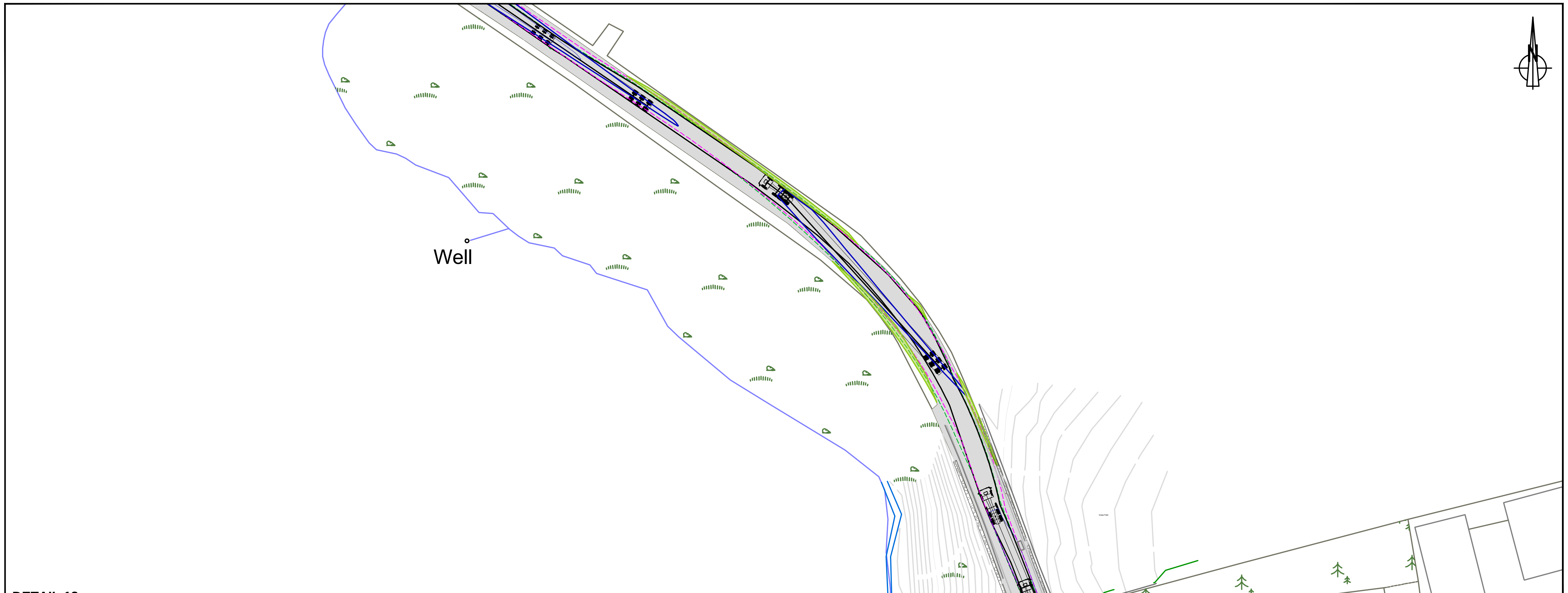
SCALE: 1:500 — ORIGINAL PLOT SIZE: A3

PROJECT TITLE: HIGHLEE HILL WIND FARM

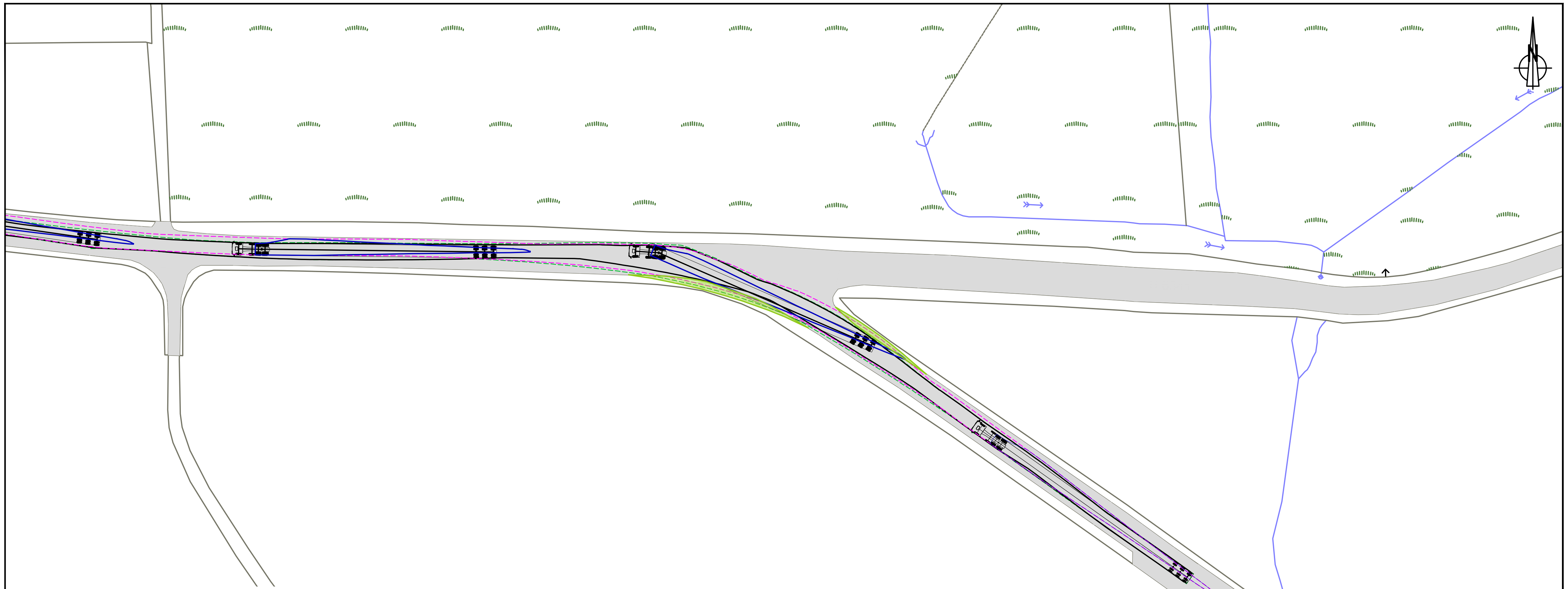
DRAWING TITLE: 57.3m BLADE ACCESS ANALYSIS - PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE, KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

DETAIL 17
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 18
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED



DETAIL 19
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH

- WHEEL EXTENTS (BLACK)
- BODY EXTENTS (GREEN)
- DELIVERY VEHICLE (BLACK)
- LOAD (BLUE)
- LOAD EXTENTS (MAGENTA)

NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAILS 18 - 19
SHEET 10 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A — T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

PURPOSE FOR DESIGN

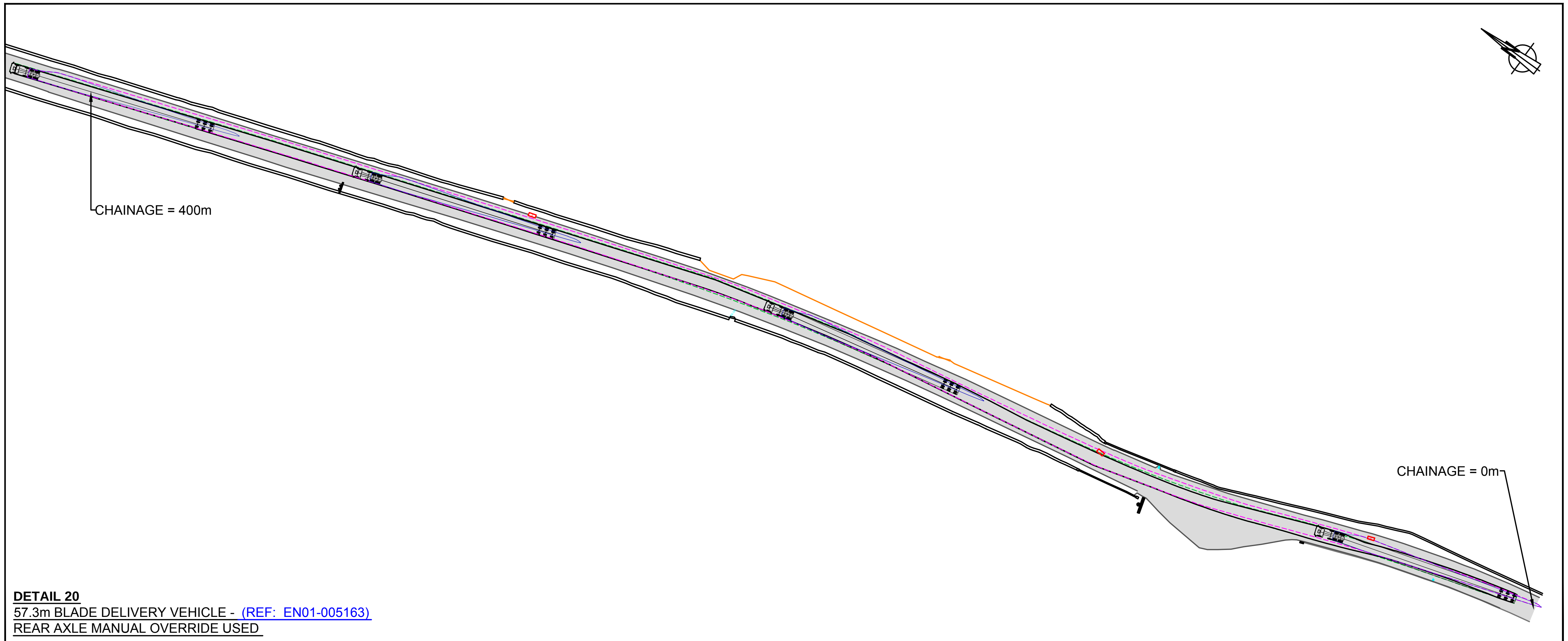
SCALE 1:1000 — ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS - PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE, KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

TOPOGRAPHICAL DATA SUPPLIED BY
360 SURVEYS - DATE JAN 2016

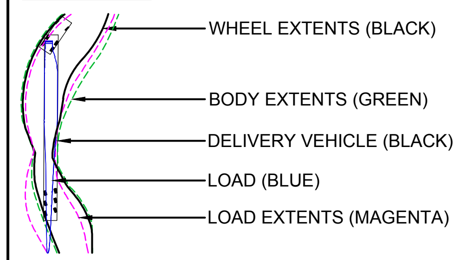


DETAIL 20
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH



NOTES

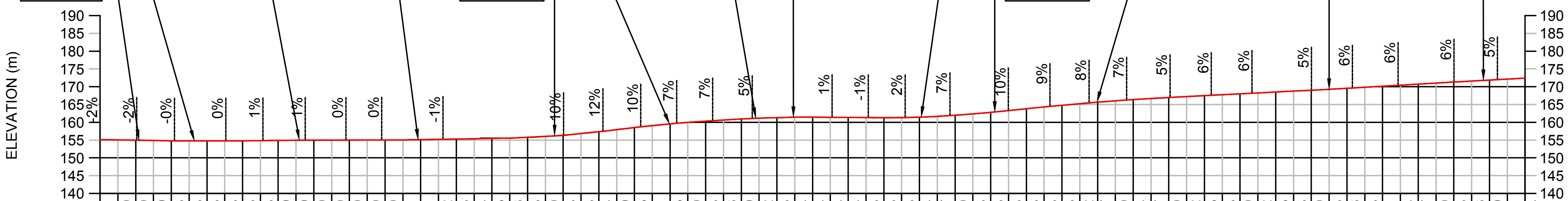
1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAIL 20
SHEET 11 OF 13

KEY

GI	GRADIENT IN
GO	GRADIENT OUT
CH	CHAINAGE
R	PROFILE CURVE RADIUS
TL	PROFILE CURVE LENGTH

GI	GO	CH	LEV	R	TL
-1.61%	-1.64%	0+10.94	154.938	2443.544	0.712
-1.64%	0.90%	0+26.46	154.683	1027.597	26.068
0.90%	0.38%	0+55.96	154.948	1334.909	6.954
0.38%	1.81%	0+89.30	155.074	1041.302	14.890
1.81%	12.58%	1+27.59	155.766	298.030	32.096
12.58%	5.45%	1+59.84	159.820	445.670	31.756
5.45%	2.90%	1+84.06	161.140	137.226	3.495
2.90%	-0.66%	1+94.62	161.447	78.102	2.783
-0.66%	7.97%	2+30.49	161.210	275.497	23.776
7.97%	10.81%	2+51.13	162.855	477.205	13.550
10.81%	5.06%	2+79.81	165.955	750.497	43.152
5.06%	5.89%	3+45.01	169.254	3364.029	27.951
5.89%	5.12%	3+88.29	171.803	2289.276	17.619



CHAINAGE (m)	EXISTING LEVEL (m)	LEVEL DIFFERENCE (m)
0	155.1	0.0
5	155.0	0.0
10	155.0	0.0
15	154.9	0.0
20	154.8	0.0
25	154.8	0.0
30	154.8	0.0
35	154.8	0.0
40	154.8	0.0
45	154.8	0.0
50	154.9	0.0
55	154.9	0.0
60	155.0	0.0
65	155.0	0.0
70	155.0	0.0
75	155.0	0.0
80	155.0	0.0
85	155.1	0.0
90	155.1	0.0
95	155.2	0.0
100	155.3	0.0
105	155.4	0.0
110	155.5	0.0
115	155.6	0.0
120	155.8	0.0
125	156.0	0.0
130	156.3	0.0
135	156.8	0.0
140	157.4	0.0
145	157.9	0.0
150	158.5	0.0
155	159.1	0.0
160	159.5	0.0
165	160.0	0.0
170	160.3	0.0
175	160.6	0.0
180	160.9	0.0
185	161.2	0.0
190	161.3	0.0
195	161.4	0.0
200	161.4	0.0
205	161.4	0.0
210	161.4	0.0
215	161.3	0.0
220	161.3	0.0
225	161.3	0.0
230	161.4	0.0
235	161.7	0.0
240	162.0	0.0
245	162.3	0.0
250	162.8	0.0
255	163.3	0.0
260	163.8	0.0
265	164.3	0.0
270	164.8	0.0
275	165.2	0.0
280	165.7	0.0
285	166.0	0.0
290	166.4	0.0
295	166.7	0.0
300	167.0	0.0
305	167.2	0.0
310	167.5	0.0
315	167.8	0.0
320	168.0	0.0
325	168.2	0.0
330	168.5	0.0
335	168.8	0.0
340	169.0	0.0
345	169.3	0.0
350	169.6	0.0
355	169.8	0.0
360	170.1	0.0
365	170.4	0.0
370	170.7	0.0
375	171.0	0.0
380	171.3	0.0
385	171.6	0.0
390	171.9	0.0
395	172.1	0.0
400	172.4	0.0

DETAIL 20 - LONG SECTION
SCALE 1:1500

DETAIL 20 - LONG SECTION
CHAINAGE 0m - 400m

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

PURPOSE FOR DESIGN

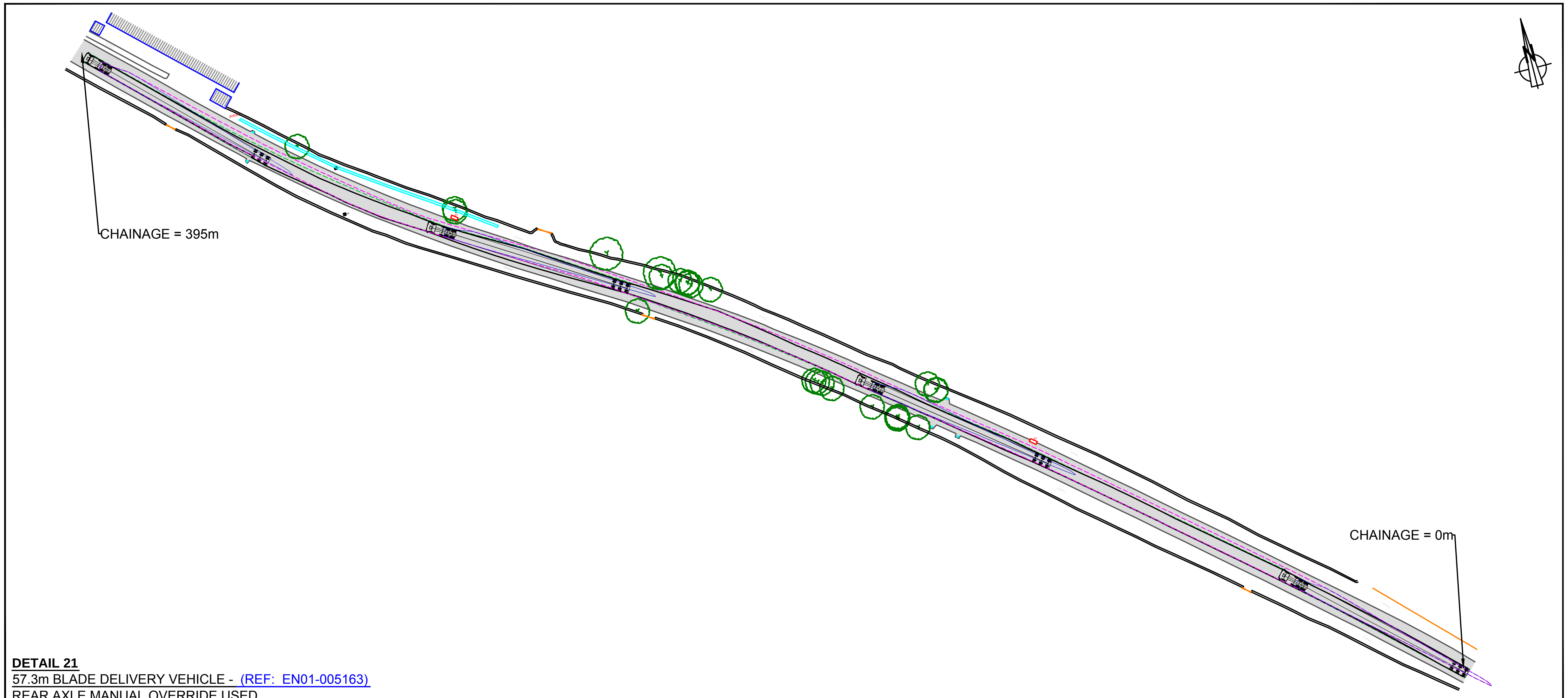
SCALE 1:1000
ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS -
PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

TOPOGRAPHICAL DATA SUPPLIED BY
360 SURVEYS - DATE JAN 2016



DETAIL 21
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY

GI	GRADIENT IN
GO	GRADIENT OUT
CH	CHAINAGE
R	PROFILE CURVE RADIUS
TL	PROFILE CURVE LENGTH

GI: -0.25% GO: -2.51% CH 0+11.23 LEV 199.659 R 974.828 TL 22.122

GI: -2.51% GO: -8.22% CH 0+86.86 LEV 197.757 R 444.751 TL 25.378

GI: -8.22% GO: 1.60% CH 1+29.78 LEV 194.229 R 380.618 TL 37.391

GI: 1.60% GO: 3.66% CH 1+67.95 LEV 194.841 R 936.511 TL 19.244

GI: 3.66% GO: -2.48% CH 2+08.97 LEV 196.341 R 984.797 TL 60.454

GI: -2.48% GO: -8.30% CH 2+51.25 LEV 195.292 R 414.103 TL 24.114

GI: -8.30% GO: -9.00% CH 2+77.58 LEV 193.106 R 608.945 TL 4.252

GI: -9.00% GO: -8.40% CH 2+93.99 LEV 191.628 R 921.056 TL 5.539

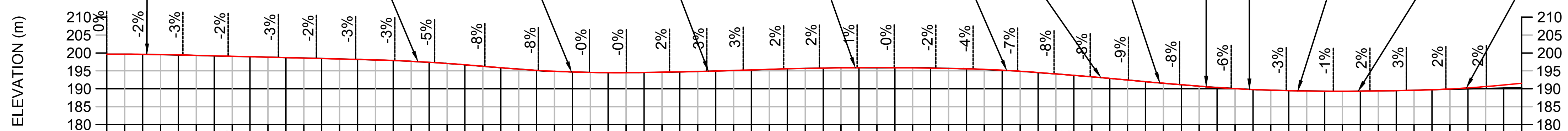
GI: -8.40% GO: -6.30% CH 3+06.93 LEV 190.541 R 13.688 TL 0.288

GI: -6.30% GO: -2.84% CH 3+19.00 LEV 189.781 R 92.294 TL 3.191

GI: -2.84% GO: -0.82% CH 3+32.52 LEV 189.397 R 194.236 TL 3.920

GI: -0.82% GO: 2.03% CH 3+49.37 LEV 189.258 R 694.936 TL 19.836

GI: 2.03% GO: 10.70% CH 3+79.57 LEV 189.871 R 372.730 TL 32.331



CHAINAGE (m)	EXISTING LEVEL (m)	LEVEL DIFFERENCE (m)
0	199.7	0.0
5	199.7	0.0
10	199.6	0.0
15	199.5	0.0
20	199.4	0.0
25	199.3	0.0
30	199.2	0.0
35	199.1	0.0
40	198.9	0.0
45	198.8	0.0
50	198.7	0.0
55	198.6	0.0
60	198.5	0.0
65	198.3	0.0
70	198.2	0.0
75	198.0	0.0
80	197.9	0.0
85	197.7	0.0
90	197.4	0.0
95	197.1	0.0
100	196.7	0.0
105	196.3	0.0
110	195.9	0.0
115	195.5	0.0
120	195.1	0.0
125	194.9	0.0
130	194.7	0.0
135	194.6	0.0
140	194.5	0.0
145	194.5	0.0
150	194.6	0.0
155	194.6	0.0
160	194.7	0.0
165	194.8	0.0
170	195.0	0.0
175	195.1	0.0
180	195.3	0.0
185	195.4	0.0
190	195.6	0.0
195	195.7	0.0
200	195.8	0.0
205	195.8	0.0
210	195.9	0.0
215	195.9	0.0
220	195.9	0.0
225	195.9	0.0
230	195.8	0.0
235	195.7	0.0
240	195.6	0.0
245	195.4	0.0
250	195.1	0.0
255	194.9	0.0
260	194.5	0.0
265	194.2	0.0
270	193.7	0.0
275	193.3	0.0
280	192.9	0.0
285	192.4	0.0
290	192.0	0.0
295	191.5	0.0
300	191.1	0.0
305	190.7	0.0
310	190.4	0.0
315	190.1	0.0
320	189.8	0.0
325	189.6	0.0
330	189.5	0.0
335	189.4	0.0
340	189.3	0.0
345	189.3	0.0
350	189.3	0.0
355	189.4	0.0
360	189.5	0.0
365	189.6	0.0
370	189.7	0.0
375	189.8	0.0
380	190.0	0.0
385	190.1	0.0
390	190.2	0.0
395	190.3	0.0

DETAIL 21 - LONG SECTION
CHAINAGE 0m - 395m

DETAIL 21 - LONG SECTION
SCALE 1:1500

KEY

- EXISTING ROAD/TRACK SURFACE
- OVERRUN WITHIN ADOPTED ROAD LAND
- OVERSAIL WITHIN ADOPTED ROAD LAND
- OVERRUN WITHIN 3rd PARTY LAND
- OVERSAIL WITHIN 3rd PARTY LAND
- EXTENT OF WORKS WITHIN 3rd PARTY LAND
- LAMP POST
- SIGN POST
- BOLLARD
- WALL

VEHICLE PATH

- WHEEL EXTENTS (BLACK)
- BODY EXTENTS (GREEN)
- DELIVERY VEHICLE (BLACK)
- LOAD (BLUE)
- LOAD EXTENTS (MAGENTA)

NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

DETAIL 21
SHEET 12 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

PURPOSE FOR DESIGN

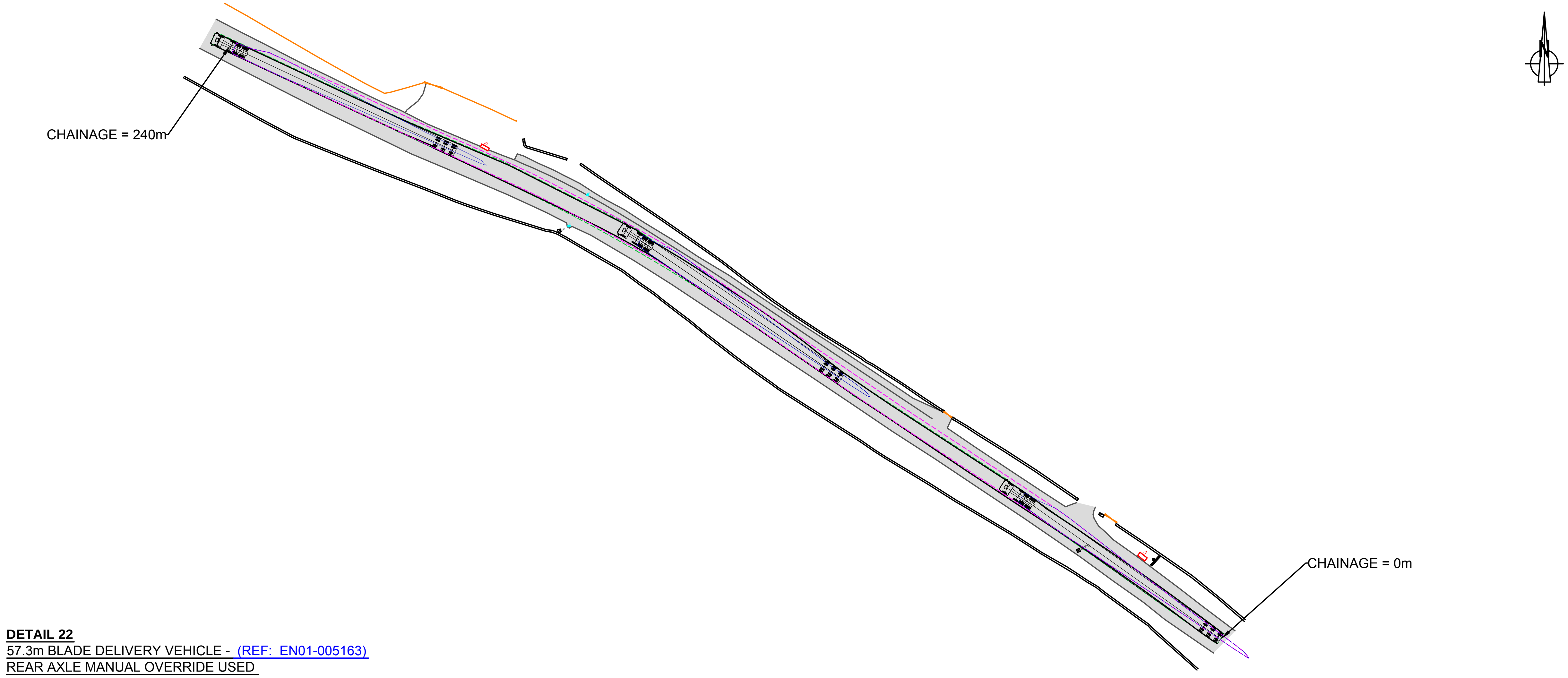
SCALE 1:1250
ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL
WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS -
PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

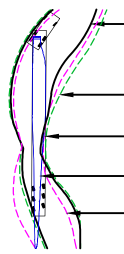
TOPOGRAPHICAL DATA SUPPLIED BY 360 SURVEYS - DATE JAN 2016



DETAIL 22
57.3m BLADE DELIVERY VEHICLE - (REF: EN01-005163)
REAR AXLE MANUAL OVERRIDE USED

KEY
EXISTING ROAD/TRACK SURFACE
OVERRUN WITHIN ADOPTED ROAD LAND
OVERSAIL WITHIN ADOPTED ROAD LAND
OVERRUN WITHIN 3rd PARTY LAND
OVERSAIL WITHIN 3rd PARTY LAND
EXTENT OF WORKS WITHIN 3rd PARTY LAND
LAMP POST
SIGN POST
BOLLARD
WALL

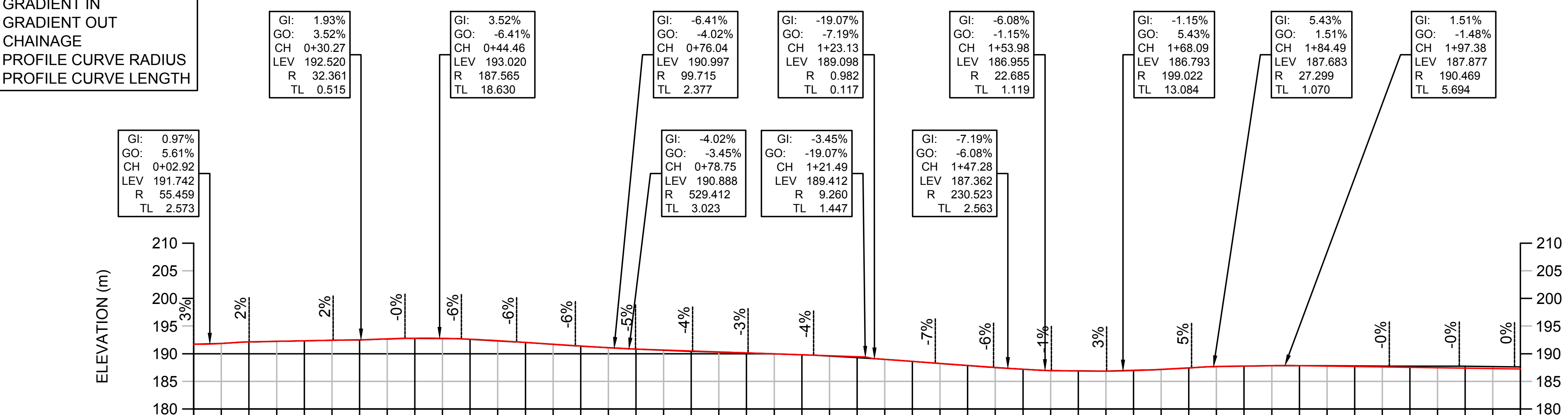
VEHICLE PATH



NOTES

1. ALL VEHICLE DIMENSIONS SHOWN ARE INDICATIVE ONLY AND SUBJECT TO CONFIRMATION FOLLOWING TURBINE AND HAULIER SELECTION.
2. STREET FURNITURE LOCATIONS APPROXIMATE AND BASED ON BEST AVAILABLE SOURCE. ONLY ITEMS IN THE PROXIMITY OF VEHICLE PATH INCLUDED.
3. AREAS OF LANDTAKE WITHIN 3rd PARTY LAND APPROXIMATE ONLY, DO NOT INCLUDE TEMPORARY LANDTAKE FOR CONSTRUCTION.
4. FOR TOWER VEHICLE SWEPT PATH PLEASE REFER TO HALCROW REPORT HIGHLEE HILL - PHASE 1 ACCESS STUDY.

KEY
GI GRADIENT IN
GO GRADIENT OUT
CH CHAINAGE
R PROFILE CURVE RADIUS
TL PROFILE CURVE LENGTH



CHAINAGE (m)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
EXISTING LEVEL (m)	191.7	191.9	192.1	192.2	192.3	192.4	192.5	192.7	192.8	192.8	192.6	192.3	192.0	191.7	191.4	191.1
LEVEL DIFFERENCE (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CHAINAGE (m)	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155
EXISTING LEVEL (m)	190.8	190.6	190.4	190.3	190.2	190.0	189.8	189.6	189.3	189.0	188.6	188.2	187.9	187.5	187.2	187.0
LEVEL DIFFERENCE (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CHAINAGE (m)	160	165	170	175	180	185	190	195	200	205	210	215	220	225	230	235	240
EXISTING LEVEL (m)	186.9	186.9	187.0	187.2	187.4	187.7	187.8	187.8	187.8	187.8	187.8	187.8	187.8	187.7	187.7	187.7	187.6
LEVEL DIFFERENCE (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DETAIL 22 - LONG SECTION
CHAINAGE 0m - 240m

DETAIL 22 - LONG SECTION
SCALE 1:1000

DETAIL 22
SHEET 13 OF 13

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
02	CT	PS	DM	01-04-2016	57.3M BLADE ASSESSED
01	JB	CS	SF	06-06-2013	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

DRAWING NUMBER
02836D2402-02

COORDS BRITISH NATIONAL GRID

PURPOSE FOR DESIGN

SCALE 1:1000
ORIGINAL PLOT SIZE A3

PROJECT TITLE
HIGHLEE HILL WIND FARM

DRAWING TITLE
57.3m BLADE ACCESS ANALYSIS - PORT OF BLYTH

BEAUFORT COURT, EGG FARM LANE, KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299