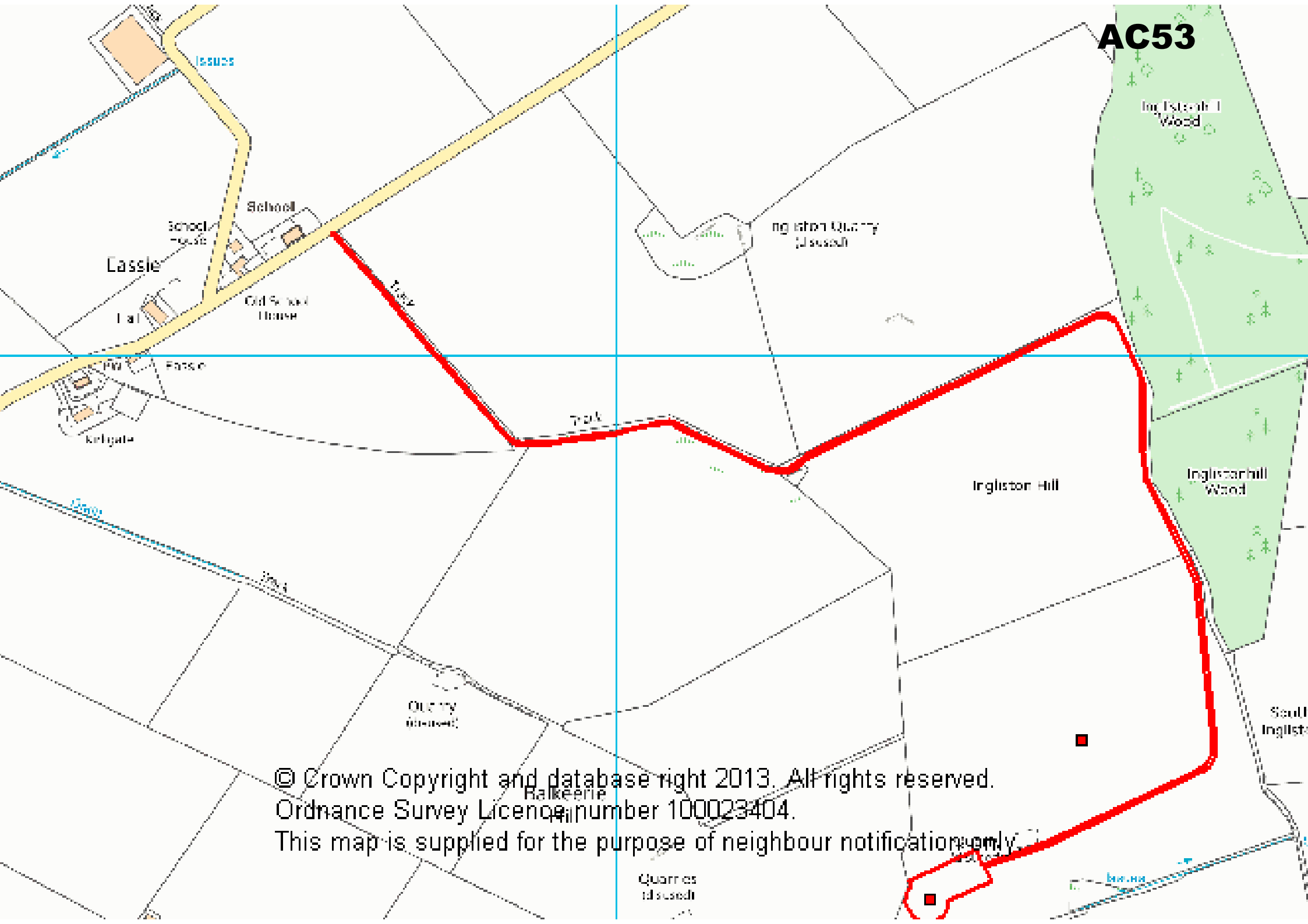
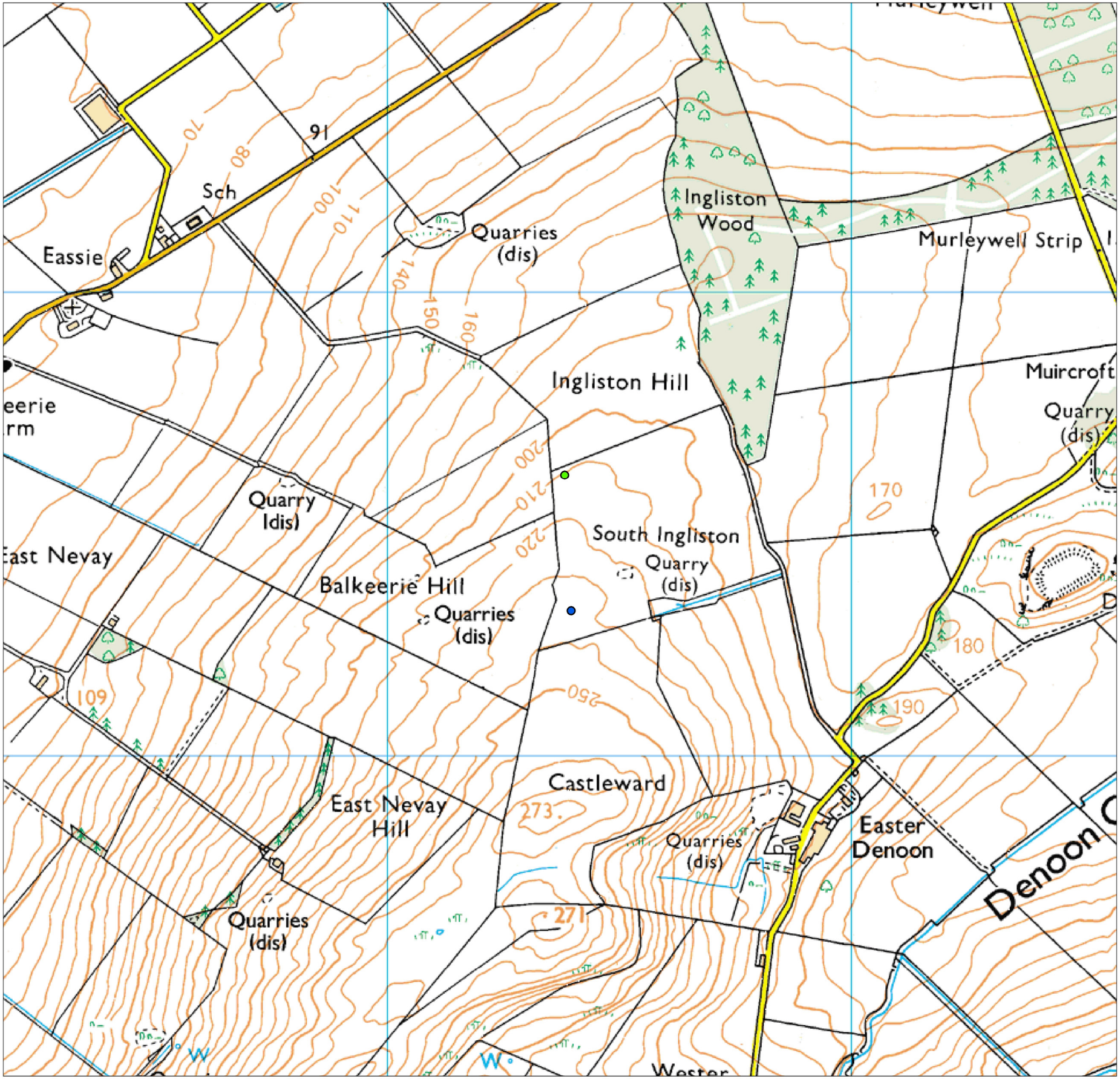

AC53
Lassie
School
Old School House
Inglistonhill Wood
Inglistonhill Wood
Inglistonhill
Quarry
Quarries
Ralkeerie Hill
© Crown Copyright and database right 2013. All rights reserved.
Ordnance Survey Licence number 100023404.
This map is supplied for the purpose of neighbour notification only.



AC54

Locogen Ltd, 44 Constitution St, Edinburgh, EH6 6RS
Tel: +44 (0) 131 555 4745; Email: info@locogen.com
Company Number: SC370060; VAT Number: 983 3836 77

Project Description

Number of Turbine(s):	1
Turbine Model:	EWT Directwind 54
Hub Height:	50m
Blade Diameter:	54m
Total Height to Blade Tip:	77m
Existing Turbine Location:	334397 744313
Proposed Turbine Location:	334383 744606

Notes

This map shows the existing and proposed turbine location.

Legend

- Existing Turbine Location
- Proposed Turbine Location

PROJECT:	**Ingliston**
DRAWING TITLE:	Revised Turbine Location
DRAWING NO:	N/A
DOCUMENT SIZE:	A3
SCALE:	1:8,000
DATE:	10/01/2014
DRAWING BY:	Bojan Jevtic
APPROVED BY:	Andy Lowe

N

0 100 200 300 400 500 m

AC54

Locogen Ltd, 44 Constitution St, Edinburgh, EH6 6RS
Tel: +44 (0) 131 555 4745; Email: info@locogen.com
Company Number: SC370060; VAT Number: 983 3836 77

Project Description

Number of Turbine(s):	1
Turbine Model:	EWT Directwind 54
Hub Height:	50m
Blade diameter:	54m
Total height to blade tip:	77m
Turbine location:	334397 744313

Notes

This map shows the proposed turbine location in black and the boundary of land ownership in blue.

Legend

- Turbine Location
- Boundary of Land Ownership

PROJECT:	**Ingliston Farm**
DRAWING TITLE:	Location Plan
DRAWING NO:	ING001
DOCUMENT SIZE:	A3
SCALE:	1:30,000
DATE:	27/08/2013
DRAWING BY:	Bojan Jevtic
APPROVED BY:	Andy Lowe

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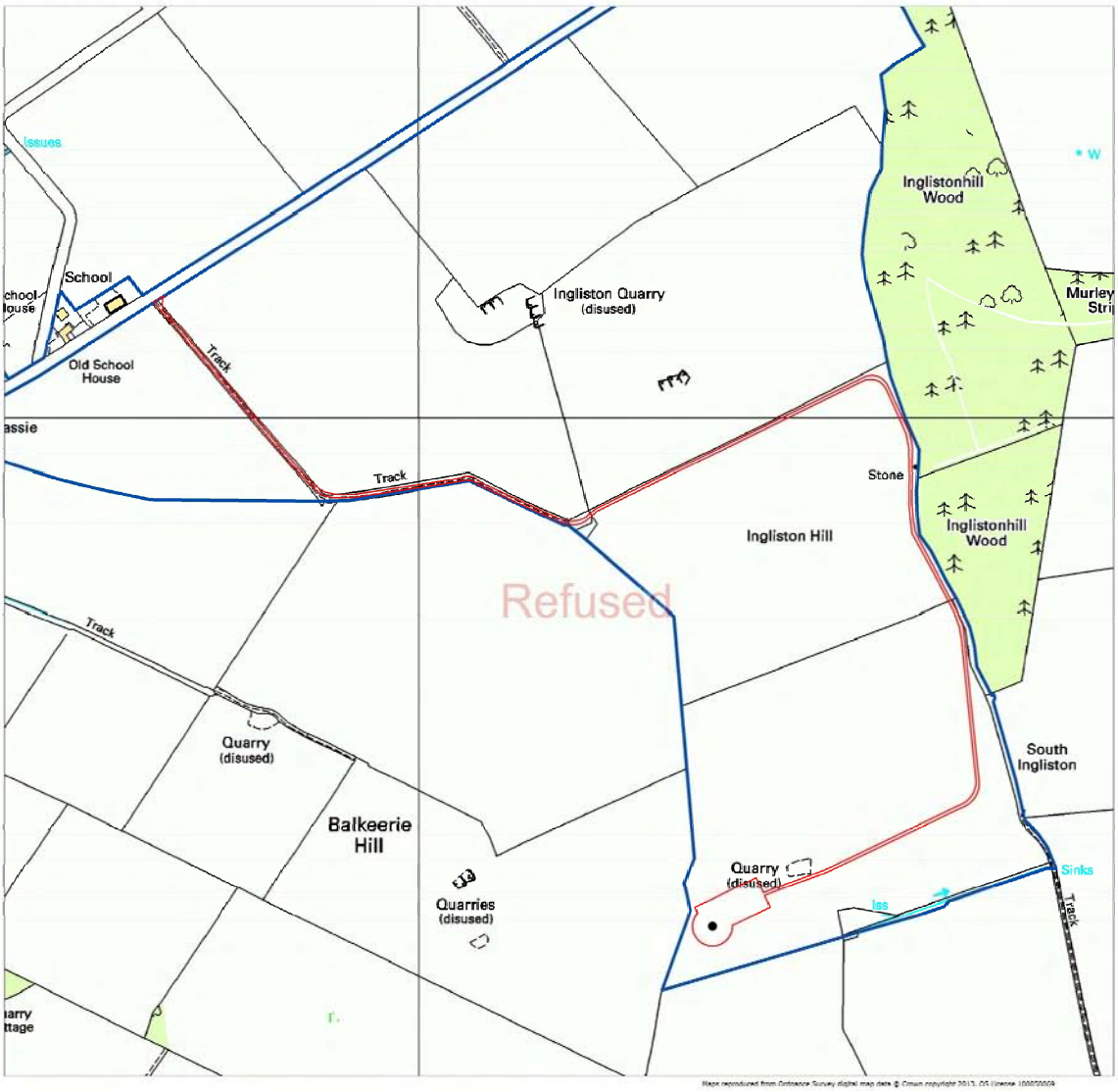
AC54



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Tel: +44 (0) 131 555 4745; Email: info@locogen.com
Company Number: SC370060; VAT Number: 983 3836 77

Project Description

Number of Turbine(s):	1
Turbine Model:	EWT Directwind 54
Hub Height:	50m
Blade diameter:	54m
Total height to blade tip:	77m
Turbine location:	334397 744313

Notes

This map shows the proposed turbine site layout.

Legend

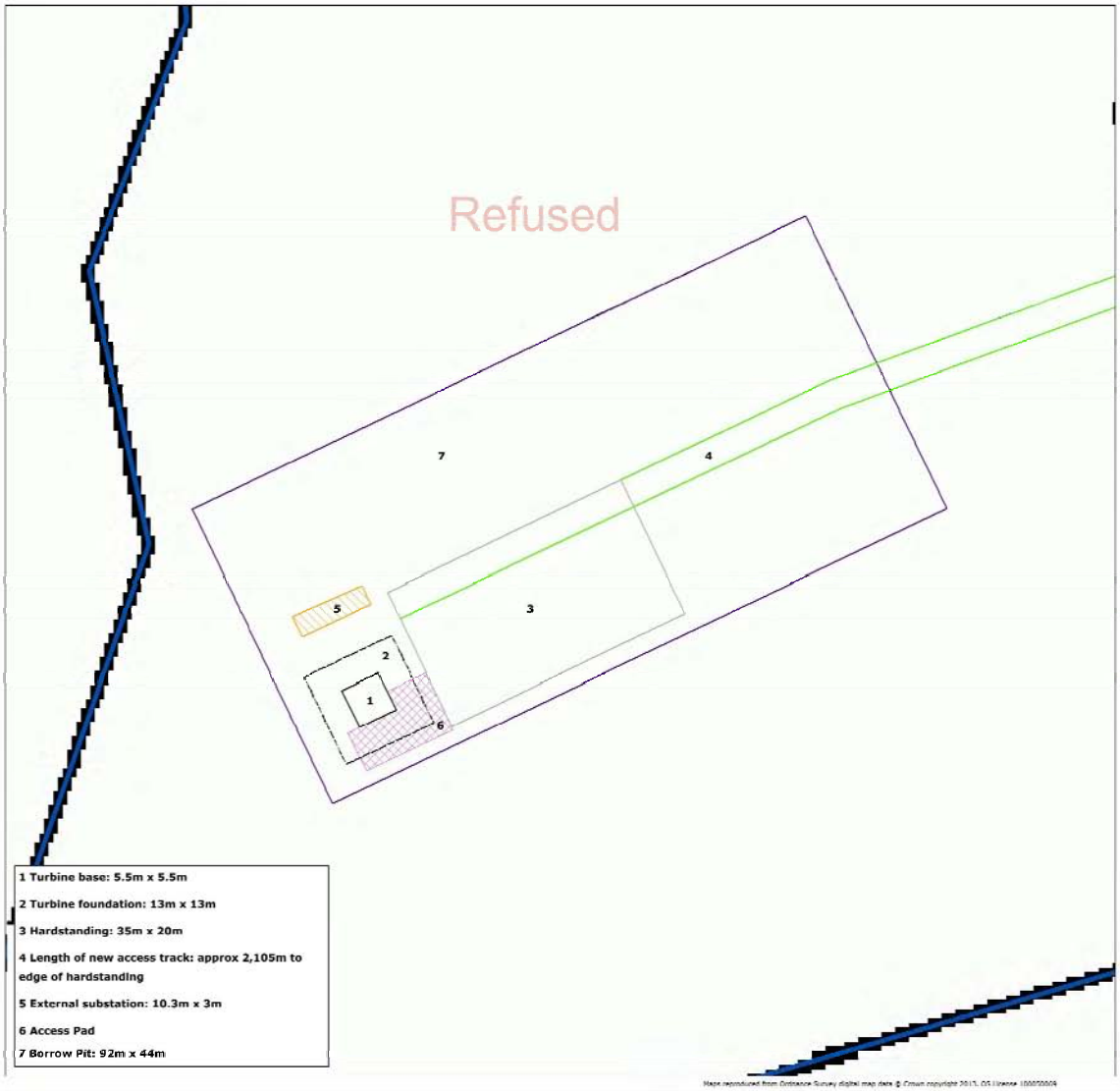
- Turbine Location
- Application Area : 13,707 m²
- Boundary of Land Ownership

PROJECT:	**Ingliston Farm**
DRAWING TITLE:	Site Layout
DRAWING NO:	ING002
DOCUMENT SIZE:	A3
SCALE:	1:5,000
DATE:	27/08/2013
DRAWING BY:	Bojan Jovtic
APPROVED BY:	Andy Lowe

N

0 100 200 300 400 m

AC54



1 Turbine base: 5.5m x 5.5m

2 Turbine foundation: 13m x 13m

3 Hardstanding: 35m x 20m

4 Length of new access track: approx 2,105m to edge of hardstanding

5 External substation: 10.3m x 3m

6 Access Pad

7 Borrow Pit: 92m x 44m

Locogen Ltd, 44 Constitution St, Edinburgh, EH6 6RS
Tel: +44 (0) 131 555 4745; Email: info@locogen.com
Company Number: SC370060; VAT Number: 983 3836 77

Project Description

Number of Turbine(s):	1
Turbine Model:	EWT Directwind 54
Hub Height:	50m
Blade diameter:	54m
Total height to blade tip:	77m
Turbine location:	334397 744313

Notes

This drawing displays the block plan of the proposed wind turbine project at Ingliston Farm.

The application site includes the turbine foundation, hardstanding, external substation, access track to the site and borrow pit.

Legend

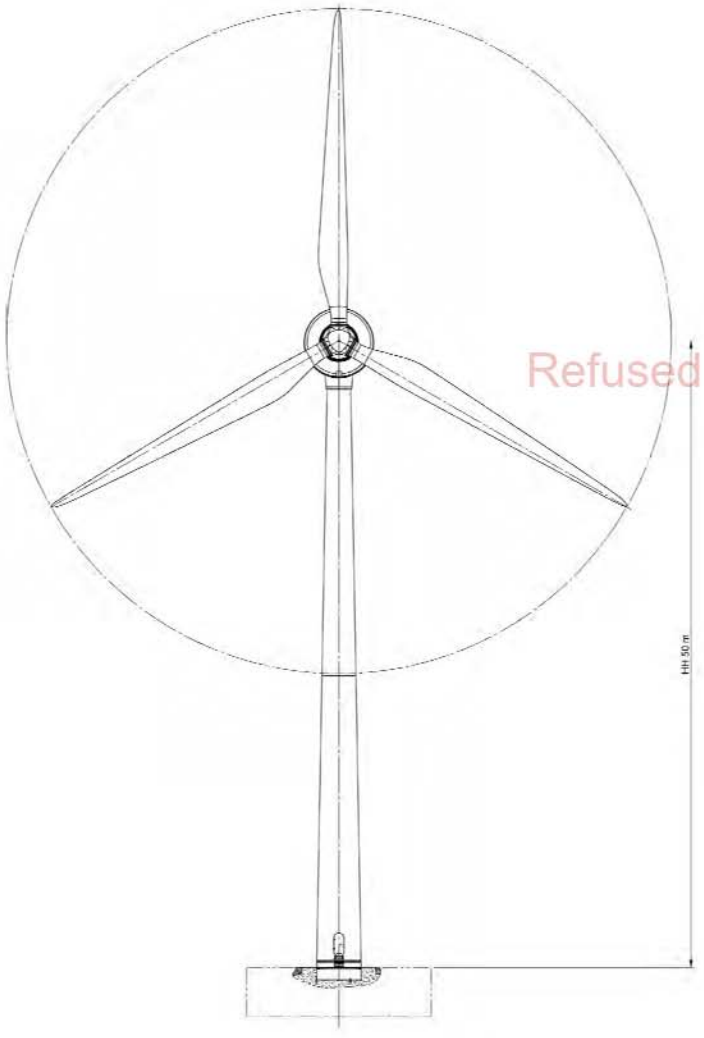
- Turbine Base
- Turbine Foundation
- Hardstanding
- Access Pad
- External Substation
- Access Track
- Borrow Pit
- Boundary of Land Ownership

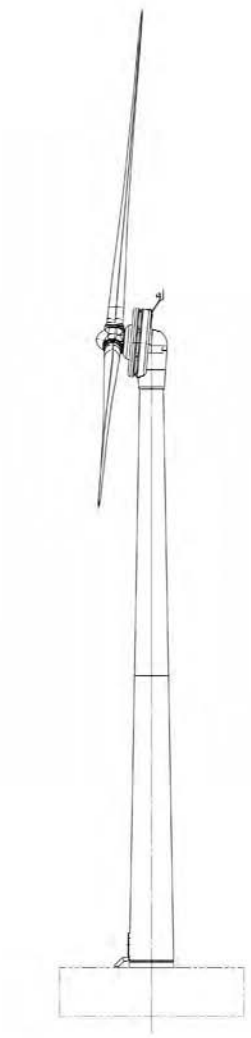
PROJECT:	**Ingliston Farm**
DRAWING TITLE:	Block Plan
DRAWING NO:	ING003
DOCUMENT SIZE:	A3
SCALE:	1:500
DATE:	27/08/2013
DRAWING BY:	Bojan Jovtic
APPROVED BY:	Andy Lowe

N

0 10 20 30 40 m

AC54





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Tel: +44 (0) 131 555 4745; Email: info@locogen.com
Company Number: SC370060; VAT Number: 983 3836 77

Project Description

Number of Turbine(s):	1
Turbine Model:	EWT Directwind 54
Hub Height:	50m
Blade diameter:	54m
Total height to blade tip:	77m
Turbine location:	334397 744313

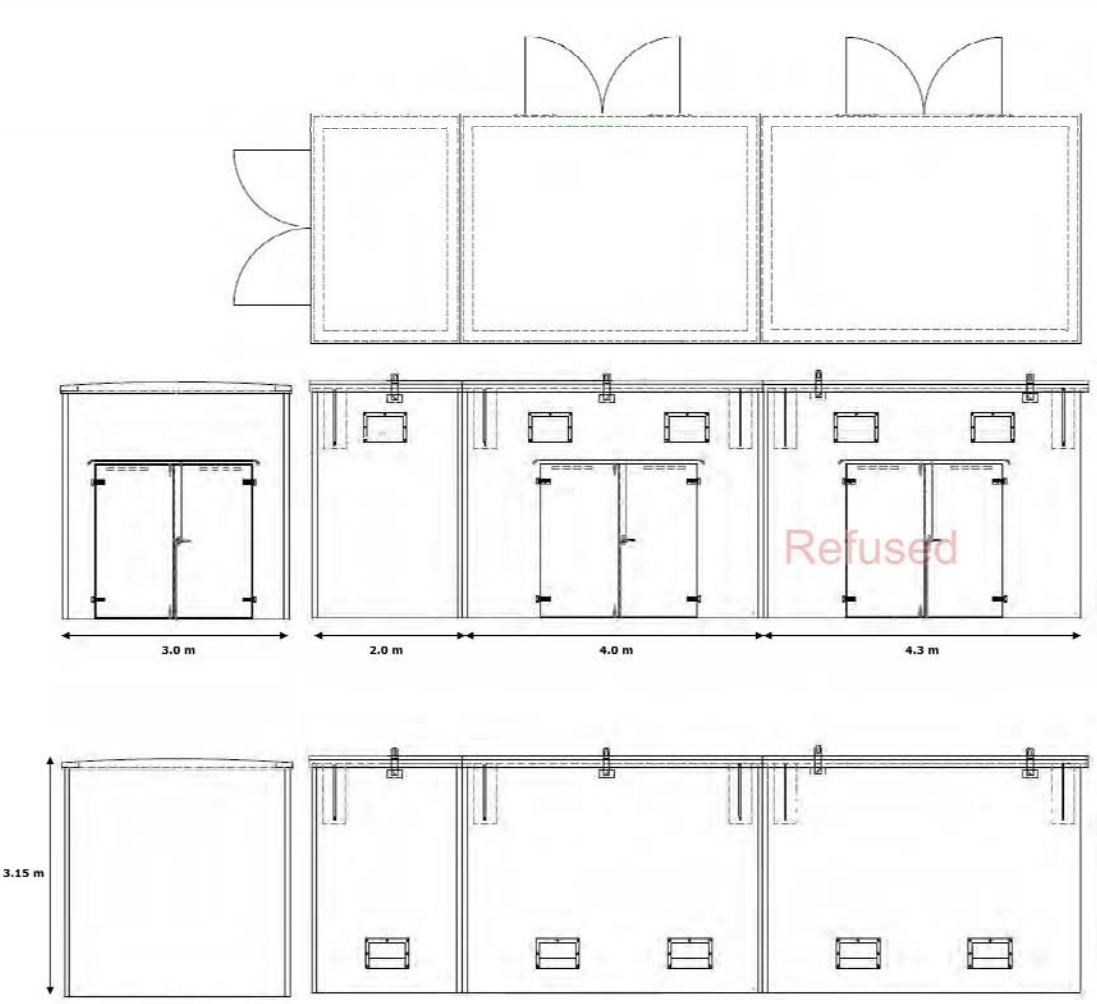
Notes

This drawing details the elevation of the proposed wind turbine.

PROJECT:	**Ingliston Farm**
DRAWING TITLE:	Wind Turbine Elevation Drawings
DRAWING NO:	ING004
DOCUMENT SIZE:	A3
SCALE:	1:300
DATE:	27/08/2013
DRAWING BY:	Bojan Jovtic
APPROVED BY:	Andy Lowe

0 5 10 15 20 m

AC54



Locogen Ltd, 44 Constitution St, Edinburgh, EH6 6RS
Tel: +44 (0) 131 555 4745; Email: info@locogen.com
Company Number: SC370060; VAT Number: 983 3836 77

Project Description

Number of Turbine(s):	1
Turbine Model:	EWT Directwind 54
Hub Height:	50m
Blade diameter:	54m
Total height to blade tip:	77m
Turbine location:	334397 744313

Notes

This drawing shows the elevation and floor plan of the external sub station building, as required by Scottish and Southern Energy.

The building will house the transformer, switch gear and safety equipment. The building will be constructed from Glass Reinforced Plastic (GRP) and painted green.

PROJECT:	**Ingliston Farm**
DRAWING TITLE:	External Substation
DRAWING NO:	ING005
DOCUMENT SIZE:	A3
SCALE:	1:50
DATE:	27/08/2013
DRAWING BY:	Bojan Jovtic
APPROVED BY:	Andy Lowe

0 1 2 3 4 m

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ANGUS COUNCIL

TOWN AND COUNTRY PLANNING (SCOTLAND) ACT 1997
(AS AMENDED)
TOWN AND COUNTRY PLANNING (DEVELOPMENT MANAGEMENT PROCEDURE)
(SCOTLAND)
REGULATIONS 2013

PLANNING PERMISSION REFUSAL
REFERENCE 13/00865/FULL

To Mr William Shaw
c/o Locogen
Per Ian Mclean
Mitchell House
5 Mitchell Street
Edinburgh
EH6 7BD

With reference to your application dated 23 September 2013 for planning permission under the above mentioned Acts and Regulations for the following development, viz.:-

LIST OF DWELLINGErection Of Wind Turbine Of 50 Metres To Hub Height And 77 Metres To Blade Tip And Ancillary Development at Field 1500M South East Of Ingliston Farm Eassie for Mr William Shaw

The Angus Council in exercise of their powers under the above mentioned Acts and Regulations hereby Refuse Planning Permission (Delegated Decision) for the said development in accordance with the particulars given in the application and plans docqueted as relative hereto in paper or identified as refused on the Public Access portal.

The reasons for the Council's decision are:-

1 That the proposed turbine by virtue of its height and skyline location would have an unacceptable landscape and visual impact and accordingly the siting and appearance of the turbine has not been chosen to minimise impact on amenity. As such the proposal is contrary to policies ER5, ER34 and S6 of the Angus Local Plan Review 2009.
2 That the proposed turbine would have an unacceptable cumulative impact on the landscape and visual amenity of this part of the Sidlaw Hills and would give rise to unacceptable impacts on the visual amenity of occupants of nearby residential property and this is contrary to Policy ER35 of the Angus Local Plan Review, 2009.
3 That the proposed turbine by virtue of its height and skyline location, and proximity to the existing Castleward and Denoon Law burial sites would have an unacceptable impact on the setting of these Scheduled Ancient Monuments. As such, the proposal is contrary to Scottish Planning Policy, 2014 and Policies ER18 and ER34 of the Angus Local Plan Review, 2009.

The application has not been subject of variation.

Dated this 4 August 2014

Iain Mitchell - Service Manager
Angus Council
Communities
Planning
County Buildings
Market Street
FORFAR
DD8 3LG

Supporting Environmental Document

for

Ingliston Farm Wind Turbine

Prepared by:	Andy Lowe
Telephone:	0131 555 4745
Email:	Andy.Lowe@locogen.com
Issued to:	Angus Council – Planning
Contact address:	County Buildings, Market St, Forfar, Angus, DD8 3LG.
Telephone:	01307 461 460
Email:	planning@angus.gov.uk
Date of issue:	18/09/2013

Version	Date	Purpose of amendment
0422RRev1	18/09/2013	Final planning submission to LPA

Table of Contents

Abbreviations

AGL	Above Ground Level
AOD	Above Ordnance Datum
ALS	Area of Landscape Significance
ASL	Above Sea Level
ATC	Air Traffic Control
BAA	British Airports Authority
CAA	Civil Aviation Authority
CO_2	Carbon dioxide
EIA	Environmental Impact Assessment
GHG	Greenhouse Gas
GRP	Glassfibre Reinforced Plastic
GDL	Gardens and Designed Landscapes
HGV	Heavy Goods Vehicle
HBT	Height to Blade Tip
IPCC	Inter-governmental Panel on Climate Change
kW	Kilowatt (a unit of power)
kWh	Kilowatt-hour (a unit of energy generation)
LCA	Landscape Character Assessment
LCT	Landscape Character Type
LPA	Local Planning Authority
LVIA	Landscape and Visual impact Assessment
MOD	Ministry of Defence
MW	Megawatt
NATS	National Air Traffic Services
NSA	National Scenic Areas
Ofcom	Office of Communications
RSPB	Royal Society for the Protection of Birds
SINC	Site of Importance for Nature Conservation
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
ZTV	Zone of Theoretical visibility

1. Introduction

This Supporting Environmental Document describes and quantifies the potential environmental and social impacts associated with the construction, operation and decommissioning of a medium scale wind turbine at Ingliston Farm, near Balkeerie. It also provides further information on the proposed development, its compliance with planning policy and the reasons for development. It is to be read alongside the formal planning application submitted to Angus Council.

The remainder of this chapter provides background information on the Ingliston Farm site and the drivers that led to the proposed development being put forward. Information of the alternative sites that were also examined are provided later in this Supporting Environmental Document.

1.1. Turbine site

The proposed turbine will be situated within an upland grassland field, approximately 1.6km east south east of Balkeerie, and 4.5km west south west of Glamis. The area that comprises the Ingliston Farm site is illustrated in Figure 1 below with the boundary of the agricultural land owned by the applicant shown in blue. The proposed turbine location is highlighted by the black circle.

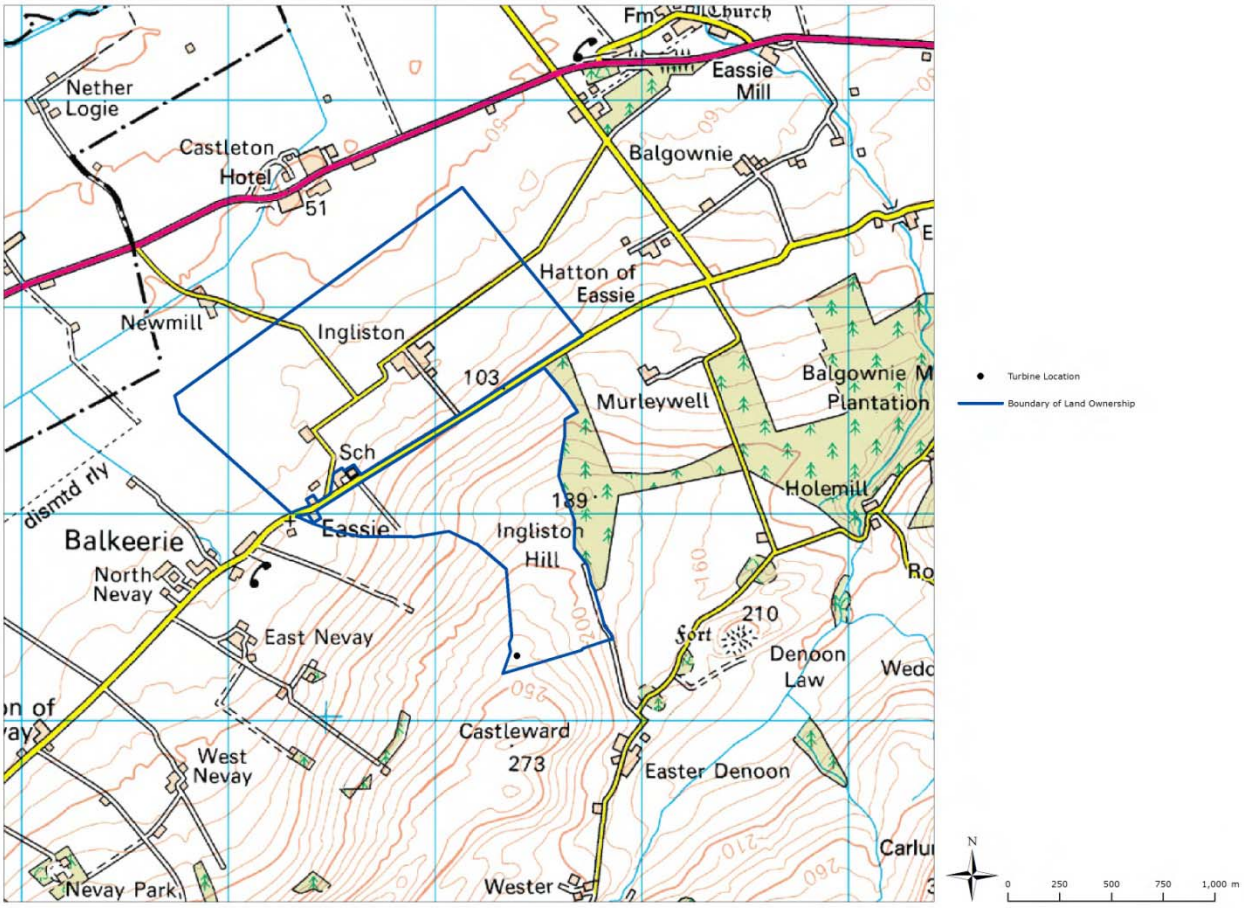

Figure 1: Map showing the land comprising the Ingliston Farm site

1.2. Project Benefits

There are three core drivers for the applicant to develop wind energy on the farm:

1. Diversification of farming business;
2. Improve environmental performance; and
3. Combating climate change.

These drivers are discussed further in the chapters below.

1.2.1. Diversification

The development of a wind turbine at Ingliston Farm would lead to an additional sustainable source of income for the farmer, Mr William Shaw. Concerns have been raised over the poor weather conditions experienced in recent years and the significant impact this has had on the farming business. This has prompted the applicant to explore alternative areas of income to help support his farming business. Mr Shaw's farming business currently employs 4 full time staff and a number of seasonal staff. Ingliston Farm has been in Mr Shaw's family's ownership for over 70 years.

The proposed wind turbine will provide a source of additional income over the 25 years of expected operation. Agriculture incomes can be very variable year to year due to variations in weather conditions, crop quality and yield, market prices, exchange rates and operational costs for fertiliser, fuel etc. The operation of the wind turbine will provide an income stream that is separate from these factors and the project therefore demonstrates best practice diversification. The development will also have a minimal footprint and allow for the continuation of the current farming operation on the vast majority of the land.

The main objectives of the proposed income diversification are as follows:

- To increase direct business revenue and thus support the continued viability of the existing farming business;
- To improve attractiveness of food produce to suppliers through improved sustainability credentials;
- To support existing employment;
- To create new employment;
- To provide renewable energy to meet demand;
- To reduce the overall carbon footprint of the farm through offsetting energy usage;
- To promote the use of renewable energy generation in the area and contribute towards achieving national and regional renewable energy targets; and
- To spread the farmer’s risk into a non-agricultural sector.

The development of wind energy at the site by the applicant will also maximise the local benefits from renewable development as the revenue from the project will stay in the local economy. The additional benefits of locally developed renewable energy projects are described in further detail in the socioeconomic chapter of this document but will lead to a more significant opportunity for local job creation.

1.2.2. Improve Environmental Performance

Ingliston Farm is a mixed arable and livestock farm comprising approximately 150 acres of permanent grassland and 400 acres of arable farm land. Mr Shaw also farms Huntly Farm in Invergowrie (650 acres), and is a tenant farmer at Newton of Ballunie in Kettins (280 acres). In total Mr Shaw farms an area totalling approximately 1,480 acres.

Arable cropping across the farming estate includes winter wheat, winter barley, spring barley, oil seed rape, cattle feed beans and potatoes.

1,000 cattle per annum are finished for the beef trade on the permanent grassland and in the farm buildings at Ingliston Farm.

Ingliston Farm itself comprises a number of farm buildings, some of which are about to be replaced after a major fire in September 2012. The buildings will include:

- A new 1,000m^2 grain store and associated grain drier, capable of storing 2,000t of grain and drying 40t of grain per hour;
- A new 1,000m^2 refrigerated cold store;
- An existing 5,000m^2 of cattle buildings (housing up to 500 head of cattle at any one time); and
- An existing 1,000m^2 of general purpose buildings.

Huntly Farm also includes approximately 5,500m^2 of grain storage and general purpose buildings.

All of Mr Shaw's spring barley, wheat and oil seed rape are sold through local merchants. The grassland is used for silage and grazing, and the winter barley and beans are used as cattle feed. The 1,000 cattle per year finished at Ingliston Farm are sold to 4 Scottish abattoirs.

Given the above operations the farm has a significant carbon footprint from normal operations and this is primarily linked to the energy consumption required to run the farming business. For example, it is estimated that Mr Shaw's farm business annually consumes ~100,000 litres of red diesel and this is considered to directly lead to 267 tonnes of CO_2[1] emitted per annum. This carbon footprint will increase significantly with the addition of the new buildings at Ingliston Farm.

The current electricity use of the farming operations is also high, and with the erection of the new buildings this is expected to double. Electricity is therefore a significant cost to the business and a source of associated carbon emissions, and this will only increase as the farm business continues to grow and energy prices increase.

As a high energy user, a supplier to local and national food companies, and a supplier of British produce, the farm is seeking to improve its sustainability credentials and reduce its carbon footprint. The requirement to demonstrate a tangible commitment to sustainability is increasing, with markets demanding higher environmental standards from their supply chain, and buyers requesting support from suppliers to help meet their environmental commitments. In a competitive market the ability to demonstrate that the farm business is working hard to support buyers' environmental strategies is becoming increasingly important to maintain business. Energy prices are also increasing and to ensure farming remains viable, both environmentally and financially, a sustainable energy supply is essential.

[1] Using current figures from DECC and the Carbon Trust each litre of diesel used emits 2.6676 kg of CO_2.

Given the strong expected wind resource at the proposed location the operation of 1 No. 500kW wind turbine is expected to generate in the region of 1,660MWh per annum[2]. This would directly offset the emission of approximately 871 tonnes of CO_2 for every year of operation[3].

This would be a significant step towards reducing the carbon footprint of the farming business and meeting Mr Shaw's desire to achieve environmentally friendly farming practices.

1.2.3. Combating Climate Change

In addition to the above local drivers the development will also be a small step towards combating climate change. It is now generally accepted that there is an important requirement to reduce the emission of harmful Greenhouse Gases (GHG's) – specifically carbon dioxide (CO_2) – in order to mitigate the worst impacts of human-induced global climate change. To this end there are global and national targets in place that address this requirement for a move to a low carbon way of life.

The UK has signed up to targets to reduce total CO_2 emissions. Over and above the terms laid out in the UK, Scotland has set further ambitious targets. Around 20% of the UK's CO_2 emissions are caused by the production of electricity from conventional burning of fossil fuels (coal, oil and gas). Therefore the increased development of renewable energy technologies – such as wind energy – is a key part of the strategy to meet the UK's legal requirements. To this end a number of national and regional targets have been set out for the increased provision of electricity from renewable sources and these are summarised for Scotland and the UK in Table 1 below.

	Scotland	**UK**
CO_2 emissions reduction targets by 2020[4]	42%	34%
Proportion of electricity demand to be met by renewable technologies by 2020	100%	15%
Estimated renewable electricity generation required to meet target	45TWh	>100TWh
Expected proportion of the above to be met by onshore wind	50%	40%
Equivalent GW capacity required from onshore wind to meet this target	~9.5GW	~15-19GW
Actual onshore installed capacity as of October 2012	3.4GW	5.0GW

Table 1: Overview of energy related CO_2 emission reduction targets

From the above table it can be seen that Scotland and the UK are a considerable way from achieving the scale of on-shore wind development considered necessary to meet their targets. This proposed development is therefore a small but positive step towards meeting the Scottish and UK goals regarding wind energy.

This locally owned development will also contribute to the target of 500MW community and locally-owned renewable energy schemes by 2020, as laid out in the 2011 document, the '2020 Routemap for Renewable Energy in Scotland'. This target was put forward with the aim of generating local revenue and sustaining local economies and it is considered that the applicant is well placed to support these aims through his farming business.

[2] This figure is based on a turbine capacity factor of 38%.
[3] Using current figures from DECC and the Carbon Trust each kWh of electricity generated offsets 0.5246kg of CO_2.
[4] From 1990 levels

1.3. Remainder of the Document

This Environmental Supporting Document is divided into separate chapters. The environmental assessment chapters describe the subject being addressed, summarise relevant background and guidance documentation, state the relevance to the Ingliston Farm project and discuss the methodologies used in the assessment. The results of each impact assessment are then presented and, where appropriate, mitigation measures are suggested. A brief overview of the contents of each chapter is provided below:

2. **The Wind Turbine Proposal –** A description of the proposed development, including turbine description, site layout, access, grid connection, delivery routes etc.

3. **Planning & Environmental Policy** – An introduction and overview of the national, regional and local planning legislation relevant to the project.

4. **Work to Date** – An outline of the development works completed prior to this planning submission.

5. **Landscape & Visual –** This chapter uses ZTVs, photomontages and wireframe analysis to demonstrate and assess the landscape and visual impacts associated with the proposed development.

6. **Soils & Hydrology –** Provides a description of the hydrological and the hydrogeological features surrounding the site and the expected impact of the development.

7. **Socioeconomic –** Provides a description of the activity of the local economy and tourism and the expected impacts of the development on these areas.

8. **Cultural Heritage –** Provides an assessment of the effects of the wind development on the setting of cultural sites in the area such as Listed Buildings and Scheduled Ancient Monuments.

9. **Ecology –** Provides a description of the flora and fauna within the surrounding region of the turbine and the expected impact of development.

10. **Shadow Flicker –** Industry software has been used to identify dwellings which may be subject to the effect of shadow flicker. The exact times and durations are calculated and, should any shadow flicker impact be expected, mitigation measures are suggested.

11. **Noise –** A noise assessment was carried out to assess the effect of background noise on the nearby residential areas.

12. **Telecommunications –** Relevant industry bodies have been contacted to assess any potential impact on communication signals and infrastructure.

13. **Aviation –** Considers any potential impacts on civil and military aviation operations in the area.

14. **Public Safety –** Based on national planning guidelines, this chapter outlines the public safety issues associated with the proposed development. The proximity of the turbine locations to pipeline consultation zones is also discussed in this chapter.

15. **Summary & Mitigation –** Summarises the main conclusions of the Supporting Environmental Document and provides justification as necessary for the proposal.

2. The Wind Turbine Proposal

This chapter provides an overview of the proposed location of the medium scale turbine at the site, given the existing constraints and the available space within the surrounding area. A single medium scale turbine was deemed suitable for this site to ensure maximum utilisation of the available wind resource, whilst ensuring a minimal impact on the local environment.

2.1. Site Selection

The primary criteria to consider for the feasible installation of a medium scale wind turbine are as follows:

- **Distance from residential buildings** – It is important to maximise the distance between the turbine and nearby residential dwellings to mitigate potential issues such as noise, shadow flicker and a loss of visual amenity. Satisfactory residential exclusion zones were applied to mitigate these key issues from those properties not in the ownership of the applicant;
- **Avoidance of key environmental areas** – In choosing the most suitable location, efforts were made to avoid environmentally sensitive areas. Ecological studies undertaken at the site identified it as being a low sensitivity site in terms of the habitats and species noted within or adjacent to the development area;
- **Available wind resource** – The best available wind resource for the turbine was sought through maximising the height of the location without significantly impacting upon visual concerns. The wind resource for the area was assessed through desk based models and the suitable areas (to maximise generation) were considered to be on the higher areas of land to the south of the land ownership area;
- **Access to site** – Efforts should be made to minimise the need for additional civil works. The preferred access utilises as much of the existing road network as possible and this in turn will minimise the footprint and associated environmental impact of the development. Direct access to the turbine location will be provided via approximately 2.1km of access track. Approximately 730m of this will be an upgraded existing farm track which is regularly used to provide access to the cattle corral at the top of the track. The remaining 1,370m will be a new access track which will provide direct access to the turbine location. This track will also provide the farmer with permanent improved access to the field in which the turbine will be located;
- **Avoidance of culturally sensitive areas** – The disturbance of archaeological or historical sites, including stone walls and ruins of interest was avoided through the sympathetic selection of the site; and
- **Clearance from public roads** – The required clearance distance for a turbine from public roads is dependent on the Local Planning Authority (LPA) but a conservative distance of 84.7 m (equal to fall-over distance plus 10%) was used as a minimum to ensure public health and safety.

When examining the above criteria, the key concerns were to maximise the distance from residential properties, minimise visual impact whilst still ensuring sufficient wind resource and avoid areas of higher ecological sensitivity.

The next section discusses the development components in further detail.

2.2. Site Layout

The proposed position of the turbine is in a grass upland field. The proposed installation will include the following components:

- **Wind turbine** – The candidate turbine is discussed in further detail in Chapter 2.3 below;
- **Foundation** – For the chosen turbine the foundation will be a square structure with expected dimensions of 13m x 13m. Once constructed this structure will be backfilled so that only the tower base pedestal will be visible;
- **Electrical substation kiosk** – It is proposed that the required turbine transformer be located in a GRP building located next to the base of the tower along with the necessary switchgear and protection equipment. In addition this building would have space for the Distribution Network Operator's (DNO's) electrical equipment. This building will have maximum dimensions of 10.3m x 3m, and will have an elevation of 3.15m;
- **Access road** – Direct access to the turbine location will be provided via approximately 2.1km of access track. Approximately 730m of this will be an upgraded existing farm track which is regularly used to provide access to the cattle corral at the top of the track. The remaining 1,370m will be a new access track which will provide direct access to the turbine location. This track will also provide the farmer with permanent access to the field in which the turbine will be located;
- **Construction compound** – There will be a requirement for the construction of a hardstanding area for the assembly of the crane and rotor. This would measure an estimated 20m x 35m with an adjacent temporary compacted area for lay down of turbine components during construction; and
- **Underground cable** – The 11kV cable connecting the turbine to the proposed grid connection point will be buried to minimise visual impacts.
- **Borrow pit** – As highlighted in Drawing ING003, the development will also include the utilisation of a small borrow pit. The borrow pit will measure 92m x 44m, and will involve a limited amount of excavation to 700mm depth below the current bedrock level. The extracted bedrock material will form the crushed rock layer of the new access track (see Figure 6 below). The foundation, electrical substation kiosk and construction compound will lie within the limits of the borrow pit. As such, the required borrow pit excavation area is in reality smaller than that outlined above, as it will include excavated material from the construction of features that would be present regardless of the inclusion of the borrow pit.

The proposed layout of the construction components is illustrated in Figure 2 and Figure 5 below, with further information provided in Drawings ING002 and ING003 which are attached to this Supporting Environmental Document.

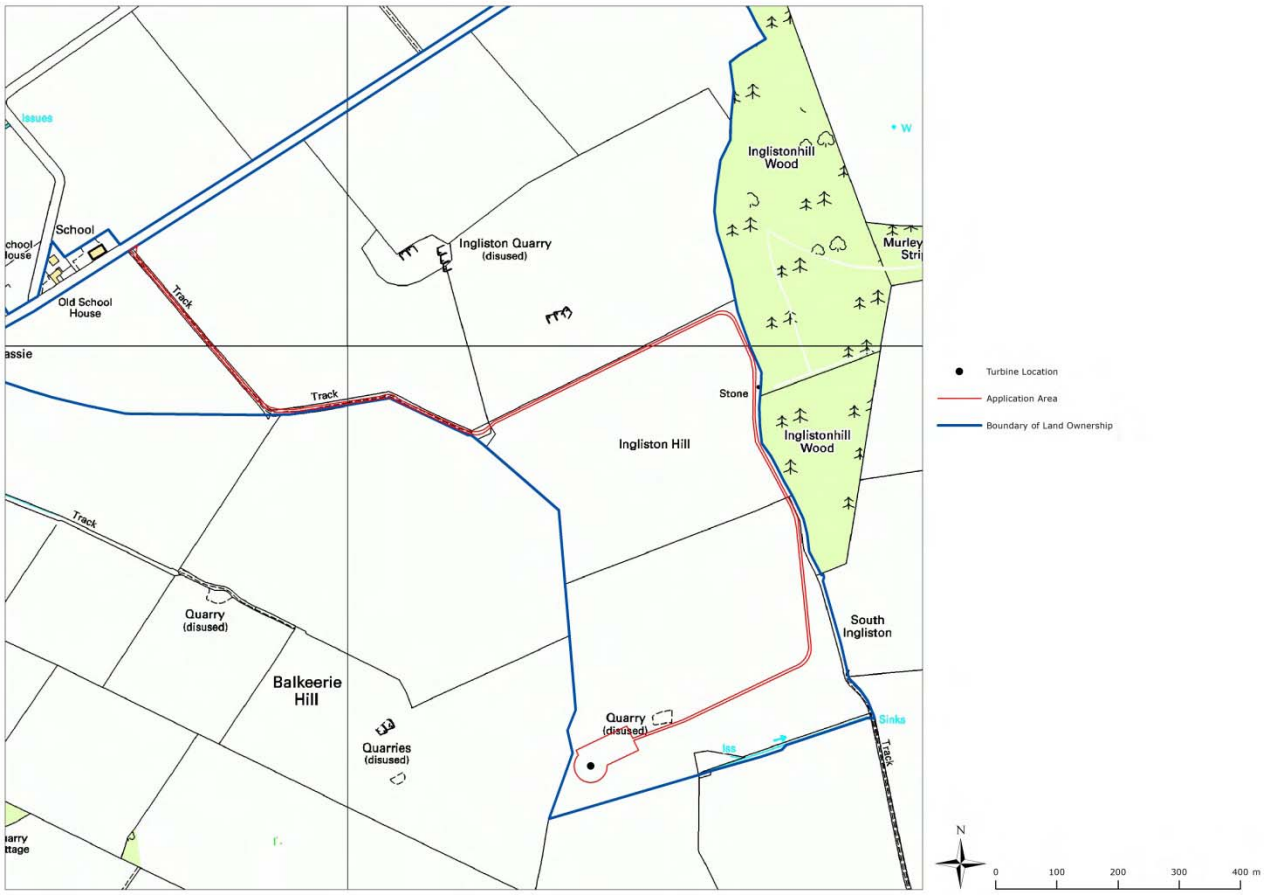

Figure 2: Proposed layout of application site

From the above information it can be seen that all works for this application will take place on the applicant's land. The requirement for ancillary structures will be minimal with limited additional permanent structures required alongside the turbine. The only visible aspects of the development once construction is complete will be the retained access road, crane pad, turbine and substation kiosk. The next chapters discuss the various components of the development in further detail.

2.3. Turbine Specification

The proposed choice of turbine for development is a medium scale turbine with a capacity of up to 500kW. At this time the preferred choice of turbine is the EWT Directwind 54 model. The final choice of turbine may differ but would not increase in size from what is proposed or vary significantly in design (e.g. all considered turbine options would be 3 bladed upwind designs as used in commercial wind farms).

The outline technical specifications for the Directwind 54 are provided in Figure 3 below alongside a photograph of an operational turbine.

	Directwind 54
Rated Capacity	500kW
Status	New
IEC Wind Class	IIIa
Proposed Hub Height	50m
Rotor diameter	54m
Distance from ground to blade tip	77m
IEC Maximum Rotational Speed	12 – 28rpm
Rated wind speed	10m/s
Operational turbine life	25 years

Figure 3: Technical specifications and photograph of the proposed turbine option

2.4. Transport to Site

It is intended that the wind turbine components will be delivered to site from a suitable port on the east coast from where they will be loaded onto road vehicles. The access road requirement for a turbine of the scale proposed is provided in Table 2 below. The longest single load will be the blades themselves which are each approximately 26m in total length, while the tower will be delivered in two sections of approximately 23m.

Consideration	Requirement
Useful width of carriageway	4m
Clearance width	5.7m
Clearance height	4.6m
Radius of curve, external	20m
Maximum longitudinal slope	8°
Maximum lateral slope	0 - 2°
Maximum axle load	16.5t

Table 2: Minimum access considerations for the proposed scale of wind turbine

At this time it is proposed that the turbine components are transported to site from Dundee Port. The delivery vehicles will utilise the A90 and A94 roads leading to Glamis. From here, the delivery vehicles will utilise the minor road network to access the site. Direct access to the turbine location will be provided via approximately 2.1km of access track. Approximately 730m of this will be an upgraded existing farm track which is regularly used to provide access to the cattle corral at the top of the track. The remaining 1,370m will be a new access track which will provide direct access to the turbine location. This track will also provide the farmer with permanent access to the field in which the turbine will be located. The proposed access route from Dundee Port is shown in Figure 4 below.

Figure 4: Proposed transport route (shown orange). Radii are at 5km intervals.

From an initial assessment of the route, the junctions can generally be considered to be suitable to allow for the safe movement of the turbine delivery vehicles. This assumes that front and rear axle steered vehicles would be used to allow for increased manoeuvrability. If consented a full transport assessment can be provided to Angus Council's Roads Department for discussion and approval.

2.5. Construction Traffic

The turbine components will be delivered in approximately 8 individual loads. Extendable trailers will be employed to transport the larger turbine components. All vehicles carrying abnormally long loads will have rear wheel steering to facilitate delivery down minor roads. The axle loading of the heaviest delivery vehicle is 16.5 tonnes. Two cranes are required for the offloading and construction of the turbine, the main crane is expected to be a 250 – 400 tonne mobile crane. The tailing crane is likely to be a 90 tonne, rear wheel steering crane. Additional construction traffic would be necessary for the construction of the hardstanding area. There will also be small vehicle access for site workers/individual contractors throughout the construction program.

2.6. Construction Compound

The construction hardstanding area will comprise an area of suitably firm footing for the cranes to operate. There will also be levelled lay down and assembly area to allow for the set down of components, rotor blade assembly and for general installation works. The proposed construction area is shown in Figure 5 below (this is also provided in Drawing ING003).

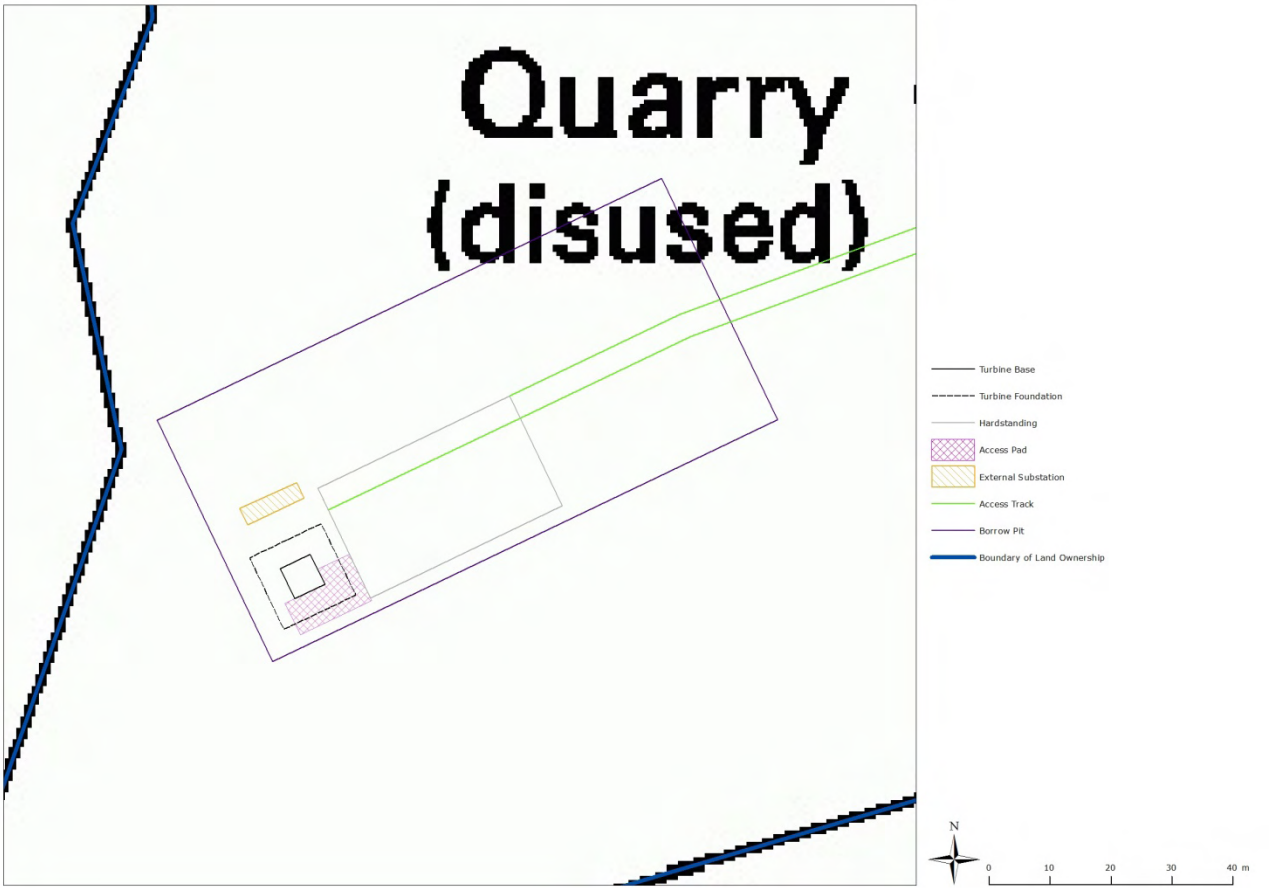

Figure 5: Overview of construction area

An area of hardstanding at a size of 20m x 35m (area of approximately 700m^2) will be required for the safe operation of the main mobile crane and the tailing crane. This area will be filled with crushed stone and/or aggregate of a maximum depth of approximately 750mm.

2.7. Access Road

The new access track will be constructed to resemble existing farm tracks, where possible, to minimise the visual impact of the development. The turbine delivery route will spur off the minor road, which links Glamis with Newtyle and intersects the applicant's land ownership, as shown in Figure 2 and Drawing ING002. Direct access to the turbine location will be provided via approximately 2.1km of access track. Approximately 730m of this will be an upgraded existing farm track which is regularly used to provide access to the cattle corral at the top of the track. The remaining 1,370m will be a new access track which will provide direct access to the turbine location. This track will also provide the farmer with permanent access to the field in which the turbine will be located.

The new access track will have a constant useable width of 4m and a load bearing capacity capable of handling the abnormal load vehicles required for delivering the turbine components and installation equipment.

The new dedicated access track will be constructed, where possible, along the field border of the permanent grassland so there will be no significant loss of habitat associated with this additional construction requirement and minimal loss of useable farming land. An example of the access road specification is provided in Figure 6 below.

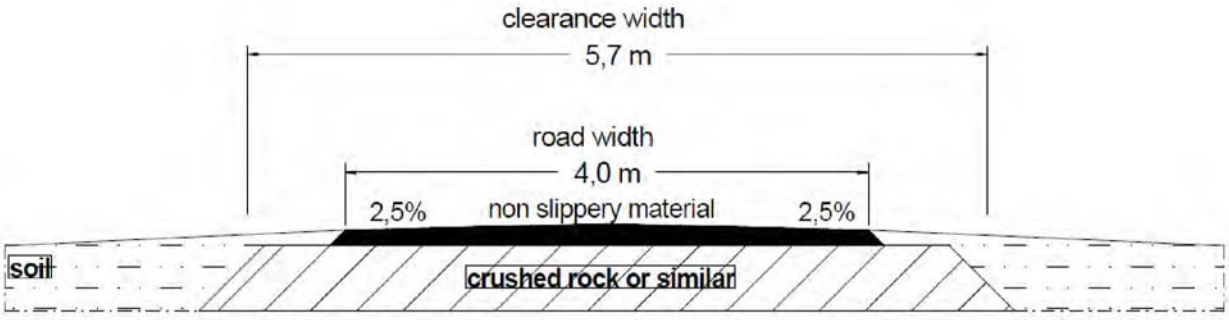

Figure 6: Access track cross-section

2.8. Turbine Foundations

The turbine foundation will consist of a square reinforced concrete base footing and a pedestal. This is illustrated in Figure 7 below, although the exact layout of the foundation may be subject to minor change. The majority of the foundation will be below ground level with only the pedestal being visible post-construction. The standard raft foundation will comprise of a reinforced concrete plinth with approximate dimensions of 13m x 13m. The total depth of the foundation is expected to be approximately 2.5m, however in some cases, following ground investigations, there may be a requirement for a deeper foundation.

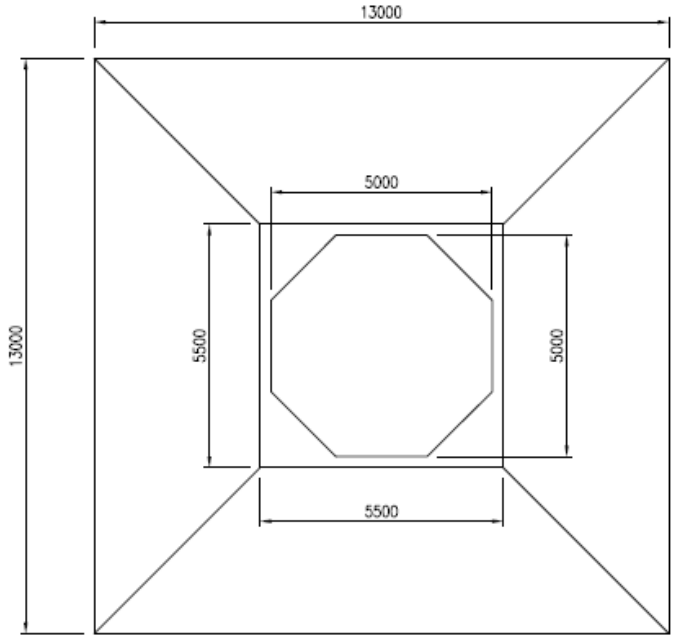

Figure 7: Plan drawing of standard turbine foundation

2.9. Borrow Pit

As highlighted in Drawing ING003, the development will also include the utilisation of a small borrow pit. The borrow pit will measure 92m x 44m, and will involve a limited amount of excavation to 700mm depth below the current bedrock level (assumed to be approximately 300mm below current ground level). The extracted bedrock material will form the crushed rock layer of the new access track (see Figure 6). The foundation, electrical substation kiosk and construction compound will lie within the limits of the borrow pit. As such, the required borrow pit excavation area is in reality smaller than that outlined above, as it will include excavated material from the construction of features that would be present regardless of the inclusion of the borrow pit. The turf and topsoil removed during the excavation process will be used post-construction to re-instate the borrow pit to permanent grassland, up to the edge of the permanent features included within the construction area (see Figure 5). Therefore during the operational period cattle will be able to continue to graze up to the edge of the permanent construction area.

2.10. Ancillary Works

2.10.1. Grid Connection

It is proposed that the electricity generated by the turbine will be fed directly into the National Grid via 11kV cabling, for subsequent sale as part of a long term power purchase contract. The electricity exported to the National Grid will offset electricity used on site. Scottish and Southern Energy are currently undertaking an assessment of preferred grid connection options for the development, however it is currently proposed to connect to the National Grid at a point approximately 290m North North West of the hamlet of Eassie. It is currently envisaged that 11kV cabling will run underground from the proposed turbine to the point of grid connection.

2.10.2. Substation Kiosk

There is a requirement for the transformer, switchgear, communications and further protection equipment to be located in a glass reinforced plastic (GRP) kiosk close to the turbine. As the nature of the final grid connection infrastructure is still being agreed, this building may also be required to have space for the Distribution Network Operator's (DNO's) electrical equipment. The maximum dimensions of the substation kiosk are outlined in Table 3 below.

Length	10.3m
Breadth	3.0m
Height	3.15m

Table 3: Likely substation kiosk dimensions

The substation kiosk can be painted to the most unobtrusive colour that conforms to the surroundings. Typical colours are grey, green or brown. A suitable structure will be confirmed with the DNO (Scottish and Southern Energy) prior to construction.

2.11. Construction Programme

The construction work will be carried out in three phases. During the first phase a soil study will be conducted to determine the foundation design. During the second phase, the civil works will be carried out. This includes the laying of electrical cable and construction of the construction compound. The foundations will also be completed and left to cure for a period of at least 28 days. During the third phase, the turbine will be delivered, erected and

commissioned prior to the necessary reinstatement works being completed. The phased construction process is shown in more detail in Table 4 below.

Construction	Works carried out	Approximate duration
Phase 1	Soil investigation survey Turbine foundation design	2 days on site (36 days for survey results and foundation design)
Phase 2	Borrow pit excavation works Construct access track Cable trenching and laying Prepare turbine base Prepare transformer kiosk base Install turbine insert & re bars Concrete pour to base Lay turbine external earth mat Install transformer HV jointing at TX and Gen sw/gear	28 days on site (28 days for concrete curing)
Phase 3	Cranes on site Delivery of turbine components Lay out and fit blades to cone Delivery of tower sections Erect Turbine tower/nacelle/blades Internal tower wiring External LV wiring and connecting Site (including borrow pit) reinstatement Commission turbine and handover	12 days

Table 4: Phased construction program

2.12. Decommissioning

On reaching the end of its operational life (25 years), and if no agreed turbine replacement is consented, the proposed turbine will be decommissioned, dismantled and removed, leaving no visible trace of the development. The site will be completely restored to pasture land and there will be no lasting implications on the land usage/character. The turbine components will be dismantled and removed from site. The foundation will be broken down and removed to a licensed off-site facility. A decommissioning programme will be agreed with Angus Council prior to the commencement of decommissioning works.

3. Planning & Environmental Policy

This chapter provides an introduction and overview of the global, European, national and local planning policy documentation which is relevant to a wind energy development of this scale.

Scientific evidence is clear that most of the observed global rises in temperature since the mid-20th century is linked to the emissions of anthropogenic greenhouse gases. This is expected to continue if present emissions levels are maintained or expand without suitable controls. Climate change policy and renewable energy policy are vital tools in controlling and minimising the future impacts of man-made climate change.

EU and individual Government policies have placed the development of renewable energy, including wind energy, as a primary target in their strategic energy policies. These targets have then been translated into planning policy.

In Scotland, national planning policy is principally provided in the National Planning Framework for Scotland 2 (NPF2) and in Scottish Planning Policy (SPP). These documents are produced by the Scottish Government to provide overarching planning policy and are currently subject to review. Regional and local planning policy is formulated by local planning authorities in the form of Structure and Local Plans (which are being phased out) and Strategic and Local Development Plans.

The following is a review of the policies and legislation, at international, European and national level, which relate to the proposed development at Ingliston Farm.

3.1. Global Context

The burning of fossil fuels results in the release of greenhouse gases such as carbon dioxide (CO_2). These gases contribute to the process of climate change. The following policies provide a summary of global policy relating to the current effects of climate change and the policies which aim to avoid and reduce it.

3.1.1. Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is the leading body for the assessment of climate change, established by the United Nations Environment Programme and the World Meteorological Organisation to provide the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences. The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide, relevant to the understanding of climate change.

The main activity of the IPCC is to provide regular Assessment Reports of the state of knowledge on climate change. The Fourth Assessment Report was released in 2007. The IPCC is now beginning the process towards preparing the Fifth Assessment Report which is due to be finalised in 2014. Some of the findings of the Fourth Assessment Report included the following:

- Unmitigated climate change would, in the long term, be likely to exceed the capacity of natural, managed and human systems to adapt;
- A wide range of mitigation options are currently available or projected to be available by 2030 in all sectors;
- Some planning adaptation of human activities is occurring now but more extensive adaptation is required to reduce vulnerability to climate change;

- Many impacts can be reduced, delayed or avoided by mitigation. Delayed emissions reductions significantly constrain the opportunities to achieve lower stabilisation levels and increase the risk of more severe climate change impacts; and
- Decisions about macro-economic and other policies that seem unrelated to climate change can significantly affect emissions.

In the past sixteen years a number of international conferences have been held in relation to the issue of climate change, in particular Kyoto (1997) and subsequent UN conferences.

Kyoto Protocol

Following the World Summit Conference held in Kyoto, Japan, in 1997, nations which signed the Protocol agreed to take actions to control, reduce or limit their emissions of the six main greenhouse gases (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride).

The Kyoto Protocol (1997) to the United Nations Framework Convention on Climate Change, 1992 (UNFCCC) imposes legally binding targets to be achieved in the period 2008 – 2012:

- 5% overall reduction in the emission of greenhouse gases in developed countries;
- 8% reduction below 1990 levels within the EU;
- The United Kingdom's contribution is a limit of 12.5% above 1990 levels by 2008-2012. This implies an 8% reduction in CO_2 emissions over this time period; and
- Countries not fulfilling their obligations will be forced to purchase carbon credits on an open market from compliant countries.

3.2. European Context

3.2.1. EU Directive on the Promotion of the Use of Energy from Renewable Sources

An EU Directive (2009/28/EC) on the Use of Energy from Renewable Sources came into force on 23 April 2009 – 'The Renewables Directive'. It establishes the rules for achieving 20% of EU energy consumption from renewable sources by 2020[5]. Other measures introduced at the same time aim to ensure a 20% cut in greenhouse gas emissions by 2020, and a 20% reduction in energy consumption through energy efficiency and demand reduction – the EU's 20:20:20 Plan.

The Renewables Directive recognises the need to promote renewable energy sources and technologies which will have a positive impact on:

- Security of energy supply;
- Regional and local development opportunities;
- Rural development;
- Export prospects;

[5] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directive 2001/77/EC and 2003/30EC.

- Social cohesion; and
- Employment opportunities.

Under an EU 'burden sharing' arrangement, the UK's overall national target for the share of energy from renewable sources in gross final consumption of energy in 2020 is 15% (increased from 1.3% in 2005)[6]. The promotion of electricity produced from renewable energy sources is therefore an extremely important component in the UK achieving its mandatory target.

On 6th June 2012 the European Commission presented a Communication on its renewable energy policy, outlining options for the period beyond 2020. It confirms the market integration of renewables and the need for their growth in the decades after 2020. The Communication also calls for a more coordinated European approach in the establishment and reform of support schemes and an increased use of renewable energy trading among Member States.

It recognises that renewable energy development increases our security of supply and improves European competitiveness creating new industries, jobs, and economic growth and export opportunities, whilst also reducing our greenhouse gas emissions. It states that "*strong renewables growth to 2030 could generate over 3 million jobs, including in small and medium sized enterprises*[7]".

The associated Staff Working Document, also published on 6th June 2012, states that wind energy will provide at least 12% of European electricity by 2012, therefore significantly contributing to the 20:20:20 goal outlined above. Beyond 2020, the integration of 50% wind power into an electricity system is seen as technically possible.

3.3. National Context

The UK Government has set a target to cut the UK's carbon dioxide emissions by 60% by 2050. The UK Government's Energy White Paper, published in May 2007, concludes that if the UK is to achieve a reduction in carbon emissions of that order, then by 2050 renewables will need to contribute at least 30 – 40% of our electricity generation and possibly more.

The Scottish Government's Draft Electricity Generation Policy Statement, published in March 2012, takes full account of the amended target of delivering the equivalent of at least 100% of gross electricity consumption from renewables by 2020. It advises that "*wind power, alongside other forms of onshore and offshore renewables, provides an electricity supply which is largely emissions-free and, because of its decentralised nature, contributes significantly to greater security of supply*".

With regard to the scale of the overall challenge, one of the key findings of the Scottish Government commissioned modelling study is that "*achieving the 100% target will require Scottish installed generation capacity to almost double over the 10 year period to 2020 – with wind (offshore and onshore) accounting for around 13GW of capacity*".

As noted in the 2020 Routemap for Renewable Energy in Scotland, the benefits are not only in terms of energy generation, security of supply and reduced carbon emissions, but also in

[6] Directive of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources, 2008/0016 (COD), Council of the European Union, Brussels, December 2008; http://www.ewea.org/fileadmin/ewea_documents/documents/00_POLICY_document/RES-directive_consolidated.pdf.

[7] "Renewable energy: a major player in the European energy market", June 2012.

terms of economic recovery. During the period to 2020, renewables in Scotland could provide "*up to 40,000 jobs and £30bn investment to the Scottish economy*".

With specific regard to onshore wind, the Routemap notes that "*it is a mature and relatively low cost renewable technology with a large supply chain already established*". Furthermore, "*onshore wind turbines can make a very large contribution to the progress to Scotland's renewable electricity target…*".

In addition to the 100% renewable electricity generation target, the Routemap also outlines a new objective of 500MW of community and locally-owned renewable energy schemes by 2020. This target seeks to allow communities and rural businesses to take advantage of the revenue streams that can accrue from onshore wind within the Feed in Tariff, thereby generating local revenue and sustaining local economies.

As explained elsewhere within this Document, the proposals at Ingliston Farm fully comply with these community objectives.

3.4. National Planning Policy

3.4.1. National Planning Framework for Scotland 2 (NPF2) 2009

Published in June 2009, National Planning Framework for Scotland 2 (NPF2) guides Scotland's future development and establishes strategic priorities to support the Scottish Government's central purpose of sustainable economic growth.

The spatial strategy to 2030 therefore seeks to *"promote development which helps to reduce Scotland's carbon footprint and facilitates adaptation to climate change",* and *"realise the potential of Scotland's renewable energy resources and facilitate the generation of power and heat from all clean, low carbon sources*".

With regard to renewable energy in general, the Scottish Government is *"committed to establishing Scotland as a leading location for the development of renewable energy technology and an energy exporter over the long term"*. The aim of national planning policy is therefore to develop the country's renewable energy potential whilst safeguarding the environment and communities.

With specific regard to onshore wind, the Scottish Government is *"assisting planning authorities with the preparation of supplementary planning guidance on the location of wind farms",* and *"participating in a UK-wide project to identify technical solutions to potential conflicts between wind farm developments and radar systems"*.

NPF2 will eventually be replaced by NPF3. In this respect, the Scottish Government has recently published the NPF3 Main Issues Report (MIR). The consultation window on the MIR closed at the end of July 2013.

To help make Scotland a 'low carbon place', the MIR recommends that NPF3 builds on NPF2 by: *"supporting the further deployment of onshore wind farms, whilst addressing concerns raised about the impacts of some wind energy development"*; *"reflecting the objective of greater community and local ownership of renewable energy"*; and *"identifying further necessary enhancements to the electricity transmission and distribution grid"*.

The MIR reiterates the Scottish Government's ambitious target of generating the equivalent of at least 100% of gross electricity consumption from renewable sources by 2020, with an interim target of 50% by 2015. To put this into context, Scotland met the equivalent of 39% of its gross electricity demand from renewable sources in 2012. If the 100% target is to be met, around 14 – 16 GW of capacity needs to be deployed over the next seven years, with onshore wind playing a significant role.

The Scottish Government supports onshore wind energy development in appropriate locations. Within this context, accompanying the continuing priority to ensure green forms of electricity is to ensure that wind farms are appropriately sited and well designed. The proposed adjustments to national planning policy (in which greater protection is to be given to nationally important designations such as National Parks and 'wild land') are outlined in draft Scottish Planning Policy (SPP) and summarised in Chapter 3.4.2 below.

3.4.2. Scottish Planning Policy (SPP) 2010

Scottish Planning Policy (SPP) outlines the Scottish Government's policy on land use planning and reaffirms its commitment to increasing sustainable economic growth.

The need to tackle climate change, and in particular reduce emissions of the greenhouse gases that contribute to it, is a principal challenge of sustainable economic growth. Within this context, *"the need to help mitigate the causes of climate change and the need to adapt to its short and long term impacts should be taken into account in all decisions throughout the planning system"*.

The commitment to increase the amount of electricity generated from renewable sources is a vital part of the response to climate change. In this respect, *"renewable energy generation will contribute to more secure and diverse energy supplies and support sustainable economic growth"*.

Planning authorities should therefore *"support the development of a diverse range of renewable energy technologies, guide development to appropriate locations and provide clarity on the issues that will be taken into account when specific proposals are assessed"*. Development plans and supplementary guidance should support all scales of renewable energy generation development, while ensuring that issues in relation to landscape, natural heritage, residential amenity and any cumulative impacts are properly considered.

With specific regard to onshore wind energy, planning authorities should *"support the development of wind farms in locations where the technology can operate efficiently and environmental and cumulative impacts can be satisfactorily addressed"*. Development plans should establish criteria for the assessment of wind farm proposals, including extensions. *"The criteria will vary depending on the scale for development and its relationship to the characteristics of the surrounding area, but are likely to include:*

- *Landscape and visual impact;*
- *Effects on the natural heritage and historic environment;*
- *Contribution of the development to renewable energy generation targets;*
- *Effect on the local and national economy and tourism and recreation interests;*
- *Benefits and disbenefits for communities;*
- *Aviation and telecommunications;*
- *Noise and shadow flicker; and*
- *Cumulative impact".*

The design and location of any wind farm should reflect the scale and character of the landscape. Specifically, *"the location of turbines should be considered carefully to ensure that the landscape and visual impact is minimised"*.

When considering cumulative impact, planning authorities should take account of existing wind farms, those which have permission, and valid applications for wind farms which have not

been determined. *"The weight that planning authorities attach to undetermined applications should reflect their position in the application process."* Cumulative impact will largely relate to the *"scale and proximity of further development"* and the criteria for its assessment should be set out in the development plan or supplementary guidance.

SPP is currently in the process of being updated. In this respect, the consultation window for the SPP Consultation Draft ended at the end of July 2013.

Fundamentally, the Consultation Draft states that the planning system should help to address climate change by supporting the expansion of renewable energy generating capacity and heat networks. Development plans should therefore *"support all scales of development associated with the generation of electricity and heat from renewable sources with a view to realising the renewable energy potential of the areas they cover"*.

The Consultation Draft provides revised guidance to Local Planning Authorities in the preparation of spatial frameworks to inform the location of wind energy developments, regardless of their scale. In this respect, proposals for wind farms in National Parks and National Scenic Areas *"will not be acceptable"*.

Within 'areas of significant protection', wind farms will only be appropriate where it can be demonstrated that any significant effects on the qualities for which an area is identified can be satisfactorily overcome. For the first time, it is proposed to include areas of 'wild land' as defined by SNH under this tier. It is also intended to increase the suggested separation distance between wind farms and cities, towns and villages from 2km to 2.5km. This is to reduce visual impact but *"decisions on individual developments should take into account specific local circumstances and geography"*.

More generally, in determining applications for wind turbine development, account should be taken of:

- Community benefits, where they are 'material considerations';
- Landscape and visual effects, including wild land character;
- Natural heritage effects, including birds;
- Impacts on carbon rich soils;
- Historic environment effects;
- Impacts on tourism and recreation;
- Impacts on communities, including residential amenity;
- Noise and shadow flicker effects;
- Impacts on aviation and defence interests, including radar and seismological recording;
- Impacts on telecommunications and broadcasting installations;
- Impacts on road traffic;
- Contribution towards renewable energy generation targets; and
- Cumulative impacts.

The Consultation Draft states that *"proposals for onshore wind turbine development should continue to be determined while spatial frameworks and local policies are being updated",* and *"moratoria on onshore wind development are not appropriate"*.

3.4.3. Specific Advice Sheet – Onshore Wind Turbines (Updated October 2012)

Last updated in October 2012, this Sheet replaces PAN 45 and provides advice in relation to the determination of onshore wind turbines. The key areas for consideration are summarised in Table 5 below.

Subject	Comments
Impact on Landscape	The ability of the landscape to absorb development often depends on features of landscape character such as landform and vegetation. Different layouts of turbines may be more or less suited to particular landscape types and the physical form and/or colour of turbines may also be relevant. In considering wind farm visibility, it is important to note that visibility and distance do not follow a linear relationship. Factors including the backcloth/skyline against which turbines are seen, turbine colour and typical weather conditions require careful consideration. *"As more areas of search are taken up and as more sites are proposed within or near sensitive landscapes, landscape protection and designing appropriate mitigation through conditions and/or legal agreements, will become a more routine consideration alongside maximising the potential of wind energy"*.
Impact on Wildlife & Habitat, Ecosystems & Biodiversity	*"Wind turbine developments have the capacity to have both positive and negative effects on the wildlife, habitats, ecosystems and biodiversity of an area"*. With regard to the former, renewable energy generation counteracts climate change while wind farm developments offer opportunities to introduce environmental enhancement through land management, land restoration and habitat creation. Conversely, there is also potential for negative environmental effects, including: loss of or damage to valuable habitat; risk of collision, displacement or disturbance to bird and bat species; and impacts on designated sites and protected species, even from a distance. Notwithstanding, *"there is scope for mitigation in the location of wind turbines, construction techniques, design measures and management"*.
Impact on Communities	As a general rule, turbines should be sited ten rotor diameters from the nearest properties so as to avoid shadow flicker. With regard to noise, the Sheet refers the reader to other documents that provide a framework for the measurement of wind farm noise, including acceptable indicative noise levels. One of the cited reports concludes that *"there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines"*.
Separation Distances	SPP currently refers to a guideline separation of up to 2km (current proposals are to increase this to 2.5km) between wind farm areas of search and the edge of settlements, to reduce visual impact. However, *"this 2km separation distance is a guide not a rule and decisions on individual developments should take into account specific local circumstances and geography"*. Furthermore, there is no recommended distance between established and proposed groups of turbines.
Aviation Matters	It is essential that the safety of UK aerodromes, aircraft and airspace is not adversely affected by new wind energy infrastructure. Developers and planning authorities are therefore required to consult with the relevant aviation and communication authorities.
Military Aviation & Other Defence Matters	It is important that new wind energy infrastructure does not significantly impede or compromise the safe and effective use of any defence assets. Developers and planning authorities are therefore

Subject	Comments
	required to engage with the Ministry of Defence in relation to wind farm proposals.
Impact on the Historic Environment	The Sheet notes that Scottish Ministers policies for the protection of the historic environment are outlined in SPP, SHEP and PAN 2/2011. Historic Scotland's guidance on setting explains how the impact of change can be assessed and mitigated. *"Wind farm developments have the potential for direct and/or indirect impacts by virtue of the location of turbines and ancillary development, or changes to groundwater levels or surface water patterns, which may affect archaeological deposits. Developments can be designed to avoid or minimise such impacts"*.
Impact on Road Traffic	In siting turbines close to main roads, pre-application discussions with Transport Scotland are recommended. This is particularly important for the movement of large components (abnormal load routing) during construction, periodic maintenance and decommissioning. Driver distraction may also be a consideration during the operational phase.
Cumulative Impact	In assessing cumulative landscape and visual impacts, the scale and pattern of the turbines as well as access tracks, power lines and ancillary development will be relevant considerations. Consistent with advice published by Scottish Natural Heritage, *"it will also be necessary to consider the significance of the landscape and the views, proximity and inter-visibility and the sensitivity of visual receptors"*. The issue of cumulative impact on Ministry of Defence operations and facilities also needs to be considered. In this respect, it cannot be assumed that the MoD can continue to meets its current operational requirements in cases where there is a further proliferation of turbines.
Good Practice During Construction	Developers are encouraged to appoint Ecological Clerks of Works to ensure that agreed methodologies are followed after planning approval.
Decommissioning	Planning authorities are instructed to *"ensure via conditions and/or legal agreement that site restoration takes place either on the expiry of the consent or in the event of the project ceasing to operate for a specified period"*.

Table 5: Summary of Specific Advice Sheet

3.5. Regional and Local Planning Policy

Planning legislation clearly states that development proposals are to be determined in accordance with the 'development plan' unless 'material considerations' indicate otherwise. With regard to this site, the current 'development plan' comprises the approved TAYplan Strategic Development Plan 2012-2032 and the Angus Local Plan 2009.

3.5.1. TAYplan Strategic Development Plan 2012-2032

The TAYplan Strategic Development Plan has replaced the Dundee and Angus Structure Plan (2009). The plan provides a broad-brush direction for the next 20 years about where new development and infrastructure should take place. The current Strategic Development Plan was approved in June 2012 and the Plan is constantly reviewed. The four Local Authorities in the TAYplan area (including Angus) have their own Local Development Plan which identifies the detail of what development should take place for the next ten years and they must reflect the TAYplan strategy.

The plan recognises *"opportunities to grow the renewable energy sector as a whole within the TAYplan region. The issue is no longer about whether such facilities are needed but instead about helping to ensure they are delivered in the most appropriate locations"*.

TAYplan is underpinned by three principles:

- Supporting sustainable economic development and improving regional image and distinctiveness;
- Enhancing the quality of place through better development outcomes; and
- Ensuring effective resource management and promoting an accessible, connected and networked region.

The main strategic policy relating to wind energy is Policy 6: Energy & Waste/Resource Management Infrastructure. The key elements of this policy, insofar as they relate to small to medium scale wind energy proposals, are summarised in Table 6 below:

Policy 6: Energy & Waste/Resource Management Infrastructure
"Local Development Plans should identify areas that are suitable for different forms of renewable heat and electricity infrastructure and for waste/resource management infrastructure or criteria to support this; including, where appropriate, land for process industries (e.g. the co-location/proximity of surplus heat producers with heat users)." *"Local Development Plans and development proposals should ensure that all areas of search, allocated sites, routes and decisions on development proposals for energy and waste/resource management infrastructure have been justified, at a minimum, on the basis of these considerations (inter alia):* • *The specific land take requirements associated with the infrastructure technology and associated statutory safety exclusion zones where appropriate;* • *Proximity of resources (e.g. woodland, wind or waste material); and to users/customers, grid connections and distribution networks for the heat, power or physical materials and waste products, where appropriate;* • *Anticipated effects of construction and operation on air quality, emissions, noise, odour, surface and ground water pollution, drainage, waste disposal, radar installations and flight paths, and, of nuisance impacts on off-site properties;* • *Sensitivity of landscapes (informed by landscape character assessments and other work), the water environment, biodiversity, geo-diversity, habitats, tourism, recreational access and listed/scheduled buildings and structures;* • *Cumulative impacts of the scale and massing of multiple developments, including existing infrastructure; and* • *Consistency with the National Planning Framework and its Action Programme."*

Table 6: TAYplan Policy 6

Other relevant policies include:

- Policy 2: Shaping Better Quality Places;
- Policy 3: Managing TAYplan's Assets; and
- Policy 8: Delivering the Strategic Development Plan.

3.5.2. Angus Local Plan (2009)

This document sets out the detailed guidance for new development in Angus from 2009. It conforms to the Dundee and Angus Structure Plan (now superseded by TAYplan), which sets out the broader guidance for new development in both Angus and Dundee up to the end of 2015.

The development strategy of the Local Plan sets the background within which the various policies and proposals of the plan provide for the sustainable development of Angus. Relevant points within this strategy are:

- *"Provide opportunities for diversification of the rural economy;*
- *Maintain and protect the diversity and quality of the rural area and encourage local development which supports the population and services of local communities;*
- *Support the protection and enhancement of the countryside; and*
- *Maintain the quality of valued landscapes; the natural, built and historic environment, and biodiversity".*

With regard to planning policy that is relevant to this development, Local Plan Policy **ER34** relates to renewable energy developments and is provided below:

"Proposals for all forms of renewable energy development will be supported in principle and will be assessed against the following criteria:

a) The siting and appearance of apparatus have been chosen to minimise the impact on amenity, while respecting operational efficiency;

b) There will be no unacceptable adverse landscape and visual impacts having regard to landscape character, setting within the immediate and wider landscape, and sensitive viewpoints;

c) The development will have no unacceptable detrimental effect on any sites designated for natural heritage, scientific, historic or archaeological reasons;

d) No unacceptable environmental effects of transmission lines, within and beyond the site; and

e) Access for construction and maintenance traffic can be achieved without compromising road safety or causing unacceptable permanent and significant change to the environment and landscape."

Policy **ER35** deals directly with wind energy development:

"Wind energy developments must meet the requirements of Policy ER34 and also demonstrate:

a) The reasons for site selection;

b) That no wind turbines will cause unacceptable interference to birds, especially those that have statutory protection and are susceptible to disturbance, displacement or collision;

c) There is no unacceptable detrimental effect on residential amenity, existing land uses or road safety by reason of shadow flicker, noise or reflected light;

d) That no wind turbines will interfere with authorised aircraft activity;

e) That no electromagnetic disturbance is likely to be caused by the proposal to any existing transmitting or receiving system, or (where such disturbances may be caused) that measures will be taken to minimise or remedy any such interference;

f) That the proposal must be capable of co-existing with other existing or permitted wind energy developments in terms of cumulative impact particularly on visual amenity and landscape, including impacts from development in neighbouring local authority areas; and

g) A realistic means of achieving the removal of any apparatus when redundant and the restoration of the site are proposed."

Table 7 below provides the other policies in the local plan document that are particularly relevant to this development.

Policy S1: Development boundaries
"Development proposals on sites outwith development boundaries (i.e. in the countryside) will generally be supported where they are of a scale and nature appropriate to the location and where they are in accordance with the relevant policies of the Local Plan."
Policy S5: Safeguard Areas
"Planning permission for development within the consultation zones of notifiable installations, pipelines or hazards will only be granted where the proposal accords with the strategy and policies of this Local Plan and there is no objection by the Health & Safety Executive, Civil Aviation Authority or other relevant statutory agency."
Policy S6: Development Principles
"Proposals for development should where appropriate have regard to the relevant principles set out in Schedule 1 which includes reference to amenity considerations; roads and parking; landscaping, open space and biodiversity; drainage and flood risk, and supporting information."
Policy ER1: Natura 2000 and Ramsar Sites
"Development likely to have a significant effect on a designated, candidate or proposed Natura 2000 site (Special Protection Areas and Special Areas of Conservation), or Ramsar site and not connected with or necessary to the conservation management of the site must undergo an appropriate assessment as required by Regulation 48 of the Conservation (Natural Habitats etc.) Regulations 1994. Development will only be permitted exceptionally and where the assessment indicates that: *a) it will not adversely affect the integrity of the site; or* *b) there are no alternative solutions; and* *c) there are imperative reasons of overriding public interest, including those of a social or economic nature.* *Where proposals affect a priority habitat and/or priority species as defined by the Habitats Directive (92/43/EEC), the only overriding public interest must relate to human health, public safety or beneficial consequences of primary importance to the environment. Other allowable exceptions are subject to the views of the European Commission."*
Policy ER4: Wider natural heritage and biodiversity
"The Council will not normally grant planning permission for development that would have a significant adverse impact on species or habitats protected under British or European Law, identified as a priority in UK or Local Biodiversity Action Plans or on other valuable habitats or species. *Development proposals that affect such species or habitats will be required to include evidence that an assessment of nature conservation interest has been taken into account. Where development is permitted, the retention and enhancement of natural heritage and biodiversity will be secured through appropriate planning conditions or the use of Section 75 Agreements as necessary."*
Policy ER5: Conservation of Landscape Character
"Development proposals should take account of the guidance provided by the Tayside Landscape Character Assessment and where appropriate will be considered against the following criteria: *d) Sites selected should be capable of absorbing the proposed development to ensure that it fits into the landscape;* *e) Where required, landscape mitigation measures should be in character with, or enhance, the existing landscape setting;* *f) New buildings/structures should respect the pattern, scale, siting, form, design, colour and density of existing development; and* *g) Priority should be given to locating new development in towns, villages or building groups in preference to isolated development."*

Policy ER11: Noise Pollution

"Development which adversely affects health, the natural or built environment or general amenity as a result of an unacceptable increase in noise levels will not be permitted unless there is an overriding need which cannot be accommodated elsewhere.

Proposals for development generating unacceptable noise levels will not generally be permitted adjacent to existing or proposed noise sensitive land uses. Proposals for new noise-sensitive development which would be subject to unacceptable levels of noise from an existing noise source or from a proposed use will not be permitted."

Policy ER16: Development Affecting the Setting of a Listed Building

"Development proposals will only be permitted where they do not adversely affect the setting of a listed building. New development should avoid building in front of important elevations, felling mature trees and breaching boundary walls."

Policy ER18: Archaeological Sites of National Importance

"Priority will be given to preserving Scheduled Ancient Monuments in situ. Developments affecting Scheduled Ancient Monuments and other nationally significant archaeological sites and historic landscapes and their settings will only be permitted where it can be adequately demonstrated that either:

a) the proposed development will not result in damage to the scheduled monument or site of national archaeological interest or the integrity of its setting; or

b) there is overriding and proven public interest to be gained from the proposed development that outweighs the national significance attached to the preservation of the monument or archaeological importance of the site. In the case of Scheduled Ancient Monuments, the development must be in the national interest in order to outweigh the national importance attached to their preservation; and

c) the need for the development cannot reasonably be met in other less archaeologically damaging locations or by reasonable alternative means; and

d) the proposal has been sited and designed to minimise damage to the archaeological remains.

Where development is considered acceptable and preservation of the site in its original location is not possible, the excavation and recording of the site will be required in advance of development, at the developer's expense."

Policy ER19: Archaeological Sites of Local Importance

"Where development proposals affect unscheduled sites of known or suspected archaeological interest, Angus Council will require the prospective developer to arrange for an archaeological evaluation to determine the importance of the site, its sensitivity to development and the most appropriate means for preserving or recording any archaeological information. The evaluation will be taken into account when determining whether planning permission should be granted with or without conditions or refused.

Where development is generally acceptable and preservation of archaeological features in situ is not feasible Angus Council will require through appropriate conditions attached to planning consents or through a Section 75 Agreement that provision is made at the developer's expense for the excavation and recording of threatened features prior to development commencing."

Policy ER20: Gardens and Designed Landscapes

"Sites included in the "Inventory of Gardens and Designed Landscapes in Scotland", and any others that may be identified during the plan period, will be protected from development that adversely affects their character, amenity value and historic importance. Development proposals will only be permitted where it can be demonstrated that:

a) The proposal will not significantly damage the essential characteristics of the garden and designed landscape or its setting; or

b) *There is a proven public interest, in allowing the development, which cannot be met in other less damaging locations or by reasonable alternative means. Protection will also be given to non-inventory historic gardens, surviving features of designed landscapes, and parks of regional or local importance, including their setting."*

Policy ER29: Agricultural Land
"Proposals for development that would result in the permanent loss of prime quality agricultural land and/or have a detrimental effect on the viability of farming units will only normally be permitted where the land is allocated by this Local Plan or considered essential for implementation of the Local Plan strategy."

Table 7: Relevant policies of the Angus Local Plan relating to the development

These individual policies are discussed further in this document.

3.5.3. Angus Council Implementation Guide for Renewable Energy Proposals (June 2012)

The Angus Local Plan Review establishes the Development Plan policies to be taken into account when assessing proposals for renewable energy projects: Policies ER34: Renewable Energy Development; and ER35: Wind Energy Development. In support of the development plan position the Implementation Guide provides:

- More detailed information and clarification of the main factors that will be taken into account in considering and determining renewable energy proposals in Angus;
- An application checklist;
- Specific guidance for landscape and visual assessment issues in relation to wind turbines; and
- Specific guidance for guidance on noise assessment in relation to wind turbines.

The proposed development lies within the Igneous Hills landscape type (LT) and the guidance which relates to a suitable turbine blade tip for this LT states that it is *"considered to have scope for turbines circa 80m in height which do not disrupt the principle ridgelines or adversely affect the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort".*

The landscape advice and wider guidance has been taken into account while assessing the various technical and environmental considerations of the development, particularly with regards to the landscape and visual impact assessment.

3.5.4. Angus Windfarms Landscape Capacity and Cumulative Impacts Study (2008)

Angus Council appointed a landscape architect in 2008 to assess the potential for cumulative landscape and visual impacts of proposed wind developments within Angus. As part of this study, the landscape was assessed on its ability to accept change without significant or unacceptable effect on its character. The landscape in which the Ingliston Farm turbine will be located is described as Igneous Hills. The landscape capacity for this area is described as follows:

"This area of prominent lowland hills clearly separates Dundee and the Dipslope Farmland in the south from the Broad Valley Lowland of Strathmore in the north. Extending west into Perthshire it is a considerably more extensive and higher hill area than the Low Moorland Hills to the east. The hills are of medium landscape character sensitivity. Being of medium scale and fairly complex topography they are clearly farmed and managed with only the upper slopes and hilltops open pasture or heather moor, and the small glens enclosed and populated with small scale settlements and farms connected by a network of roads and tracks. There are a number of large communications masts on the highest hills and power lines cross in some locations. Visually the area is of medium sensitivity, varying from being enclosed with short

distance views and a low population within, to being a prominent backdrop to Strathmore and Dundee when seen from without. Overall the landscape is of medium sensitivity.

There are no landscape designations but a number of footpaths, viewpoints and small fishing lochs as well as hillforts, scattered dwellings and settlements giving this area a medium landscape value. Overall the Sidlaw Hills have a medium capacity for development. The scale and type of landscape suggests that careful siting of windfarms of a medium to small scale only would be appropriate."

This study will be discussed further within the Landscape and Visual Impact Assessment chapter of this document.

4. Work to Date

This chapter provides a summary of the works completed to date relating to wind energy development.

4.1. Requirement for Environmental Assessment

Under the Town and Country planning act (Scotland) 1997, planned developments above a certain scale or activity require consent from the Local Planning Authority (LPA). For more significant developments this may require the inclusion of supporting Environmental documentation to address the full extent, and potential mitigation, of those environmental impacts considered by the LPA to be relevant to the project.

Major planned developments are normally required to complete a full Environmental Impact Assessment (EIA), a systematic process of quantifying those environmental concerns related to the proposed project. The most relevant and up to date document outlining the requirement for an EIA is the Environmental Impact Assessment (Scotland) Regulations 1999.

An EIA must be carried out if the particular development is likely to give rise to significant environmental effects. A written request for a screening opinion was made to Angus Council on 20th June 2013 outlining details of the proposal (location, scale, location map). The response stated that the proposed development was not considered to require an EIA[8].

The response did however recommend the following topics be addressed as part of the planning application:

- Relevant planning policy;
- Site selection and description of project;
- Landscape and visual assessment;
- Cumulative visual assessment;
- Noise assessment;
- Ecological assessment;
- Pollution prevention measures;
- Transportation and access;
- Cultural Heritage; and
- Electromagnetic interference/air traffic safety.

4.2. Initial Development & Screening Work

A number of different site layouts were considered during the development process. Various constraints to the development were identified and examined in detail. Location of water courses, houses, telecommunication links, ecologically sensitive areas, noise sensitive areas, archaeological sites and visually sensitive areas were noted. Using Geographical Information Systems (GIS) software, separation distances were applied to these constraints. Different sizes of turbine were examined, relating both to height, generating capacity and noise impact. An

[8]Response from Neil Duthie, 29/07/13

initial constraints map was produced for the site and is shown in Figure 8 below. Buffers have been included for the land ownership boundary (blue, buffered by 1.1 x blade length to avoid oversail onto third party land), residential (green, buffered to 500m for non-financially involved properties and yellow, buffered to 400m for financially involved properties), overhead lines (purple, buffered to 1.5 x tip height) and roads (orange, buffered to 1.1 x tip height).

Figure 8: Initial constraints map

Following further assessment of other development constraints (e.g. noise, shadow flicker, visual impacts etc), it was considered that the proposed EWT Directwind wind turbine of 77m tip height would be a suitable turbine model for the Ingliston Farm site.

There are areas to the north of the proposed development site, which are on lower ground and also lie outwith any development buffers. However, a development in any of these locations would not be viable as the summit at Castleward (273m AGL), to the south of the proposed turbine location, will inhibit laminar airflow from the predominant southerly and south westerly directions. The turbulence created by this obstacle will cause unacceptable wear on the generator, and the resultant drop in wind speed will render the project unfeasible. As such, these alternative locations were ruled out at an early stage in the project's development.

4.2.1. Other Consultation

Other stakeholders were contacted as part of the screening study. An overview of the responses received are provided in Table 8 below.

Consultee	Comments	Further work required
Historic Scotland	No objection to the proposed development in principle, but would expect certain aspects to be assessed.	Assessment of cultural heritage assets in the area. This is provided in Chapter 8 of this document.
Scottish Natural Heritage (SNH)	No specific comments to make on the proposal. Wildfowl and Wetland Trust (WWT) goose data held by SNH indicate that land immediately around the proposed turbine does not form part of the preferred foraging areas for pink-footed or greylag geese and as a result VP surveys are not essential in this instance.	Ecology survey carried out by EnviroCentre Ltd. Full report provided within the appendices of this document.
Telecommunication link operators, including Ofcom, Atkins and Joint Radio Company (JRC)	No telecommunications will be affected by the proposal.	No further assessment necessary.

Table 8: Other pre-application consultee responses received

The above points and general requirements discussed in the screening stage have informed the environmental assessment and ultimately the final design of the development. Pre planning consultation has been carried out where possible however, due to the level of pre-application queries received, some statutory consultees state they are unable to provide a response (e.g. MOD, NATS) and in these situations Locogen's experience has been utilised to assess the potential for impact.

5. Landscape & Visual

5.1. Introduction

Locogen commissioned a chartered landscape architect (Douglas Harman CMLI) to undertake a Landscape and Visual Impact Assessment (LVIA) of the proposed development. Based on a 25km study area, it identifies the baseline against which the effects of the proposed development are assessed and concentrates on predicting the likely effects during the operational phase. The scheme design, including any mitigation measures incorporated to minimise adverse effects, is informed by the findings of the baseline study.

Effects on features identified as important to the landscape quality and effects on the landscape character of the site and its setting are assessed. Although interrelated, effects on views of the site and its setting and visual amenity, are assessed separately.

Landscape effects are on the fabric, character and quality of the landscape and are concerned with:

- Landscape elements;
- Landscape character – regional and local distinctiveness; and
- Special interests e.g. designations, conservation sites, cultural associations.

Visual effects on people are concerned with the changes in available views through intrusion or obstruction and whether important opportunities to enjoy views may be improved or reduced.

The objectives of the assessment are to:

- Describe and evaluate the landscape and visual amenity of the site and surrounding area which may be affected by the proposed development;
- Identify and assess the significance of any effects on landscape or visual amenity, associated with the design, operation and reinstatement of the proposed development;
- Identify mitigation measures which will be implemented in order to avoid, reduce or remedy adverse effects; and
- Describe any enhancements of the landscape or visual amenity incorporated into the proposals.

The findings of the LVIA are presented in the following sections:

5.1.1. Baseline Assessment

- Planning policy context: a summary of the regional and local landscape related planning policies relevant to the proposed development;
- Baseline description: a description of the landscape and visual resource of the study area conducted through desk study and site survey; and
- Design optimisation and mitigation strategy: a summary of the design process in response to landscape and visual issues.

5.1.2. Impact Assessment

- Viewpoint assessment: a detailed assessment of landscape and visual effects at a selection of representative viewpoints;
- Landscape effects: assessment of the potential residual effects upon the landscape resource, landscape character areas and designated landscapes;

- Visual effects: assessment of potential residual effects on people of the changes in available views through intrusion or obstruction and whether important opportunities to enjoy views may be improved or reduced;
- Cumulative landscape and visual effects: assessment of the potential residual effects arising from the proposed development in conjunction with built/consented wind farms within the study area and those at planning application stage; and
- Summary and Conclusions.

5.1.3. Appended Methodology

A description of the methods and associated guidance used to inform the assessment process is provided in Appendix A, at the end of this Supporting Environmental Document.

5.1.4. Summary of proposed development

The proposed development will consist of the following elements (a detailed description of the proposed development can be found in Chapter 2 of this Supporting Environmental Document:

- Wind turbine – the proposed turbine is 50m to hub height, has a blade diameter of 54m and is 77m to blade tip;
- Foundation – a foundation with expected dimensions of 13m x 13m. Once constructed this structure will be backfilled so that only the tower base and pedestal will be visible;
- Transformer kiosk – it is proposed that a turbine transformer is either located within the base of the tower (preferred option) or alternatively in a small kiosk located next to the base of the tower with the necessary switchgear and protection equipment;
- Sub-station building – a substation building will be located near the base of the turbine. The approximate dimensions of the building will be 10.3m x 3m and 3.15m in height. This can be painted the most unobtrusive colour that conforms to its surroundings. Typical colours are grey, green or brown. A suitable structure will be confirmed with Scottish and Southern Energy prior to construction;
- Access road – the construction of a dedicated access road to the proposed wind turbine totalling approximately 2.1km in length, 730m of which would require an upgrade of an existing track;
- Construction compound – the construction of a temporary hardstanding area for the assembly of the crane and rotor. This would measure an approximate area of 20m x 35m with an adjacent area for lay down of turbine components;
- A borrow pit – measuring 92m x 44m x 0.7m deep. This will be re-instated to permanent grassland up to the edge of the hardstanding, access track, foundation and substation kiosk, after construction. The hardstanding, foundation, substation kiosk and part of the access track will all be included within the proposed boundary of the borrow pit; and
- Underground cable – an 11kV cable connecting the turbine to a suitable grid connection point will be undergrounded to minimise visual impacts.

5.2. Planning Policy context

The development plans relevant to this application are the TAYplan Strategic Development Plan (2012) and the Angus Local Plan Review (2009). The adopted policies of the planning authority relevant to landscape are listed in Sections 5.2.1 to 5.2.2 and Section 5.2.3 summarises the *'Implementation Guide for Renewable Energy Proposals'* (2012) which explains and clarifies the existing Angus Local Plan Review policy base.

5.2.1. TAYplan Strategic Development Plan (2012)

The Tayplan Strategic Development Plan has replaced the Dundee and Angus Structure Plan (2009). The plan provides a broad-brush direction for the next 20 years about where new development and infrastructure should take place. The current Strategic Development Plan was approved in June 2012 and the Plan is constantly reviewed. The four Local Authorities in the TAYplan area (including Angus) have their own Local Development Plan which identifies the detail of what development should take place for the next ten years and they must reflect the TAYplan strategy.

The plan recognises *'opportunities to grow the renewable energy sector as a whole within the TAYplan region. The issue is no longer about whether such facilities are needed but instead about helping to ensure they are delivered in the most appropriate locations'*.

The TAYplan Plan does not provide the locations for energy infrastructure; this role is for Local Development Plans. It is the role of this Plan to ensure consistency between Local Development Plans in fulfilling Scottish Planning Policy requirements to define areas of search for renewable energy infrastructure. As part of this, the following policy is relevant to this application:

Policy 6: Energy and Waste/Resource Management Infrastructure

"A - Local Development Plans should identify areas that are suitable for different forms of renewable heat and electricity infrastructure…."

"C - Local Development Plans and development proposals should ensure that all areas of search, allocated sites, routes and decisions on development proposals for energy and waste/resource management infrastructure have been justified, at a minimum, on the basis of these considerations:

- *The specific land take requirements associated with the infrastructure technology and associated statutory safety exclusion zones where appropriate;*
- *Waste/resource management proposals are justified against the Scottish Government's Zero Waste Plan and support the delivery of the waste/resource management hierarchy;*
- *Proximity of resources (e.g. woodland, wind or waste material); and to users/customers, grid connections and distribution networks for the heat, power or physical materials and waste products, where appropriate;*
- *Anticipated effects of construction and operation on air quality, emissions, noise, odour, surface and ground water pollution, drainage, waste disposal, radar installations and flight paths, and, of nuisance impacts on off-site properties;*
- *Sensitivity of landscapes (informed by landscape character assessments and other work), the water environment, biodiversity, geo-diversity, habitats, tourism, recreational access and listed/scheduled buildings and structures;*
- *Impacts of associated new grid connections and distribution or access infrastructure;*
- *Cumulative impacts of the scale and massing of multiple developments, including existing infrastructure;*
- *Impacts upon neighbouring planning authorities (both within and outwith TAYplan); and,*
- *Consistency with the National Planning Framework and its Action Programme."*

5.2.2. Angus Local Plan Review (2009)

In delivering strategic policy, the following policies within the Angus Local Plan are key considerations in assessing the acceptability of the proposed development in landscape terms:

Policy ER5: *Conservation of Landscape Character*

"Development proposals should take account of the guidance provided by the Tayside Landscape Character Assessment and where appropriate will be considered against the following criteria:

(a) sites selected should be capable of absorbing the proposed development to ensure that it fits into the landscape;

(b) where required, landscape mitigation measures should be in character with, or enhance, the existing landscape setting;

(c) new buildings/structures should respect the pattern, scale, siting, form, design, colour and density of existing development;

(d) priority should be given to locating new development in towns, villages or building groups in preference to isolated development."

Policy ER20: *Historic Gardens and Designed Landscapes*

"Sites included in the "Inventory of Gardens and Designed Landscapes in Scotland", and any others that may be identified during the plan period, will be protected from development that adversely affects their character, amenity value and historic importance. Development proposals will only be permitted where it can be demonstrated that:

(a) the proposal will not significantly damage the essential characteristics of the garden and designed landscape or its setting; or

(b) there is a proven public interest, in allowing the development, which cannot be met in other less damaging locations or by reasonable alternative means.

Protection will also be given to non-inventory historic gardens, surviving features of designed landscapes, and parks of regional or local importance, including their setting."

Policy ER34: *Renewable Energy Developments*

"Proposals for all forms of renewable energy development will be supported in principle and will be assessed against the following criteria:

(a) the siting and appearance of apparatus have been chosen to minimise the impact on amenity, while respecting operational efficiency;

(b) there will be no unacceptable adverse landscape and visual impacts having regard to landscape character, setting within the immediate and wider landscape, and sensitive viewpoints;

(c) the development will have no unacceptable detrimental effect on any sites designated for natural heritage, scientific, historic or archaeological reasons;

(d) no unacceptable environmental effects of transmission lines, within and beyond the site; and

(e) access for construction and maintenance traffic can be achieved without compromising road safety or causing unacceptable permanent and significant change to the environment and landscape."

Policy ER35: *Wind Energy Development*

"Wind energy developments must meet the requirements of

Policy ER34 and also demonstrate:

(a) the reasons for site selection;

(b) that no wind turbines will cause unacceptable interference to birds, especially those that have statutory protection and are susceptible to disturbance, displacement or collision;

(c) there is no unacceptable detrimental effect on residential amenity, existing land uses or road safety by reason of shadow flicker, noise or reflected light;

(d) that no wind turbines will interfere with authorised aircraft activity;

(e) that no electromagnetic disturbance is likely to be caused by the proposal to any existing transmitting or receiving system, or (where such disturbances may be caused) that measures will be taken to minimise or remedy any such interference;

(f) that the proposal must be capable of co-existing with other existing or permitted wind energy developments in terms of cumulative impact particularly on visual amenity and landscape, including impacts from development in neighbouring local authority areas;

(g) a realistic means of achieving the removal of any apparatus when redundant and the restoration of the site are proposed."

5.2.3. The '*Implementation Guide for Renewable Energy Proposals*' (2012)

The '*Implementation Guide for Renewable Energy Proposals*' (2012) explains and clarifies the existing Angus Local Plan Review policy base that will be used by Angus Council in determining renewable energy planning applications. It has been prepared to support the Angus Local Plan Review (adopted 2009) Policies ER34: *Renewable Energy Developments* and ER35: *Wind Energy Development*. This incorporates the findings of the '*Landscape Capacity and Cumulative Impacts Study*' (2008), a strategic level study providing a context for the consideration of the cumulative effects of existing and potential future windfarm developments.

The guide develops a classification of landscape types and identifies 'Levels of Acceptable Landscape Character Change'. Outwith development boundaries, it is considered that there is scope for turbines to be accommodated in some landscapes. The guide heights are extrapolated from sources including the Tayside Landscape Character Assessment, the Landscape Capacity and Cumulative Impacts Study, Reporters findings from planning appeals, responses from statutory consultees and reflect the particular scale and landscape of Angus.

For the *Igneous Hills* Landscape Character Type (LCT) in which the site of the proposed development is located, this states:

- Existing Windfarm Character: "*Landscape with Views of Windfarms";*
- Acceptable Future Windfarm Character: "*Landscape with Occasional Windfarms"; and*
- Guidance: *"Considered to have scope for turbines circa 80 m in height which do not disrupt the principle ridgelines or adversely affect the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort."*

The guidance also states:

"The relative height and style of turbine (e.g. tower construction, number of blades, blade length) should increasingly reflect those already consented to promoted a harmonious development pattern."

The application of this guidance to the design of the proposed development is discussed in Section 5.4.

5.2.4. Summary of policy context

In summary, development plan policy is generally supportive of wind energy development. This is subject to specific developments avoiding unacceptable landscape and visual impacts and with limitations on the cumulative impact of more than one development within Angus or in neighbouring local authority areas. The *Tayside Landscape Character Assessment* (SNH 1999) is the basis for describing landscape character and the *'Implementation Guide for Renewable Energy Proposals'* (2012) provides guidance for the assessment of the development proposals. This states that the *Igneous Hills* LCT in which the proposed development is located is *'considered to have scope for turbines circa 80 m in height'.*

At a strategic level therefore, the proposed development is acceptable in landscape policy terms notwithstanding any significant adverse effects identified in this Landscape & Visual Impact Assessment and the associated application of Local Plan Policy criteria.

Further guidance on the capacity of the Angus landscape to accommodate a range of wind energy developments is set out in the *'Landscape Capacity and Cumulative Impacts Study'* (2008). A summary of this in relation to the proposed development is set out in Section 5.3.4 of this report.

5.3. Baseline description

The baseline description establishes the existing landscape and visual resource against which the effects of the proposed development are predicted. It describes the site and its setting and examines the existing landscape designations and landscapes character types within the study area and their associated sensitivity to wind energy development. Visual receptors including settlements, road and rail users, users of recreational routes and their associated sensitivity are also identified along with an overview of the landscape and visual receptors to be assessed at the representative viewpoints.

5.3.1. The site and surrounding landscape

The site of the proposed development is located on Ingliston Farm, situated within the northern fringes of the Sidlaw Hills in Angus (see Figure ING001). The village of Balkeerie is located immediately to the west of the land ownership boundary with Dundee approximately 10km to the south, Forfar 11km to the north-east and Coupar Angus 12km to the south-west.

The proposed turbine location is on the northern slopes of Ingliston Hill at approximately 232m AOD and to the north of Balkeerie Hill, which rises to a height of 273m AOD. The site comprises of several medium to large sloping pastoral fields with boundaries defined by post and wire fences with stone walls along a local road which dissects the site on lower ground towards the northern part of the site. There is a small disused quarry near to the proposed turbine location and one further north to the south of the local road. To the north of the local road, Ingliston Farmstead is located on lower ground to the north-east of Balkeerie. Within the immediate surroundings, the landscape is very open in character apart from Ingliston Wood, which forms part of the eastern boundary to the site.

The surrounding landscape to the south exhibits a large scale, open character with coniferous forestry plantations and woodland, a dispersed settlement pattern and intrusive influences including power lines, pylons, communication masts and existing wind energy development

including Ark Hill Wind Farm, located approximately 2km to the south of the site. Kinpurnie Tower, located on Kinpurney Hill forms an important landmark feature approximately 3.3km to the south-west of the site. There are also a number of hillforts occupying prominent hilltop locations including Auchterhouse Hillfort, located approximately 4.6km to the south of the site.

To the north, the site overlooks the extensive low lying broad Vale of Strathmore. This contains some of the best agricultural land in Scotland with a network of busy roads and a pattern of villages and small towns. Further north, the Grampians form a distant but important backdrop to the area.

From areas of higher ground across the site, views to the north and west are generally long range with shorter range views to the south and east, curtailed by rising ground and Ingliston Wood. Views towards to the site are limited to small areas of open hill tops and slopes to the south of the site. From the north, there are large areas along the Vale of Strathmore where the site is visible although a pattern of woodlands and the influence of large wooded estates provide a degree of local screening from many locations.

5.3.2. Landscape designations

A very small part of the Cairngorms National Park is located within the study area, approximately 23km to the north of the site. Other landscape designations within the study area include Gardens and Designed Landscapes (GDLs), Local Landscape Designations and Country Parks (see Drawing ING006).

Gardens and Designed Landscapes

There are nineteen Gardens and Designed Landscape (GDLs) within the study area, seven of which are within 15km from the proposed development. Due to their national importance, GDLs are assessed as having a *high* sensitivity to change.

Local Landscape Designations

There are parts of two Local Landscape Designations (part of an Area of Great Landscape Value to the east of Perth and the Tay Coast Special Landscape Area in Fife) within the study area. Both of these designations are located over 15km of the proposed development and due to their regional importance, they are considered as having a *medium-high* sensitivity to change.

Country Parks

There are also four Country Parks within the study area, two of which are within15 km from the proposed development. As a local recreational designation, Country Parks are considered to be of *medium* sensitivity to change.

Summary of landscape designations within the study area

For all landscape designations within 15km from the turbine location, a description and associated sensitivity are set out in Table 9. Outside of 15km, all other designations have been listed. A number of other features of cultural importance occur within the study area. These individual features are assessed in more detail in Chapter 8.

Landscape Designation	Description	Distance to turbine (km)	Sensitivity
All designations within 15km			
Glamis Castle GDL	Located within the broad vale of Strathmore, Glamis Castle designed landscape dates from the late 17th century and is outstanding in almost every value category. The Castle is set in the low plain of the Dean Water and the land slopes gently north from the Sidlaw Hills in the south to the Castle and the Dean Water. There are magnificent views to the surrounding area from the parks and particularly from the roof of the Castle, the Grampian Mountains forming a magnificent backdrop to the north. The policy woodlands are particularly significant to the designed setting of the Castle. Views into the parks from the surrounding roads are limited by the woods and the high policy walls which form a significant scenic feature in themselves. The Castle is visible from the A928 to the west, and the farmed parks to the east are visible from the A94.	4.3	High
Drumkilbo GDL	A compact 19th century landscape with 20th century formal gardens. To the north there are panoramic views to the Grampian Mountains and, to the south, views to the Sidlaw Hills, both of which are important from within the site. The designed landscape of Drumkilbo is of some significance in the surrounding landscape due to the woodland canopy of the shelterbelts which enclose the gardens. The surrounding policy farmland is important to the setting of the designed landscape and particularly to views from the drive and the edge of the gardens.	4.5	High
Airlie Castle GDL	An outstanding 19th century landscape on several counts: historically, architecturally and for nature conservation. The formal gardens are beautifully laid out and the whole composition of natural gorge and designed features is highly significant in the surrounding scenery. The Castle stands on the south-east side of the confluence of the River Isla and the Melgam Water both of which occupy deep gorges in the landscape. From the Castle, fine views are gained all around, in particular to the Grampians in the north and the flatter landscape of the Vale of Strathmore to the south. Views out from many areas in the woods and gardens are restricted. The woodlands along the gorges of the River Isla and Melgam Waters are the most significant scenic features.	7.8	High
Clatto	The park is located on the north-eastern fringes of Dundee and immediately to the north of	9.9	Medium

Landscape Designation	Description	Distance to turbine (km)	Sensitivity
Country Park	Camperdown and Templeton Woods Country Park. It is centred on a reservoir with woodlands along the northern, southern and western edges. Facilities at include a water sports centre, children's play areas, picnic and barbecue site.		
Camperdown and Templeton Woods Country Park	Camperdown Country Park is the largest public park in Dundee. With the stunning neo-classical Camperdown House as its centre-piece, the park covers an area of over 400 acres, and is home to no fewer than 190 species of trees. One of the most popular parks in Dundee, among locals and visitors alike, Camperdown is open all year round and offers a wide range of activities and events.	10.0	Medium
Forfar Loch Country Park	Forfar Loch Country Park situated on the west side of Forfar. With woodland, grassland and wetland habitats, the park is a haven for wildlife and visitors. Forfar Loch is circled by a 2.5 mile long trail which is part of the Forfar Path Network and the loch is important for a host of recreational activities.	11.0	Medium
Ascreavie GDL	Ascreavie is situated on the southern edge of the lower foothills of the Grampian Mountains overlooking the Vale of Strathmore. The gardens lie about 1.5km north of Kirkton of Kingoldrum off the B951, and some 6 km north of Kirriemuir. There are long views to the south and south-west across the valley. There are no significant views into the gardens. It is a mid-19th century designed landscape of parkland, woodland clumps, specimen trees and shelter planting with, near the house, alpine gardens and woodland gardens.	12.4	High
Balgay Park GDL	Balgay Park dominates Dundee's cityscape, and it is an important park because it retains its original layout comprising not only walks for pedestrians but also rides and drives. Bounded on the north by Ancrum Road, there are panoramic views of the city of Dundee including Dundee Law and the Firth of Tay, and Camperdown Park.	13.9	High
Baxter Park GDL	Baxter Park is the only complete park wholly designed by Sir Joseph Paxton in Scotland. It is located east of the town centre of Dundee within an entirely urban setting. From Gallows Hill there is a glimpse of the former panoramic view over the Firth of Tay to Fife although trees have all but obscured this view.	14.2	High
Rossie Priory GDL	An outstanding designed landscape. The setting of the policies on the south-facing slope of Rossie Hill provides fine views out to the south across the	14.3	High

Landscape Designation	Description	Distance to turbine (km)	Sensitivity
	Firth of Tay to the Ochil and Lomond Hills in Fife. Features of the designed landscape, particularly the woods, are significant in the local landscape.		
Designations within 15-25km			
Cairngorms National Park		Fingask Castle GDL	
Cortachy Castle GDL		Megginch Castle GDL	
Craighall Rattray GDL		Errol Park GDL	
Meikleour GDL		The Guynd GDL	
Glendoick GDL		Tay Coast Special Landscape Area	
Naughton GDL		East Perth Area of Great Landscape Value	
Guthrie Castle GDL		Crombie County Park	
House of Pitmuies GDL		Monikie Country Park	
Stobhall GDL			

Table 9: Landscape Designations

5.3.3. Landscape character: the site and study area

The landscape character of the study area has been mapped and described using the following landscape character assessments (see Drawing ING009):

- Tayside Landscape Character Assessment (1999); and
- The Fife Landscape Character Assessment (1999).

The proposed turbine is located towards the northern fringes of Sidlaw Hills within the *Igneous Hills* landscape character type (LCT). The LCT is an elevated, large-scale landscape, with conical summits and unimproved grass and moorland, distinctive scarp, dipslopes, short glens, and areas of coniferous forestry in prominent geometric plantations and shelterbelts. The LCT also reflects a long history of settlement with burial mounds, medieval castles and mottes and other hill-forts and follies exploiting the natural defences of steep slopes. There are many modern influences with telecommunication masts at the summit of a number of hills, operational wind turbines, transmission lines and a number of existing and disused quarries.

There are a further seven LCTs within 15km and eleven LCTs within 15-25km. Table 10 identifies the key characteristics and features of each LCT and their associated sensitivity to wind energy for those within 15km of the proposed development and lists the LCTs from 15 to 25km.

Landscape Character Type	Landscape character & features	Sensitivity
LCTs within 15km		
Igneous Hills	• The Sidlaw hills, comprising hard volcanic rocks • Short burns and rivers flowing from short steep glens • A few large glens through the hills • Often distinctive scrap and dip slopes • Generally open landscape of almost conical summits dominated by grass moorland • Some extensive areas of forestry • Many modern influences	Medium
Broad Valley Lowland	• Broad Straths formed by glacial erosion • Undersized, misfit rivers • Complex local topography caused by glacial deposition • Distinctive red soils and red building stone • Influence of large estates, particularly in terms of woodland and policies • Dominance of arable and root crops • Tree loss weakening landscape character	Medium
Low Moorland Hills	• Eastern outliers of the Sidlaws • Combination of low, rounded hills and craggy, ridged upland • Moorland character evident in areas of heather and gorse • Some areas of extensive woodland • Rich historic heritage • Scattered modern settlement	Medium to high
Dipslope Farmland	• Extensive area of land, generally sloping from the north-west to the south-east • dominated by productive agricultural land • Low woodland cover, expect on large estates and along river corridors • Variety of historic sites • Dispersed settlement pattern, including some suburban development • Limited visual impact of Dundee and Arbroath	Medium
Highland Foothills	• Complex geological structure resulting from their position along the line of the Highland Boundary Fault • Glacial deposits • Steep whale backed hills and south-west to north-east valleys • Winding, gorge like river valleys • Gateway to the Angus Glens with a rich historic heritage • Building materials reflecting geological transition • Complex, sometimes disorientating landscape with glimpses of Highland and lowland	Medium to High
Highland Glens	• Uppermost sections of principal Highland glens • Narrow • Dominated by the scale and enclosing mountains • Classic glacial landforms and features • Sparse settlement and woodland cover • Upland, remote character • In some areas the character has been weakened by modern development	Medium to High

Landscape Character Type	Landscape character & features	Sensitivity
Highland Summits and Plateau	• Areas of upland separating principle glens • West Highlands comprise distinct summits and ranges, separated by fault line lochs, the hills are sharply defined and often craggy • Mounth Highlands comprise a more extensive area of upland with spurs extending southwards, the hills are more rounded than those to the west and rock outcrops are fewer • Vegetation patterns closely reflect altitude and exposure and include heather, grassland, blanket bog and arctic alpine plant communities, variations reflecting underlying geology • Most of the area managed as open m moorland • Little or no settlement • Some extensive plantations • One of the remotest and wildest landscapes in the UK	Medium
Firth Lowlands	• Predominantly flat, fertile area • Enclosed by the steep Sidlaws escarpment to the north and bounded by the Firth of Tay to the south • Estuarine reed-beds and mudflats • Large rectangular fields • Decaying structure of hedges and hedgerow trees • Well-settled with some urban influences	Medium to high
LCTs within 15-25km		
Lowland River Corridors		
Lowland Hills		
Coastal Hills		
Lowland Dens		
Lowland Hills and Valleys		
Lowland Glacial Melt Water Valley		
Coastal Braes		
Upland Foothills		
Coastal Terraces		
Coastal Flats		
Lowland Mixed Coasts		

Table 10: Landscape Character Types

5.3.4. Landscape Capacity

Guidance on the capacity of the Angus landscape to accommodate a range of wind energy developments is set out in the '*Landscape Capacity and Cumulative Impacts Study'* (2008). For the *Igneous Hills* LCT in which the proposed turbine is located, the study states:

"This area of prominent lowland hills clearly separates Dundee and the Dipslope Farmland in the south from the Broad Valley Lowland of Strathmore in the north. Extending west into Perthshire it is a considerably more extensive and higher hill area than the Low Moorland Hills to the east. The hills are of medium landscape character sensitivity.

Being of medium scale and fairly complex topography they are clearly farmed and managed with only the upper slopes and hilltops open pasture or heather moor, and the small glens enclosed and populated with small scale settlements and farms connected by a network of roads and tracks. There are a number of large communications masts on the highest hills and power lines cross in some locations. Visually the area is of medium sensitivity, varying from being enclosed with short distance views and a low population within, to being a prominent backdrop to Strathmore and Dundee when seen from without. Overall the landscape is of medium sensitivity.

There are no landscape designations but a number of footpaths, viewpoints and small fishing lochs as well as hillforts, scattered dwellings and settlements giving this area a medium landscape value.

Overall the Sidlaw Hills have a medium capacity for development. The scale and type of landscape suggests that careful siting of windfarms of a medium to small scale only would be appropriate."

- **Summary of capacity**

The capacity study concludes that the *Igneous Hills* LCT has a **medium overall sensitivity** and a **medium capacity** for windfarm development. This is reinforced by the *'Implementation Guide for Renewable Energy Proposals'* (2012) which states that LCT is:

"Considered to have scope for turbines circa 80m in height which do not disrupt the principle ridgelines or adversely affect the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort."

Therefore at a strategic level, the site is appropriate for development at the proposed scale subject to the detailed findings of this LVIA.

5.3.5. Individual dwellings and settlements

Table 11 identifies the villages and towns and their associated sensitivity within 15km of the proposed development that will form the basis of the residential assessment. This also includes all individual dwellings within 2km from the proposed turbine location (see Drawings ING081-082 for further details).

Within 5km, the area is characterised by a pattern of scattered dwellings and farmsteads, small clusters of dwellings and the village of Balkeerie located approximately 1.5km to the west of the turbine location. The wider study area is relatively well settled across the lowlands and includes the towns of Coupar Angus, Dundee, Forfar and Kirriemuir. The Highland landscape to the north of the study area and the Sidlaws to the south are relatively unsettled.

Receptor	**Approx. distance (km)**	**Sensitivity**
Individual dwellings within 2km		
51 dwellings in total (including those in the village of Balkeerie) – see Drawings ING 081-82.		
Villages & Towns within 15km		
Milton	3.8	High
Newtyle	5.3	High
Kirton of Auchterhouse	5.4	High
Meigle	5.5	High

Receptor	Approx. distance (km)	Sensitivity
Ardler	8.2	High
Westmuir	8.4	High
Tealing	9.2	High
Lundie	9.3	High
Gateside	9.4	High
Kirriemuir	9.7	High
Alyth	10.1	High
Dundee	10.2	High
Inveraldie	10.3	High
Forfar	11.5	High
Coupar Angus	12.7	High

Table 11: Residential Receptors

5.3.6. Roads & rail routes

Main roads within the study area that will potentially experience theoretical visibility of the turbine include the A94 located within 5km from the proposed development and the A90, A926, and the A928 located beyond 5km and to the west, north and north of the site, respectively. There is a good network of secondary and local roads within the study area, many of which fall within the ZTV, particularly within 15km and to the north of the site. There is a rail route that broadly follows the coast to the south of the study area. All these routes are judged to have a *medium* sensitivity to change.

5.3.7. Nationally important recreational routes

The National Cycle Route 1 and the Fife Coastal Path are both located beyond 15 km from the proposed development and broadly follow the coast to the south of the study area. Considering their national importance for recreation, these are judged to have a *high* sensitivity to change.

5.3.8. Viewpoints

The following fourteen viewpoints have been selected as a basis for further investigation of landscape and visual effects (see Drawing ING038).

VP Location	Distance (km)	Landscape		Visual	
		LCT	Sensitivity	Receptor	Sensitivity
1. Easter Denoon	0.7	Igneous Hills	Medium	Residents	High
				Local road users	Medium
2. Denoon Law	1.1	Igneous Hills	Medium	Walkers	High
3. Local road	1.2	Broad Valley	Medium	Residents	High

VP Location	Distance (km)	Landscape		Visual	
		LCT	Sensitivity	Receptor	Sensitivity
near Eassie School		Lowland		Local road users	Medium
4. Balkeerie	1.4	Broad Valley Lowland	Medium	Residents	High
				Local road users	Medium
5. Carlunie Hill	2.4	Igneous Hills	Medium	Scheduled Monument	High
6. Eassie Bridge	3.2	Broad Valley Lowland	Medium	Residents	High
				Local road users	Medium
7. Kinpurney Hill	3.3	Igneous Hills	Medium	Walkers	High
8. Auchterhouse Hill	4.6	Igneous Hills	Medium	Walkers	High
9. Glamis Castle	5.0	Broad Valley Lowland	Medium	Visitors	High
10. B954 near Belmont Castle	5.4	Broad Valley Lowland	Medium	Minor road users	Medium
11. Local road near Dryloch	7.1	Broad Valley Lowland	Medium	Local Road users	Medium
12. A928 near Kirriemuir	9.7	Broad Valley Lowland	Medium	Residents	High
				Main road users	Medium
13. A926 near Padanaram	11.5	Broad Valley Lowland	Medium	Residents	High
				Main road users	Medium
14. A923 near Coupar Angus	12.8	Broad Valley Lowland	Medium	Residents	High
				Main road users	Medium

Table 12: Viewpoints

5.3.9. Operational, consented and proposed developments

The following schemes listed in Table 13 have been identified as the baseline scenario to further investigate the cumulative landscape and visual effects of the proposed development. The locations of these schemes are identified in Drawing ING019.

Name	No. of Turbines	Tip height (m)	Status	Distance from turbine (km)
Ark Hill	8	77.0	Installed	1.8
Henderston Quarry	1	66.0	Approved	3.3

Name	No. of Turbines	Tip height (m)	Status	Distance from turbine (km)
Scotson	1	79.6	Installed	4.3
Davidston Farm	1	62.0	Pending	5.0
Govals Wind Farm	6	86.5	Pending	7.1
Frawney Wind Farm	5	80.0	Pending	7.3
North Leoch	1	45.6	Approved	7.4
West Mains Farmhouse	1	61.0	Approved	7.6
Balkemback Farm	2	46.5	Approved	7.7
Reedie Farm	2	46.9	Approved	7.8
House On The Hill Kettins	1	45.4	Approved	8.8
West Adamston Farm	1	47.5	Installed	8.9
Lundie Castle Farm	1	48.5	Pending	8.9
North Tarbax	1	45.9	Approved	9.1
House On The Hill	1	46.5	Approved	9.4
Tealing	1	86.5	Approved	9.5
Former Tealing Airfield	1	86.5	Pending	9.5
Dodd Hill Wind Farm	5	126.5	Pending (Appeal)	10.6
Loyal Farm	1	47.0	Pending	10.7
Wester Meathie Farm	2	46.6	Approved	11.6
Bamff Wind Farm	7	111.0	Pending (Appeal)	14.6
Greenhillock 1	1	45.9	Approved	15.2
Greenhillock 2	1	67.0	Pending	15.2
Drowndubbs Farm	2	46.5	Pending	15.3
Glenbran Farm	1	56.3	Pending	15.4
Michelin Tyres	2	120.0	Installed	15.4
Wester Derry Farm	1	45.0	Approved	15.5
Stotfaulds Farm	1	77.0	Pending	15.7
Gallow Hill	1	46.5	Pending	17.2
Outfield Farm Abernyte	1	40.0	Approved	17.3
Lochlair Farmhouse	1	47.0	Approved	17.4
Kalulu House	2	44.8	Pending	18.1
East Memus	1	86.5	Approved	18.2
White Top	1	86.5	Pending	18.6
Netheraird of Glasclune	1	67.0	Pending	19.1
Drumderg	16	107.0	Installed	19.1

Name	No. of Turbines	Tip height (m)	Status	Distance from turbine (km)
Newmill Of Balgavies	1	66.5	Pending	19.3
West Mains Of Turin	1	49.0	Pending	19.5
New Downie Farm	1	54.0	Pending	19.8
Broom Farm	1	49.5	Pending	20.1
Newton Of Idvies Farm	1	47.5	Approved	20.3
Hill Of Lethendy Farm	1	66.6	Approved	20.6
Upper Balmachie Farm	1	77.0	Pending	21.0
Pitkennedy Farm	1	74.0	Pending	21.9
The Corb Bridge	1	84.0	Pending (Appeal)	22.0
Wester Kilmany Farm	1	86.5	Pending	22.2
East Gormack Farm	1	66.7	Approved	22.2
Shandry Farm Rait	2	45.5	Approved	22.4
North Mains Of Cononsyth	1	66.7	Installed	22.8
Easter Logie	1	47.0	Pending	23.0
Pickerton	1	77.0	Approved	23.5
Parkconon Farm	1	45.0	Approved	23.5
Dubton Farm	1	77.0	Pending	23.9
Afflochie Farm	2	46.9	Approved	24.0
Cuthlie	1	77.0	Pending	24.3
Dunswood	1	77.0	Approved	25.0
Balnacake Farm	1	67.0	Pending	25.4
Newington Farm	1	41.5	Approved	25.6
Lordscairnie Farm	1	45.7	Approved	25.7
Balhall Lodge	1	49.0	Pending	25.9
Balhall Lodge	1	47.5	Approved	26.2
Glen Trusta	2	46.9	Approved	26.4
Stewart Tower Farm	1	45.0	Approved	27.0
Nathro Hill	17	135.0	Pending	27.1
Pitbladdo Farm	1	51.0	Approved	27.3
Hatton Mill Farm	1	77.0	Pending (Appeal)	28.0
Lumbennie Hill Pitcairlie	1	84.0	Approved	28.4
Westhall Cupar Fife	1	45.5	Installed	29.4

Table 13: Wind Farm Developments within 30km

5.3.10. Design optimisation and mitigation strategy

In the context of other technical and environmental constraints, objectives to minimise the landscape and visual effects have been considered in developing the location and design of the proposed development. Within this, the following landscape design aims have been adopted during the iterative process of site selection and scheme design to minimise any likely adverse effects:

- ***Design Aim 1***: Selection of a development pattern and scale that repeats the emerging pattern of one to two turbine wind energy developments throughout the lowland landscape in Angus;
- ***Design Aim 2:*** Selection of a location which prevents the coalescence of currently clearly separated wind farms visible in the surrouning landscape; and
- ***Design Aims 3*****:** Selection of a location and scale which avoids the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort.

5.4. Impact Assessment

5.4.1. Construction and decommissioning phases

In addition to the operational phase, there is also a requirement to assess the landscape and visual effects of the construction and decommissioning phases of the proposed development.

Visual effects

Any visual effects associated with the construction and decommissioning phases will primarily consist of short term effects on some residents, road users and walkers with open views of the skyline where the proposed turbine would be located resulting from the presence of install cranes and other plant machinery. For a limited number of residents and walkers within approximately 1.5km of the proposed turbine location with direct open views of the site during the construction and decommissioning phases, ***mod-major*** (significant) visual effects are predicted. These would only be experienced in relative short duration given the short term nature of these phases.

Landscape effects

The extent of the proposed development is shown on Drawing ING002. The construction and decommissioning phase are likely to result in the permanent loss of approximately 0.64 hectares of agricultural land as a result of the construction of the new access track, turbine foundations and substation building. The access track would be 2.1km in total, 730m of which would be along an existing farm track. A temporary borrow pit measuring 92m x 44m x 0.7m deep is also required although this would be re-instated to permanent grassland up to the edge of the hardstanding, access track, foundation and substation kiosk, after construction. The land will remain in permanent pasture agricultural use and no other landscape elements are predicted to experience direct effects from the construction and decommissioning phases.

Taking these factors into account, it is predicted these works would result in direct localised ***mod-minor*** (not significant) landscape effects in the short-medium term. Indirect effects on surrounding landscape character are predicted to be ***moderate*** (not significant) largely as a result of the crane and plant machinery affecting the surrounding rural character and the containment provided by the hill on nearby lower lying areas.

5.4.2. Operational phase

Overall, the additional structures associated with the proposed development (see Section 5.1.4) are judged to have a worst case ***mod-minor*** (not significant) additional impact on the

landscape and visual amenity of the surrounding area. The remainder of this assessment will therefore focus on the likely landscape and visual effect of the proposed wind turbine during the operational phase, having taken account of the mitigation measures described in Section 5.3.10. This is presented through separate assessments of landscape effects, visual effects and cumulative effects and informed through a detailed viewpoint assessment.

5.4.3. Overall pattern of theoretical visibility

The 3 point zone of theoretical visibility (ZTV) is illustrated in Drawings ING010-014. This demonstrates that within 5km of the proposed turbine location, the large majority of the northern part of the area is within theoretical views of the turbine. This includes nearly all of the A94 and surrounding local roads, the village of Balkeerie and most of the scattered dwellings and farmsteads. To the south of the proposed turbine location, theoretical visibility is restricted by surrounding higher ground and is concentrated to relatively small areas of some north facing slopes and hill summits including Kinpurney Hill and Carlunie Hill.

Outwith 5km, nearly all of the study area to the south is outside of theoretical visibility except a swath of land to the south of the A94 and small areas of north facing slopes and hill summits to the south-east of the site. To the north of the site, theoretical visibility is much more extensive. Most of the Vale of Strathmore is within theoretical visibility including a large proportion of main, minor and local roads and settlements. Further north, there is pattern of small areas of scattered theoretical visibility across the south facing summits and slopes of the Grampian foothills.

As the ZTV takes no account of the screening effects of woodland, development and other landcover, it is likely that the patterns of broadleaved woodlands and wooded estates scattered throughout the Vale of Strathmore would significantly limit actual visibility of the turbine in practice.

5.5. Viewpoint Assessment

Table 14 provides a summary of the landscape and visual assessment undertaken from the fourteen representative viewpoint locations. At each viewpoint, a detailed assessment was undertaken to identify any landscape and visual effects that is also used to inform the general assessment of landscape and visual effects.

The accompanying photomontages (Drawings ING039-080) have been prepared by combining a wireframe of the view with the photograph of the existing view and rendering the image using a model of the proposed wind turbines, also generated electronically. The images should be viewed at a distance as recommended on each montage to most closely replicate the view that will be obtained from the viewpoint.

It should be noted that every effort has been made to provide clear views of the turbine although due to intervening vegetation; clear views were not always available. Where this is the case, these viewpoints have been retained to demonstrate the limited effect of the proposed development in practice.

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
1. Easter Denoon	0.7	Igneous Hills	Medium	<u>*Medium-high*</u>: the turbine would be relatively prominent on the nearby local skyline although all of the lower part of the tower would be screened by intervening rising ground. For views in this direction, the movement of blades would detract from the smooth profile of the open topography and the prevailing rural and tranquil quality experienced along the intimate glen floor. The sense of containment and enclosure provided by the surrounding rising ground would also be compromised. Although there are other views of the nearby Ark Hill turbines to the south, the turbine would be an uncharacteristic addition to this part of the skyline, to the north. However, given a large proportion of the tower is screened from view, the sense of containment and enclosure provided by the surrounding rising ground would reduce the perceived scale of the development. At this point, landscape pattern is not particularly strong and is largely unaffected.	**Moderate to mod-major**	✓	Residents	High	<u>*Medium-high*</u>*:* residents of one nearby dwelling would experience direct views of the moving turbine blades on the nearby skyline from one upstairs room at the back of the dwelling and from the rear of the curtilage. The turbine would create a new visual focus within the important part of the view from the rear of the dwelling, dwarfing the scale of the local landform and surrounding landscape elements. It would detract from glimpsed long range views to the north-east and at this distance, the turbine would occupy a relatively large proportion of view, appearing as the most noticeable element in a predominantly short range view. It should be noted that the primary views from the dwelling are to the south and these would be unaffected by the proposed development.	**Mod-major to major**	✓
							Local road users	Medium	<u>*Medium*</u>*:* The visual changes experienced by a very small number of local road users are very similar to those experienced by residents (see above) although any changes would be experienced in mostly oblique views along a short section of the road.	Moderate	x

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
2. Denoon Law	1.1	Igneous Hills	Medium	*Medium-high*: given the near full visibility of the turbine and its elevated position, the turbine would be a very prominent structure on the local skyline. It would add further movement into the landscape and would compromise the intricate landform of ridges and rolling terrain. The turbine would contrast with the semi natural character of the rugged, open ridges and the prevailing rural and tranquil experience of the surrounding landscape although this is already compromised by the nearby Ark Hill turbines. The sense of containment and enclosure provided by the surrounding rising ground and the field pattern along the hillside would also be affected. Although there are other prominent views of wind energy development to the south, the turbine would be an uncharacteristic addition to this part of the landscape, to the west.	**Moderate to mod-major**	✓	Walkers	High	*Medium to high:* Due to the secluded nature and relatively inaccessible location of Denoon Law, a very low number of walkers would experience direct views of the turbine very prominent on the local skyline although within a wider panoramic view already compromised by the nearby wind energy development of Ark Hill. It would create a major visual focus within the important part of the view towards the nearby ridges and would dwarf the scale of surrounding trees and woodland blocks. Although at this distance, the turbine would occupy a large proportion of the vertical view, appearing as the most noticeable element in a mostly short range view, the turbine would relate well to the vertical scale of landform.	**Mod-major to major**	✓

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
3. Local road near Eassie School	1.2	Broad Valley Lowland	Medium	*Medium-high:* the turbine would be a prominent structure on the local skyline and would detract from the smooth profile of the open topography and the prevailing rural and tranquil quality experienced along the local road. The sense of containment and enclosure provided by the surrounding rising ground would also be affected although the turbine would relate well to the relatively large scale of the topography and vertical scale of landform. Although there are other views of distant wind energy development to the north, the turbine would be an uncharacteristic addition to the local landscape in this particular direction. The turbine would also contrast with the field pattern along the hillside to a limited degree.	**Moderate to mod-major**	✓	Residents	High	*Medium-high:* residents of one nearby dwelling would experience mostly open direct views of the turbine prominent on the nearby skyline from several rooms and curtilage although garden vegetation would provide a degree of screening. The turbine would create a new visual focus within the important part of the view. The turbine would occupy a relatively large proportion of view, appearing as the most noticeable element in a short range view. The turbine would also be back lit and would generally be more noticeable as a result. It should be noted that the primary views from the dwelling are to the north across the Vale of Strathmore and these would be unaffected by the proposed development.	**Mod-major to major**	✓
							Local road users	Medium	*Medium:* The visual changes experienced by a moderate number of local road users are very similar to those experienced by residents (see above) although any changes would be experienced in mostly oblique views from along this section of open road.	Moderate	x

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
4. Balkeerie	1.4	Broad Valley Lowland	Medium	*Medium-high:* the turbine would be a prominent structure on the local skyline and would detract from the smooth profile of the open topography and the prevailing rural and tranquil quality experienced along the local road. The sense of containment and enclosure provided by the surrounding rising ground would also be affected although the turbine would relate well to the relatively large scale of the topography. Although there are other views of distant wind energy development to the north, the turbine would be an uncharacteristic addition to the local landscape in this particular direction. The turbine would also contrast with the field pattern along the hillside to a limited degree.	**Moderate to mod-major**	✓	Residents	High	*Medium-high:* residents of several nearby dwellings would experience open and direct views of the turbine prominent on the nearby skyline from several rooms and curtilage. The turbine would create a new visual focus within the important part of the view. The turbine would occupy a relatively large proportion of the vertical view, appearing as the most noticeable element in a short range view, however the turbine would relate well to the relatively large scale of the topography. The turbine would also be back lit and would generally be more noticeable as a result. Views from the rear of nearby dwellings to the north across the Vale of Strathmore would be unaffected by the proposed development.	**Mod-major to major**	✓
							Local road users	Medium	*Medium:* The visual changes experienced by a moderate number of local road users are very similar to those experienced by residents (see above) although any changes would be experienced in mostly oblique views from along this section of open road.	Moderate	x

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
5. Carlunie Hill	2.4	Igneous Hills	Medium	Given that access to Carlunie Hill is extremely difficult, the experience of landscape and visual effects at this location from walkers is unlikely to be experienced in practice. Given that there is a cairn (Scheduled Ancient Monument) on the hill, the primary consideration from this location is the effect of the proposed development on its setting. An assessment of this is therefore presented in Chapter 8.							
6. Eassie Bridge	3.2	Broad Valley Lowland	Medium	*None:* the turbine would be screened from view by a dense intervening conifer plantation and no changes on the surrounding nearby landscape are predicted.	None	x	Residents	High	*None:* the turbine would be screened from view and no changes to the views of residents are predicted.	None	x
							Local road users	Medium	*None:* the turbine would be screened from view and no changes to the views of road users are predicted.	None	x

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
7. Kinpurney Hill	3.3	Igneous Hills	Medium	Low: the turbine would be a noticeable change on an intervening ridge and back clothed by views of the Vale of Strathmore. It would add further movement into the landscape although the turbine would be in scale with the surrounding landform, nearby conifer plantations and the turbines of Ark Hill. The rural character and tranquility would only be affected to a small extent as these are already compromised by a nearby pylon and the turbines of Ark Hill which occupy a more prominent position on the nearby skyline. The landscape pattern is not particularly strong at this point and considering the influence of Ark Hill wind farm, the turbine would not be uncharacteristic to the landscape.	Mod-minor	x	Walkers	High	Low-medium: A moderate number of walkers and visitors to Kinpurnie Tower would experience direct views of the turbine although within a wider panoramic view already compromised by nearby wind energy development. Given the extent and close proximity of the Ark Hill turbines, there would be little change to the focus of the view and the important views of the extensive Vale of Strathmore backed by the Grampians would be largely unaffected. At this distance, the turbine would occupy a relatively small proportion of the wider view and it would be less noticeable than the more extensive and prominent turbines of Ark Hill.	Moderate to mod-major	x

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
8. Auchterhouse Hill	4.6	Igneous Hills	Medium	<u>Low</u>: the turbine would be an evident change on an intervening wooded ridge and back clothed by views of the Vale of Strathmore. It would add further movement into the landscape although the turbine would be in scale with the surrounding landform, nearby conifer plantations and would appear smaller than the turbines of Ark Hill. The rural character and tranquility would only be affected to a very limited extent as these are already significantly compromised by a nearby pylon and the turbines of Ark Hill which occupy a more prominent position in the foreground. The landscape pattern is not particularly strong at this point and considering the influence of Ark Hill wind farm, the turbine would not be uncharacteristic.	Mod-minor	x	Walkers	High	<u>Low:</u> A relatively low number of walkers would experience direct views of the turbine although within a wider view and one already significantly compromised by the nearby turbines of Ark Hill in the foreground. There would be little change to the focus of the view and the important views of the extensive Vale of Strathmore backed by the Grampians would be largely unaffected. At this distance, the turbine would occupy a small proportion of the wider view and it would be much less noticeable than the more extensive and prominent turbines of Ark Hill.	Moderate	x
9. Glamis Castle	5.0	Broad Valley Lowland	Medium	<u>Negligible</u>: the turbine would be screened from view by dense intervening broadleaved woodland during summer months and during winter the turbine would be hardly discernible.	Minor	x	Visitors	High	<u>Negligible</u>: the turbine would be screened from view by dense intervening broadleaved woodland during summer months and during winter the turbine would be hardly discernible.	Mod-minor	x

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
10. B954 near Belmont Castle	5.4	Broad Valley Lowland	Medium	<u>Low-medium</u>: the turbine would be a noticeable change, situated relatively prominent on the predominantly open skyline. It would add movement into the backdrop of the landscape and would detract from the sense of containment and enclosure provided by the hills to an extent. The rural character would also be affected to a degree and the change would be uncharacteristic to the backdrop of the valley given that Ark Hill is screened by a conifer plantation at this point. However, a composition of transmission poles in the foreground offsets this to an extent.	Moderate to mod-minor	x	Minor road users	Medium	<u>Low:</u> Minor road users would experience oblique views of the turbine experienced in very short duration along a relatively quiet section of minor road. Although the turbine would detract from views of Kinpurnie Tower to an extent, there would be little change to focus of the view which at this point is along the wooded road corridor with a backdrop of hills beyond. At this distance, the turbine would be in scale with the vertical height of the landform and the turbine would only occupy a relatively small proportion of the framed view.	Mod-minor	x
11. Local road near Dryloch	7.1	Broad Valley Lowland	Medium	<u>Negligible</u>: The turbine would be viewed amongst of the turbines of Ark Hill and as such, the changes to the skyline of the Sidlaw Hills as a backdrop to the valley and the containment this provides would be hardly discernible. Furthermore, the rural character of the foreground is significantly compromised by a large transmission line crossing the valley floor.	Minor	x	Local road users	Medium	<u>Low-negligible</u>: a low number of local road users would experience direct views in short duration of the turbine amongst the Ark Hill turbines. There would be no change to the focus of view towards Ark Hill on the skyline although the introduction of the proposed turbine would add to the visual complexity with the composition of existing turbines.	Mod-minor to minor	x

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
12. A928 near Kirriemuir	9.7	Broad Valley Lowland	Medium	<u>Negligible</u>: The turbine would be viewed to the west of Ark Hill wind farm and Scotson turbine and as such, the changes to the skyline of the Sidlaw Hills as a backdrop to the valley and the containment this provides would be very limited. Considering the extent of existing turbines across the skyline, the strong rural character and tranquil quality of the foreground would only be affected to a very limited degree.	Minor	x	Residents	High	<u>Low-negligible</u>: residents of several nearby dwellings would have open views from some rooms and curtilage of the turbine on the distant skyline amongst a view of existing turbines. There would be little change to the focus of view towards Ark Hill although the introduction of the proposed turbine would add to the visual complexity with the composition of existing turbines on the skyline.	Moderate to mod-minor	x
							Main road users	Medium	<u>Low-negligible</u>: The visual changes experienced by a high number of main road users are very similar to those experienced by residents (see above) as views would be direct along a section of open road.	Mod-minor to minor	x
13. A926 near Padanaram	11.5	Broad Valley Lowland	Medium	<u>Negligible</u>: The turbine would be viewed to the west of Ark Hill wind farm and Scotson turbine and as such, the changes to the skyline of the Sidlaw Hills as a backdrop a drop to the valley and the containment this provides would be very limited. Furthermore, the rural character of the foreground is significantly compromised by a large transmission line crossing valley	Minor	x	Residents	High	<u>Negligible</u>: residents of a small number of nearby dwellings would have mostly oblique views from some rooms and curtilage of the turbine on the distant skyline amongst a view of existing turbines. There would be little change to the focus of view towards Ark Hill on the skyline although the introduction of the proposed turbine would add to the visual complexity with the composition of existing turbines.	Mod-minor	x

VP Location	Distance	LANDSCAPE					VISUAL				
		LCT	Sensitivity	Magnitude of Change	Effect	Significant	Receptor	Sensitivity	Magnitude of Change	Effect	Significant
				floor.			Main road users	Medium	*Negligible:* The visual changes experienced by a large number of local road users are very similar to those experienced by residents (see above) although any changes would be experienced in mostly oblique views from along this section of open road.	Minor	x
14. A 923 near Coupar Angus	12.8	Broad Valley Lowland	Medium	*Low-negligible*: the turbine would be a relatively noticeable change at this distance, situated on the predominantly open skyline. It would add further movement into the backdrop of the landscape and would detract from the sense of containment and enclosure provided by the hills to an extent. The rural character would also be affected to a degree although the change would be not uncharacteristic.	Mod-minor to minor	x	Residents	High	*Negligible*: residents of one nearby dwelling would have views filtered by nearby trees of the turbine on the distant skyline. It would create a visual focus and would detract from views of Kinpurnie Tower to an extent. The turbine would be back lit for part of the day but would occupy a very small proportion of the skyline at this distance.	Mod-minor	x
							Main road users	Medium	*Negligible:* The visual changes experienced by a relatively high number of local road users are very similar to those experienced by residents (see above) although any changes would be experienced in mostly oblique views from along this section of open road.	Minor	x

Table 14: Viewpoint Assessment

5.6. Landscape effects

5.6.1. Residual landscape effects

Table 15 sets out a summary of the predicted effects on all landscape designations and LCTs within 15km from the proposed development. The findings have been informed by the detailed viewpoint assessment (see Table 14) and through further field survey assessment. For those designations from 15-25km from the turbine, a summary of likely effects are presented in Section 5.6.2. Where any significant effects are identified, a more detailed assessment is presented in Section 5.6.3.

Receptor	Sensitivity	Magnitude of Change	Effect	Significance
Landscape designations				
Within 0 km to 15 km				
Glamis Castle GDL	High	*Low:* Glamis Castle GDL is located approximately 4.3km to the north-east of the turbine at its closest point. The ZTV demonstrates that there are continuous areas of theoretical visibility of the turbine across the entire designation. Due to the heavily wooded nature of the polices surrounding the GDL and the screening effect of nearby intervening conifer plantations to the south-west, actual visibility from the grounds is likely to be limited to occasional glimpses of the turbine in very limited locations during winter months. However, panoramic views from the top of the Castle are available where the turbine is likely to be noticeable although in close proximity to the Ark Hill turbines with other developments visible across the wider view. The important views towards the Grampians would be unaffected.	Moderate	Not significant
Drumkilbo GDL	High	*Low:* Drumkilbo is located approximately 4.5km to the north-west of the turbine at its closest point and all of the designation is within theoretical views. In practice, some views of the turbine on the skyline are likely to be experienced from the house and the south-eastern part of the grounds although this would be in the context of the nearby Ark Hill turbines which already detract from the backdrop of the hills thus limiting the changes to the skyline and associated effects on the quality of the GDL.	Moderate	Not significant
Airlie Castle GDL	High	*None:* Located approximately 7.8km to the north-west of the turbine, the southern and northern parts of the glens are within theoretical views although the Castle is outside of theoretical visibility. Considering the heavily wooded nature of the glens, views of the turbine in practice are very unlikely to be experienced and no changes are predicted.	None	Not significant
Clatto Country Park	Medium	*None*: Clatto Country Park is outside of the ZTV and no changes are predicted.	None	Not significant
Camperdown and Templeton Woods	Medium	*None*: The Country Park is outside of the ZTV and no changes are predicted.	None	Not significant

Receptor	Sensitivity	Magnitude of Change	Effect	Significance
Country Park				
Forfar Loch Country Park	Medium	*None:* Located 11km to the north-east, the entire park is within theoretical views of the turbine. Talking into account the screening effect of the belt of coniferous planting along the south-western edge and trees along the A90, views of the turbine in practice are very unlikely to be experienced.	None	Not significant
Ascreavie GDL	High	*Negligible:* Ascreavie GDL is located 12.4km to the north of the turbine and all of the designation is within theoretical visibility. Although there are long views to the south and south-west across the valley, a nearby wooded belt is likely to limit views in practice to possible glimpses of the turbine above the woodland.	Mod-minor	Not significant
Balgay Park GDL	High	*None*: The GDL is outside of the ZTV and no changes are predicted.	None	Not significant
Baxter Park GDL	High	*None*: The GDL is outside of the ZTV and no changes are predicted.	None	Not significant
Rossie Priory GDL	High	*None*: The GDL is outside of the ZTV and no changes are predicted.	None	Not significant
Landscape Character Types				
Within 0 km to 15 km				
Igneous Hills	Medium	*Low-medium:* The turbine would be located within the Igneous Hills LCT. The ZTV (see Drawing ING018) demonstrates that there are near continuous areas of theoretical visibility across the landscape within approximately 2.5km of the proposed turbine location. Beyond 2.5km, theoretical visibility is restricted by surrounding higher ground and is concentrated to relatively small areas of some north facing slopes and hill summits including Kinpurney Hill and Carlunie Hill. Taking into account the prevailing open nature of the hills, the extent of actual visibility would be very similar in practice. Overall however, only a relatively small proportion of the LCT would experience views of the turbine. The landscape assessments from viewpoints 1 and 2 (both within 1.1km from the proposed turbine location) predict a *medium-high* magnitude of change where the	Moderate to mod-minor	Not significant

Receptor	Sensitivity	Magnitude of Change	Effect	Significance
		turbine would be prominent on the local skyline, adding movement into the landscape and dwarfing the scale of the surrounding intricate landform of ridges and rolling terrain. It would also compromise the semi natural character of the rugged, open ridges and the prevailing rural and tranquil experience of the surrounding landscape. Taking into account the effects of Ark Hill wind farm on the surrounding character and quality of the landscape, the magnitude of change decreases with distance. From viewpoint 7 (3.3km) and viewpoint 8 (4.6km) the magnitude of change is predicted to be *low*. Considering the limited extent of changes across the entire LCT and the decreasing magnitude of change with distance, the overall magnitude is predicted to be *low-medium*.		
Broad Valley Lowland	Medium	*Low-medium:* The LCT is located in close proximity to the north of the proposed turbine location and the ZTV demonstrates that nearly all of the Broad Valley Lowland LCT is within theoretical visibility of the turbine. Due to the screening effect of the characteristic patterns of woodland blocks and the dense polices of wooded estates across the LCT, the extent of views in practice would be significantly reduced, particularly further away from the proposed turbine location. The landscape assessments from Balkeerie at viewpoint 3 (1.2km) and viewpoint 4 (1.4km) both predict a *medium-high* magnitude of change, largely as a result of the prominence of the turbine compromising the containment of the valley floor and detracting from the surrounding rural character and tranquil quality. At viewpoint 10 (5.4km), the magnitude of change reduces to *low-medium*. From those locations beyond approximately 7km, the influence of Ark Hill wind farm on the skyline becomes more evident thus limiting the magnitude of change of the proposed development on the sensitive skyline. Viewpoints 9, 11, 12, and 13 all predict a *negligible* change. Taking all these factors into account, the magnitude of change across the LCT is predicted to be *low-medium* overall.	Moderate to mod-minor	Not significant
Low Moorland	Medium	*Negligible:* The Low Moorland Hills LCT is located approximately 8 km to the east of the site at its closet point with scattered areas of theoretical visibility across	Mod-minor to	Not significant

Receptor	Sensitivity	Magnitude of Change	Effect	Significance
Hills		some areas of higher ground. Considering the screening effect of large conifer plantations across the area, the extent of views in practice would be significantly reduced. Where open views are apparent, the turbine would tend to be viewed on the skyline of the Sidlaws, amongst the turbines of Ark Hill and other nearby single turbines.	minor	
Dipslope Farmland	Medium	*None:* Only very small areas of the LCT are within theoretical visibility and the effect of intervening woodlands are likely to screen any views in practice.	None	Not significant
Highland Foothills	Medium to High	*Negligible:* Located mostly beyond 10km from the proposed turbine location, there are scattered areas of theoretical views across the south facing hills and slopes of the LCT. In practice, occasional conifer plantations across the hills and associated wooded glens would provide a degree of local screening. Where open views are experienced, the turbine would be viewed on the distant skyline across the Vale of Strathmore amongst Ark Hill wind farm and other nearby single turbines. Taking into account the findings of the viewpoint assessment at this distance, the overall magnitude of change is predicted to be *negligible*.	Mod-minor to minor	Not significant
Highland Glens	Medium to High	*Negligible:* The three glens are located mostly beyond 10km from the proposed turbine location with scattered areas of theoretical visibility across a relatively small proportion of the glens. Areas of woodland along the valley sides would limit views in practice to localised areas. Where open views are experienced, the turbine would be viewed on the distant skyline across the Vale of Strathmore amongst Ark Hill wind farm and other nearby single turbines. Taking into account the findings of the viewpoint assessment at this distance, the overall magnitude of change is predicted to be *negligible*.	Mod-minor to minor	Not significant
Firth Lowlands	Medium to high	None: The LCT is outside of the ZTV and no changes are predicted.	None	Not significant

Table 15: Residual effects on landscape receptors

5.6.2. Residual landscape effects from 15-25km

As the purpose of the assessment process is to focus on likely *significant* effects, a detailed assessment of landscape designations and LCTs from 15km to 25km from the turbine location has not been undertaken. However, the following landscape designations and LCTs are all outside of theoretical views and no effects would be experienced:

- Lowland Hills and Valleys LCT
- Lowland Glacial Melt Water Valley LCT
- Coastal Braes LCT
- Upland Foothills LCT
- Coastal Terraces LCT
- Coastal Flats LCT
- Lowland Mixed Coasts LCT
- Cairngorms National Park
- Cortachy Castle GDL
- Craighall Rattray GDL
- Glendoick GDL
- Naughton GDL
- Guthrie Castle GDL
- House of Pitmuies GDL
- Stobhall GDL
- Fingask Castle GDL
- Megginch Castle GDL
- Errol Park GDL
- The Guynd GDL
- Crombie County Park
- Monikie Country Park

The Lowland River Corridors LCT, Lowland Hills LCT, Meikleour GDL, Tay Coast Special Landscape Area and the East Perth Area of Great Landscape Value are all within theoretical visibility. However, as indicated by the findings of the viewpoint assessment, the magnitude of change is not predicted to be greater than *negligible* at this distance and where any views of the turbine would be experienced, effects would not be significant at this distance.

5.6.3. Summary of significant landscape effects

As demonstrated by the viewpoint assessment, **localised significant** effects are predicted on parts of the *Igneous Hills* LCT and the *Broad Valley Lowland* LCT within approximately 1.5km from the proposed turbine location.

However, **no significant** landscape effects are predicted on the overall integrity of these two LCTs or on any landscape designations or other LCTs within the study area. This demonstrates in landscape terms, that the *Igneous Hills* LCT has the capacity to accommodate the proposed development without a detrimental effect on its character. This reinforces the findings of the *Angus Windfarms - Landscape Capacity and Cumulative Impacts Study* (2008) which concludes the landscape has a medium capacity for development at the proposed scale.

5.7. Visual effects

5.7.1. Residential dwellings and settlements

Table 16 provides an assessment of the visual effects on residents from all individual dwellings within 2km from the turbine location and villages and towns within 15km. It should be noted that the study was undertaken on the basis of visits to locations to which access was obtainable without access to private property. Aerial photographs were also used to supplement site visits.

In considering the overall acceptability of the scheme, it is important to consider that where any significant effects have been identified, these often relate to views from a limited number of rooms that may have direct and open views of the turbine. In many instances, **the primary views from dwellings would not have any views towards the proposed development** and as such, views from these rooms would be unaffected.

Furthermore, given the distance from the turbine and the horizontal extent of change is limited to that of a single turbine, any significant effects on visual amenity are very **unlikely to**

result in significant effects on residential amenity. For a scheme of this nature, significant visual effects are likely to be experienced in close proximity to a turbine, but this does not necessarily result in the scheme being unacceptable.

Taking into account the findings of the viewpoint assessment, significant effects are very unlikely to be experienced outside of 15km and as such, the limited number of larger villages and towns that are within theoretical visibility have not been assessed in detail. Where open views of the turbine from these settlements are available, the magnitude of change is predicted to be no greater than *negligible* resulting in a worst case ***mod-minor*** (not significant) effect.

Receptor	Distance (km)	Sensitivity	Magnitude of Change	Effect	Significance
Individual dwellings within 2 km – (N.B. see Drawings ING081-082 for location of numbered dwellings)					
1. (7 dwellings)	1.5	High	*Medium-high*: residents of all dwellings would have some direct and open views of the turbine prominent and back lit on the nearby skyline from front facing rooms and curtilage.	Mod-major to major (no views from rear facing rooms)	Significant
2. (School)	1.2	High	*Low:* From front facing rooms, views of the turbine would be mostly screened during summer months by roadside trees with filtered views during winter months.	Moderate (no views from rear facing rooms)	Not significant
3. (1 dwelling)	1.2	High	*Medium-high*: residents would have direct and open views of the turbine prominent and back lit on the nearby skyline from front facing rooms and curtilage.	Mod-major to major (no views from rear facing rooms)	Significant
4. (1 dwelling)	1.2	High	*Medium-high*: residents would have direct and open views of the turbine prominent and back lit on the nearby skyline from front facing rooms and curtilage.	Mod-major to major (no views from rear facing rooms)	Significant
5. (2 dwellings)	1.2	High	*Medium:* residents of one dwelling would have oblique and mostly open views of the turbine prominent and back lit on the nearby skyline from rear facing rooms and curtilage.	Mod-major (no views from front facing rooms)	Significant
			Low: residents of one dwelling would have oblique views, mostly screened or filtered by garden trees from rear facing upstairs rooms only.	Moderate (no views from rear facing rooms)	Not significant
6-14. (14 dwellings)	1.4	High	*Medium-high*: residents of fourteen dwellings would have direct and open views of the turbine prominent and back lit on the nearby skyline from front facing rooms and curtilage.	Mod-major to major (no views from rear facing rooms)	Significant
15. (1 dwelling)	1.4	High	*Medium-high*: residents would have direct and open views of the turbine prominent and back lit on the nearby skyline from rear facing rooms and curtilage.	Mod-major to major (no views from rear facing rooms)	Significant

Receptor	Distance (km)	Sensitivity	Magnitude of Change	Effect	Significance
16. (3 dwellings)	1.5	High	*Medium-high*: residents would have direct and open views of the turbine prominent and back lit on the nearby skyline from rear facing rooms and curtilage.	Mod-major to major (no views from front facing rooms)	Significant
17. (1 dwelling)	1.5	High	*Medium:* residents would have oblique and mostly open views of the turbine prominent and back lit on the nearby skyline from rear facing rooms and curtilage.	Mod-major (no views from front facing rooms)	Significant
18. (1 dwelling)	1.6	High	*Low*: views are mostly screened by garden vegetation and nearby roadside trees although the tips maybe visible above nearby dwellings from the curtilage only.	Moderate (no views from rooms)	Not significant
19. (1 dwelling)	1.5	High	*Low*: views are mostly screened by garden vegetation and nearby roadside trees although the tips maybe visible above nearby dwellings from the curtilage only.	Moderate (no views from rooms)	Not significant
20. (1 dwelling)	1.5	High	*None*: views are likely to be screened by nearby trees and built development.	None	Not significant
21. (1 dwelling)	1.5	High	*Medium-high*: residents would have direct and open views of the turbine prominent and back lit on the nearby skyline from some front facing rooms and curtilage.	Mod-major to major (no views from rear facing rooms)	Significant
22. (1 dwelling)	1.6	High	*Low*: views would mostly be screened by garden vegetation and nearby roadside trees although the tips maybe visible above nearby dwellings from the curtilage only.	Moderate (no views from rooms)	Not significant
23. (1 dwelling)	1.6	High	*Medium*: views would mostly be screened by garden vegetation and nearby roadside trees although open oblique views from some front facing rooms and curtilage would be experienced.	Mod-major (no views from rear facing rooms)	Significant
24. (1 dwelling)	1.7	High	*None*: views would likely to be screened by nearby trees	None	Not significant

Receptor	Distance (km)	Sensitivity	Magnitude of Change	Effect	Significance
			and built development.		
25. (1 dwelling)	1.4	High	*Low*: views are likely to be screened by adjacent farm buildings although there may be some views of the turbine tips above adjacent buildings from the curtilage.	Moderate	Not significant
26. (1 dwelling)	1.3	High	*Low-medium*: some direct views maybe possible although partly filtered by intervening trees.	Moderate to mod-major	Significant
27. (1 dwelling)	1.5	High	*Low*: views of the turbine are likely to be screened although the tips maybe visible above an intervening conifer plantation.	Moderate	Not significant
28. (1 dwelling)	1.7	High	*None*: views are likely to be screened by nearby trees and adjacent farm buildings.	None	Not significant
29. (1 dwelling)	1.9	High	*None*: views are likely to be screened by surrounding trees and woodland.	None	Not significant
30. (1 dwelling)	1.1	High	*None*: views are likely to be screened by surrounding trees and woodland.	None	Not significant
31. (2 dwellings)	1.3	High	*Medium*: residents of 2 dwellings would have open views of the turbine on the nearby skyline from a small number of areas within the curtilage only.	Mod-major (no views from rooms)	Significant
32. (1 dwelling)	1.9	High	*None*: views would be screened by surrounding trees and nearby woodlands.	None	Not significant
33. (1 dwelling)	0.7	High	*Medium-high*: residents of the dwelling would have direct and open views of the turbine prominent on the nearby skyline from a single rear facing room and parts of the curtilage.	Mod-major to major (no views from main front facing rooms)	Significant
34. (1 dwelling)	0.7	High	*None*: views are likely to be screened by adjacent farm buildings.	None	Not significant

Receptor	Distance (km)	Sensitivity	Magnitude of Change	Effect	Significance
35. (1 dwelling)	0.9	High	*None:* Outside of theoretical views and no changes are predicted.	None	Not significant
36. (1 dwelling)	1.2	High	Unable to access	N/A	N/A
37. (1 dwelling)	1.9	High	*None*: views are likely to be screened by adjacent farm buildings.	None	Not significant
Villages and towns within 15 km					
Milton	3.8	High	*None:* the settlement is outside of the ZTV and no changes are predicted.	None	Not significant
Newtyle	5.3	High	*None:* Most of the village is within theoretical views although views are likely to be screened by intervening conifer plantations.	None	Not significant
Kirton of Auchterhouse	5.4	High	*None:* the settlement is outside of the ZTV and no changes are predicted.	None	Not significant
Meigle	5.5	High	*Negligible*: The entire village is within theoretical views and from the large majority of dwellings; views would be screened by nearby built development and surrounding woodlands. From several dwellings along the B954, views of the tips of the turbine might be possible above a nearby intervening woodland belt.	Mod-minor	Not significant
Ardler	8.2	High	*None*: the entire village is within theoretical visibility although in practice, views would be screened by nearby intervening woodlands.	None	Not significant
Westmuir	8.4	High	*Low*: the entire village is within theoretical visibility although in practice; views from the majority of dwellings would be screened by nearby built development intervening woodlands. Several dwellings along the	Moderate	Not significant

Receptor	Distance (km)	Sensitivity	Magnitude of Change	Effect	Significance
			southern edge would have open views of the turbine on the skyline.		
Tealing	9.2	High	*None:* the settlement is outside of the ZTV and no changes are predicted.	None	Not significant
Lundie	9.3	High	*None:* the settlement is outside of the ZTV and no changes are predicted.	None	Not significant
Gateside	9.4	High	*None:* the settlement is outside of the ZTV and no changes are predicted.	None	Not significant
Kirriemuir	9.7	High	*Low-negligible*: nearly the entire town is within theoretical views and from the large majority of dwellings; views would be screened by nearby built development. From several dwellings along the southern edge, views of the turbine on the skyline would be experienced.	Moderate to mod-minor	Not significant
Alyth	10.1	High	*Negligible*: The entire village is within theoretical views and from the large majority of dwellings; views would be screened by nearby built development and surrounding woodlands. From several dwellings along the southern edge, views of the turbine on the skyline might be possible amongst intervening trees and woodlands.	Mod-minor	Not significant
Dundee	10.2	High	*None:* the settlement is outside of the ZTV and no changes are predicted.	None	Not significant
Inveraldie	10.3	High	*None:* the settlement is outside of the ZTV and no changes are predicted.	None	Not significant
Forfar	11.5	High	*Negligible*: Most of the town is within theoretical views and from the large majority of dwellings; views would be screened by nearby built development and surrounding woodlands. From several dwellings along the southern	Mod-minor	Not significant

Receptor	Distance (km)	Sensitivity	Magnitude of Change	Effect	Significance
			edge, views of the turbine on the skyline might be possible amongst intervening trees.		
Coupar Angus	12.7	High	*Negligible*: The entire town is within theoretical views and from the large majority of dwellings; views would be screened by nearby built development and surrounding woodlands. From several dwellings along the east edge of the town, views of the tips of the turbine are likely to be experienced amongst intervening trees.	Mod-minor	Not significant

Table 16: Summary of residual effects on residential settlements

5.7.2. Summary of effects on Individual dwellings within 2 km

Of the 51 individual dwellings within 2km, approximately 34 would have some direct open views from either rooms and/or the curtilage of the turbine on the skyline. From these, the magnitude of change is predicted to be *medium* or *medium to high* resulting in **mod-major** or **mod-major to major** (significant) effects.

However, the extent of significant effects are often limited to a small number of rooms that may have direct and open views of the turbine or where views are experienced from parts of the curtilage only. **In many instances, the primary orientation of dwellings would be in the opposite direction to the proposed development and as such, views from these rooms would be unaffected.**

Although significant, given the distance from the turbine and the horizontal extent of change is limited to that of a single turbine, the effects are **very unlikely to result in significant effects on residential amenity.** It should be noted however that a detailed residential amenity assessment is beyond the scope of this assessment.

From 7 dwellings, views would either be oblique and/or filtered or partly screened by nearby trees and woodlands or built development. From these, effects are likely to be **not significant**.

From a further 9 dwellings, views would be screened by intervening buildings or vegetation or are outside of theoretical views and as such, no visual effects are predicted.

5.7.3. Summary of effects on villages and towns within 15km

Of the fifteen villages and towns assessed within 15km from the proposed turbine location, the majority of these are outside of theoretical views or in practice, any theoretical views are screened by nearby woodlands and built development. A very limited number of dwellings on the edges of some settlements would experience open views of the turbine but at a distance where effects are predicted to be **not significant**.

5.7.4. Roads and recreational routes

Main Roads within 15km

The ZTV indicates that approximately a 9km section of the A94 within 5km of the proposed turbine location will have potential views of the turbine. In practice, occasional roadside woodlands and trees and built development will provide some localised screening although along the majority of the route, road users would experience open but oblique views of the turbine on the skyline. Considering the duration of likely views and the distance from the turbine, the magnitude of change is predicted to be *medium* with a **moderate** and **not significant** effect.

Along the main roads outside of 5km within the theoretical views (A90, A926, and the A928), as demonstrated by the findings of the viewpoint assessment, significant effects are very unlikely to be experienced at this distance.

Local & Minor roads within 15km

There is a network of local roads within the study area. For the majority of these routes, actual visibility is limited by intervening vegetation and the magnitude of change limited by distance to the turbine and orientation of view. As demonstrated by the findings of the assessment at viewpoints in close proximity to the turbine, effects on road users are not judged to be significant given the relatively short duration of predominantly oblique views. Taking these factors into account, effects on all road users within 15km are predicted to be **not significant**.

Recreational routes

The National Cycle Route 1 and the Fife Coastal path are both located beyond 15km from the proposed development and outside of theoretical views. No effects are therefore predicted.

5.8. Cumulative effects

This section assesses the potential landscape and visual effects arising from the proposal in conjunction with other wind developments that have been consented, are operational or are at application stage. The proposed site forms the focus of the study area and includes all those schemes within a 30km radius (see Table 13 and Drawing ING019). The cumulative assessment identifies the ways in which the proposal may have additional effects, when considered together with the cumulative situation resulting from other planned, consented or operational wind energy developments.

5.8.1. Individual Cumulative Inter-Visibility

There are seventeen planned, approved or installed schemes within 10km which have the greatest potential to present significant cumulative effects with the proposed development. These are highlighted below.

Name	No. of Turbines	Tip height (m)	Status	Distance from turbine (km)
Ark Hill	8	77.0	Installed	1.8
Henderston Quarry	1	66.0	Approved	3.3
Scotson	1	79.6	Installed	4.3
Davidston Farm	1	62.0	Pending	5.0
Govals Wind Farm	6	86.5	Pending	7.1
Frawney Wind Farm	5	80.0	Pending	7.3
North Leoch	1	45.6	Approved	7.4
West Mains Farmhouse	1	61.0	Approved	7.6
Balkemback Farm	2	46.5	Approved	7.7
Reedie Farm	2	46.9	Approved	7.8
House On The Hill Kettins	1	45.4	Approved	8.8
West Adamston Farm	1	47.5	Installed	8.9
Lundie Castle Farm	1	48.5	Pending	8.9
North Tarbax	1	45.9	Approved	9.1
House On The Hill	1	46.5	Approved	9.4
Tealing	1	86.5	Approved	9.5
Former Tealing Airfield	1	86.5	Pending	9.5

Table 17: Planned, approved or installed schemes within 10km

Drawings ING021-037 demonstrate the areas of individual combined theoretical cumulative visibility with the seventeen schemes within 10km from the proposed turbine location. These demonstrate that there would be no combined theoretical visibility with North Leoch, West Mains Farmhouse, Balkemback Farm, West Adamston Farm, Lundie Castle Farm, Tealing and Former Tealing Airfield and as such, no cumulative effects are predicted with these schemes.

Considering the combined theoretical visibility with the remaining ten schemes within 10km, the proposed development would result in a slight increase in areas to the south-west of the turbine location (to the south of the A94) where no developments are currently theoretically visible.

The extent of combined individual theoretical visibility is greatest with Ark Hill Wind Farm, Scotson, Govals Wind Farm, Reedie Farm, House On The Hill Kettins and House On The Hill with the large majority of the Vale of Strathmore predicted to experience cumulative views. The combined theoretical visibility with North Tarbax, Frawney Wind Farm, Davidston Farm and Henderston Quarry are relatively limited in comparison. Given the screening effect of woodland blocks and the wooded estates across the Vale of Strathmore to the north of the site, actual cumulative intervisibility would be more likely in practice to the south of the site from areas of higher open ground across the Sidlaw Hills.

The fourteen representative viewpoints have been used to demonstrate the actual cumulative intervisibility and the cumulative effects of the proposed development with one or more wind farms. As noted previously, these viewpoints are considered to be representative of a range of receptor types and distances. Table 18 outlines the cumulative effect on each representative viewpoint.

VP Location	Distance	Predicted view containing Turbines – without proposed development	Predicted view including proposed development	VISUAL				
				Receptor	Sensitivity	Magnitude of Change	Effect	Significant
1. Easter Denoon	0.7	In the combined view, no other developments would be visible. To the south, successive views of Ark Hill and the tips of Henderston Quarry and Scotson are mostly screened by nearby intervening trees and built development although open views would be experienced from the front of the nearby dwelling of the Ark Hill turbines in close proximity on the skyline. To the north-east, distant views of Reedie Farm, Gallow Hill, East Memus and White Top would be screened by a nearby intervening tree belt.	The proposed development would be relatively prominent in close proximity on the nearby skyline, although siting allows for a significant proportion of the tower to be screened from view. Although it would not bring development appreciable closer, it would contrast with the pattern of Ark Hill and bring development to a new part of the view.	Residents	High	Medium-high	**Mod-major to major**	✓
				Local road users	Medium	Medium	Moderate	x
2. Denoon Law	1.1	In the combined view, Bamff Wind Farm and Drumderg would be evident on the distant skyline and Netheraird of Glasclune would be hardly discernible in the distance. To the south, Ark Hill would be very prominent in close proximity with the tips of Henderston Quarry and Scotson noticeable on the skyline. Further north, a number of single turbines would be evident and back clothed against a distant backdrop of the Grampians.	The proposed development would be prominent in close proximity on the nearby skyline. Although it would not bring development appreciable closer, it would contrast with the pattern of Ark Hill, and bring development to a new part of the view for the few walkers likely to visit Denoon Law. *This is an assessment of the impact on what is expected to be a low number of walkers visiting the site. The impact on Cultural Heritage setting is outlined in Chapter 8.*	Walkers	High	Medium-high	**Mod-major to major**	✓

VP Location	Distance	Predicted view containing Turbines – without proposed development	Predicted view including proposed development	VISUAL				
				Receptor	Sensitivity	Magnitude of Change	Effect	Significant
3. Local road near Eassie School	1.2	In the combined view, no other developments would be visible. To the north, a number of developments would be evident in the distance.	The proposed development would be prominent in close proximity on the nearby skyline. Although it would bring development much closer and to a new part of the view, as a single turbine it would not significantly extend the influence of nearby wind energy development.	Residents	High	Low	Moderate	x
				Local road users	Medium	Low-negligible	Mod-minor to minor	x
4. Balkeerie	1.4	In the combined view, no other developments would be visible. To the north and west, successive views of distant developments would be screened by nearby built development.	N/A – the proposed development is screened from view	Residents	High	None	None	x
				Local road users	Medium	None	None	x
5. Carlunie Hill	2.4	Given that access to Carlunie Hill is extremely difficult, the experience of landscape and visual effects at this location from walkers is unlikely to be experienced in practice. Given that there is a cairn (Scheduled Monument) on the hill, the primary consideration from this location is the effect of the proposed development on its setting. An assessment of this is therefore presented in Chapter 8.						
6. Eassie Bridge	3.2	N/A – the proposed development is screened from view	N/A – the proposed development is screened from view	Residents	High	None	None	x

VP Location	Distance	Predicted view containing Turbines – without proposed development	Predicted view including proposed development	VISUAL				
				Receptor	Sensitivity	Magnitude of Change	Effect	Significant
				Local road users	Medium	None	None	x
7. Kinpurney Hill	3.3	In the combined view, Ark Hill is prominent in the foreground with a further ten developments evident across the Vale of Strathmore and beyond. In successive views to the south, Scotson is prominent on a nearby skyline, Davidston Farm and Henderston Quarry very noticeable against a backdrop of nearby hills and twelve other more distant developments scattered across the Sidlaw Hills.	The proposed development would be a noticeable change on an intervening ridge and back clothed by views of the Vale of Strathmore. It would not bring development closer or introduce a new pattern of development. It would extend the influence of turbines further towards the Vale of Strathmore, appearing as an outlier to Ark Hill and contrasting with its pattern.	Walkers	High	Low-medium	Moderate to mod-major	x
8. Auchterhouse Hill	4.6	In the combined view, Ark Hill is prominent in the foreground with a further eight developments of varying scales scattered across the view. In successive views to the west, Scotson is prominent on a nearby skyline, with up to twenty two other developments evident to the west and east.	The proposed development would be a noticeable change on an intervening ridge and back clothed by views of the Vale of Strathmore. It would not bring development closer or introduce a new pattern of development.	Walkers	High	Low	Moderate	x
9. Glamis Castle	5.0	Taking into account the screening effect of dense surrounding policy woodlands, views of all developments are likely to be screened in practice.	Taking into account the screening effect of dense surrounding policy woodlands, cumulative views are very likely to be screened in practice.	Visitors	High	None	None	x

VP Location	Distance	Predicted view containing Turbines – without proposed development	Predicted view including proposed development	VISUAL				
				Receptor	Sensitivity	Magnitude of Change	Effect	Significant
10. B954 near Belmont Castle	5.4	In the combined view, the tips of Ark Hill are just evident above a skyline conifer plantation. Afflochie would be screened by intervening woodland. Views of all other development to the north and west would be screened by nearby woodlands and built development.	The proposed development would be quite prominent on the skyline and would be the most noticeable turbine in view. It would not bring development appreciably closer but would extend the influence of development further east across the skyline.	Minor road users	Medium	Low	Mod –minor	x
11. Local road near Dryloch	7.1	In the combined view, Govals, Ark Hill, Scotson Davidston Farm and Henderston Quarry would all be noticeable across the skyline. Successive views of developments would be screened by nearby woodlands and intervening forestry blocks.	The proposed development would be viewed amongst of the turbines of Ark Hill. It would not introduce a new pattern of development, bring development to a new part of the view or extend the influence of development. A slight degree of visual complexity with the Ark Hill turbines would however be evident with possible contrasts in turbine design.	Local Road users	Medium	Negligible	Minor	x
12. A928 near Kirriemuir	9.7	In the combined view, House On The Hill Kettins and House On The Hill, Ark Hill, Scotson and Henderston Quarry would all be noticeable across the skyline. Successive views of other developments would be screened by nearby woodlands, built development and intervening forestry blocks.	The proposed development would be viewed amongst a skyline of other developments in relatively close proximity. It would not introduce a new pattern of development or bring development to a new part of the view. It would appear slightly closer than existing developments.	Residents	High	Negligible	Mod-minor	x
				Main road users	Medium	Negligible	Minor	x

VP Location	Distance	Predicted view containing Turbines – without proposed development	Predicted view including proposed development	VISUAL				
				Receptor	Sensitivity	Magnitude of Change	Effect	Significant
13. A926 near Padanaram	11.5	In the combined view, Govals, Ark Hill, Scotson Davidston Farm and Henderston Quarry would all be noticeable across the skyline. Successive views of developments would be screened by nearby woodlands and intervening forestry blocks.	The proposed development would be viewed amongst a skyline of other developments in relatively close proximity. It would not introduce a new pattern of development or bring development to a new part of the view. It would appear slightly closer than existing developments and extend the influence of development further west across the skyline.	Residents	High	Negligible	Mod-minor	x
				Local road users	Medium	Negligible	Minor	x
14. A 923 near Coupar Angus	12.8	In the combined view, House On The Hill Kettins and House On The Hill, Ark Hill, and Henderston Quarry would all be noticeable across the skyline. Successive views of other developments would be screened by nearby woodlands and built development.	The proposed development would be viewed amongst a skyline of other developments but would extend the influence of development further east across the skyline. It would not bring development closer, introduce a new pattern of development or bring development to a new part of the view.	Residents	High	Negligible	Mod-minor	x
				Local road users	Medium	Negligible	Minor	x

Table 18: Summary of cumulative effects

5.8.2. Assessment of significant cumulative effects

Significant cumulative effects are only predicted at viewpoints 1 and 2. These relate to the views of residents in one dwelling near to viewpoint 1 and what is expected to be a low number of walkers at viewpoint 2. The nature of significant effects is primarily due to the proposed development appearing prominent in close proximity. Although the proposed turbine is very similar to the scale of the turbines of Ark Hill Wind Farm, for some close up views there is a contrast in pattern and an extension of the influence of turbines in view.

For all other viewpoints, no significant cumulative impacts are predicted.

5.9. Conclusion

5.9.1. Summary of Effects

- The Landscape and Visual Impact Assessment has demonstrated that the proposed development would not result in any significant direct effects on the physical landscape features of the site or indirect effects on its surroundings during the construction and operational phases;
- Short term significant visual effects during construction and decommissioning are predicted on a limited number of residents and walkers within approximately 1.5km of the proposed turbine location;
- Of the fourteen viewpoints, significant visual and landscape effects are only predicted at viewpoints 1-4 (all within 1.4km from the turbine location);
- No significant effects are predicted on the overall integrity of any landscape character types within the study area;
- No significant effects are predicted on any landscape designations within the study area;
- Significant visual effects are predicted on the residents of approximately 34 dwellings within 1.5km from the turbine location that would have some direct and open views of the proposed turbine on the skyline;
- No significant visual effects are predicted on any road users within the study area;
- No significant visual effects are predicted on any nationally important recreational routes within the study area; and
- Significant cumulative effects are predicted on residents at only one dwelling near to viewpoint 1 and a limited number of walkers at viewpoint 2.

5.9.2. Statement of Significance

Local, Regional and National planning policy are supportive of wind energy developments subject to developments avoiding unacceptable landscape and visual effects. This assessment of effects on the landscape and visual resource has identified that the proposed development will have some localised significant landscape, visual and cumulative effects which considering the nature of the development, is generally to be expected on the immediate area surrounding the turbine location.

For the landscape surrounding the site, the *Angus Windfarms - Landscape Capacity and Cumulative Impacts Study* (2008) study states:

Overall the Sidlaw Hills have a ***medium capacity*** *for development. The scale and type of landscape suggests that careful siting of windfarms of a medium to small scale only would be appropriate."*Furthermore, the *'Implementation Guide for Renewable Energy Proposals'* states that the Igneous Hills in which the proposed development is located are:

*"Considered to have **scope for turbines circa 80 m in height** which do not disrupt the principle ridgelines or adversely affect the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort."*

The guidance also states:

"The relative height and style of turbine (e.g. tower construction, number of blades, blade length) should increasingly reflect those already consented to promoted a harmonious development pattern."

Overall, these factors indicate the landscape has the strategic capacity to effectively accommodate the proposed development without an unacceptable and detrimental change to its inherent character or visual amenity.

This is reinforced by the findings of this assessment which demonstrate that any significant effects are limited to within approximately 1.5km from the turbine location and overall, the proposed development avoids significant landscape and cumulative effects on important landscape features such as Kinpurney Monument and Auchterhouse hillfort.

Furthermore, from many of the nearby open hill summits and from views across the Vale of Strathmore of the sensitive skyline, the landscape character and quality is already significantly compromised by Ark Hill windfarm which limit the changes that would be introduced by the proposed development.

Although significant visual effects are predicted on a number of dwellings within 1.5km from the proposed turbine location, effects are not judged to be overbearing on residential amenity given the distance from turbine and the relatively limited extent of view a single turbine would affect. The nature of any significant visual effects is **unlikely to result in significant effects on residential amenity.**

In considering the overall acceptability of the scheme, it is important to consider that where any significant visual effects on residents have been identified, these often relate to views from a limited number of rooms that may have direct and open views of the turbine. In many instances, the primary orientation of dwellings would be in the opposite direction to the proposed development and as such, views from these rooms would be unaffected.

In conclusion, the findings of this assessment, in context of the policy framework, indicate that the proposed development would be acceptable in landscape and visual terms, notwithstanding the predicted significant but limited effects that would occur in close proximity to the site.

6. Soils & Hydrology

This chapter addresses soils, hydrology and hydrogeology in the existing environment, identifies the potential impacts of the proposed development and outlines measures to mitigate concerns as required.

The activities involved with the construction, operation and decommissioning of the wind turbine could have an impact on the hydrological elements within the surrounding area. All hydrological and hydrogeological impacts are examined including impacts on any watercourses, lochs, groundwater, other water features and sensitive receptors. Where necessary, mitigation measures have been outlined to prevent erosion, pollution, sedimentation or discolouration of receptors.

Such issues are thought to be minor at this site. Nevertheless, the risk of any negative effects have been evaluated and appropriately mitigated where necessary.

6.1. Methodology

The methodology used to assess the impact of the proposed development is described as follows:

- All geological and hydrological information available is gathered and potential receptors that may be at risk from the proposed development are identified;
- Each activity of the development such as construction, operation and decommissioning is assessed for the potential to create a pollution risk; and
- Proposed mitigation measures and preventative actions are detailed, as appropriate.

6.2. Baseline Assessment

Relevant legislation and guidance is highlighted in Table 19 below.

Legislation/Guidelines	Source of information
Legislation	- Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 - Flood Risk Management (Scotland) Act 2009 - Water Environment (Controlled Activities) Regulations 2005 (CAR) - Water Framework Directive (2000/60/EC)(WFD) and Water Environment and Water Services (Scotland) Act 2003 (WEWSA) - Water Resources Act 1991 - Control of Pollution Act 1974 (as amended) (COPA)
SEPA Policies	- No. 19: Groundwater Protection Policy for Scotland, Dec 2003 - No. 26: Policy on the Culverting of Watercourses - No. 54: Land Protection Policy
Scottish Planning Policies	- SPP (2010) – Flooding & Drainage
Planning Advice Notes (PANs)	- PAN 51: Planning, Environmental Protection and Regulation - PAN 58: Environmental Impact Assessment - PAN 61: Planning and Sustainable Urban Drainage Systems - PAN 79: Water and Drainage

Legislation/Guidelines	Source of information
SEPA Pollution Prevention Guidelines (PPGs)	- PPG1: General guide to the prevention of water pollution - PPG4: The disposal of sewage where no mains drainage is available - PPG5: Works in, near or liable to affect watercourses - PPG6: Working at construction and demolition sites - PPG8: Safe storage and disposal of used oil - PPG21: Pollution incident response planning
Other Guidelines	- CIRIA: Environmental Good Practice on Site - CIRIA: Control of water pollution from construction sites, C532, 2001 - CIRIA: Control of water pollution from linear construction projects - Department of Environment (DoE) – PPG14 – Development on Unstable Land (1990)

Table 19: Relevant policy and guidelines for hydrology assessment

6.2.1. Site Context

This chapter details the existing geological, hydrological and hydrogeological conditions at the site and its surroundings. This includes information on nearby watercourses, groundwater and any potential risks of flooding.

Soils

The site is located within the Midland Valley of Scotland. The geology of the area is part of the Scone Sandstone Formation[9] and is described as follows:

"Purple-brown and purple-grey, fine- to coarse-grained, commonly cross-bedded sandstones with subsidiary siltstone, mudstone, conglomerate, sparse andesitic lava flows and some calcareous beds with concretionary limestones towards the top."

Surface Water

From the 1:10,000 OS map in Figure 9 below, it is seen that the nearest surface water feature is the spring which 'issues' approximately 200m to the east of the proposed turbine location before running in a west-east direction for approximately 300m before it 'sinks' underground. This surface water feature is not a drinking water supply. The site of the proposed turbine will drain in a south-north direction towards Dean Water approximately 3.75km to the north east.

[9] As defined by British Geological Society, http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html, accessed 27/08/2013.

Figure 9: Ingliston Farm turbine location

Groundwater & Hydrogeology

Groundwater is present under most landforms, although some geological formations are more permeable than others. Any groundwater within the area may be used as a source of water and is also essential for irrigation within highly productive agricultural areas. The hydrogeology at the site has been examined to determine whether any groundwater at the site is at risk of contamination.

The site of the proposed development is underlain by the Vale of Strathmore bedrock and extensive sand and gravel aquifers (I.D 150261) which covers an area of 402.08km^2. The quality of the groundwater has been classified as good with high confidence and the quantity of groundwater has been classified as poor with medium confidence in 2008[10].

Despite the above, the Carnoustie bedrock and localised sand and gravel aquifers is classified as a Drinking Water Protection Zone. The Scottish Government has identified these areas as those which are used for the abstraction of water for human consumption, which provides more than 10m^3/day as an average, or serve more than 50 persons.

[10] As defined by SEPA, http://gis.sepa.org.uk/rbmp/, accessed 27/08/2013.

Any reduction in the quality of the groundwater resource is of potential concern and should be avoided.

Flooding in the Vicinity of the Site

The areas shaded in blue in Figure 10 below are those areas identified by SEPA as being at risk to flooding from rivers[11]. The nearest river to the proposed development which is at risk to flooding is Elliot Water to which the proposed development site is likely to drain. Any significant increase in run-off would have the potential to increase the risk of flooding already presented by Elliot Water, and should therefore be avoided.

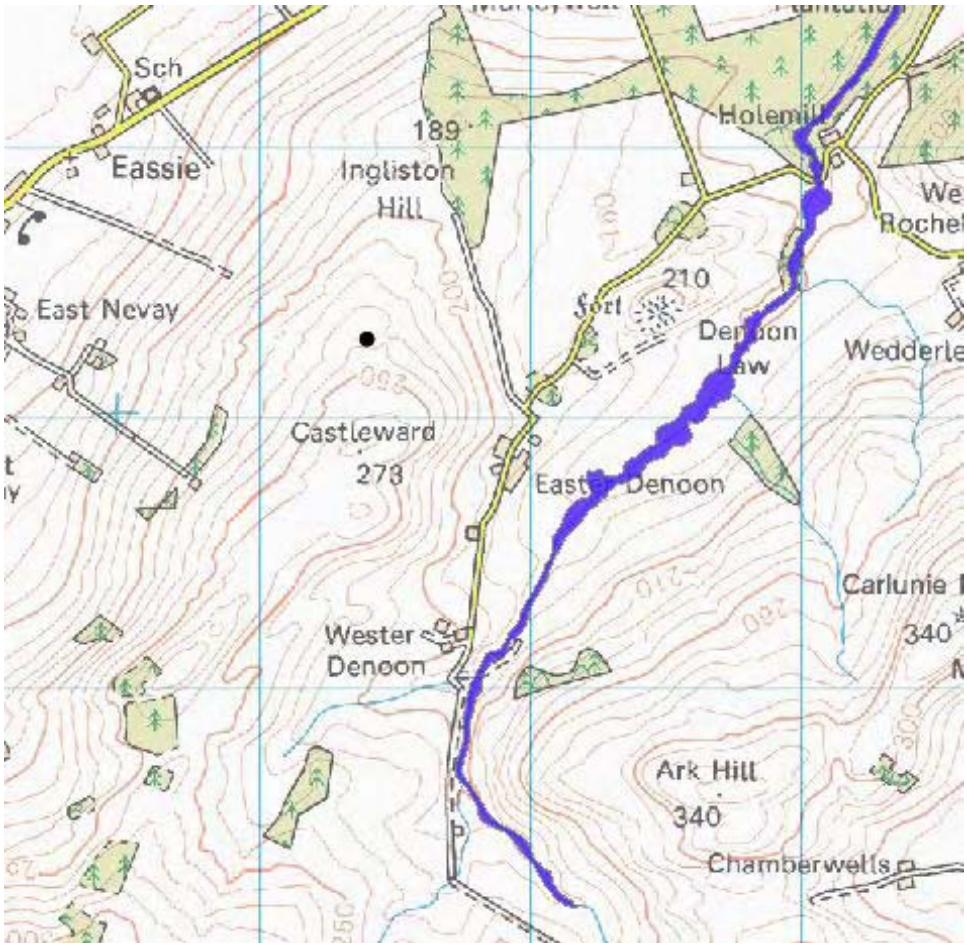

Figure 10: Flooding Risk in Vicinity of Proposed Wind Turbine Development

The total area of new permanent hardstanding associated with the proposed development is approximately 0.64 hectares (ha). The increase in run-off associated with this is considered negligible and will not have an impact on flooding in the receiving catchment.

[11] As defined by SEPA, http://www.sepa.org.uk/flooding/flood_extent_maps/view_the_map.aspx, accessed 27/08/2013.

6.3. Impact Assessment

6.3.1. Soils

The permanent proposed works require the construction of a turbine foundation on an area of 169m^2, hardstanding of 700m^2 and approximately 1.37km of new access road on an area of permanent grassland.

There will also be the creation of a temporary borrow pit, which will extend the excavated area temporarily, as highlighted in Drawing ING103. The total excavated area will be 92m x 44m and this will include part of the access track, the crane hardstanding, access pad and turbine foundations. The subsoil removed to expose the borrow pit area will be used to re-instate the existing grassland up to the edge of the permanent development, once construction works are completed.

The removal of subsoil and bedrock to form a borrow pit, turbine base, access road and crane pad, in addition to the interference with existing site drainage is a direct permanent effect that, without mitigation, could alter the existing hydrogeological balance of the site.

The existing environment is a modified one due to existing agricultural activities and existing drainage characteristics, but generally consists of surface water runoff which is largely non-intercepted. The potential additional impacts of the development on the soils, hydrology and hydrogeology of the site are listed below:

- The excavation and removal of the subsoils and bedrock will be necessary at the proposed turbine location and for new areas of road formation. This could have a direct permanent impact on these soils and rock in the form of increased erosion and sediment release, which could in turn have additional impacts on water quality (due to sedimentation of water courses);
- The dewatering of excavations with inappropriate disposal of excess water can potentially lead to erosion or undercutting of slopes or saturation and weakening of materials;
- Soil compaction can occur due to movement of construction and maintenance traffic. This could lead to an increase in runoff and subsequently to an increase in flooding and erosion; and
- Removal of soils can result in the exposure of the underlying rock to sources of contamination. Chemical pollution could occur as a result of spillage or leakage of chemicals, runoff from vehicle washing facilities, unset concrete, storage of fuels or refuelling activities, etc. Chemical pollutants could enter groundwater supplies and have implications for damage to ecology and local water supplies.

6.3.2. Surface water

During each phase of the wind turbine development (construction, operation and decommissioning), a number of activities will take place on site, some of which will have the potential to affect the hydrological regime or water quality at the site or its vicinity.

Potential Construction Impacts

The main potential impact of the development on water quality is an increase in sediment during the construction phase. There is also the potential for oil spillages from tanks and machinery on site. A list of risks to surrounding water bodies that require appropriate mitigation measures is provided below:

- Chemical pollution – potential pollutants include spillage or leakage of chemicals, runoff from vehicle wash down facilities, unset concrete, fuel or oil, during use or storage on

site. Such pollutants can damage the ecology and quality of affected soils, watercourses and groundwater, affecting biodiversity, fish stocks and water supplies;

- Erosion and sediment release – high levels of sediment can damage fish populations, flood storage capacity and water sources. Spoil heaps from excavations for the turbine base and borrow pit will be stored temporarily; if left exposed, this could lead to an increase in silt-laden run-off draining off site;
- Soil compaction – movement of construction traffic can lead to compaction of the soil, reducing soil permeability and rainfall infiltration;
- Increase in runoff – areas of hard standing will cause local increases in runoff volume. This could influence rates of soil erosion, and alter the way local streams respond to storm rainfall;
- Cable trenches could act as a conduit for surface water flows;
- Incorrect site management of excavations for both the access track and borrow pit which could lead to loss of solids and nutrients to surface waters; and
- The construction of new infrastructure (site tracks) has the potential to obstruct existing overland flow.

The construction phase is most likely to give rise to environmental impacts as many of the associated activities have a direct influence on the amount of water, and the amount of suspended solids in the water, arising on the site. Impacts on water quality in the network of streams draining the development could affect receptors sited at some considerable distance from the proposed development. Chemical contamination of ground and surface waters is a risk throughout all phases of construction activity and requires appropriate control and management.

Potential Operational Impacts

When operational, the development will have a negligible effect on surface water quality as there will be no further disturbance of soils post construction. Given that the soil extracted to expose the bedrock for the borrow pit will also be re-instated, it is not envisaged that there will be any operational impacts from the inclusion of the borrow pit.

Due to the insignificant increase in potential run-off from the site, commitment to best practice construction activities and the minimal requirement for new infrastructure, there will be negligible release of sediment to the watercourses from site operations.

During the operational phase, small quantities of oil will be used in cooling the turbine transformer. Whilst there is potential for oil spills they are in no way likely to be significant, given the low volumes of oil present and the presence of the transformer in an internal structure.

Potential Decommissioning Impacts

Potential impacts during the decommissioning stage, albeit at a lesser scale, will be similar to those relating to the construction phase.

6.3.3. Groundwater

In order to protect the bedrock from entry of contaminants, mitigation measures will be put in place to deal with concrete displacement within the bedrock.

Pending site investigations, it is expected that the turbine foundation will be dug at a maximum depth of approximately 2.5m and there is a low risk that groundwater will be present at this level. This will be investigated during the pre-construction ground investigation

works and will determine whether sensitive disposal of groundwater at the foundation is necessary.

6.4. Mitigation Measures

Mitigation measures for this wind development will focus on preventing the disturbance and pollution of soil, watercourses and groundwater. With regards to surface water contamination, new drainage pathways may be introduced and carry contaminated run-off. Mitigation measures to prevent these scenarios are outlined within this chapter.

6.4.1. Soils

- The designers will carry out a design risk assessment to evaluate risk levels for the construction, operation and maintenance of the works. Identified risks will be minimised by the application of the principles of avoidance, prevention and protection. Information on residual risks will be recorded and relayed to appropriate parties;
- A method statement for each element of the works will be prepared prior to any element of the work being carried out;
- Details of the relevant assumptions, relating to methods and sequencing of work will be provided to the contractor;
- No amendments to the designed works will be carried out without the prior approval of a suitably qualified and experienced engineer;
- Prior to construction, a site-specific environmental management plan for construction will be prepared in consultation with the relevant statutory bodies;
- Excavation works associated with the construction phase of the development will be monitored by suitably qualified and experienced engineering personnel; and
- The programming of the works will be such that earthworks/excavations are not scheduled to be carried out during severe weather conditions. Where such weather is forecast, suitable measures will be taken to secure the works.

6.4.2. Surface Water

- During construction any oil, fuel or other chemicals will be stored in a suitable temporary storage area. Oil spill cleanup materials will also be stored on site throughout the construction period;
- It is anticipated that concrete will be delivered ready made to the site. Provisions will be made to ensure that deliveries are supervised by qualified personnel and site staff should be aware of what to do in the event of spillage. Mitigation measures will be outlined within construction method statements with regards to concrete delivery and will be carried out in accordance with SEPA guidance (particularly PPG6 and PPG13);
- Washing out of the delivery vehicles will be carried out to ensure that washings do not pollute surface water at the site, and it is proposed to undertake the washing out of concrete trucks offsite at the source location;
- Any stored diesel or fuel oils will be bunded to 110% of capacity. The turbine transformer enclosure will be self-contained or bunded to preclude the release of contaminants to the environment;
- Regular visual inspections of the surrounding burns will be undertaken during the construction phase to examine the turbidity and clarity of the water;

- Underground cables will be laid in small trenches that are parallel to access tracks as far as possible. Trenches will be dug during dry weather periods and the cables will be laid quickly and backfilled to minimise water entering the trenches. Suitable drainage measures will be detailed within the construction method statement and will accord with best practice in the SUDS manual C697;
- Where possible construction will take place from existing tracks, building the new site roads ahead of machinery, such that excavators will avoid operating on bare soils;
- No work will take place on site during severe weather conditions; and
- Soil will be re-instated to the borrow pit area as soon as excavation and construction are complete, so any impacts on increased surface water drainage will be temporary.

6.4.3. Groundwater & Hydrology

As with any construction project there is a risk of a pollution spill that may enter the water table and contaminate groundwater. It is considered that this risk can be satisfactorily mitigated through use of best practice construction methods. This will require compliance with all of the guidance contained in the relevant Pollution Prevention Guidance (PPG) notes listed in Table 19.

An assessment of groundwater levels at the turbine location will be carried out prior to construction. A borehole will be made to assess whether groundwater is present. This will be carried out as part of a pre-construction soil investigation survey. In the unlikely event that groundwater is present at this depth it will be necessary to temporarily lower the ground water level to avoid any contamination from materials used for the turbine foundations.

6.5. Conclusion

Detailed mitigation measures have been provided with regard to the design, construction and maintenance of the proposed development. Provided that these mitigation measures are adhered to, the impacts on soils, surface water and groundwater are considered to be negligible.

7. Socioeconomic

7.1. Methodology

This chapter will outline the socioeconomic profile of the area as well as describing the tourism and recreational activity within the area. An assessment will then be made on the effect of the proposed wind development on the local economy and tourism sector through consideration of the key business and tourist sites in the region and any relevant previous studies regarding the social/economic impact of wind turbines.

7.2. Baseline Assessment

7.2.1. Site Characteristics

The site lies in a predominantly upland agricultural setting, within the boundary of The Newtyle & Eassie Community Council, within the Ward of Kirriemuir and Dean. Tourism and recreation is locally important but is considered to be of a lesser importance to other employment sectors in the immediate area. There are a number of tourist attractions that are important in terms of their cultural heritage value in the local area.

7.2.2. Population

An overview of the demographics of the surrounding area is provided in Table 20 below.

Area	Total resident population (all ages)
Immediate Output Area[12]	168
Dundee	154,674
Angus	108,400
Scotland	5,062,011

Table 20: Population of area surrounding Ingliston Farm (2001 Census data)

7.2.3. Economic Activity

Employment data was provided from the 2001 Census for the immediate area and for Dundee, with the Scotland wide average provided as a comparison. This information is provided in Table 21 below.

[12] Output area related to the wider postcode area of DD8 1SP, www.scrol.gov.uk

	Immediate Output Area	Dundee	Scotland
All persons aged 16-74 in employment	87	58,073	2,163,035
% employed in each sector			
- % A. Agriculture and hunting and forestry	25.29	0.55	2.2
- % B. Fishing	2.3	0.03	0.31
- % C. Mining and quarrying	0	0.6	1.29
- % D. Manufacturing	10.34	16.24	13.65
- % E. Electricity and gas and water supply	0	0.95	1.02
- % F. Construction	4.6	7.12	7.76
- % G. Wholesale & retail trade and repairs	10.34	14.71	13.3
- % H. Hotels and restaurants	4.6	4.63	4.95
- % I. Transport and storage and communication	4.6	6.26	6.89
- % J. Financial intermediaries	4.6	2.86	4.74
- % K. Real estate and renting and business activities	9.20	9.77	11.42
- % L. Public administration and defence and social security	2.30	6.08	7.23
- % M. Education	6.90	9.1	7.42
- % N. Health and social work	9.20	15.84	12.63
- % O.P.Q. Other	5.75	5.25	5.18

Table 21: Summary of employment for immediate area and wider zones

Over 25% of the population within the immediate area are employed in 'agriculture, hunting and forestry'; this is considerably higher than both the Dundee and Scotland averages. No data was found relating to employment within the Community Council ward but the key employment type is again expected to be agriculture given the rural nature of the majority of the area.

7.2.4. Tourist Activity

An assessment of existing tourist attractions in the locality was undertaken. The assessment focused on those attractions where the scenic value of the surrounding landscape is important to the draw and/or enjoyment of the attraction. The extent of the assessment was limited to a 10km radius from the turbine as visual impacts are considered to be of greatest significance within this zone. Table 22 below lists the identified attractions.

Tourist Site	Description	Distance to proposed turbine (closest point)
Angus Core Paths Network	Walking Route	1.4km
Kinpurney Hill	Scheduled Monument and Walking Route	3.3km
Auchterhouse Hill	Walking Route	4.7km
Glamis Castle	A Listed Building and Gardens and Designed Landscapes	5.0km
Airlie Castle	National Nature Reserve and Gardens and Designed Landscapes	7.9km
Clatto Country Park	Country Park	9.8km

Table 22: Tourist activity within the area

Further discussion regarding the impact on tourism on these attractions is provided in the following chapter.

7.3. Impact Assessment

The direct and indirect impacts of the proposed development on the local area can be separated into the following areas:

1. Economic benefits for the landowner;
2. Economic and social benefits for the local community;
3. Economic benefits from construction and operation;
4. Potential adverse impacts on the wider community; and
5. Potential impact on wider tourism and recreation assets.

The potential impact of the development on each of the above areas is discussed further below.

7.3.1. Economic Benefit for the Landowner

Agricultural incomes can vary significantly year on year due to variations in weather conditions, crop quality and yield, market prices, exchange rates, and operational costs for fertiliser, fuel etc. The forthcoming reforms (2014 onwards) to direct payments under the Common Agricultural Policy (CAP) are also a concern.

The combined effect of these uncertainties has prompted the landowner to explore alternative sources of income to help support his business in the long-term. In this respect, the proposed turbine will provide a guaranteed additional source of income over the 25 year expected operational period. The proposed development also has a minimal footprint therefore current farming operations will be largely unaffected.

In addition to the considered suitability of the land for wind energy, the non-agricultural nature of the project also reduces the level of financial risk through diversification outwith the farming sector. In this respect, the renewable energy market is quite stable when compared to other sectors such as agriculture, especially after the introduction of the Feed in Tariff (FiT).

The development of a wind turbine at Ingliston Farm would lead to an additional sustainable source of income for the farmer, Mr Shaw. In addition to providing an additional source of income, the electricity generated by the proposed development will offset a key expense to the

farm business. With the erection of the new buildings, as outlined in Section 1.2.2 above, electricity use at Ingliston Farm is expected to double.

7.3.2. Economic and social benefits for the local community

Farmers are considered to be particularly good at recycling extra income back to the farm and wider local economy. Results from the Scottish Income-Output Tables[13] demonstrate that agriculture in general displays a high multiplier effect on the wider economy. Within this assessment agriculture is seen to be within the top 10% of industries for generating additional income in other industries, and within the top 25% for generating additional employment in other industries. Previous studies have also demonstrated that agricultural activity is particularly effective in supporting local economic activity and employment.

The local ownership of this project by a farmer is therefore considered to maximise the real economic benefit available to Angus from renewable energy development. This is the main reason that the Scottish Government have set a target for 500MW of locally owned renewable energy projects by 2020.

As outlined above, Mr Shaw's farming business also currently employs 4 full time staff and a number of seasonal staff. Diversifying the farming activities will bring an additional sustainable income stream into the farming business, helping to safeguard these jobs and create new jobs as the business continues to expand through investing the project income into the wider farming business.

7.3.3. Economic Benefits from Construction and Operation

The capital cost of the proposed wind turbine development at Ingliston Farm has been estimated at approximately £1.5m. In 2006 Scottish Enterprise published a report discussing the economic impact of wind farm construction. Based on this report, it is estimated that 29%, or at least £435,000, of the capital cost of the installation and operation of the development would be spent locally in Scotland. This would involve:

- Services (consultancy, planning advice);
- Construction (roads, access, fences etc.);
- Cabling (throughout site and to grid access point); and
- Operation and maintenance.

The use of suitably experienced local contractors and sub-contractors will be encouraged for construction, operation and maintenance works associated with the development, as long as they meet the financial and technical requirements for the build.

The increased likelihood to be able to utilise local companies is an additional benefit of smaller commercial wind energy proposals. In this respect, the significant scale of works associated with larger commercial wind farms often dictates that national or multinational companies are used.

The 2010 SAC study into the benefits of locally owned wind energy developments demonstrated what the above factors may mean in terms of local job creation. It was

[13] http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output/IOAllFiles2007

concluded that through development and construction a total of over 5 jobs would be created for a 1 year period, while during operation 2.5 long-term jobs would be created.

7.3.4. Potential Adverse Impacts on the Wider Community

There are a number of potential impacts on the wider community from the proposed development and these include:

- Landscape and visual amenity;
- Noise;
- Shadow flicker; and
- Telecommunications and television reception.

These potential impacts are considered and quantified (where possible) individually in their respective chapters of this Document.

7.3.5. Potential Impact on Wider Tourism and Recreational Assets

From the baseline assessment a number of attractions have been highlighted as having particular importance for tourist activity within the area. The potential impact at each of these attractions is discussed in Table 23 below.

Attraction	Distance from turbine	Potential impact
Angus Core Paths Network	1.4km	Parts of the Core Paths Network within 5km of the site are predicted to experience some theoretical visibility. In practice, users of the Network would experience mostly oblique views of the turbine, where the turbine is visible above the skyline and forms a small element within a wide, open upland agricultural and moorland landscape. Where there are potential views, they are short in duration, oblique and intermittent. Taking into account the distance to the site, the impact of the turbines on the Network is not deemed to be significant.
Kinpurney Hill	3.3km	As illustrated by the ZTV (see Drawing ING010), there is a small area on the summit of Kinpurney Hill (which includes the fort), which will have full theoretical visibility of the proposed wind turbine. The main route members of the public would take to the summit of Kinpurney Hill is understood to be from the south west, on part of the Angus Core Paths Network. This approach to Kinpurney Hill has no theoretical visibility to the turbine. As highlighted by Drawing ING056, the view of the proposed turbine from the summit of Kinpurney Hill does not break the distant ridgeline. Given this, and the scale and distance to the proposed turbine, it is considered that the impact on this tourist feature is not significant, especially when considered in combination with the existing impact of the more visually imposing Ark Hill wind farm, which lies within the same field of view and breaks the ridgeline. The assessment in Chapter 5 of this Supporting Environmental Document also considers that there will be no significant landscape and visual impact, either as a standalone development or cumulatively.

Auchterhouse Hill	4.7km	As illustrated by the ZTV (see Drawing ING010), only a small area of the Auchterhouse Hill summit has theoretical visibility to the nacelle and blades, with a small area on the northern hillside having only theoretical visibility to the proposed turbine blades. As highlighted by Drawing ING060, there will only be distant views of the proposed development, which are considered insignificant in their impact, especially given the more dominant views to Ark Hill wind farm and the single turbine development at Henderson Quarry. The assessment in Chapter 5 of this Supporting Environmental Document also considers that there will be no significant landscape and visual impact, either as a standalone development or cumulatively.
Glamis Castle	5.0km	Although the majority of Glamis Castle has full theoretical visibility of the turbine, it is considered that existing vegetation cover will shield the majority of the GDL from views of the turbine. This is demonstrated further in Drawing ING063. As such, the visual impact of the proposed development on Glamis Castle is considered to be negligible. The assessment in Chapter 5 of this Supporting Environmental Document also considers that there will be no significant landscape and visual impact, either as a standalone development or cumulatively.
Airlie Castle	7.9km	This GDL is predominantly a river valley with steep sides. The majority of the GDL is entirely shielded from views of the turbine, as indicated by Drawing ING010. For any areas on the edge of the GDL which do have theoretical visibility to the turbine, it is considered that the distance to the turbine, and the existing vegetation cover, will render any visual impact from the turbine as not significant.
Clatto Country Park	9.8km	There is no theoretical visibility to the proposed turbine from Clatto Country Park.

Table 23: Discussion on tourist attractions within the area

In summary, the proposed development is not expected to have a significant adverse impact on tourism and recreation attractions in the surrounding area.

A national study commissioned by the Scottish Government[14] examined the likely economic impact of wind energy development. It should be noted that this report focuses on larger scale commercial wind developments but many points are relevant to smaller wind projects such as the one proposed at Ingliston Farm. The latest Tourism Attitudes Survey states that 'scenery' and 'natural environment' are the main attractions for tourists visiting Scotland. If wind farms were to deter significant numbers of tourists, they could potentially threaten the tourism industry and also the economic sustainability of the local community.

The study assessed the economic impact of four case studies within Scotland where wind farms were likely to be visible. It was carried out in four key stages:

- Identifying the change in likelihood of tourists returning to Scotland;
- Identifying the proportion of tourists in each area where this applies;
- Identifying the proportion of accommodation exposed (drop in 'room with view' sales); and
- Estimating likely proportion of change in expenditure in the affected accommodation.

[14] Scottish Government (2008) Economic Impacts of Wind Farms on Scottish Tourism

From the study, it was concluded that *"overall there does not appear to be any robust evidence to suggest a serious negative economic impact of wind farms on tourism"*. A change in tourism expenditure is predicted if a substantial amount of wind developments is installed in Scotland, however this loss of revenue is expected to be *"offset or reinforced"* by other positive economic or environmental impacts from wind farms. The study also concluded that tourism activity is likely to be displaced to other areas around Scotland rather than reduced entirely.

A survey of tourists was conducted within the four areas used in the case study; it involved information from tourists that were likely to have seen a wind farm during their visit. The survey confirmed that a minority of around 20% - 39% preferred a landscape that contained no wind farms; overseas visitors were found to be more positive than domestic tourists. The vast majority of the tourists surveyed (93% - 99%) that had seen a wind farm during their visit said that it would not affect their decision to return the area or Scotland as a whole.

A more recent document[15], prepared by ClimateXChange on behalf of the Scottish Government, found no evidence to suggest that wind energy development within the four case study areas adversely affected tourism.

7.4. Conclusions

The baseline assessment indicates that the immediate area has a relatively low rural population. It is acknowledged that the turbine could potentially result in adverse impacts on residential amenity. Further studies in relation to visual, noise and shadow flicker impacts have therefore been undertaken to determine whether the development falls within acceptable limits.

The project has been assessed as having an overall positive socio-economic impact on the local area. The turbine represents a strong example of diversification for the farmer and is a significant additional source of revenue. This income stream will not only support the ongoing farming business but will also have direct and indirect benefits on other local businesses and the wider community.

With regard to domestic properties there is no robust evidence to suggest that the wind development will have a substantial negative impact on property values within the area and all effort has been made to maximise the distance from houses and therefore negate any adverse impacts on these properties from impacts such as noise and shadow flicker.

Individual assessment of landscape and visual impacts on tourism sites have shown generally low impacts and these impacts are considered to be insufficient to cause a detrimental effect on the attraction of these sites.

[15] ClimateXChange (2012) The Impact of Wind Farms on Scottish Tourism

8. Cultural Heritage

This chapter assesses the impact of the proposed Ingliston Farm wind turbine on those known cultural heritage or archaeological features within the area. This assessment focuses on the impacts upon Listed Buildings and noted archaeological features within the immediate area of the turbine. This includes important Scheduled Ancient Monuments and Gardens and Designed Landscapes (GDLs) within the wider area.

8.1. Methodology

The construction of a single wind turbines at the location proposed will have no direct impact on known archaeological sites or features.

The potential impact of the proposal on the setting of *inter alia* Gardens & Designed Landscapes within a 25km radius of Ingliston Farm has been assessed as part of Chapter 5: Landscape & Visual.

This assessment therefore focuses on how the development might impact on the setting of any sensitive cultural heritage sites and has been carried out in accordance with Historic Scotland's 'Managing Change in the Historic Environment – Setting' dated October 2010. In the case of this development, potential impacts mainly relate to the landscape context, the surrounding landscape character, and the impact on the aesthetic qualities of the site. Where relevant, discussion will be provided on whether the development will impact upon the historical understanding of the site.

Initially a desk-based study was completed using Historic Scotland's available GIS databases. All A Listed buildings and Scheduled Monuments within a 5km radius were identified (see Drawing ING007). For completeness, a search of B and C Listed buildings within 1km of the proposed turbine location was undertaken; no additional sites were identified as a result.

As requested by Angus Council, the non-scheduled archaeological site at Auchterhouse Hill has also been included within the assessment.

The assessment focuses mainly on the visual impact on these sites; the matrix used to assess the overall impact is detailed in Table 24 below.

Magnitude	**Sensitivity**			
		High	**Medium**	**Low**
	High	Major	Major/Moderate	Moderate
	Medium	Major/Moderate	Moderate	Moderate/Minor
	Low	Moderate	Moderate/Minor	Minor
	Negligible	Moderate/Minor	Minor	Minor/None

Table 24: Overall impact assessment matrix

The guide in Table 25 and Table 26 below is used to determine the magnitude and sensitivity of the potential impact on cultural heritage receptors.

Magnitude	Description	Definition
High	Dominant	Receptor(s) are within 500m of the development
Medium	Conspicuous	Receptor(s) are between 500m - 2km of the development
Low	Apparent	Receptor(s) are within 2km - 5km of the development
Negligible	Inconspicuous	Receptor(s) are > 5km of the development

Table 25: Magnitude of impact

Sensitivity	Definition
High	• Category A and B Listed buildings • Gardens & Designed Landscapes • Scheduled Ancient Monuments • Non-statutory sites of high significance (of international or national importance)
Medium	• Category C listed buildings • Archaeological sites on the Sites & Monuments Record (of regional or local importance) • Conservation Areas • Country Parks
Low	• Archaeological sites of lesser importance • Non – Inventory Gardens and Designed Landscapes

Table 26: Cultural Heritage Sensitivity

8.2. Baseline Assessment

8.2.1. Relevant Legislation, Policy and Guidance

- Historic Environment (Amendment) (Scotland) Act 2011;
- Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997;
- Ancient Monuments and Archaeological Areas Act 1979;
- Town and Country Planning (Scotland) Act 1997 as amended by Planning etc. (Scotland) Act 2006;
- Scottish Historic Environment Policy;
- PAN 2/2011 Planning and Archaeology;
- Scottish Planning Policy 2010;
- Local Plan Policy ENV19: Archaeological Sites and Ancient Monuments; and
- Local Plan Policy ENV18: Listed Buildings.

8.2.2. Site Context

An assessment was carried out for any sensitive sites within 5km of the Ingliston Farm turbine. Details of these sites are shown in Table 27 below. These sites are shown relative to the turbine in Drawing ING007 within the appendices.

Site	Description	Distance to Ingliston Farm turbine (km)
Castleward, burial mound	Scheduled Ancient Monument	0.5
Denoon Law, fort	Scheduled Ancient Monument	1.1
Wester Denoon, burial mound	Scheduled Ancient Monument	1.3
Hatton of Eassie, ring-ditch	Scheduled Ancient Monument	2.1
Balkeerie, unenclosed settlement	Scheduled Ancient Monument	2.2
Newmill, ring ditch	Scheduled Ancient Monument	2.2
Carlunie Hill, cairn	Scheduled Ancient Monument	2.4
Castleton Motte	Scheduled Ancient Monument	2.6
Carlunie Hill, hut platforms	Scheduled Ancient Monument	2.7
West Nevay, burial mound	Scheduled Ancient Monument	2.8
Nevay Church, Kirkinch	Scheduled Ancient Monument	3.2
Mains Of Rochelhill, Dovecot	A Listed Building	3.2
Eassie Old Church and cross slab	Scheduled Ancient Monument	3.3
Kinpurney Hill, fort	Scheduled Ancient Monument	3.3
Cookston Farm, enclosure	Scheduled Ancient Monument	3.8
Newton of Glamis, unenclosed settlement	Scheduled Ancient Monument	3.9
Newton of Glamis, enclosure	Scheduled Ancient Monument	3.9
Braideston, enclosures	Scheduled Ancient Monument	4.1
Cardean, Roman camps	Scheduled Ancient Monument	4.7
Auchterhouse Hill	Archaeological Site	4.7
Glamis Manse, cross slab	Scheduled Ancient Monument	4.9
Glamis, Kirkwynd, St Fergus's Church, Strathmore Aisle	A Listed Building	4.9
Glamis Castle, Dovecot	A Listed Building	5.0

Table 27: Cultural heritage sites within 5km of Ingliston Farm

8.3. Impact Assessment

This impact assessment discusses the potential direct and indirect impacts that may occur at the cultural heritage receptors outlined within the baseline section. Outwith any direct disturbance on known cultural heritage sites the main impact will be visual. In relation to rural settings any development seen in principal views to or from a designated site can be considered as affecting its setting.

8.3.1. Assessed Impacts

With regard to the potential for direct impacts, it is noted that no known archaeological sites or features lie within the extent of construction works for the turbines, crane pad/laydown areas or access road. Any potential impacts (during construction and operation) are therefore expected to be visual. This chapter discusses the potential impact on the sites described within the baseline assessment.

Table 28 below provides details of cultural heritage sites identified within 5km, along with the demonstrated extent of the theoretical turbine visibility, sensitivity, magnitude and potential impact according to the methodology described in Chapter 8.1.

Further discussion is then provided on those sites where there is a theoretical major or major/moderate impact.

Name	Theoretical visibility	Sensitivity	Magnitude	Overall Potential Impact
Castleward, burial mound	Nacelle and blades	High	High	Major
Denoon Law, fort	Full	High	Medium	Major/Moderate
Wester Denoon, burial mound	Nacelle and blades	High	Medium	Major/Moderate
Hatton of Eassie, ring-ditch	Nacelle and blades	High	Low	Moderate
Balkeerie, unenclosed settlement	Nacelle and blades	High	Low	Moderate
Newmill, ring ditch	Nacelle and blades	High	Low	Moderate
Carlunie Hill, cairn	Full	High	Low	Moderate
Castleton Motte	Nacelle and blades	High	Low	Moderate
Carlunie Hill, hut platforms	None	High	Low	N/A
West Nevay, burial mound	Nacelle and blades	High	Low	Moderate
Nevay Church, Kirkinch	Nacelle and blades	High	Low	Moderate
Mains Of Rochelhill, Dovecot	None	High	Low	N/A
Eassie Old Church and cross slab	Full	High	Low	Moderate
Kinpurney Hill, fort	Full	High	Low	Moderate
Cookston Farm, enclosure	Nacelle and blades	High	Low	Moderate
Newton of Glamis, unenclosed settlement	Full	High	Low	Moderate
Newton of Glamis, enclosure	Full	High	Low	Moderate
Braideston, enclosures	Nacelle and blades	High	Low	Moderate
Cardean, Roman camps	Nacelle and blades	High	Low	Moderate
Auchterhouse Hill	Full	Medium	Low	Moderate/Minor
Glamis Manse, cross slab	Nacelle and blades	High	Low	Moderate

Glamis, Kirkwynd, St Fergus's Church, Strathmore Aisle	Nacelle and blades	High	Low	Moderate
Glamis Castle, Dovecot	Full	High	Low	Moderate

Table 28: Assessed impact on cultural heritage sites

20 of the 23 heritage assets listed above only have a theoretical moderate/minor or moderate impact. As such, it is considered that the proposed turbine at Ingliston Farm will not have a significant level of impact on the setting of these heritage assets. With the exception of the Scheduled Ancient Monument (cairn) at Carlunie Hill, these are not assessed further.

As outlined in Table 28, the cairn at Carlunie Hill is considered to only have a moderate impact from the proposed development. However, as requested by Angus Council in pre-application discussions, visualisations have been prepared from this heritage asset. As highlighted by Drawings ING051-053, it is considered that the presence of a wind turbine at Ingliston Farm does not impact significantly upon the setting of this heritage asset, especially given that the existing setting is in such close proximity to the Ark Hill wind farm.

The three sites for which there is a theoretical major or major/moderate impact are discussed in more detail below.

8.3.2. Castleward, burial mound

Although the turbine is within 0.5km of the proposed development, it is considered that the impact upon the setting of this heritage asset will not be significant, for the following reasons:

1. As demonstrated in Drawing ING016, the SAM only has theoretical visibility of the turbine nacelle and blades, as opposed to full visibility of the turbine;

2. It is considered that the consented and operational wind farms and single turbine developments within the immediate vicinity of the SAM create a setting and a baseline level of impact which the proposed development does not significantly increase upon; and

3. Following initial consultation with Angus Council it is understood that a primary consideration for wind turbine developments within the area is their impact upon the interaction between key SAMs across the prominent hilltops of the wider Sidlaw Hills. Such monuments will include those at Kinpurney Hill, Auchterhouse Hill and Denoon Law. The proposed turbine will not significantly impact upon interactive views from the SAM at Castleward in the direction of any of the other prominent monuments within the upland area. The other SAMs are generally to the east, south east, south and south west of Castleward. The turbine is located due north of the SAM. As such, it is not expected to impinge upon interactive views between the noted monuments.

8.3.3. Denoon Law, fort

Drawings ING042-044 highlight the visual impact the proposed development will have on the SAM at Denoon Law. There is full visibility of the turbine from the monument and the visualisations prepared highlight that the turbine will be a prominent feature but only in views to the east. It is considered that the turbine would relate well to the vertical scale of upland landform in this viewing direction. With no horizontal spread the majority of the wider views of the lowland areas to the north and west remain open and these are considered to be the primary views in relation to the setting of this defensive feature. The single turbine proposed at Ingliston Farm is therefore not considered to impact significantly upon the existing setting of this heritage asset, especially given the presence of other turbines within the vicinity having changed the current setting of the monument in the wider landscape.

8.3.4. Wester Denoon, burial mound

As highlighted by Drawing ING016, the burial mound at Wester Denoon will only have theoretical visibility of the nacelle and blades of the proposed development. The SAM is also on the periphery of this level of visibility, and after further assessment it can be concluded that none of the turbine tower will be theoretically visible. Given the distance to the turbine, the level of theoretical visibility, and the presence of other turbines within the vicinity having changed the current setting of the monument in the wider landscape, it is not considered that there will be a significant impact upon this heritage asset.

8.4. Mitigation Measures

No groundwork or construction will be undertaken within, or adjacent to recorded sites of cultural heritage. Therefore there have been no mitigation measures proposed at this stage.

8.5. Conclusions

This assessment has examined the expected impact of the proposed Ingliston Farm turbine on cultural heritage sites.

With regard to the potential for direct impacts, it is notable that no known archaeological sites are within the proposed construction area for the turbines, crane pad/set down areas or access road. The primary consideration was whether the turbine would have a significant impact on the setting of the sites through significant visual impact as stated in the relevant National and Local policy.

From an initial desk based assessment of the surrounding area, 23 high sensitivity cultural heritage assets were found within 5km of the Ingliston Farm development site. In assessing the setting of these sites it was determined that for three sites there is a potential significant impact upon the monuments. This is primarily due to their proximity to the proposed development. However, as outlined in the sections above, it is considered that the proposed turbine will not significantly impact upon these heritage assets.

It is considered that any adverse impacts on the remaining 20 heritage sites would not be significant. This is due to the distance (>2km) from the proposed turbine location, which reduces the potential for views of the turbine being considered 'dominant' or 'conspicuous'.

As such, it is considered that the proposed development at Ingliston Farm will not have a significant impact on nearby heritage assets.

9. Ecology

The ecological impact of the Ingliston Farm developments has been assessed by Ecologist EnviroCentre Ltd. The ecology report is attached within the appendices of this Supporting Environmental Document. The potential ecological impact of the development is summarised as follows:

"No further survey of the site is necessary.

While the borrow pit will mean the loss of an area of improved grassland, this habitat is widespread and common throughout the surrounding area and is considered to have low ecological value. The borrow pit will be reinstated once works are complete and in time the vegetation will regenerate. The borrow pit is unlikely to cause any lasting ecological impacts.

A bird survey is not necessarily required if construction work can be either timed to avoid the bird breeding season or a pre-construction check of any vegetation to be removed is undertaken immediately prior to works.

Natural England has developed guidance that provides information on how best to site turbines to avoid impacts to bat species. This guidance states that:

"A bat survey should normally be recommended for applications for turbines that will be located within 50m of the following features:

- *Buildings or other features or structures that provide potential as bat roosts, including bridges, mines etc;*
- *Woodland;*
- *Hedgerows;*
- *Rivers or lakes; and*
- *Within or adjacent to a site designated for bats (SSSI or SAC)."*

Therefore, 50m should be the minimum distance between the tip of the turbine blade to the nearest feature which may be used by bats. This distance should not be measured from the base of the turbine but instead should take into account the height of the feature. In order to accurately measure this stand-off distance from the blade tip Natural England have produced the following equation:

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$, *where:*

b = the minimum distance;

bl = blade length (27m);

hh = hub height (50m); and

fh = feature height (2m).

At Ingliston Hill the minimum distance equates to 60.2m.

As the proposed turbine is located approximately 75m from the nearest linear feature, it is unlikely to affect any feature that may be used by roosting, foraging or commuting bats.

No further survey for bats is required."

10. Shadow Flicker

Under certain combinations of geographical position, time of day and time of year, the sun may pass behind a turbine rotor and cast a shadow over neighbouring properties. When the blades rotate a shadow forms for short periods and this effect is known as 'shadow flicker'. Shadow flicker is considered an issue when the blade shadow passes over a narrow opening, such as a neighbouring property's window. The main cause for concern is the potential annoyance to homeowners. This is an issue that can be completely mitigated, if required, through understanding the periods of concern and controlling the turbine appropriately during these periods.

This chapter considers the potential shadow flicker impact on local properties from the operation of the proposed Ingliston Farm wind turbine.

10.1. Methodology

The effect of shadow flicker can be assessed using specialist software. This software models the shadow flicker from the following geometric considerations:

- The position of the sun at a given date and time;
- The size and orientation of the windows that may be affected; and
- The size of the proposed turbines that would cast the shadow.

Within this assessment, the sensitivity of any identified receptors is assumed to be High due to the direct impact on local residential amenity.

10.2. Baseline Assessment

10.2.1. Relevant Legislation, Policy and Guidance

The Scottish Government's web based Specific Advice Sheet – Onshore Wind Turbines (most recently updated in October 2012) states:

"Under certain combinations of geographical position, time of day and time of year, the sun may pass behind the rotor and cast a shadow over neighbouring properties. When the blades rotate, the shadow flicks on and off; the effect is known as "shadow flicker". It occurs only within buildings where the flicker appears through a narrow window opening. The seasonal duration of this effect can be calculated from the geometry of the machine and the latitude of the potential site".

"Where this could be a problem, developers should provide calculations to quantify the effect. In most cases however, where separation is provided between wind turbines and nearby dwellings (as a general rule 10 rotor diameters), "shadow flicker" should not be a problem. However, there is scope to vary layout/reduce the height of turbines in extreme cases."

10.2.2. Site Context

There are no properties within 10 rotor diameters of the turbine location. The nearest residential property, at Easter Denoon, is at the approximate grid reference of E334985 N743907 and is shown in Figure 11 below (marked as H1).

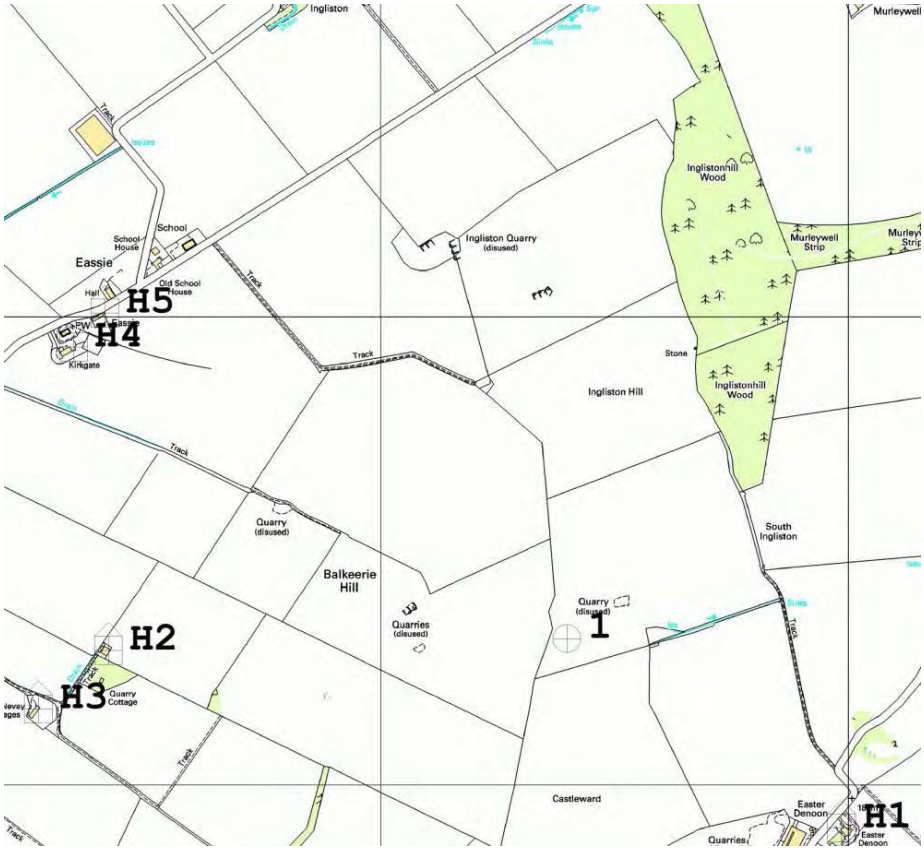

Figure 11: Properties assessed for shadow flicker impacts

10.3. Impact Assessment

A map assessment was undertaken to demonstrate the extent of shadow flicker at the site assuming the worst case assumptions. This map is shown in Figure 12 for the proposed development. The contours mark the number of hours of potential impact to an individual window at 2m above ground level. Each contour represents 50 hours of shadow flicker events per annum.

Figure 12: Theoretical shadow flicker zone surrounding the Ingliston Farm turbine

The calculated flicker events are detailed in Table 29 below.

House	Days per year	Max hours per day	Mean hours per day	Total hours per year
H1	0	0	0	0
H2	0	0	0	0
H3	0	0	0	0
H4	0	0	0	0
H5	0	0	0	0

Table 29: Summary of theoretical shadow flicker impacts

10.4. Conclusion

The following conclusions have been made regarding shadow flicker considerations and the proposed wind development:

- A shadow flicker assessment was completed using Windfarm Software to quantify the areas of potential impact. The model was run using conservative, worst – case assumptions;

- No shadow flicker impacts are expected at nearby properties; and
- Screening from trees has not been considered during this assessment. This means that, if there were potential flicker effects, these will be greatly reduced.

The above assessment considered worse case conditions for the effects of shadow flicker. Therefore shadow flicker should not be considered to be a sustained concern in terms of local residential amenity.

11. Noise

This chapter assesses whether a wind turbine at Ingliston Farm is likely to cause a noise disturbance to the nearest residential dwellings. The chapter will initially provide an overview of relevant policy, wind turbine noise and site context before assessing the extent of wind turbine derived noise on the nearest residents.

11.1. Methodology

A desk based assessment has been carried out in accordance with the relevant guidelines (discussed further in Chapter 11.2.2). Following recent discussion with Angus Council, particular attention has been made to the Institute of Acoustics 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2013). Within the guidance it is outlined that the following parameters should be set when calculating noise predictions:

- A ground factor of G=0.5;
- The use of warranted manufacturer data or, if warranted data is not available, the use of measured data. In the scenario where measured data is used, an uncertainty factor provided by the manufacturer, multiplied by a margin of 1.645, should be used to ensure that suitable uncertainties have been incorporated. This is highlighted within the IEC 61400-11 standard;
- The adoption of a receiver height of 4.0m is recommended (regardless of time of day), as it has the effect of reducing the potential over-sensitivity of the calculation to the receiver region ground factor compared to lower receiver heights; and
- Atmospheric conditions of 10^{o}C and 70% humidity are recommended to represent a reasonably low level of air absorption.

In line with the above guidance, predicted noise levels have been calculated based on measured sound power information provided by the manufacturer and have been compared with the noise limits set out within ETSU-97.

The measured and warranted sound power data from the manufacturer and extracts from the ReSoft Windfarm software used to complete the assessment can be viewed in Appendix C.

The extent of turbine noise has been quantified using International Standard ISO 9613 "Acoustics – Attenuation of Sound during Propagation Outdoors" and from this work it has been considered that further detailed noise survey work is not required for the proposed turbine location and model.

11.2. Baseline Assessment

11.2.1. Turbine Noise

Wind turbines generate noise as they rotate. Wind turbine derived noise will occur above the "cut-in" wind speed and below the "cut-out" wind speed. Below the cut-in wind speed there is insufficient strength in the wind to generate efficiently and above the cut-out wind speed the turbine is automatically shut down to prevent any malfunctions from occurring. The cut-in wind speed for the proposed turbine is 3 meters per second (m/s) and the cut out wind speed is normally around 25m/s (measured at hub height). Above wind speeds of 8 – 12m/s, background noise begins to exceed turbine noise as shown in Figure 13. Therefore, it is within the range 3 to 12m/s that turbine noise is typically most audible.

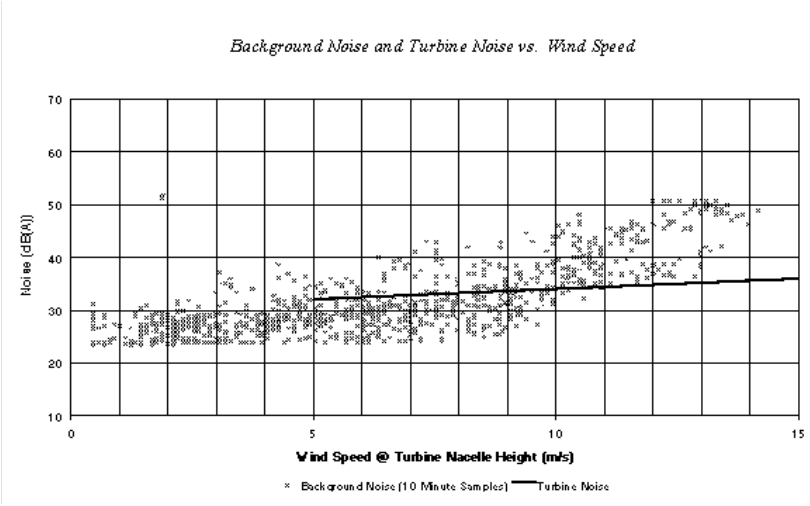

Figure 13: Background Noise and Wind Turbine Noise vs. Wind Speed[16]

During the operational phase there are two potential sources of noise from a wind turbine; aerodynamic noise from the movement of the blades through the air, and mechanical noise from the operation of turbine engine components (e.g. gearbox and generator) in the nacelle.

Modern wind turbines have been designed to be considerably quieter than earlier turbine models and significant progress has been made in recent years in achieving lower noise signatures. Well designed modern wind turbines are generally quiet in operation and compared to the noise of road traffic and construction activities in other locations, the noise from wind turbines is very low.

Aerodynamic noise can be minimised through careful attention to blade design, whilst mechanical noise can be minimised through innovative design and noise insulation materials within the nacelle.

The locational and turbine specific noise details for this project are provided in Table 30 below and the noise data has been provided from EWT documentation for their Directwind 54 turbine which is proposed for this site.

Turbine	EWT Directwind 54
Easting	334397
Northing	744313
Height ASL	235m
Measured sound power level at 95% operation (10m/s) including uncertainty factor of 1.15dB (0.7dB uncertainty factor provided by the manufacturer x 1.645, as outlined in Section 11.1).	100.65dBA

Table 30: Turbine details used in this assessment

11.2.2. Relevant Legislation, Policy and Guidance

The following policy and guidance documents were utilised in the completion of this chapter:

[16] Graph taken from The Assessment & Rating of Noise from Wind Farms, The Working Group on Wind Turbine Noise, September 1996.

- Scottish Planning Policy;
- Institute of Acoustics 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise';
- PAN 1/2011 Planning and Noise and accompanying Technical Advice Note;
- Specific Advice Sheet – Onshore Wind Turbines (which replaces PAN 45 Renewable Energy Technologies);
- BS 5228 Parts 1 & 2 – Code of Practice for Noise and Vibration Control on Construction and Open Sites; and
- ETSU-R-97 The Assessment and Rating of Noise from Wind Farms.

The Scottish Government's online guidance (last updated in October 2012) states:

"The Report 'The Assessment and Rating of Noise from Wind Turbines' (Final Report, Sept 1996, DTI), (ETSU-R-97), describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available. This gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burdens on wind farm developers, and suggests appropriate noise conditions".

ETSU (1997) suggests that current practice on controlling wind farm noise should be by the application of noise limits at the nearest noise-sensitive properties. These noise limits should be applied to external locations and should apply only to those areas frequently used for relaxation or activities for which a quiet environment is highly desirable. The report suggests that noise limits should be set at a $LA90_{10min}$ of no more than 5 dB(A) above background, subject to a minimum of 35-40 dB(A) for daytime and 43 dB(A) for night-time. These limits are applicable up to a wind speed of 12 m/s measured at 10 m height on the site. However, the report also states both day and night-time lower fixed limits can be increased to 45 dB(A) to increase the permissible margin above background where the occupier of the property has some financial interest in the wind farm.

11.2.3. Site Context

The 5 residential locations closest to the proposed turbine are numbered in Figure 14 below with details provided in Table 31.

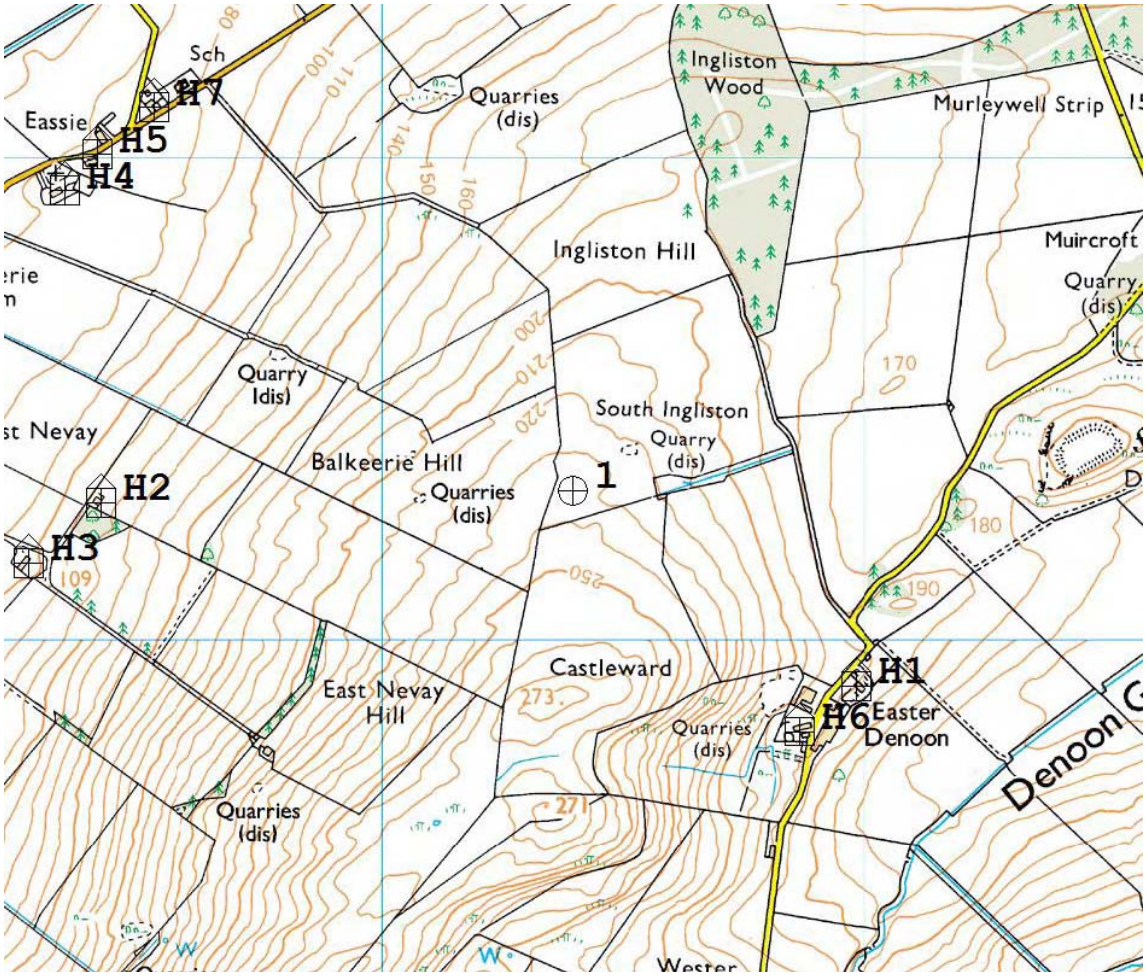

Figure 14: Residential areas surrounding the proposed turbine

House	Easting	Northing	Distance to turbine
H1	334985	743907	714m
H2	333417	744287	978m
H3	333268	744163	1138m
H4	333343	744934	1223m
H5	333409	745008	1207m
H6	334866	743812	686m
H7	333528	745106	1176m

Table 31: Details of the dwellings in proximity to the proposed turbine

With regards to the existing sources of background noise in the area, the site was considered to be a relatively quiet rural area although there will be anthropogenic noise from farm vehicles and other vehicles on the public roads.

11.3. Impact Assessment

Noise related issues need to be considered for the construction, operational and decommissioning phases of the project.

11.3.1. Construction and decommissioning phases

During these phases there will be a number of short term noise impacts of varying intensity and these include:

- The transportation of abnormal loads (equipment and materials) to site will require the use of Heavy Goods Vehicles (HGV's). The majority of the transport route is likely to be via motorways and other busy regional roads so there is unlikely to be significant additional noise impacts for sensitive receptors along the majority of this route; and
- The construction/excavation of the borrow pit, foundations and ancillary structures (including the excavation of earth to lay foundations and underground cabling) is likely to have short-term noise impacts higher than background levels. In accordance with best practice, this type of construction work will take place during daylight hours to ensure minimal disturbance to nearby residential dwellings.

Given the single turbine nature of the development there will only be a short term noise impact from construction traffic and turbine components coming to and from site along local roads. These stages are therefore considered to have a negligible overall noise impact.

11.3.2. Operational phase

Although noise levels arising from wind turbines are fairly low relative to other anthropogenic sources, as the turbines are generally situated in rural environments there are often few other sources of noise. When wind speeds are high this is not a problem since any turbine noise is masked by wind induced noise effects, particularly that of the trees being blown. At lower wind speeds, however, or in particularly sheltered locations, the wind induced background noise may not be sufficient to mask the noise from the turbine. However, under these conditions, the generated noise levels may be so low as to generate very little impact.

As discussed, a desk-based noise impact was undertaken based on ISO 9613:

- ISO 9613 – 1: Attenuation of Sound During Propagation Outdoors, part 1: Calculation of the Absorption of Sound by the Atmosphere; and
- ISO 9613 – 2: Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation.

The propagation model described in Part 2 of the ISO 9613 standard provides for the prediction of sound pressure levels based on either short-term, down-wind (i.e., worst case) conditions, or long term, downwind overall averages. ISO 9613 is considered a conservative model as it assumes all receivers are downwind from the noise sources. In reality, when wind is blowing in the opposite direction (i.e. from receivers to sources), the source attributable noise levels are lower.

Turbine sound power levels

In this assessment, noise predictions for this site have been based on measured sound pressure levels. Table 32 below gives the calculated octave band sound power levels for the proposed turbine for wind speeds at 10m/s. An uncertainty factor of 1.15dB has been added to each sound power level to provide a more conservative assessment, as per the Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'.

Octave Band Frequency (Hz)	Sound Power Level (dB(A))
63	82.75
125	88.95
250	94.25
500	95.55
1000	94.15
2000	91.65
4000	84.75
8000	72.95

Table 32: Octave band spectrum at 10m/s

11.3.3. Other Factors

Directivity Factor

The directivity correction describes the extent to which a point source radiates sound. For a wholly omnidirectional source (like a turbine nacelle), the directivity correction is 0.

Atmospheric Absorption

The atmospheric absorption depends on the relative humidity of the air, ambient temperature and ambient pressure. For this model, an ambient temperature of 10°C with a relative humidity of 70% was used in line with the Institute of Acoustics recommended atmospheric factors. This generated the octave band absorption coefficients used in the model, as shown in Table 33 below.

Frequency (Hz)	63	125	250	500	1,000	2,000	4,000	8,000
Absorption Coefficient (dB/km)	0.12	0.4	1.04	1.93	3.66	9.66	32.8	117.00

Table 33: Octave Band Absorption Coefficients

Ground Factor

The ground region parameter (i.e. how acoustically hard or soft the ground is) was set at 0.5 for the model. The ground region can be set between 0 (hard ground such as water or concrete) to 1.0 (grassland or farm land). In accordance with the Institute of Acoustics guidance, a ground factor of 0.5 was used in the model as the guaranteed turbine sound power level has been utilised.

Barrier Attenuation

There are no screening obstacles (i.e. barriers) included in this model.

11.4. Results

The ETSU Guidelines state that the L_{A90} noise descriptor should be adopted for both background and wind farm noise levels and that, for the wind farm noise, this is likely to be between 1.5 and 2.5 dB less than the L_{Aeq} levels over the same period. Use of the L_{A90} descriptor for wind farm noise allows reliable measurements to be made without corruption from relatively loud, transitory noise events from other sources.

Noise predictions were carried out for a wind speed of 10m/s at 10m height. The receiver was set at a 4m height above ground level. The results are plotted in the form of noise contours shown in Figure 15 below. It should be noted that this represents downwind propagation in all

directions simultaneously, which clearly cannot happen in practice. The predicted turbine noise L_{Aeq} has been adjusted by subtracting 2dB to give the equivalent L_{A90} as suggested in ETSU-R-97. The L_{A90} figures with the uncertainty factor of 1.15dB outlined are included in Appendix C. These have been inserted manually into the ReSoft Windfarm software, to prepare the model in Figure 15 below.

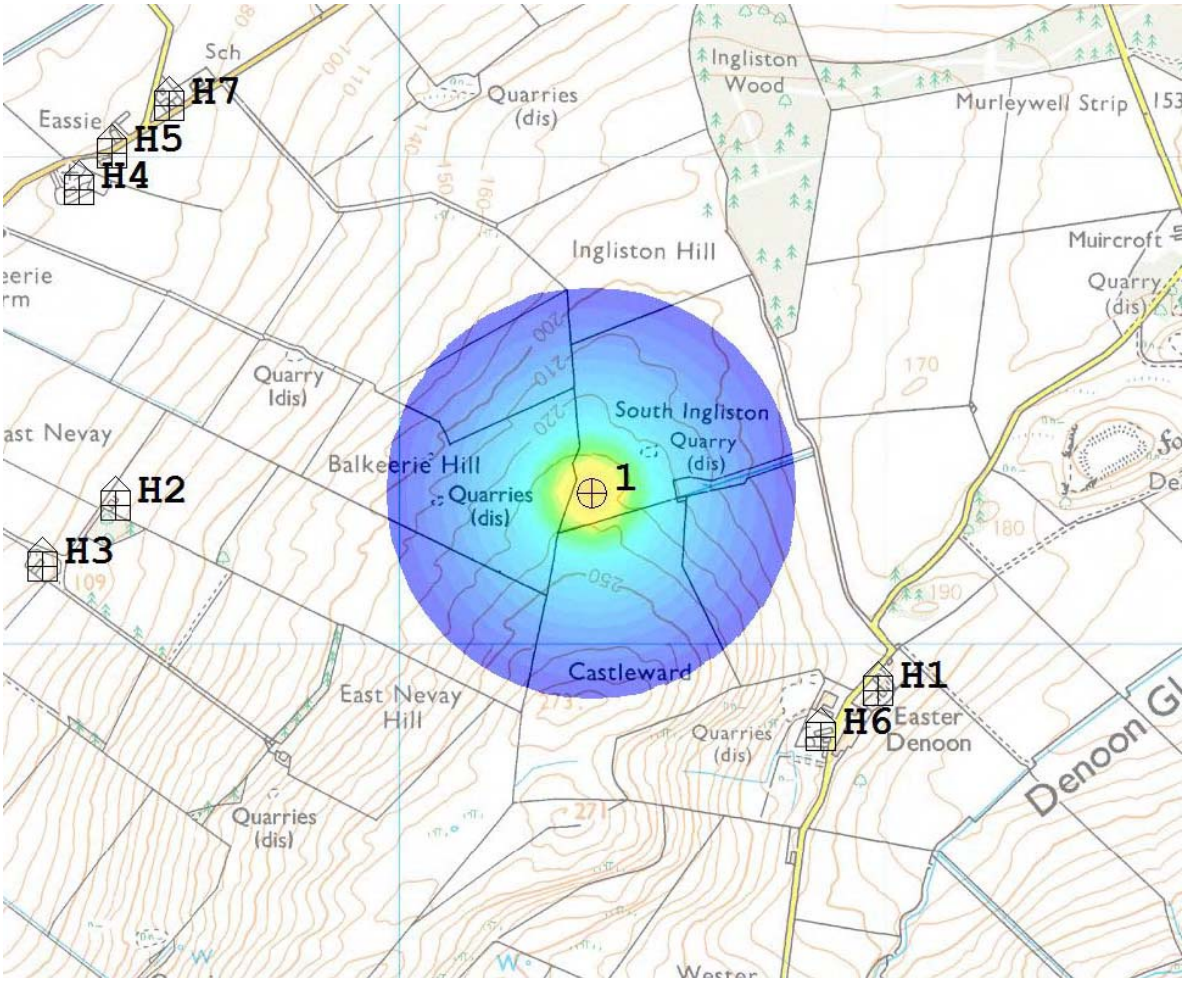

Figure 15: Ingliston Farm Noise Model (using ReSoft Windfarm and L_{A90} data)

As is shown by the above noise assessment, the maximum expected noise levels at the nearest residential areas will be under 35db(A). Based on the ETSU guidance this is considered to be within acceptable levels and background noise measurements are not considered necessary. It should also be noted that:

- Wind turbine noise is modelled at its rated power output and consequently the rated sound power level;
- The model assumes a direct line of sight and does not consider terrain; and
- The noise model assumes that the wind direction is always blowing from the wind turbine to each house simultaneously. Noise levels can be expected to be 2 dB less during cross winds (i.e. where the wind blows across a path between the turbine and the house).

The results of the noise assessment for each house shown in the baseline assessment are shown in Table 34 below.

House no	Predicted Noise (dB)
H1	29.75
H2	26.44
H3	24.83
H4	24.05
H5	24.18
H6	30.17
H7	24.47

Table 34: Calculated noise levels at surrounding properties

11.5. Mitigation

Construction

Several safeguards exist to minimise the effects of construction noise including:

- The various EC Directives and UK Statutory Instruments that limit noise emissions of a variety of construction plant;
- Guidance set out in BS 5228: 2008: Part 1 which covers noise control on construction sites; and
- The powers that exist for local authorities under the Control of Pollution Act 1974 to control environmental noise on construction sites.

As part of the construction contract, the contractor would be required to implement all committed mitigation measures including those set out in this Document. With a view to ensuring compliance with the agreed noise limits, the adoption of Best Practicable Means, as defined in the Control of Pollution Act 1974, is usually the most effective means of controlling noise from construction sites.

Other additional generic measures to be adopted for the control of noise are as follows:

- All site staff would receive appropriate environmental training at the beginning of the contract and throughout the construction;
- Silenced or sound reduced compressors would be used where necessary;
- Silencers or mufflers would be fitted to pneumatic tools where required;
- Deliveries would be programmed to arrive during daytime hours only and care would be taken to minimise noise when unloading vehicles;
- Delivery vehicles would be prohibited from waiting within the site construction compound with their engines running;
- Plant items would be properly maintained and operated according to manufacturers' recommendations, in such a manner as to avoid causing excessive noise; and
- Appropriate noise limits and working hours would be specified in the contract documents. It is assumed that construction activities would be undertaken during daytime periods only, between the hours of 07:00 to 19:00 hours Monday to Friday and 07:00 to 13:00 hours on Saturday.

Operation

The noise assessment demonstrates that the highest predicated noise level at the nearest residential dwellings to the proposed turbines is under 35 dB(A), which meets ETSU guidelines. On this basis, no mitigation is deemed necessary in relation to the operational phase of development.

11.6. Conclusions

The following conclusions have been made regarding noise considerations and the proposed wind development:

- The area is rural in nature and is expected to have relatively low background noise;
- The nearest property (house and or boundary) to the turbine is measured as being 686m from the turbine position;
- The proposed turbine (EWT Directwind 54) is a modern turbine design with a low noise signature compared with other turbines of a similar size;
- Noise modelling was completed for the proposed development using ReSoft Windfarm software and the guaranteed noise levels for the proposed wind turbine at normal operation. This model is based on ISO 9613;
- The noise at the nearest residential dwellings (applicant and non applicant owned) to the proposed turbine site is shown not to exceed 35 dB(A) (L_{A90}) at a wind speed of 10m/s and at a received height of 4m, in accordance with ETSU and the guidance from the Institute of Acoustics; and
- ETSU guidance states that in the above scenario the wind turbine development is not considered to require detailed background noise modelling as the turbine noise would be below what is expected to be seen as background noise in a low noise environment.

Overall, noise impacts are predicted to be low and assessed levels are well within ETSU guideline limits.

12. Telecommunications

This chapter examines the proposed development of a wind turbine at the Ingliston Farm site with regards to the potential to interfere with telecommunications and television reception.

12.1. Methodology

To assess the potential impact on telecommunications, Locogen initially provided details of this development to the Office of Communications (Ofcom). Ofcom are the agency tasked with assessing the potential impacts of wind energy proposals on the civilian radio network (consists primarily of mobile phone operators and communication systems for public sector and utility companies). Ofcom responded with a list of those telecom links that are within a 500m radius of the proposed development. Information on the proposed development was also passed on to Atkins and the Joint Radio Company (JRC) who manage the scanning microwave and telemetry links of utility companies.

Ascertaining the potential impact on local television transmission signals previously involved the completion of the BBC wind farm assessment tool. This online assessment tool is no longer available and this is at least partially due to the move to a fully digital television reception network which is considered to significantly reduce the potential for impacts upon reception.

12.2. Baseline Assessment

The potential impacts are likely to be during the operational phase of the project. Various stakeholder bodies were contacted regarding the proposed development, the outcomes of the consultation and further assessment are provided below.

12.2.1. Telecommunications

Ofcom, Atkins and JRC were asked to give details of telemetry and microwave links within a 500m radius of the development. The outcome of this stakeholder contact has been summarised in Table 35 below.

Company	Responded	Links	Further issues
Ofcom	Yes	0	-
Atkins	Yes	0	-
JRC	Yes	0	-

Table 35: Overview of responses from telecommunication companies

12.2.2. Television Reception

With regard to domestic television reception the primary area of concern is that the presence and movement of the turbine causes shadow and/or reflection zones in the surrounding area. A worst case scenario is that television reception systems within these zones may be partially or totally impaired through the reception being blocked or mirrored by the presence of the turbine.

12.3. Impact Assessment

12.3.1. Telecommunications

Consultation with Ofcom and others found no telecommunications links within 500m of the proposed turbine locations. Development of the site therefore poses no interference risks to nearby telecommunication links.

12.3.2. Television Reception

Prior examples of instances where wind developments have impacted on television reception have involved analogue systems. Therefore a key factor to take into consideration is the UK's completed switch to an all digital broadcasting network. The following information was provided as to how this switch would be likely to significantly reduce the extent of any impact:

> *"Although analogue and digital terrestrial TV signals use different modulation systems, with different characteristics, digital signals will still be broadcast from the same transmitter sites, and in the same frequency ranges, as currently used for analogue TV. The propagation characteristics of both systems are also the same, and physical obstructions such as wind farms will therefore continue to have an effect on domestic reception in the all-digital environment. However, digital signals contain a number of error correction and recovery mechanisms, which mean that an apparently perfect picture can be decoded even in quite adverse reception conditions. The corollary of this robustness is that the failure of digital signals is abrupt: when reception conditions become too poor for the error correction systems to recover from, reception is completely lost. This is in contrast to analogue systems, where visible picture impairments become gradually worse as reception conditions deteriorate".* [17]

Therefore the recent move to digital will mean that the number of potential sites impacted upon will be reduced further due to fewer issues with partial picture distortion.

Overall, television reception issues are not perceived to be a significant concern due to the small scale of development, the limited number of dwellings in the immediate area, the move to digital reception, and the ability to rectify issues for those individual households that are affected.

12.4. Conclusions

On the basis of the above desk-based assessment, no specific mitigation measures are required in relation to telecommunications links.

Following the digital switch-over, loss of local television reception is unlikely to occur. Any impacts that do occur (expected to be minimal, if at all) can be appropriately mitigated at the expense of the developer.

[17] Peter Mandry, Senior Associate technical advisor for Ofcom

13. Aviation

Wind turbines can encroach on airspace and interfere with flight safety (both civilian and military), ground-based radar systems and aircraft navigation systems.

13.1. Methodology

Locogen have assessed the potential impact on aviation and radar through desk based assessment and stakeholder consultation. Stakeholders included the Ministry of Defence (MOD) and the Civil Aviation Authority (CAA).

13.2. Baseline Assessment

13.2.1. Relevant Legislation, Policy and Guidance

Guidance for assessing the potential impact on aviation considerations is provided in:

- Scottish Government 2002 – PAN 45: Renewable Energy Technologies and as superseded by online planning advice for 'Onshore Wind Turbines' (last updated October 2012);
- BWEA aviation guidance – www.bwea.com/aviation; and
- BERR 2002 (formerly DTI) – Wind Energy & Aviation Interests.

13.3. Impact Assessment

The vast majority of aviation impacts will be during the operational phase of the project. Due to the complexity in assessing aviation interests it is primarily left to the relevant statutory bodies to make their own views regarding the proposed development.

Locogen have completed a desk based assessment of the perceived effects of a wind turbine operation on specific aviation operations.

13.3.1. Civil Aviation

Figure 16 below illustrates that the site lies outwith the radar coverage area for both Edinburgh and Aberdeen airports and is well outwith the 15km safeguarding radius areas for both sites. Furthermore there is not considered to be a safeguarding impact on Dundee Airport, given that the turbine is located over 15km from the aerodrome reference point and that Dundee Airport has no site based radar operations.

It is concluded that objections will not be raised in relation to any of the above noted locations.

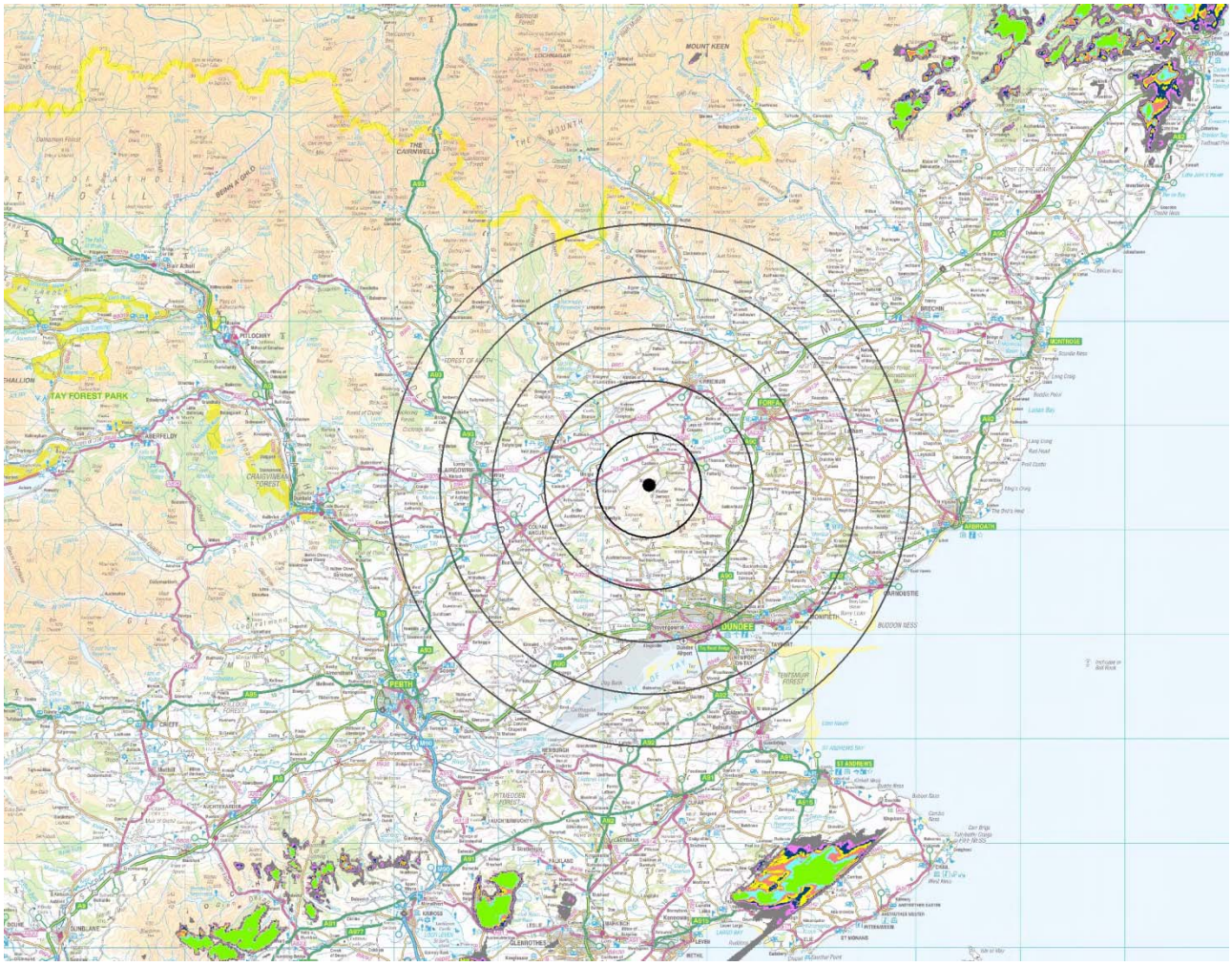

Figure 16: Edinburgh Airport (South) and Aberdeen Airport (North) radar visibility [Radii around turbine in 5km increments]

13.3.2. Military Aviation

It is understood that the Ministry of Defence (MoD) can no longer resource the provision of pre-application consultation advice. As such, no consultation has been initiated with the MoD. The site lies within a low priority military low flying zone and therefore should not raise concerns in relations to low flying military aircraft.

Based on desk-based GIS modelling, it is also considered that the Ingliston Farm site will not be visible to MoD radar at RAF Leuchars, which is located approximately 27km south south east of the proposed turbine location. It is therefore considered unlikely that the MoD will raise concerns over the radar visibility of the Ingliston Farm wind turbine.

13.3.3. NATS En-Route Ltd (NERL)

NATS En-Route Ltd (NERL) manages the UK's en-route air traffic outside of the individual air traffic control zones around airports. They therefore have a number of radar stations that provide radar coverage across the UK. As a first assessment tool this body provides radar visibility maps of the UK that allow wind developers to initially assess potential issues with regard to en-route navigational facilities. The zones where there would be radar visibility at 60m and 80m AGL are shown coloured red and green respectively in Figure 17 below. The proposed turbine is located outwith those areas having en-route radar visibility.

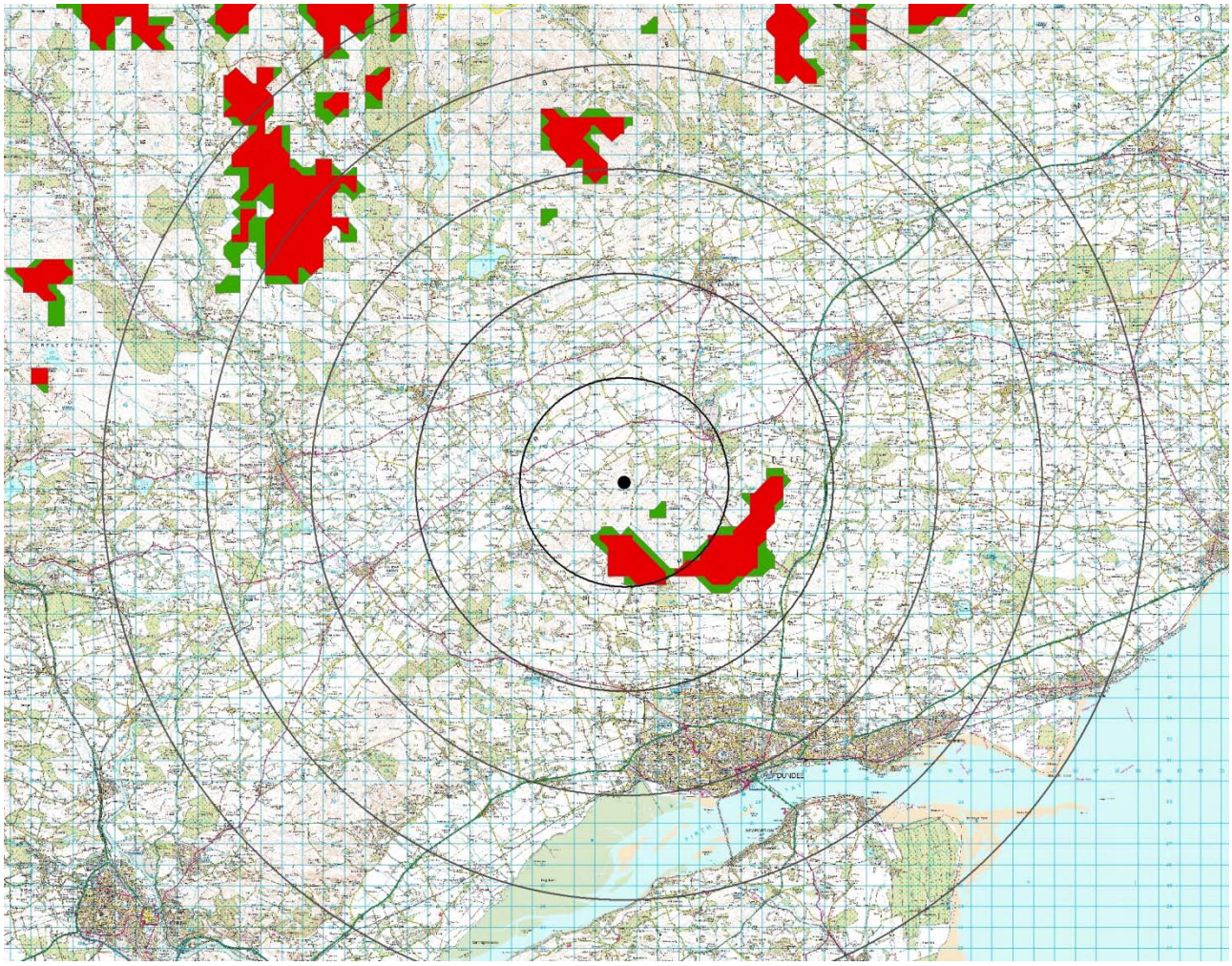

Figure 17: NERL radar visibility at 60m and 80m above ground level

13.3.4. Meteorological Station

There are no meteorological radar stations within 30km of the proposed turbine site.

13.4. Conclusions

The majority of aviation impacts will be assessed by statutory consultees once a planning application has been submitted. From an initial desk based assessment it is not expected that there will be an issue raised on the grounds of both civil and military aviation.

14. Public Safety

14.1. Baseline Assessment

Information is provided below on the national guidance relating to the operational safety of wind turbines. This is provided by PAN45 (2002) as superseded by the Scottish Government's online renewables planning advice for 'Onshore Wind Turbines'[18].

Equipment Safety: Companies supplying products and services to the wind energy industry operate to a series of international, European and British standards. The build-up of ice on turbine blades is unlikely to present problems on the majority of sites. When icing occurs the turbines' own vibration sensors are likely to detect the imbalance and inhibit the operation of the machines. Site operators also tend to have rigorous and computer aided maintenance regimes and control rooms can detect icing of blades. Danger to human or animal life from falling parts or ice is rare. Similarly, lightning protection measures are incorporated into wind turbines to ensure that lightning is conducted harmlessly past the sensitive parts of the nacelle and down into the earth.

Road Traffic Impacts: In siting wind turbines close to major roads, pre-application discussions are advisable with Transport Scotland's Trunk Roads Network Management (TRNM). This is particularly important for the movement of large components (abnormal load routing) during the construction period, periodic maintenance and for decommissioning. Although wind turbines erected in accordance with best engineering practice should be stable structures, it may be advisable to achieve a set back from roads and railways of at least the height of the turbine proposed, to assure safety. Driver distraction may, in some circumstances, be a consideration.

General Safety Standards: Companies supplying products and services to the wind energy industry operate to a series of international, European and British standards. A set of product standards for wind energy equipment has been developed by the International Electro-technical Commission - IEC 16400. There are a number of British Standards that correspond to it, for example, BS EN 61400-1: 1995 'Wind Turbine Generator Systems - Safety Requirements'.

Blade Loss: A possible but rare source of danger to human or animal life from a wind turbine would be the loss of a piece of the blade or, in most exceptional circumstances, of the whole blade. Many blades are composite structures with no bolts or other separate components. Even for blades with separate control surfaces on or comprising the tips of the blade, separation is most unlikely.

Lightning Strike: The possibility of attracting lightning strikes applies to all tall structures and wind turbines are no different. Appropriate lightning protection measures are incorporated in wind turbines to ensure that lightning is conducted harmlessly past the sensitive parts of the nacelle and down into the earth.

[18] http://www.scotland.gov.uk/Topics/Built-Environment/planning/National-Planning-Policy/themes/renewables/Onshore

14.2. Impact Assessment

General safety standards: The proposed EWT Directwind 54 turbine model meets the required international, European and British standards, including BS EN 61400-1: 1995.

Blade loss: As stated above, the turbine has been designed to meet the required safety standards and this includes suitable consideration of the risk of blade loss.

Ice throw: Modern turbine designs are able to accommodate blade heating systems for sites where there is a high likelihood of blade icing occurring. Direction will be sought from the manufacturer on the requirement for this technology and if blade heating is not utilised the turbine could be programmed to shut-down during periods of potential icing and not start up until climatic conditions where such that icing and ice throw were no longer considered to be an issue.

Lightning strike: As stated above, the turbine has been designed to meet the required safety standards and this includes appropriate lightning protection measures.

Proximity to roads, paths and railways: The nearest public road is the minor road to the south east of the site, at Easter Denoon. This road is over 600m away from the proposed turbine location at its nearest point. Given that this is well in excess of the height of the turbine, the turbine would sit well beyond the set-back distance recommended in the relevant guidance. Driver distraction is unlikely to be a concern given the distance to the turbines from public roads. To minimise distraction any signage on the turbine will be in line with Council guidelines.

Proximity to overhead transmission lines: An exclusion distance of 1.5 x tip height has been utilised to ensure safe operating distances between wind turbines and overhead power lines.

Proximity to pipelines: An exclusion distance of 1.5 x tip height from underground pipelines has been utilised to ensure safe operating distances between these and the proposed wind turbine.

Distance from buildings: The proposed siting means that the turbine is well in excess of fall-over distance with regard to off-site buildings.

14.3. Conclusions

On the basis of the above assessment, no issues in relation to public safety are anticipated.

The mitigation measures outlined within this Chapter would ensure safe operation of the turbines once installed and full turbine shutdown (if required) during operational periods when this is deemed necessary.

15. Summary & Mitigation

15.1. Residual Environmental Effects

The proposed development has the potential to have both positive and negative impacts on the receiving environment.

15.1.1. Potential Positive Effects

The potential positive effects on the environment include:

- Creation of an indigenous, local, secure, and sustainable energy resource;
- Direct economic and social benefits to the farming business;
- Direct and indirect economic and social benefits to the local community;
- Provision of a valuable new land use, which will not affect existing farming operations; and
- A direct neutral and indirect positive effect on climate.

15.1.2. Potential Negative Effects

The potential negative effects on the environment include:

- Visual impact of the proposed turbines on the surrounding landscape and heritage assets;
- Visual impact of the proposed turbines on surrounding residential dwellings; and
- Increase in local traffic during the construction stage.

15.2. Conclusions on Development and Impacts in Context

The following conclusions can be made from the completed environmental chapters:

- An assessment of landscape and visual impact concluded that the majority of receptors assessed would experience a low to moderate impact from the proposed turbine. Indeed, the extent of significant effects are very limited and given that the proposal includes a single turbine up to 77m in height within a landscape that has the capacity to absorb turbine developments of this nature, it is concluded that this proposal is acceptable in terms of the EIA regulations and local, regional and national policy. Some locally significant impacts have been noted but the single turbine nature of the project and generally low level of cumulative impact is considered to reduce the overall impact. It is therefore considered that the proposed development is acceptable in terms of landscape and visual impact;
- The turbine will provide the farmer with a crucial form of diversification and a sustainable long term income from the operation of the wind turbine. The overall impact on the local area and economy is considered to be positive through direct and indirect means;
- The proposed turbine is considered to be an acceptable distance from known archaeological sites and monuments;
- With the successful application of mitigating measures and best practice construction techniques, the wind turbine construction phase is not anticipated to have any significant, long term negative impacts on the habitats or locally occurring wildlife;

- Modelled noise and shadow flicker levels are predicted to comply with national and international guidelines and will not pose as nuisances to nearby dwellings;
- Concerns regarding telecommunications and civil aviation are not expected; and
- Construction traffic is a short term impact and its management will be coordinated with Angus Council.

In summary, based on the positive impacts of the development, and the low level of negative impacts which will be mitigated where required, it is considered Ingliston Farm is a suitable location for a wind turbine development at the scale proposed.

15.3. Development Plan & Supplementary Planning Guidance Compliance

This document, together with the accompanying drawings and specifications, has been prepared to assist Angus Council in considering the proposed development of a single wind turbine development at Ingliston Farm. It is considered that the proposed development is in accordance with planning policy at all levels in that there would be no demonstrable significant adverse impacts on the surrounding environment.

A summary of the relevant Development Plan and Local Plan policies is given in Table 36 below.

Policy	Policy Area	Comment
TAYPlan Strategic Development Plan Policy 6	Energy	The proposed development can be appropriately serviced in terms of access, grid connection and sustainable drainage. The proposed turbine have been sited so as to avoid any impacts on the oil and gas pipelines in the vicinity. After mitigation, there would be no significant adverse impacts, either individually or cumulatively, in relation to cultural heritage, nature conservation and protected species, residential amenity including noise and shadow flicker, tourism and recreation attractions, surface and ground water, and aviation and telecoms considerations. With regard to landscape and visual matters, taking into consideration the relevant Landscape Character Assessment, care has been taken to minimise potential impacts through sensitive siting and turbine selection.
Local Plan Policy S1	Development boundaries	This Supporting Environmental Document has demonstrated that the Ingliston Farm development will be within a scale and nature appropriate to the location. This has been shown through numerous assessments such as the LVIA, noise, ecological and shadow flicker.
Local Plan Policy S5	Safeguard Areas	No element of the proposed development will be within consultation zones of local hazards.
Local Plan Policy S6	Development Principles	The Supporting Environmental Document demonstrates the potential impact on the relevant principles set out in Schedule 1 of the Local Plan.

Policy	Policy Area	Comment
Local Plan Policy ER4	Wider Natural Heritage and Biodiversity	The Ecology assessment has demonstrated that the proposed development should not impact upon any species or habitats protected under British or European law.
Local Plan Policy ER5	Conservation of Landscape Character	The Landscape and Visual Impact Assessment has demonstrated in detail the impact of the Ingliston Farm turbine on the local and wider landscape. It is considered that the landscape will be capable of absorbing the wind turbine.
Local Plan Policy ER11	Noise Pollution	It has been demonstrated that the maximum expected noise output from the turbine will not have an adverse impact on local residents. The maximum noise level will be within the accepted noise limits detailed within national planning policy and planning guidance.
Local Plan Policy ER16	Development Affecting the Setting of a Listed Building	There would be no direct impact on known archaeological remains as a result of the development. An assessment of the proposed turbines on the setting of cultural heritage sites, including Scheduled Monuments and A Listed buildings, in the locality has been undertaken. The assessment concludes that, at worst, the effect of the development on the setting of identified cultural heritage assets is moderate and therefore not significant.
Local Plan Policy ER19	Archaeological Sites of Local Importance	
Local Plan Policy ER20	Historic Gardens and Designed Landscapes	As demonstrated within the Cultural Heritage and LVIA assessments, the Ingliston Farm turbine will not damage the characteristics or integrity of these sites. Chapter 5 of this report quantifies anticipated impacts on a variety of landscape designations, including designed landscapes, within 25 km of the site. In this respect, the effect of the development on the setting of such sites is not predicted to be significant.

Policy	Policy Area	Comment
Local Plan Policy ER34	Renewable Energy Development	It is considered that this application should be supported by Angus Council as the proposal demonstrates the following: a) The siting of the wind turbine has been chosen in order to minimise the impact on the local amenity; b) There is not considered to be unacceptable effects on the landscape character and sensitive viewpoints; c) There will be no unacceptable detrimental effects on any national heritage, scientific or historic sites; d) There will be no unacceptable effects of transmission lines as any new cabling will be buried underground; and e) The disruption to the local road network will be for a small period and minimal road upgrades are expected. This will be achieved without compromising road safety or causing unacceptable change to the environment.
Local Plan Policy ER35	Wind Energy Development	It is considered that this application should be supported by Angus Council as the proposal demonstrates the following: a) The selected location demonstrates the optimum location for wind development for the applicant while having minimal impact on the surrounding environment; b) It has been shown that the wind turbine will have no interference with birds; c) It has been demonstrated that there will be no unacceptable detrimental effects on residential amenity, existing land use and road safety with regards to shadow flicker and noise; d) There will be no interference with authorised aircraft activity; e) There will be no interference with telecommunication links within the area; f) The cumulative impact of the development with other wind developments in the area will be of an acceptable level; and g) The site will be reinstated to its original condition after decommissioning of the turbine.

Table 36: Summary of Development Plan and SPG compliance

Appendix A – Landscape & Visual Assessment Methodology

Landscape and Visual Impact Assessment Methodology

Although this application is not subject to an Environmental Impact Assessment (EIA), the approach taken for the assessing the landscape and visual effects follows the methods undertaken for a typical EIA wind energy development. This is based on the approach as set out in the *Guidelines for Landscape and Visual Impact Assessment* (Landscape Institute and Institute of Environmental Assessment, 2013). Other relevant best practice and policy guidance includes:

- Visual Assessment of Wind Farms Best Practice, University of Newcastle Scottish Natural Heritage Commissioned Report, (2002);
- Guidelines on the Environmental Impacts of Wind Farms and Small Scale Hydroelectric Schemes, Scottish Natural Heritage (2001);
- Visual Analysis of Wind Farms Good Practice Guidance, Scottish Natural Heritage (Draft 2005);
- Visual Representation of Windfarms: Good Practice Guidance, Scottish Natural Heritage (2007);
- Siting and Designing Windfarms in the landscape, Scottish Natural Heritage (2009); and
- Guidance, Cumulative Effect of Windfarms, Scottish Natural Heritage, (2012).

Evaluation of the Existing Environment – the Baseline

The baseline review for the landscape and visual resource has three elements:

1. Description – a systematic review and digest of existing information and policy relating to the existing landscape and visual resource;
2. Classification – analysis of the data to subdivide the landscape resource into discrete areas of similar and identifiable character and identify the visual receptors; and
3. Evaluation – Use of professional judgement to apply a sensitivity value to a landscape or visual resource with reference to specified criteria.

The baseline review is undertaken through desk-based data review followed by a site survey to verify the findings, and then analysis of the data. This process is described in detail in the following paragraphs.

Desk Based Data Review

Existing mapping, legislation, policy documents and other written, graphic and digital data relating to the proposal and broader study area was reviewed. This included the following documents:

- Scottish Planning Policy (2010);
- Typical Planning Considerations in Determining Planning Applications for Onshore Wind Turbines (web based renewables advice), Scottish Executive (October 2012);
- Fife Structure Plan 2006 – 2026 (2009);
- The Mid Fife Local Plan (2012);
- Wind Energy Supplementary Planning Guidance (2011);
- The Inventory of Historic Gardens and Designed Landscapes in Scotland;
- Tayside Landscape Character Assessment (1999);
- The Fife Landscape Character Assessment (1999);
- Ordnance Survey maps; and
- Digital sources of mapping and aerial photography.

The desk study also establishes the main users of the area, key viewpoints and key features, thus defining the visual baseline which requires to be verified on site. The potential visual receptors are identified and classified according to their associated use (settlements, footpaths, roads etc.). The aim of the baseline review of visual resources is to ensure that an appropriate range of viewpoints is included in the visual assessment. The potential extent of visibility of the proposed development as identified in the preliminary Zone of Theoretical Visibility (ZTV) provides the basis upon which the potential visual receptors are initially identified.

The desk study informs subsequent site work, which allows the confirmation of the Landscape Character Types (LCT) and Landscape Character Areas where applicable.

Site Survey

Field survey work is carried out to verify and, if required, refine the landscape character types identified within the study area, and to gain a full appreciation of the relationship between the proposed development, and the landscape.

The baseline visual resource is verified during the survey work and at this time, the validity of the list of representative viewpoints used in the LVIA. Since the ZTV is based on a 1:50,000 digital terrain model, it does not capture local landform. There are times when a viewpoint selected from analysis of the ZTV does not actually have any views to the proposed development. In some instances, this can be remedied by slight adjustments of the grid references, although the location must remain relevant to the particular receptor(s) for which the viewpoint was selected. It is also important to ensure that the viewpoints remain a representative selection of views. Wireframes supported the fieldwork, and observations are recorded with photographs.

Data Analysis

Analysis and reporting of the baseline resource took place after the completion of the desk and field surveys. The baseline landscape and visual review provides a description, classification, and evaluation of the landscape and visual resource of the study area.

The baseline review provides a robust description of the landscape and visual resource from which to assess the landscape and visual effects of the proposed development and to advise, in landscape and visual terms, on the development's acceptability in principle and upon its siting, layout and design. This involves identification of all the landscape and visual receptors and analysis of the sensitivity of each of these receptors to the proposed development.

Identification of Landscape and Visual Effects

The impact assessment aims to identify all the potential landscape, visual and cumulative effects of the development taking account of any proposed mitigation measures. This is carried out by:

- Assessing the magnitude of change brought about by the proposed development on each of the receptors identified in the baseline review;
- The effect is then predicted by combining the sensitivity of the receptor (as identified in the baseline review) with the magnitude of change; and
- Lastly, the significance of the predicted effect is assessed in a logical and well-reasoned fashion.

The assessment aims to describe the changes in the character and the landscape resources that are expected to result from the proposed development. It covers both landscape effects (changes in the fabric, character and key defining characteristics of the landscape); and the

visual effects (changes in available views of the landscape and the significance of those changes on people).

The table below identifies potential landscape and visual effects. Potential effects are those that could result from the construction and operation of a wind turbine, according to the project, site and receptor characteristics and their interactions. The inclusion of a potential effect in the table below (for example) does not imply that this will occur, or be significant. The assessment is based upon an assessment of the potential effects, in order to identify predicted effects.

Activity	**Element**	**Potential Effects**	**Potential Sensitive Receptors**
Construction	Construction plant, temporary construction compound, vehicle movements, new access tracks.	Temporary impacts on landscape fabric Temporary impacts on visual amenity	Landscapes character types Designated landscapes Gardens and designed landscapes Visual receptors
Operation	Presence of tracks, turbines, permanent site compound and substation	Long term but reversible impacts on landscape fabric Long term but reversible impacts on visual amenity Cumulative impacts with other wind farms	Landscapes character types Designated landscapes Historic gardens and designed landscapes Visual receptors including: residents, visitors, tourists, road users, walkers, cyclists
Decommissioning	Construction plant, temporary compound, vehicle movements	Temporary impacts on landscape fabric Temporary impacts on visual amenity	Landscapes character types Designated landscapes Historic gardens and designed landscapes Visual receptors including: residents, visitors, tourists, road users, walkers, cyclists

Potential Landscape & Visual Impacts

Extent of the study area and viewpoint selection

Maps of Zone of theoretical visibility (ZTVs) were prepared using digital terrain models. These represent the 'worst case' area of theoretical visibility where the proposed development may theoretically be seen. The ZTVs are based entirely on topographic factors and do not account for any screening effects provided by vegetation, buildings or minor variations in landform or the orientation of view. Therefore, the extent of any ZTVs tends to be greater than actual visibility and does not take account of climatic factors such as light conditions.

Drawing ING010 illustrates the ZTV for the proposed development and is then used as a basis for the further assessment and evaluation of the magnitude of visual impacts. This approach is described below.

Through the initial stages of the desk study, fourteen viewpoints were chosen to represent views experienced from a variety of receptors, within different landscape character types and

at a variety distances from the proposed development where the view may be apparent. The viewpoints agreed for the scheme are listed in the Supporting Environmental Document.

A study area centred on a 25 km radius from the proposed development has been used for the study of landscape, visual and cumulative effects. Given the relative scale of the development and the character of the landscape, significant effects are very unlikely to be experienced at distances over 15 km.

Landscape Sensitivity and Magnitude of Change

The sensitivity of the landscape resource is variable according to the existing landscape, its relationship to the proposed development, the nature of the development being assessed and the type of change being considered. The determination of the landscape's sensitivity to changes associated with the proposal is defined as High, Medium, Low or Negligible. This is based on the professional interpretation of the key landscape characteristics, the scale of the landscape and the nature of views, and the perceived landscape value as reflected by landscape designations (see table below).

Criteria	High	Medium	Low
Landscape designations and landscape value	Landscape designated for its national landscape value High landscape value, with very strong sense of place	Landscape designated for regional or local landscape value Medium landscape value	No designations present Low landscape value (i.e. industrial landscapes), with elements that detract from sense of place
Scale of Landscape	Small scale landscape	Medium scale landscape	Large scale landscape
Views	Enclosed, medium and short distance views	Open, medium distance views	Panoramic, open and long distance views
Cultural heritage interests that contribute to landscape character	Contains features or sites of national importance	Contains sites of regional importance	Few or no features of interest

Sensitivity of Landscape Receptors

As every proposed development and its interaction with the landscape are unique, there will be situations where predefined criteria will not accurately reflect the potential residual effects. In such cases, professional judgement takes precedence and is explained in the text. The criteria used for understanding the magnitude of landscape change are summarised below.

Level of Magnitude	Definition of Magnitude
High	Total loss or major alteration to key elements, features or characteristics of the baseline landscape so that the post development character and composition of the baseline landscape resource will be fundamentally changed.
Medium	Partial loss or alteration to one or more key elements, features or characteristics of the baseline landscape so that the post development character and composition of the baseline landscape resource will be partially, but noticeably changed.

Low	Minor loss of or to one or more key elements, features or characteristics of the baseline landscape so that the post development character and composition of the baseline landscape resource will be noticeably changed but the underlying character of the baseline landscape will be similar to the pre-development character.
Negligible	Very minor loss or alteration to one or more key elements, features or characteristics of the baseline landscape. Change to the landscape character will be barely distinguishable. No discernible effect upon the view

Definition of Landscape Magnitude of Change

Visual Receptor Sensitivity and Magnitude of Change

The sensitivity of visual receptors depends upon:

- The location of the viewpoint;
- The context of the view;
- The activity of the receptor, such as relaxing at home, taking part in leisure, recreational and sporting activities, travelling or working;
- Whether receptors are likely to be stationary or moving and how long they will be exposed to the change at any one time;
- The extent of the area or route from which the changes would be visible; and
- The frequency of the view (whether receptors will be exposed to the change daily, frequently, occasionally or rarely) and the duration of the view.

Visual receptor sensitivity is defined as High, Medium or Low and these definitions are described in the table below.

High	**Medium**	**Low**
Residents with views from the dwelling or curtilage		
Users of recognised national trails, whose attention or interest is likely to be focused on the landscape or on particular views	Other recreational routes, such as local footpath networks, used for dog walking, for example	People engaged in active outdoor sports or recreation and less likely to focus on the view
Road and rail users where appreciation of the landscape is an important part of the experience, such as scenic routes	Road and rail users likely to be travelling for other purposes than just the view, such as commuter routes	
Visitors to heritage assets or to other attractions, such as recognized beauty spots, where views of the surroundings are an important part of the experience	People at their place of work, where views are an important part of the setting and contribute to the quality of working life	People at their place of work whose attention is likely to be focused on their work or activity, not on their surroundings

Definition of Receptor Visual Sensitivity

In practice, a location may have different levels of sensitivity, according to the different receptors at that location. The specific combinations of factors that have influenced the judgement of sensitivity are described in the viewpoint baseline text.

The magnitude of visual change arising from the Development is described as High, Medium, Low or Negligible based on the overall extent of visibility (see the table below). For individual viewpoints it will depend upon the combination of a range of factors:

- The distance of the viewpoint from the development;
- The duration of effect;
- Extent of the development visible from the viewpoint (number and parts of turbine visible);
- The angle of view in relation to main receptor activity;
- The proportion of the field of view occupied by the development;
- The background to the development; and
- The extent of other built development visible, particularly vertical, elements.

Level of Magnitude	Description of change	Definition of Magnitude
High	Dominant	Highly noticeable change, affecting most key characteristics and dominating the experience of the landscape. The introduction of incongruous development A high proportion of the view is affected.
Medium	Conspicuous	Noticeable, partial change to a proportion of the landscape, affecting some key characteristics and the experience of the landscape. The introduction of some uncharacteristic elements. Some of the view is affected.
Low	Apparent	Minor change, affecting some characteristics and the experience of the landscape to an extent. The introduction of elements that are not uncharacteristic. Little of the view is affected.
Negligible	Inconspicuous	Little perceptible change. No discernible effect upon the view.

Definition of Visual Magnitude of Change

Other factors may also influence the visual effect. These relate to both human perception and to the physical environment itself. Factors which tend to reduce the apparent magnitude include the following:

- Sky-lining of front-lit turbines (where turbines are seen against the sky and the sun is behind the viewer, thus turbines reflect light and blend more easily into the brightness of the sky);
- Landform backdrop to back-lit turbines (where turbines are back-clothed by landform and the viewer sees them silhouetted with the light behind them. In this scenario the turbines are more likely to blend into the landscape);
- An absence of visual clues;
- Turbines do not form the focal point of the view;
- A complex and varied scene; and
- High relative elevation of view.

Factors which tend to increase the apparent magnitude include the following:

- Back-grounding of turbines (where turbines are seen against a backcloth of land);
- Visual clues;
- Turbines form the focal point of the view;

- A simple scene; and
- Low relative elevation of view.

Significance of Effects on Landscape and Visual Receptors

The significance of any identified landscape or visual effect has been assessed as Major, Moderate, Minor or Negligible effect. These categories have been determined by consideration of viewpoint or landscape sensitivity and predicted magnitude of change as described above, with the table below used as a guide to correlating sensitivity and magnitude to determine significance of effects. It should be noted that this is a guide only, and there will be times when the combination of sensitivity and magnitude yield a slightly different result from that predicted by the table. Where this discrepancy leads to prediction of significant effect, it is explained in the text.

	Magnitude of Change			
Sensitivity	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major/moderate	Moderate	Moderate/minor
Medium	Major /moderate	Moderate	Moderate/minor	Minor
Low	Moderate	Moderate/minor	Minor	Minor/none
Negligible	Moderate/minor	Minor	Minor/none	None

Assessment of significance of landscape and visual effects

Where overall effects are predicted to be Moderate-Major or greater (dark grey), these are considered to be equivalent to significant effects, as referred to in the *Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations* 1999. Overall effects of major/moderate (mid grey) may be significant if experienced over an extensive proportion of a receptor, area or route. Changes of moderate or less are not likely to result in significant effects.

Sequential visual effects

Sequential visual effects typically occur when moving along a linear route, as the observer moves from one point to another and gains views of other wind developments or a different view of the same development. They were driven in both directions, noting where intervening vegetation, buildings or embankments would limit views and recording the elapsed time and distance from the turbines. This was then compared with the ZTV and conclusions drawn about the likely visibility of the turbines. Assessment of the significance of the sequential effect takes into account the direction of travel, the proportion of the journey affected and the relative distance from the turbines.

Cumulative Methodology

Although a Guide to Assessing the Cumulative Effects of Wind Energy Development has been produced (DTI Final Consultation Draft December 1999), there are as yet no formalised guidelines in Great Britain defining an approved methodology for the assessment of cumulative effects on landscape and visual amenity that have been approved and endorsed by the Landscape Institute. The approach used is therefore based on draft guidance notes on cumulative landscape and visual impact assessment of wind farm developments produced by SNH (2005) and the Guidelines for Landscape and Visual Impact Assessment, LI-IEMA 2002.

Scope of Cumulative Assessment

The Cumulative Landscape and Visual Impact Assessment (CLVIA) takes account of all sites which have potentially significant overlapping study areas, and that are in 'the public domain' i.e.:

- Any constructed wind farm;
- Any consented wind farm proposal; and
- Any wind farm proposal that has been lodged as a planning application to the relevant local planning authority or the Scottish Executive.

For the assessment of cumulative effects, the relevant wind farms are listed in Table 5.5.

Types of Cumulative Effect

Cumulative effects are those that occur, or may occur, as a result of more than one wind farm project being constructed. Potential cumulative landscape and visual effects arise from the combined effects of additional wind farm developments. Combined effects relate to the following:

- Extending visibility of wind turbines over parts of the study area from where there are currently existing wind farms visible, which give rise to extended combined visibility of wind turbines at particular locations in the landscape, which may be simultaneous or successive in nature;
- Extending visibility of wind turbines over parts of the study area from where there are currently no wind turbines visible, which may give rise to an extended sequential visibility of wind turbines across the landscape; and
- Both simultaneous and sequential visibility of wind turbines.

In relation to simultaneous visibility, cumulative effects occur where more than one wind farm is visible in the same direction from a particular place. Where wind farms are visible in more than one direction from that place, this is defined as successive visibility. In relation to the sequential visibility, cumulative effects occur where the observer has to move to another viewpoint to see the second wind farm, so they appear in sequence, depending on speed of travel and distance between the viewpoints.

The assessment of potential cumulative landscape and visual effects is carried out in the same generic way as that of non-cumulative effects. Professional judgements are made in relation to the magnitude of change caused by the wind farm to the existing landscape and visual baseline.

Magnitude of Cumulative Change

Cumulative landscape and visual effects may result from additional changes to the baseline landscape or visual amenity caused by the proposed development in conjunction with other wind farm developments. The emphasis of the assessment is on the changes the proposal would bring to the existing landscape, which incorporates wind farm developments as part of its baseline landscape character and visual amenity.

The assessment therefore identifies the cumulative magnitude of change relative to existing visual impacts of wind farms rather than the combined impact of all the wind farms visible. The magnitude of cumulative change arising from the proposed development is assessed as high, medium, low or negligible, based on interpretation of the following largely quantifiable parameters, to take account of cumulative change:

- The number of existing and proposed developments and wind turbines visible;

- The distance to existing and proposed developments;
- The direction and distribution of existing and proposed developments; and
- The landscape setting, context and degree of visual coalescence of existing and developments.

The principle of magnitude of cumulative change makes it possible for the development to have a major effect on a particular receptor while having only a minor cumulative effect. For example, if the magnitude of change of Wind Farm 1 on Receptor 1 is high (for example, if it is 1 km from the receptor) the effect of Wind Farm 1 on Receptor 1 is likely to be major. In terms of a cumulative effect on this receptor, Wind Farm 2 may be visible, but if it is located, for example, 25 km from the receptor, the magnitude of cumulative change is likely to be low (Wind Farm 2 will be of limited visibility at 25 km) and the cumulative effect is therefore minor.

A significant cumulative effect is likely to only occur if both Wind Farm 1 and Wind Farm 2 are both fully visible, at close distances from the receptor, possibly in the same direction of view and forming a large developed proportion of the skyline. On the basis of professional interpretation of the above parameters, the magnitude of cumulative change arising at both landscape and visual receptors from each of the existing wind farms and the proposed development, both individually and in combination with each other, has been evaluated for the proposed development.

Significance of Cumulative Effects

SNH guidance on cumulative assessment describes the need for understanding whether the Development crosses the threshold of acceptability for the total number of wind farms in an area. As no existing methodology exists for identifying when a landscape has reached its capacity in terms of wind farms, it is necessary to revert back to SNH and Local Authority Guidance which seeks to identify the landscape objectives and policies for the area.

The level of any identified cumulative landscape or visual effect has been assessed as major, major/moderate, moderate, moderate/minor, minor, minor/none or none, in relation to the sensitivity of the receptor and the predicted magnitude of change as outlined above. As in the case of non-cumulative effects, the matrix shown above is used to bring together receptor sensitivity and magnitude of change.

Appendix B – Ecology & Ornithology Report

Ingliston Hill Single Turbine
Extended Phase 1 Habitat Survey

September 2013

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Summary

- A phase 1 habitat survey and protected species survey was undertaken at Ingliston Hill to inform plans to install a single wind turbine and borrow pit which will be restored once the works have been completed.

- The survey area does not support any sites designated for nature conservation value at a local or national level. Several Sites of Special Scientific Interest (SSSI's) were recorded within 10km of the site however these are not connected by structure or function to the site.

- The survey included a search for suitable habitat for and evidence of protected species (i.e. otters, water voles, badgers, red squirrels, bats and birds).

- Although suitable habitat for a range of protected species was identified within the site, no direct field evidence was recorded.

- No European Protected Species licences are likely to be required.

- General mitigation measures are provided.

Ingliston Hill Single Turbine
Phase 1 Habitat Survey

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1. INTRODUCTION

1.1 Remit

EnviroCentre was commissioned by Loco$_2$gen to undertake an Extended Phase 1 Habitat Survey at a site to the south east of Eassie in Angus. The survey was requested to inform a planning application to erect a single wind turbine and associated borrow pit.

The survey aimed to identify all broad habitat types within the site boundary and an appropriate buffer zone, whilst identifying those habitats, which may support populations of protected species (e.g. bats and badgers) and may consequently require further investigation. Consideration is also given to potential ornithological issues associated with the proposed development.

This report sets out the methods by which the survey was undertaken, an account of baseline results, interpretation of the results and a consideration of mitigation, compensation and any requirement for additional, species specific survey work.

1.2 Site Description

The 'site' refers to the proposed turbine location plus a buffer zone of a 500m radius. The site is located at National Grid Reference NO 34396 44336 approximately 1km to the south east of Eassie in Angus.

The site slopes steeply from south to north and is dominated by improved and semi improved grassland, currently used as grazing. The site is surrounded by a mixture of farmland and woodland.

A site location plan is located in Appendix A of this report and photographs are provided in Appendix B.

1.3 Proposed Development

The proposed development will see the erection of a single EWT 500kW turbine at the site. The turbine will be capable of generating 500kW of energy and will have a hub height of 50m and a rotor diameter of 54m. There will also be an associated borrow pit that will be restored once the aggregates have been taken.

1.4 Protected Species/ Legislation

European and National legislation along with Planning Policy and guidance relevant to the site is listed below. Cognisance has been taken of this legislation in the preparation of this report:

- The Wildlife and Countryside Act 1981 (as amended);
- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended);
- Protection of Badgers Act 1992 (as amended); and
- Local and UK Biodiversity Action Plans.

2. METHODS

All survey work was undertaken and verified by experienced and competent ecologists. The survey followed standard methods endorsed by Scottish Natural Heritage (SNH) and the Chartered Institute of Ecology and Environmental Management (CIEEM)[1]. This section provides summary details of the methods adopted.

2.1 Desk Study

Prior to the Phase 1 survey a desk study was undertaken. This included a search of the NBN Gateway[2] and Scottish Natural Heritage's SiteLink website[3], and the Woodland Trust[4] to identify records of the following within a 10km radius of the site:

- Statutory designated sites (Special Protection Areas (SPAs), Special Areas of Conservation (SACs), and Sites of Special Scientific Interest (SSSI);
- Non-statutory designated sites (e.g. Ancient Woodland Inventory, Local Wildlife Sites and Local Nature Reserves);
- Legally protected or notable species/populations (e.g. the presence of bat roosts or badgers);
- UK Biodiversity Action Plan[5] and Tayside Local Biodiversity Action Plan[6] priority habitats and species.

2.2 Phase 1 Habitat Survey

The baseline ecological data for the site was obtained by undertaking an Extended Phase 1 Habitat Survey following guidelines set out by the Joint Nature Conservation Committee (JNCC)[7]. This is a nationally adopted method for baseline ecological survey. Scientific plant names are used in the text and nomenclature follows that of the standard British flora[8].

The site was surveyed on 30th August 2013 when conditions were bright and clear with an air temperature of 17°C.

The survey aimed to identify and map broad habitat types in the proposed development site and its environs and to identify those habitats suitable for, or direct signs of, sensitive or protected faunal species.

A habitat map has been provided in Appendix C of this report while target notes are presented in Appendix D.

2.3 Protected Species Survey

Based on the outcomes of the desk study (see section 3.1) and the habitats found within the site, searches for direct evidence and suitable habitat for the following species were made:

- Otter *(Lutra lutra)*;
- Water vole *(Arvicola terrestris);*
- Badger (*Meles meles*);
- Red squirrel (*Sciurus vulgaris*)

[1] IEEM – Guidance on Survey Methodology, Winchester (2006)
[2] NBN Gateway website, available at: www.searchnbn.net
[3] Scottish Natural Heritage Site Link website available at: www.snhi.gov.uk
[4] Woodland Trust www.woodlandtrust.org.uk
[5] UK Biodiversity Action Plan from http://www.ukbap.org.uk
[6] Tayside Biodiversity Action Plan: Available at http://www.angus.gov.uk/biodiversity/actionplan.htm
[7] JNCC – Handbook for Phase 1 Habitat Survey (1991)
[8] Stace, C.A. 1995 New Flora of the British Isles. Cambridge University Press.

- Bats (various species); and
- Birds (various species).

2.3.1 Otter Survey

The otter survey extended along both banks of any streams within the site, where access allowed. The survey followed best practice guidelines[9] and a search was made for suitable habitat along with field signs, including:

- Spraints (otter faeces/droppings used as territorial signposts. Often located in prominent positions and can be placed on deliberate piles of soil or sand);
- Footprints;
- Feeding remains (can often be a useful indication of otter presence);
- Paths/Slides (otter can often leave a distinctive path from and into the watercourse);
- Holts: holts (underground shelter) are generally found:
    - Within trees roots at the edge of the bank of a river;
    - Within hollowed out trees;
    - In naturally formed holes in the river banks that can be easily extended;
    - Or preferably in ready-made holes created by other large mammals or humans such as badgers sett, rabbit burrows or outlet pipes; and
- Couches/lay-ups (couches or lay-ups are places for lying up above ground are usually located near a watercourse, between rocks or boulders, under dense vegetation).

Where evidence of otter activity was identified, a grid reference was taken at the location and photographs were taken for further interpretation.

2.3.2 Water Vole Survey

The otter survey extended along both banks of any streams on site, where access allowed, and followed standard guidelines[10]. Water voles tend to confine their activity to within 3 m of the bank edge along a watercourse where field signs are to be found. Field evidence includes:

- Faeces: 8-12 mm long, 4-5 mm wide; cylindrical and blunt ended pellets; colour variable with food type. Most droppings left in latrines near the nest, at range boundaries and at water entry points;
- Latrine sites: Concentrations of faeces, often with fresh droppings on top of old ones;
- Runways: Often 5-9 cm broad and multi-branched; usually within 2 m of water's edge and often forming tunnels through vegetation; leading to water's edge or burrows;
- Burrows: 4-8 cm diameter, wider than high; eroded entrances then contract down to typical size; entrances located at water's edge; however some entrances be up to 3m from the water; no spoil heaps;
- Nests: size and shape of a rugby ball, often in base of rushes, sedges or reeds;
- Feeding stations: located along runways, or at platforms along water's edge; usually a pile of cut/chewed vegetation in sections approximately 10 cm long; vegetation ends show marks of two large incisors. Piles of chopped grass, sedge or rush stems, rush pith and leaves;
- Lawns: Short, grazed vegetation around land entrances, often used during nursing periods;

[9] Chanin, P (2003). Natural Life Series, Monitoring the European Otter. Natural England.
[10] Strachan, R. (1998). Water Vole Conservation Handbook. Wildlife Conservation Research Unit, Oxford.

- Footprints: Difficult to tell from rat; adult hind foot 26-34 mm (heel to claw); stride 120mm (smaller than rat); occur at water's edge and lead into vegetation; and
- Sound: Characteristic 'plop' when a vole enters the water.

Emphasis was placed on locating latrine sites. Latrine sites are the most useful sign for recording purposes. They indicate whether there is definite presence of water voles at a site and are used for determining the approximate number of animals within the colony.

Given the aggressive predation on water vole by American mink (*Mustela vison*), all signs of this species were also searched for. Field signs included spraints, footprints and prey remains.

2.3.3 Badger

2.3.3.1 Habitat Suitability

The survey area was searched in its entirety to identify any potential habitat suitable for foraging and commuting badgers.

Badgers require suitable ground conditions for sett creation (e.g. soil that is free draining and can easily be excavated). Continuous well connected linear vegetation, such as tree lines and hedgerows, provide good foraging, sheltering and commuting habitats for badgers and native berry producing trees and shrub species offer a seasonal food resource for badgers.

2.3.3.2 Sett Survey

A badger sett is any structure or place which displays signs indicating current use by badger/located within an active badger territory. Setts comprise of a series of underground tunnels and chambers which form the home of a badger social group (clan). Although normally recorded in sloped, sandy soil in woodland habitats, it should be noted that badgers will excavate setts in a wide range of environs including urban settings.

Setts can be located anywhere within the territory of the clan and more than one sett can often be in use. Within one territory badgers may maintain a main sett with several annexe or satellite setts. Setts are identified by a number of characteristic features. These features include:

- A network of broad, concave entrances;
- Well-worn paths between entrances and foraging areas;
- Piles of excavated soil beside entrances (spoil heaps); and
- Piles of bedding materials beside entrances.

Diagnostic footprints and hair found around a sett can often confirm the presence of badgers and provide evidence of recent use. Fresh soil on spoil heaps can indicate recent use.

2.3.3.3 Field Signs

Badger field signs not only provide evidence of the species, but also give an indication of badger movements and how they utilise their territory. Badger field signs are described in Neal & Cheeseman[11] , Bang & Dahlstrøm[12] , and in SNH (2001)[13] and include:

[11] Neal, E. & Cheeseman, C. (1996). Badgers. Poyser Natural History, London.
[12] Bang P. and Dahlstrom P. 1980. Collins guide to animal tracks and signs. London, Collins.
[13] SNH (2001). Scotland's Wildlife: Badgers and Development (http://www.snh.org.uk/publications/online/wildlife/badgersanddevelopment/default.asp).

- Badger guard hair;
- Footprints;
- Snuffling (badgers use their snout to turn over vegetation or soft soil to forage for bulbs and invertebrates);
- Scratching posts (marks on tree trunks/ fallen trees where badgers have left claw marks);
- Breach points (gaps in fences or crossing points over roads);
- Dung pit (single faeces deposit placed in a small excavation); and
- Latrines (collection of faecal deposits often used by badger clans to mark home range boundaries).

2.3.4 Red Squirrel

The walkover survey followed best practice guidance[14] which involves the initial identification of suitable habitat (primarily coniferous woodland) within the survey area. In addition, the survey focused on searching for two distinct signs of squirrel activity. Note that neither of these methods accurately distinguishes between red or grey squirrels.

The signs of squirrel activity searched for are dreys and the remains of pine cones which have been stripped of their edible parts. The following methods are adopted:

- Drey count – dreys are the nests made by both species of squirrels in trees. Dreys are easily distinguishable from bird nests as they are normally 50 cm in diameter and 30 cm deep. They are normally located close to the main stem of the tree at a height of 3 m or more.
- Feeding transects – Where cone producing trees (conifers) are evident, a 50m x 1m transect is laid out through the woodland and evidence of squirrel feeding is searched for. Although the two species of squirrel cannot be distinguished from feeding remains, the manner in which squirrels break open seeds and nuts, which are then left on the forest floor, is diagnostic from other groups of animals.

2.3.5 Bat Roost Potential Survey (BRP)

The BRP is designed to identify those structures and features present within a site which may provide suitable habitat for roosting bats and may therefore require further survey work. Bats utilise a variety of roosts throughout the year, depending on their seasonal needs (e.g. breeding or hibernating etc.) and on the prevalent climatic conditions.

The BRP survey was conducted in accordance with the assessment criteria set out by the Bat Conservation Trust[15] and comprised a ground based visual inspections of all trees on site.

In general, it is accepted that mature, broad-leaved trees are preferred by bats, particularly Oak (*Quercus* spp.) and Beech (*Fagus sylvatica*). It is also known that for trees to be used by bats, they must be part of a wider habitat network that allows protected foraging, commuting and dispersal. The criteria used to assess the suitability of buildings and trees for bat roosts can be found in Table 1.

[14] Gurnell J, *et al* (2001). Forestry Commission Practice Note 11. Forestry Commission, Edinburgh.
[15] Bat Conservation Trust (2007). Bat Surveys – Good Practice Guidelines. Bat Conservation Trust, London.

Table 1: Bat Roosting Features and Field Signs

Features of buildings used as bat roosts	Features of trees used as roosts	Signs indicating possible use by bats
Gaps/cracks in wood barge boards, soffits and fascia boards	Cavities/ Loose bark	Tiny scratches around entry point
Gaps in end tiles, ridge tiles and eaves	Woodpecker holes	Staining around entry point
Gaps in lead flashing and roofing felt	Cracks/splits in major limbs	Bat droppings in/around/below entrance
Cavities in masonry	Behind thick ivy growth	Audible squeaking at dusk or during warm weather
Broken or hanging tiles	Within dense epicormic growth	Flies around entry point
Ventilation ducts, damaged drainage, overflow pipes	Existing bird and bat boxes	Smoothing of surfaces around cavity

Trees are more likely to be used for roosting by bats if they are part of a wider habitat network that allows protected foraging, commuting and dispersal.

According to their roosting suitability, trees are categorised as follows:

- Known roost
- Category 1*: Trees with multiple, highly suitable features capable of supporting larger roosts;
- Category 1: Trees with definite bat potential, supporting fewer features than category 1* trees or with potential for use by single bats;
- 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; and
- Category 3: Trees with no potential to support bats.

2.3.6 Birds

A desk study was undertaken to identify the potential sensitivity of avian species to the proposed wind turbine development.

The desk study was supported by a search for suitable nesting features during the Phase 1 Habitat Survey.

2.4 Constraints

The protected species surveyed for are transient in nature and this survey provides a snapshot of the activity on site.

3. SURVEY RESULTS

3.1 Desk Study

The results of the desk study are provided in the table below.

Table 2: Desk Study Results

Source	**Information Provided**			
SiteLink	**Site name**	**Designation**[16]	**Distance and orientation**	**Features**
	River Tay	SPA	3.1km N	Otter, salmon, lamprey
	Auchterhouse Hill	SSSI	4.8km S	Subalpine dry heath
	Forest Muir	SSSI	8km N	Lowland wet heath, spring fen
	Loch of Kinnordy	SSSI, SPA, RAMSAR	7.5km N	Eutrophic loch, open water transition fen, breeding bird assemblage, breeding bird assemblage, non-breeding grey-lag and pink footed goose.
Local Plan	No non-statutory designations are applicable to the site.			
Sketchmap	**Woodland name**		**Distance and orientation**	**Category (Antiquity Woodland Categories**[17]**)**
	Balgownie Muir Plantation		0.5km NE	Long-established (of Plantation origin)
	Templeton Myers		1.7km SW	Long-established (of Plantation origin)
NBN Gateway	**Species occurring within 5km of the site**		**Distance and orientation**	**Source/date**
	European Water Vole (*Arvicola terrestris*)		Three records, closest 3km N	Biological records centre (20/05/2008)
	Brown Hare (*Lepus europaeus*)		Two records 4.5 km W and E	Biological records centre (20/05/2008)
	Otter (*Lutra lutra*)		Three records, closest 2.5km N	JNCC (02/12/2004)
	Eurasian Badger (*Meles meles*)		One record, 4.5km NE	Biological Records Centre (20/05/2008)
	Common pipistrelle bat (*Pipistrellus pipistrellus*.)		Three records, closest 3km W	SNH (12/04/2007)

[16] Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar wetland designation (RAMSAR).
[17] Definition of antiquity categories, available from: http://www.snh.org.uk/publications/on-line/advisorynotes/95/95.html

	Soprano pipistrelle bat (*Pipistrellus pygmaeus)*	Three records, closest 3km W	SNH (12/04/2007)
	Brown long-eared bat (*Plecotus aurius*)	Two records, closest 4km SW	SNH (12/04/2007)
	Red squirrel (*Sciurus vulgaris*)	Eight records, closest 1.5km NW	SWT (19/04/2013)
JNCC	JNCC Article 17 reporting maps (2008) show that the distribution and range of the following species include that of the site area: Common pipistrelle (*Pipistrellus pipistrellus*), Brown long-eared (*Plecotus auritus*) Daubentons (*Myotis daubentonii*), Natterers (*Myotis nattereri*) and Soprano (*Pipistrellus pygmaeus*)		
LBAP (Tayside) and UKBAP	The following bat species are listed in UKBAP and LBAP and potentially relevant to the site: **Species:** • Badger (LBAP); • Daubentons bat(UKBAP); • Soprano pipistrelle (UKBAP); • Otter (UKBAP and LBAP); • Water vole (UKBAP);and • Red squirrel(UKBAP) Please note that other bat species are included as UKBAP priority species but are not included here as they are not considered to be relevant to the region.		

The JNCC collation of taxon designations includes those species that are included within the following items:

- Bern Convention (Appendices 1, 2 and 3);
- Biodiversity Action Plan (BAP) UK priority species list;
- Global IUCN Red List;
- Habitats Directive (Annex 2 (priority species), Annex 2 (non-priority species), Annexes 4 and 5);
- Nationally Rare/Scarce (not based on IUCN criteria);
- National Red Lists (including red listings based on IUCN guidelines);
- Species of principal importance in Scotland (NERC section 41 & 42 lists, Scottish Biodiversity List);
- The Conservation (Natural Habitats, &c.) Regulations 1994 (Schedules 2, 3 & 4) and
- Wildlife and Countryside Act 1981 (Schedules 1, 5 & 8).

The table below lists notable plant species included within the JNCC collation of taxon designations recorded for the 10 km grid square in which the site is located (NO34 between 1993-2013)

Vernacular name	Scientific name
Annual Knawel	*Scleranthus annuus*
Balm-leaved Figwort	*Scrophularia scorodonia*
Black-bindweed	*Fallopia convolvulus*
Bluebell	*Hyacinthoides non-scripta*
Bogbean	*Menyanthes trifoliata*
Box	*Buxus sempervirens*
Charlock	*Sinapis arvensis*
Chicory	*Cichorium intybus*
Corn Mint	*Mentha arvensis*
Dropwort	*Filipendula vulgaris*
Harebell	*Campanula rotundifolia*
Heath Cudweed	*Gnaphalium sylvaticum*
Heather	*Calluna vulgaris*
Hoary Cinquefoil	*Potentilla argentea*
Lesser Tussock-sedge	*Carex diandra*
Masterwort	*Peucedanum ostruthium*
Melancholy Thistle	*Cirsium heterophyllum*
Monk's-rhubarb	*Rumex alpinus*
Moschatel	*Adoxa moschatellina*
Petty Whin	*Genista anglica*
Primrose	*Primula vulgaris*
Sun Spurge	*Euphorbia helioscopia*
Wild Pansy	*Viola tricolor*
Wood Crane's-bill	*Geranium sylvaticum*

3.2 Phase 1 Habitat Survey

This section describes the habitats identified within the site. When considering this section, reference should be made to the supporting maps, target notes and photographs provided in the appendices of this report.

A total of eight habitat types were identified within the site boundaries.

- A2.2 scattered scrub;
- A3.1 broad-leaved scattered trees;
- B1.2 semi-improved grassland;
- B3 improved grassland;
- C3.1 tall ruderal vegetation;
- J2.5 wall;
- J2.6 dry ditch; and
- J3.4 fence.

Scattered scrub

Scrub is seral or climax vegetation dominated by locally native shrubs, usually less than 5m tall. This habitat is present along the field boundary to the south of the turbine location and throughout the fields in the south of the site. The species composition is primarily gorse *(Ulex europaeus*).

Broad-leaved scattered trees
Scattered trees are located within the fields in the east of the site and along the dry ditch to the east of the proposed turbine location. The species include sycamore (*Acer pseudoplatanus)*, ash (*Fraxinus excelsior)* and willow (*Salix* sp.) There is a beech (*Fagus sylvatica)* tree line present immediately to the north east of the site, adjacent to the coniferous plantation. These trees may provide suitable nesting habitat for birds and commuting corridors for bats.

Semi-improved grassland
Semi-improved grassland is a transition category made up of grassland which have been modified by artificial fertilisers, slurry and intensive grazing and consequently have a range of species which are less diverse and natural than unimproved grassland. This is the dominant habitat on site.. The species composition includes cocks foot (*Dactylis glomerata*), fescues (*Festuca* sp.), common bent (*Agrostis capillaris*), perennial ryegrass (*Lolium perenne*), daisy (*Bellis perennis*), white clover (*Trifolium repens*) and creeping buttercup (*Ranunculus repens)*.

Improved grassland
This habitat is similar to that above but has undergone more intensive grazing reducing its overall species diversity. This habitat is present in the field of the proposed turbine location and in the north and east of the site.

Tall ruderal
Areas of tall ruderal vegetation were present along the field boundaries throughout the site and adjacent to the dry ditch to the east of the proposed turbine location. The species present within this habitat included rosebay willowherb *(Chamerion angustifolium)*, common nettle *(Urtica dioica),* broadleaf dock *(Rumex obtusifolius)*, and ragwort *(Jacobaea vulgaris)*. The longer vegetation may provide suitable cover and shelter for commuting mammals.

Wall
A stone wall is present along the field boundary in the south west of the site.

Dry ditch
A dry ditch was present to the east of the turbine location, no standing water was recorded and the ditch was noted to be overgrown with tall ruderal vegetation.

Fence
A post and wire fencing is the dominant field boundary within the site and surrounding area. A deer fence is present along the east site boundary adjacent to the coniferous woodland.

3.2.1 Faunal Species

During the site walk-over, an assessment was made of the potential presence of nationally or internationally protected species and species of local importance as highlighted during the desk study. The following sections present the results of the survey.

3.2.1.1 Otter Survey

No otter field signs were identified during the survey.

No suitable habitat for otters was identified within the site as the ditch was recorded to be dry.

3.2.1.2 Water Vole Survey

No water vole field signs were identified during the survey.

No suitable habitat for water voles was identified within the site as the ditch was recorded to be dry.

3.2.1.3 Badger Survey

Habitat Survey

The survey identified steeply sloping improved and semi-improved grassland fields separated by post and wire fencing and tall ruderal vegetation. In most places soils appeared to be free draining, providing both a suitable substrate for sett excavation and foraging. In general, the survey area presented many of the features required by sheltering and commuting badgers, particularly the tall ruderal vegetation and scattered scrub.

Sett Survey

Despite suitable habitat for badgers being identified, there was no evidence of badger setts at the site. Although several rabbit warrens were recorded.

Field Signs Survey

Although generic mammal field signs were identified at the site, such as mammal paths and breaches in the fence, there was no evidence of badger field signs.

3.2.1.4 Red Squirrel Survey

As demonstrated in the Phase 1 habitat survey, there was no suitable habitat for this species within the survey area.

3.2.1.5 Bat Roost Potential Survey

While the scattered trees did not present any of the features listed in table 1, the trees are of a size and age that elevated surveys may result in cracks or crevices being found. These trees were considered to be Category 2. The willow trees along the dry ditch in the east of the site were recoded as immature and multi-stemmed with no potential to support roosting bats. These were considered to be Category 3 trees.

The survey area supports a limited number of linear vegetation features which could support foraging and commuting bats. The mitigation section below provides recommendations for how to avoid affecting foraging and commuting bats.

3.2.1.6 Birds

No evidence of nesting birds was found during the survey. While the scattered scrub and trees around the site may provide suitable nesting habitat for birds the proposed turbine location, located on improved grassland, is unlikely to affect breeding birds.

4. FURTHER SURVEY AND MITIGATION

4.1 Further Survey

No further survey of the site is necessary.

While the borrow pit will mean the loss of an area of improved grassland, this habitat is widespread and common throughout the surrounding area and is considered to have low ecological value. The borrow pit will be reinstated once works are complete and in time the vegetation will regenerate. The borrow pit is unlikely to cause any lasting ecological impacts.

A bird survey is not necessarily required if construction work can be either timed to avoid the bird breeding season or a pre-construction check of any vegetation to be removed is undertaken immediately prior to works.

Natural England has developed guidance[18] that provides information on how best to site turbines to avoid impacts to bat species. This guidance states that:

"*A bat survey should normally be recommended for applications for turbines that will be located within 50 m of the following features:*

- *buildings or other features or structures that provide potential as bat roosts, including bridges, mines etc;*
- *woodland;*
- *hedgerows;*
- *rivers or lakes; and*
- *within or adjacent to a site designated for bats (SSSI or SAC)."*

Therefore, 50m should be the minimum distance between the tip of the turbine blade to the nearest feature which may be used by bats. This distance should not be measured from the base of the turbine but instead should take into account the height of the feature. In order to accurately measure this stand-off distance from the blade tip Natural England have produced the following equation[19]:

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

b = the minimum distance
bl = blade length (27m)
hh = hub height (50m)
fh = feature height (2m)

At Ingliston Hill the minimum distance equates to **60.2m**.

As the proposed turbine is located approximately **75m** from the nearest linear feature, it is unlikely to affect any feature that may be used by roosting, foraging or commuting bats.

No further survey for bats is required.

[18] Natural England (2009). Natural England Technical Information Note TIN059 – Bats and Single Large Wind Turbines: Joint Agencies Interim Guidance
[19] Natural England (2012). Natural England Technical Information Note TIN051 – Bats and Onshore Wind Turbines (second edition)

4.2 Protected Species Licensing

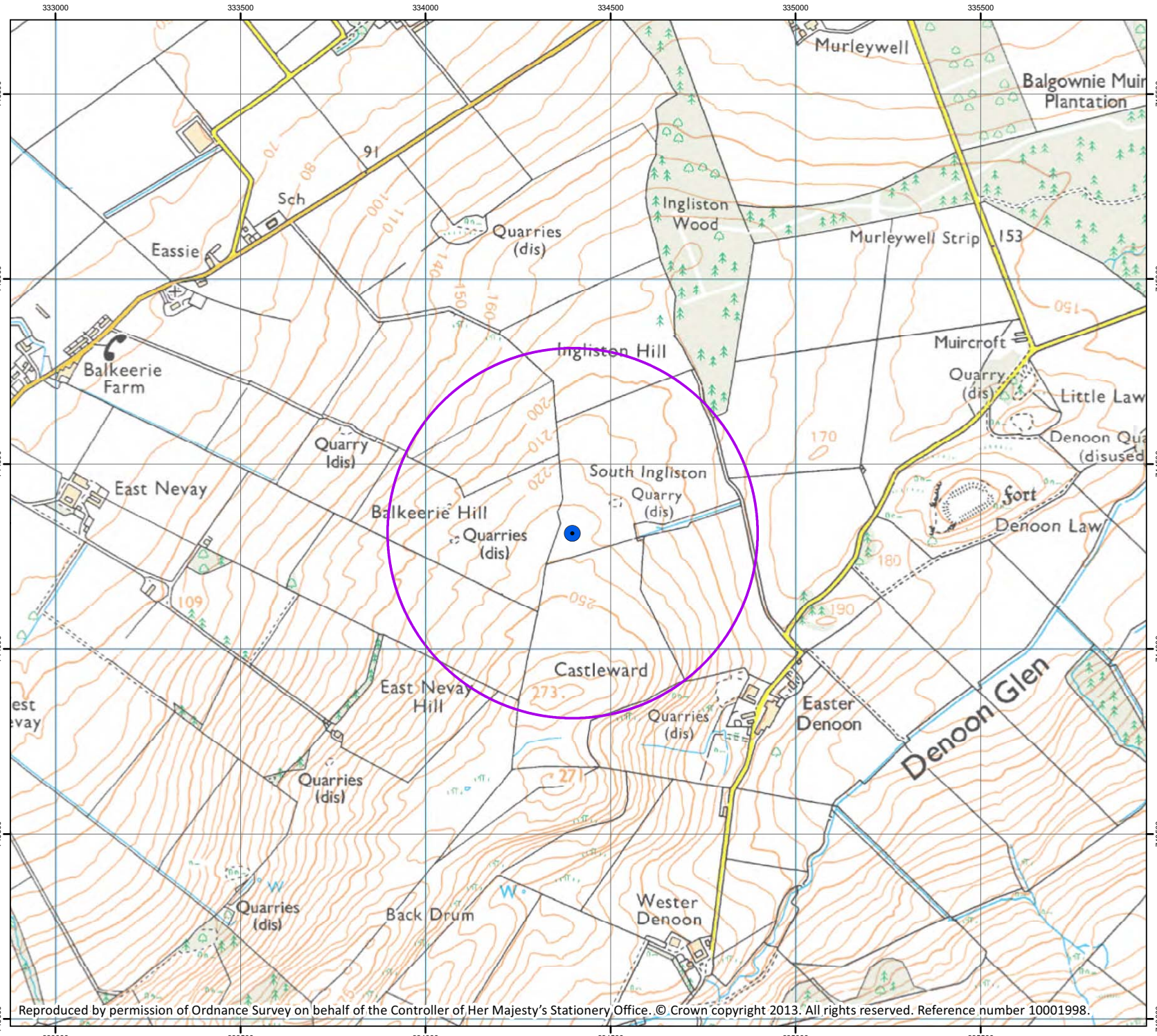
It is unlikely that a protected species licence will be required for this development. Should a protected species, or evidence of a protected species, be discovered on site the licensing requirement will require to be reviewed.

4.2.1 General Good Practice Mitigation During Construction

1. Any vegetation removal should be undertaken outside the bird nesting season, which runs from March to August. If vegetation removal is planned during the nesting season, a suitably qualified ecologist should inspect the area for the presence of nests up to a maximum of one day prior to removal. If an active nest is discovered the vegetation cannot be removed and must be left until the young have fledged. In this scenario alternative approaches to the works should be proposed.
2. Any trenches or pits should be covered when unattended or a shallow angled plank inserted to allow animals to escape, should they become trapped inside them. The ends of any pipeline should be capped when unattended, or at the end of each working day to prevent animal access.
3. In the event that a protected species is discovered on site all work in that area must stop immediately and an ecologist contacted. Details of the local police Wildlife Crime Officer, SNH Area Officer and Scottish Society for the Prevention of Cruelty to Animals (SSPCA) relevant Officer could be held in site emergency procedure documents.

Appendix A: Site Location Plan

AC57



Legend

- Survey Area
- Turbine Location

Do not scale this map

Client: Locogen

Project: Ingliston Hill Single Turbine

Title: Site Location Plan

Status: FINAL

Drawing No.: 164621 - 001

Revision:

Scale: 1:10,000

A3

Date: 10 Sept 2013

Drawn	Checked	Approved
FR	xx	FR

ENVIRO Centre
Craighall Business Park, Eagle Street, Glasgow, G4 9XA
Tel: 0141 341 5040
Fax: 0141 341 5045

Appendix B: Site Photographs

Photograph 1: A view of the proposed turbine location.

Photograph 2: A view of the deer fence along the east site boundary.

Photograph 3: A breach in the deer fence along the east site boundary.

Photograph 4: A view of the improved grassland habitat that dominates the site.

Photograph 5: A view of the tall ruderal vegetation along the filed boundary in the east.

Photograph 6: A view of the scattered sycamore trees in the east of the site.

Photograph 7: A view of the rubble pile associated with the former quarry to the east of the proposed turbine location.

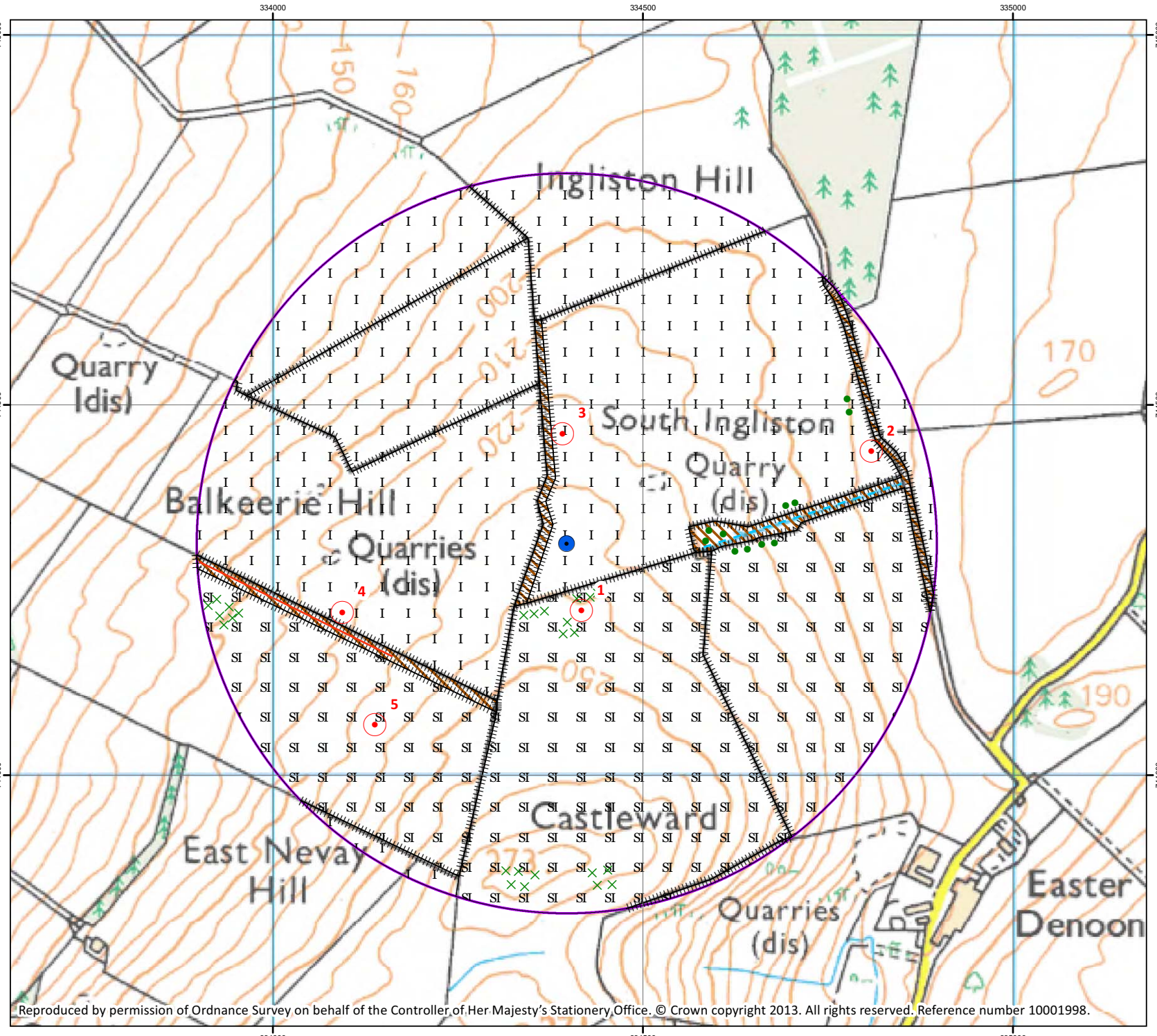
Photograph 8: A view of the scattered gorse scrub.

Photograph 9: A view of one of the many rabbit holes present within the site.

Photograph 9: A view of the stone wall along a field boundary in the west of the site.

Appendix C: Phase 1 Habitat Map

AC57



Legend

- Target Note
- Turbine Location
- Survey Area

JNCC Code

- A2.2 - Scattered Scrub
- A3.1 - Scattered Broadleaved Trees
- B4 - Improved Grassland
- B6 -Semi-Improved Grassland
- C3.1 - Tall Ruderal
- J2.4 - Post & Wire Fence
- J2.5 - Wall
- J2.6 - Dry Ditch

Do not scale this map

Client: Locogen

Project: Ingliston Hill Single Turbine

Title: Phase 1 Habitat Survey

Status: FINAL

Drawing No.: 164621 - 001

Revision:

Scale: 1:5,000

A3

Date: 10 Sept 2013

Drawn: FR

Checked: xx

Approved: FR

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Craighall Business Park, Eagle Street, Glasgow, G4 9XA
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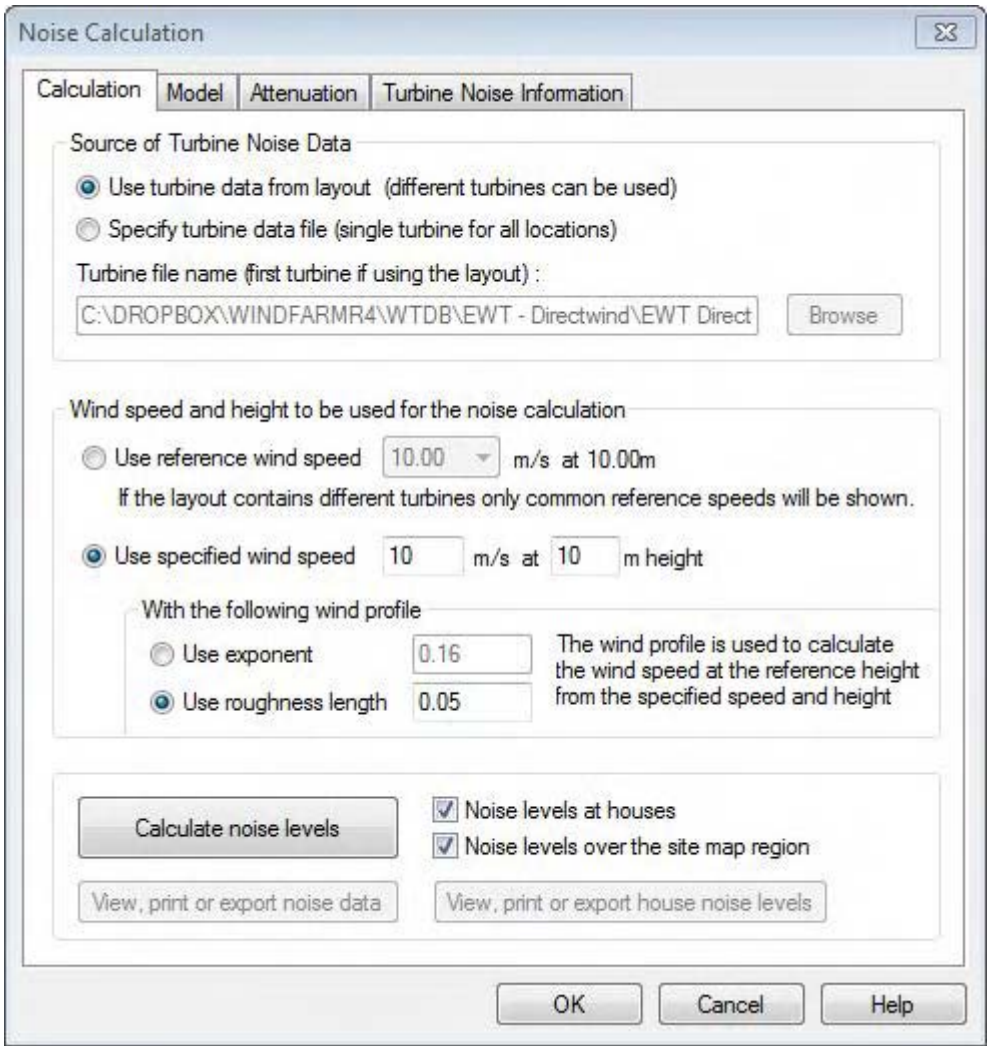
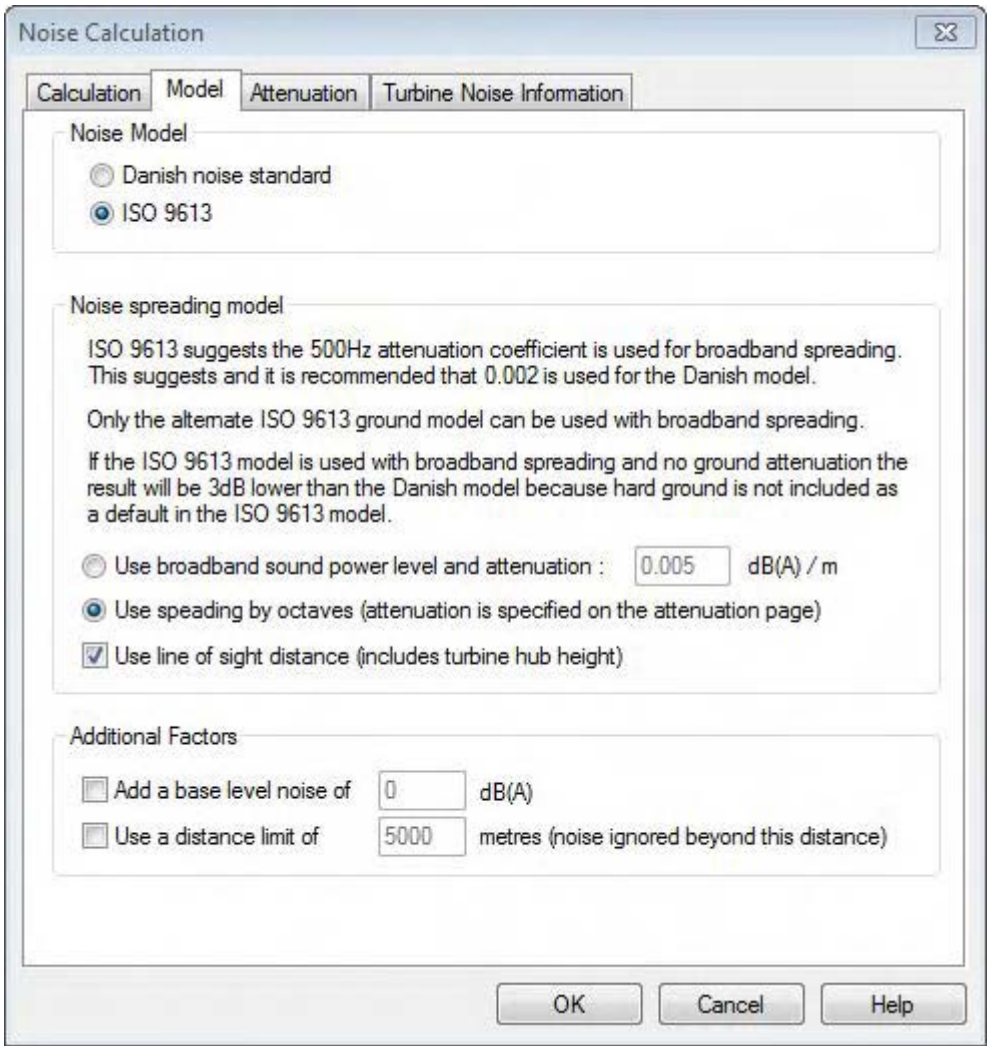
Appendix D: Target Notes

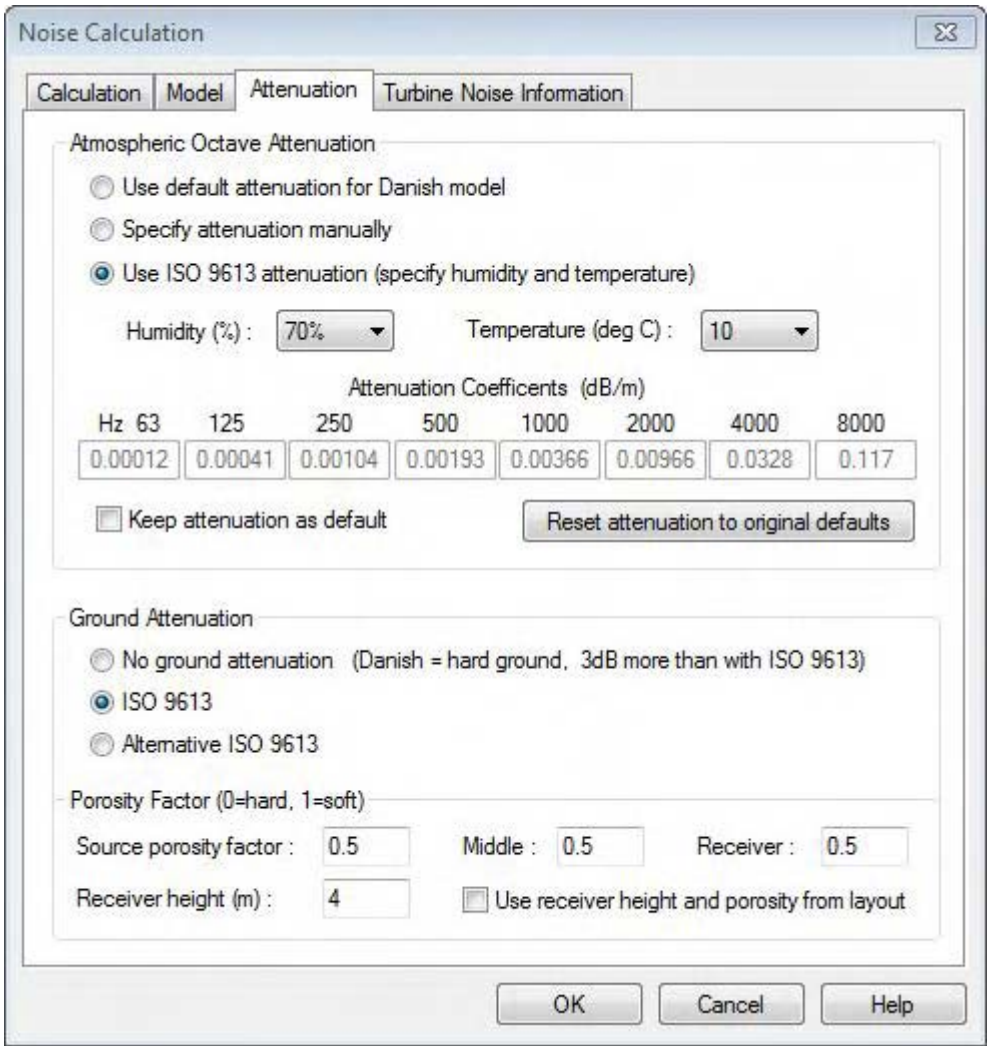
Date of Survey: 30th August 2013
Recorder Name: Karen Hassard
Weather Conditions: Bright and clear with an air temperature of 17°C.

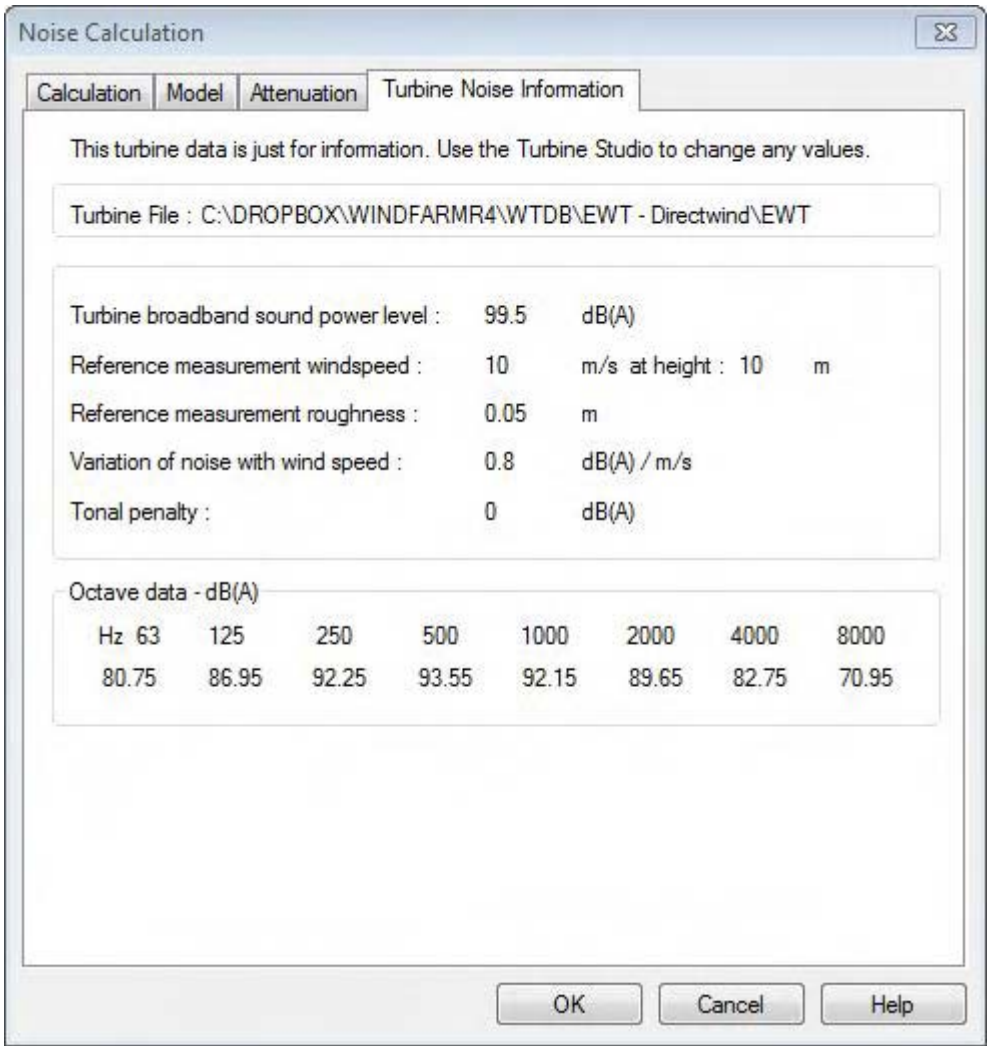
Target Note	Details
1.	**Feature:** Scattered scrub **Description:** This habitat is present to the south of the proposed turbine location. Although it is not continuous it may provide a suitable commuting and foraging route for gap tolerant bat species such as pipistrelles.
2.	**Feature:** Post and wire fencing **Description:** A deer fence is present along the east site boundary adjacent to the coniferous woodland. A breach was discovered in the bottom of the fence but no evidence of badger was identified.
3.	**Feature:** Tall ruderal **Description:** tall ruderal vegetation was present along the field boundary to the west of the proposed turbine location. The longer vegetation may provide suitable cover and shelter for commuting mammals.
4.	**Feature:** Wall **Description:** A stone wall is present along the field boundary in the south west of the site. It may provide suitable shelter for reptiles and amphibians.
5.	**Feature:** Rabbit warrens **Description:** Rabbit holes were recorded in the field to the south west of the turbine. These looked similar to badger holes from the outside but were identified to split into smaller holes just inside the entrance. These tunnels were considered too small for badger. No badger field signs were identified.

Appendix C – Manufacturer's Noise Data and ReSoft Windfarm Report Exports


Noise Calculation
Calculation
Model
Attenuation
Turbine Noise Information
Source of Turbine Noise Data
Use turbine data from layout (different turbines can be used)
Specify turbine data file (single turbine for all locations)
Turbine file name (first turbine if using the layout) :
C:\DROPBOX\WINDFARMR4\WTDB\EWT - Directwind\EWT Direct
Browse
Wind speed and height to be used for the noise calculation
Use reference wind speed
10.00
m/s at 10.00m
If the layout contains different turbines only common reference speeds will be shown.
Use specified wind speed
10
m/s at
10
m height
With the following wind profile
Use exponent
0.16
Use roughness length
0.05
The wind profile is used to calculate the wind speed at the reference height from the specified speed and height
Calculate noise levels
Noise levels at houses
Noise levels over the site map region
View, print or export noise data
View, print or export house noise levels
OK
Cancel
Help


Noise Calculation
Calculation
Model
Attenuation
Turbine Noise Information
Noise Model
Danish noise standard
ISO 9613
Noise spreading model
ISO 9613 suggests the 500Hz attenuation coefficient is used for broadband spreading. This suggests and it is recommended that 0.002 is used for the Danish model.
Only the alternate ISO 9613 ground model can be used with broadband spreading.
If the ISO 9613 model is used with broadband spreading and no ground attenuation the result will be 3dB lower than the Danish model because hard ground is not included as a default in the ISO 9613 model.
Use broadband sound power level and attenuation :
0.005
dB(A) / m
Use speading by octaves (attenuation is specified on the attenuation page)
Use line of sight distance (includes turbine hub height)
Additional Factors
Add a base level noise of
0
dB(A)
Use a distance limit of
5000
metres (noise ignored beyond this distance)
OK
Cancel
Help


Noise Calculation
Calculation
Model
Attenuation
Turbine Noise Information
Atmospheric Octave Attenuation
Use default attenuation for Danish model
Specify attenuation manually
Use ISO 9613 attenuation (specify humidity and temperature)
Humidity (%) :
70%
Temperature (deg C) :
10
Attenuation Coefficents (dB/m)
Hz 63 125 250 500 1000 2000 4000 8000
0.00012 0.00041 0.00104 0.00193 0.00366 0.00966 0.0328 0.117
Keep attenuation as default
Reset attenuation to original defaults
Ground Attenuation
No ground attenuation (Danish = hard ground, 3dB more than with ISO 9613)
ISO 9613
Alternative ISO 9613
Porosity Factor (0=hard, 1=soft)
Source porosity factor :
0.5
Middle :
0.5
Receiver :
0.5
Receiver height (m) :
4
Use receiver height and porosity from layout
OK
Cancel
Help


Noise Calculation
Calculation
Model
Attenuation
Turbine Noise Information
This turbine data is just for information. Use the Turbine Studio to change any values.
Turbine File : C:\DROPBOX\WINDFARMR4\WTDB\EWT - Directwind\EWT
Turbine broadband sound power level : 99.5 dB(A)
Reference measurement windspeed : 10 m/s at height : 10 m
Reference measurement roughness : 0.05 m
Variation of noise with wind speed : 0.8 dB(A) / m/s
Tonal penalty : 0 dB(A)
Octave data - dB(A)
Hz 63 125 250 500 1000 2000 4000 8000
80.75 86.95 92.25 93.55 92.15 89.65 82.75 70.95
OK
Cancel
Help

Project name : INGLISTON FARM
Layout name : INGLISTON FARM.WFL

Noise data file name : NINGLISTON.WFN
Created : 14:23:37 28-Aug-2013
Revised : 09:37:44 18-Sep-2013
Revision : 47
Title :
Author :
Comment :

Turbine noise data : From the layout
Turbine file (first) : ..\WTDB\EWT - Directwind\EWT Directwind - Measured 500kW ocata

NOISE MODEL
Noise standard : ISO 9613
Noise spreading model : Octaves
Use line-of-sight distance: Yes

ATMOSPHERIC ATTENUATION
Source of attenuation : ISO 9613
Humidity : 70 %
Temperature : 10 deg C
Attenuation coefficients
63 Hz : 0.00012
125 Hz : 0.00041
250 Hz : 0.00104
500 Hz : 0.00193
1000 Hz : 0.00366
2000 Hz : 0.00966
4000 Hz : 0.03280
8000 Hz : 0.11700

GROUND ATTENUATION
Formulation : ISO 9613
Source porosity : 0.50
Middle porosity : 0.50
Receiver porosity : 0.50
Receiver height : 4.00

WIND SPEED
Turbine reference : No
Wind speed : 10.00
Wind speed height : 10.0
Wind profile Z0 : 0.0500

ADDITIONAL FACTORS
Base noise level : None
Distance limit : None

House ID	Easting	Northing	Altitude	Noise (db)
1	334985	743907	0	29.75
2	333417	744287	0	26.44
3	333268	744163	0	24.83
4	333343	744934	0	24.05
5	333409	745008	0	24.18
6	334866	743812	0	30.17
7	333528	745106	0	24.47

EWT	Emergya Wind Technologies BV
	DW54

Category:	Specification	Page 1 / 11
Doc code:	S-1005030	

Created by:	RH	Creation Date:	09-05-12
Checked by:	LE	Checked Date:	09-05-12
Approved by:	TY	Approved Date:	09-05-12

Title:

Specification

Sound power level DW54 - 500kW

Revision	Date	Author	Approved	Description of changes
01	17-08-12	RH	TY	corrected format
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

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Contents

1 Introduction

Following information with regard to the sound power level measurements, are distillated from measurement data of a *DIRECT**WIND*** 54 500kW turbine, located at the Elbaweg in Venhuizen, the Netherlands.

The measurements were performed by a third party according to the International Standard IEC 64100-11 December 2002: "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques ".

2 Measurements

The measurements have been performed by measuring the sound pressure levels in the third octave bands of 25 Hz to 10,000 Hz at the reference point downwind of the operating turbine. The background noise level was measured during standstill of the turbine.

Measurements were carried out on the ground on a hard board according to the IEC standard. This method doubles the pressure on the microphone which raises the sound pressure level with +6 dB(A) compared to free field measurements.

The measured sound pressure levels can be found in Appendix 2 measured sound pressure levels.

3 Results

The sound power levels are calculated from the measured sound pressure levels according to IEC-61400-11. The wind velocities have been corrected for a reference roughness Z_0 of 0.05m by applying a factor of 1.1 on the measured wind velocity, and the sound power levels have been calculated for a reference height of 10m.

Sound power level Lwa in dB(A)		**middle frequency of the octave bands [hz]**								
Wind speed at a height of 10m		**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Wind 5 m/s	95.0 dB(A)	67.3	76.3	82.5	89.0	90.3	87.9	85.3	80.6	71.0
Wind 6 m/s	96.6 dB(A)	68.2	78.0	84.1	90.7	92.0	89.5	86.7	81.4	72.4
Wind 7 m/s	97.7 dB(A)	69.5	79.3	85.5	91.8	93.0	90.7	88.0	82.2	72.9
Wind 8 m/s	98.8 dB(A)	70.9	80.7	86.9	92.6	94.1	92.0	89.2	83.0	72.8
Wind 9 m/s	99.7 dB(A)	72.4	82.1	88.3	93.5	94.7	92.9	90.3	83.5	72.0
Wind 10 m/s	99.5 dB(A)	72.2	81.6	87.8	93.1	94.4	93.0	90.5	83.6	71.8

Table 3.1 gives the calculated sound power levels at the different wind speeds, and the calculated octave band power levels. Figure 3.1 gives the calculated 3rd octave band sound power levels, the values for these can be found in Appendix 1 Third octave band sound power levels.

Sound power level Lwa in dB(A)		**middle frequency of the octave bands [hz]**								
Wind speed at a height of 10m		**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Wind 5 m/s	95.0 dB(A)	67.3	76.3	82.5	89.0	90.3	87.9	85.3	80.6	71.0
Wind 6 m/s	96.6 dB(A)	68.2	78.0	84.1	90.7	92.0	89.5	86.7	81.4	72.4
Wind 7 m/s	97.7 dB(A)	69.5	79.3	85.5	91.8	93.0	90.7	88.0	82.2	72.9
Wind 8 m/s	98.8 dB(A)	70.9	80.7	86.9	92.6	94.1	92.0	89.2	83.0	72.8
Wind 9 m/s	99.7 dB(A)	72.4	82.1	88.3	93.5	94.7	92.9	90.3	83.5	72.0
Wind 10 m/s	99.5 dB(A)	72.2	81.6	87.8	93.1	94.4	93.0	90.5	83.6	71.8

Table 3.1 Sound power levels and the octave band data

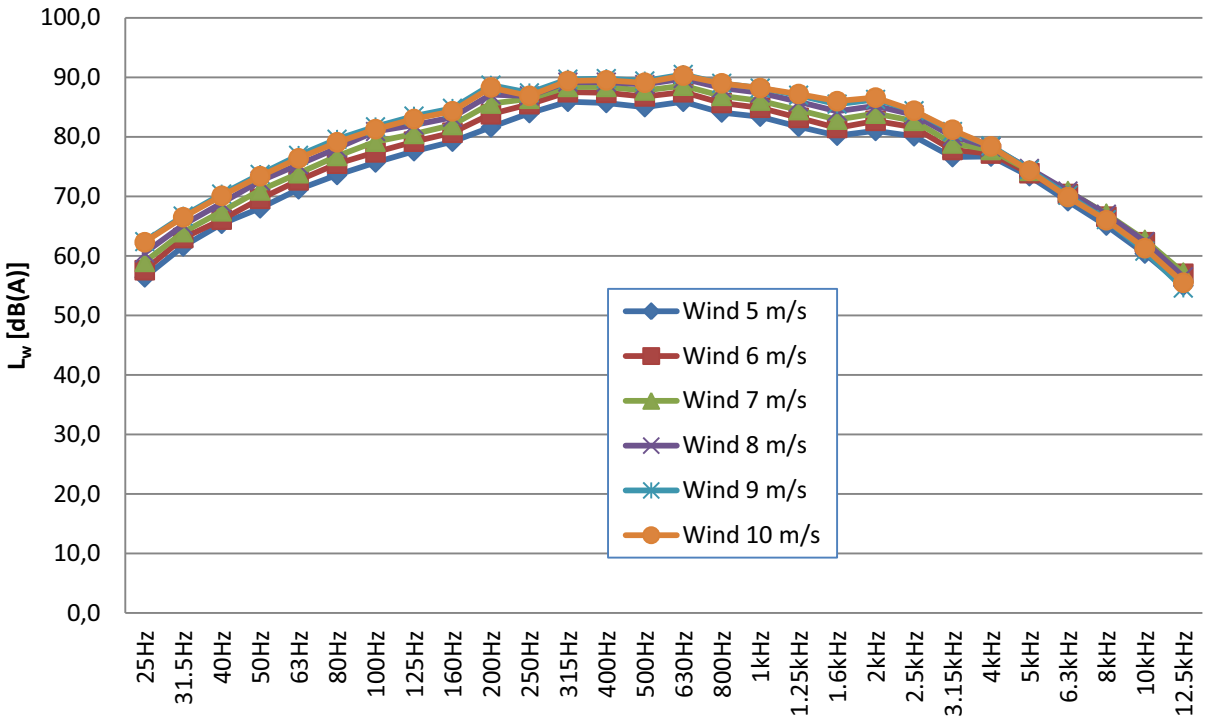

Figure 3.1 The 3rd octave band Sound Power Level spectra

3.1 Corrected sound power level graphical

Figure 3.2 and table 3.2 below provides all the calculated sound power levels at the different wind speeds at reference conditions (h = 10 m and z_0 = 0.05 m) and after correction for the background noise. The figure also gives the 4th order regression on this curve:

$$L_W = 0.0033V_{wind}^4 - 0.1327V_{wind}^3 + 1.7261V_{wind}^2 - 7.8733V_{wind} + 106.02\ dB(A)$$

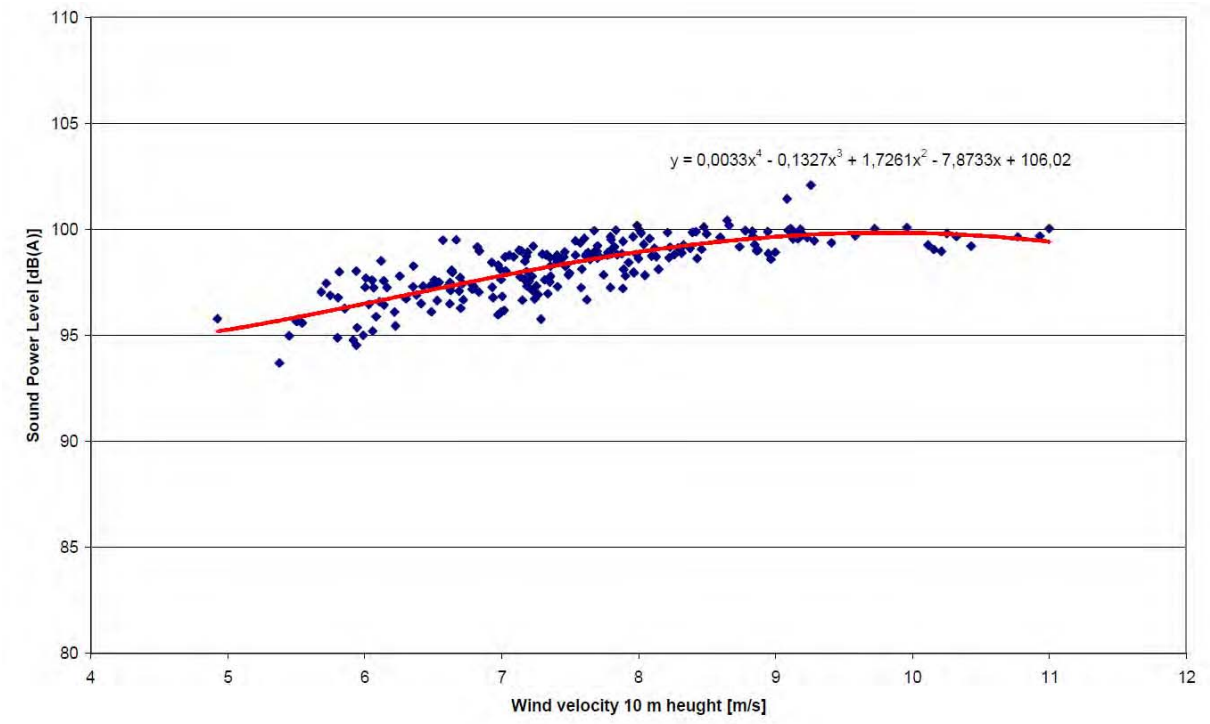

Figure 3.2 the calculated sound power level at different wind speeds

Sound power level with 4th Order regression in dB(A) **Wind speed at a height of 10m**	
Wind 5 m/s	95.3 dB(A)
Wind 6 m/s	96.5 dB(A)
Wind 7 m/s	97.8 dB(A)
Wind 8 m/s	98.9 dB(A)
Wind 9 m/s	99.6 dB(A)
Wind 10 m/s	99.8 dB(A)

Table 3.2 Sound Power Levels with 4th Order regression

3.2 Tonal Audibility

The audibility of the tones in the sound was analysed at the reference position and is given in Table 3.3 Tonal Audibility. The most important frequencies are 2.2 and 4.4 kHz. In Table 3.3 also the tonal penalty according to ETSU-R-97 (The assessment and rating of noise from wind farms – September 2006) is given. For the tone level of 3.3, the ETSU penalty of 2.5 dB can be found in Figure 3.3. No penalties are incurred for audibility levels below 2.0 dB.

According to ETSU-R-97, the tonal penalty should be added at the receiver for the specific wind speed at which the tonal audibility is present.

Wind @ 10 m ([m/s]	5	6	7	8	9
ΔL_A [dB(A)]	3.3	0.9	1.5	0.7	-0.7
ETSU Penalty [dB]	2.5	-	-	-	-

Table 3.3 Tonal Audibility

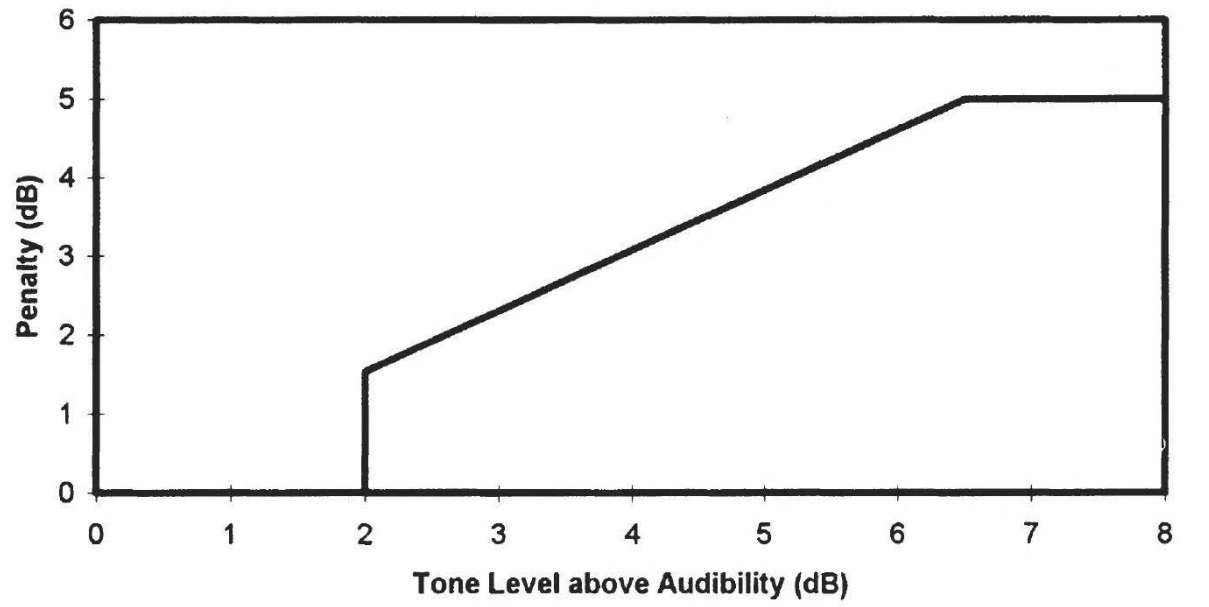

Figure 3.3 Tonal penalty according to ETSU-R-97

3.3 Uncertainty

The following Table 3.4 gives the number of measurements and the uncertainty in dB(A) for each different wind speed.

Wind Class	Number of measurements	Uncertainty [dB(A)]
Wind 5 m/s	4	1.7
Wind 6 m/s	37	1.4
Wind 7 m/s	77	1.2
Wind 8 m/s	68	0.9
Wind 9 m/s	26	0.9
Wind 10 m/s	9	0.7

Table 3.4 Number of measurements and uncertainty

Appendix 1 Third octave band sound power levels

V10[m/s]	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz
Wind 5 m/s	56,4	61,6	65,4	68,0	71,2	73,6	75,7	77,6	79,2
Wind 6 m/s	57,6	63,0	66,1	69,6	72,7	75,5	77,4	79,2	80,7
Wind 7 m/s	59,0	64,0	67,5	71,0	73,9	76,8	79,2	80,5	82,0
Wind 8 m/s	60,5	65,2	68,9	72,6	75,3	78,1	80,9	82,0	83,3
Wind 9 m/s	62,4	66,7	70,4	73,7	76,9	79,6	81,7	83,5	84,8
Wind 10 m/s	62,3	66,5	70,1	73,4	76,4	79,1	81,3	83,0	84,3

V10[m/s]	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz
Wind 5 m/s	81,6	84,0	85,9	85,7	85,0	85,9	84,1	83,4	81,7
Wind 6 m/s	83,8	85,5	87,5	87,4	86,8	87,5	85,7	84,9	83,2
Wind 7 m/s	85,6	86,4	88,4	88,4	87,8	88,6	86,9	86,1	84,5
Wind 8 m/s	87,1	86,9	89,2	89,2	88,8	89,8	88,2	87,4	85,9
Wind 9 m/s	88,7	87,4	89,7	89,8	89,4	90,5	89,0	88,2	87,0
Wind 10 m/s	88,3	86,9	89,4	89,5	89,1	90,3	89,0	88,2	87,2

V10[m/s]	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz	12.5kHz
Wind 5 m/s	80,2	81,0	80,1	76,6	76,7	73,4	69,2	65,1	60,4	55,0
Wind 6 m/s	81,5	82,7	81,6	77,8	77,2	73,9	70,4	66,6	62,3	57,0
Wind 7 m/s	82,9	83,9	82,7	78,9	77,8	74,3	70,9	67,1	62,7	57,2
Wind 8 m/s	84,3	85,2	83,7	80,1	78,3	74,7	70,9	67,0	62,4	56,5
Wind 9 m/s	85,5	86,3	84,4	80,9	78,5	74,5	70,2	66,1	60,8	54,6
Wind 10 m/s	86,0	86,6	84,4	81,2	78,4	74,3	69,9	66,0	61,3	55,5

Appendix 2 measured sound pressure levels

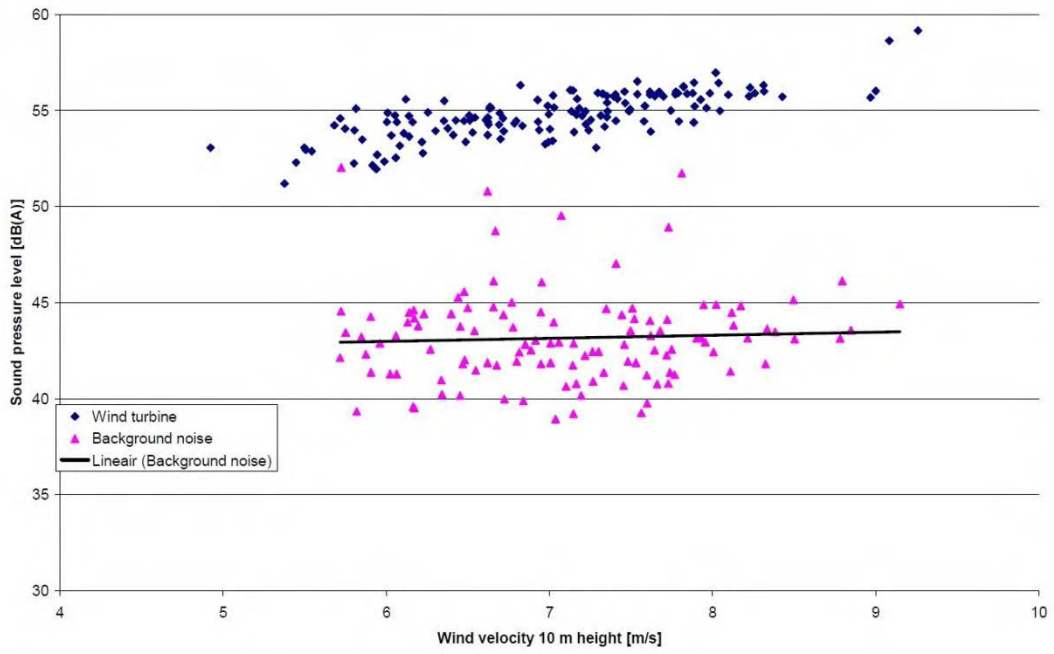

Figure 0.1 Measured sound pressure levels 11 November 2011

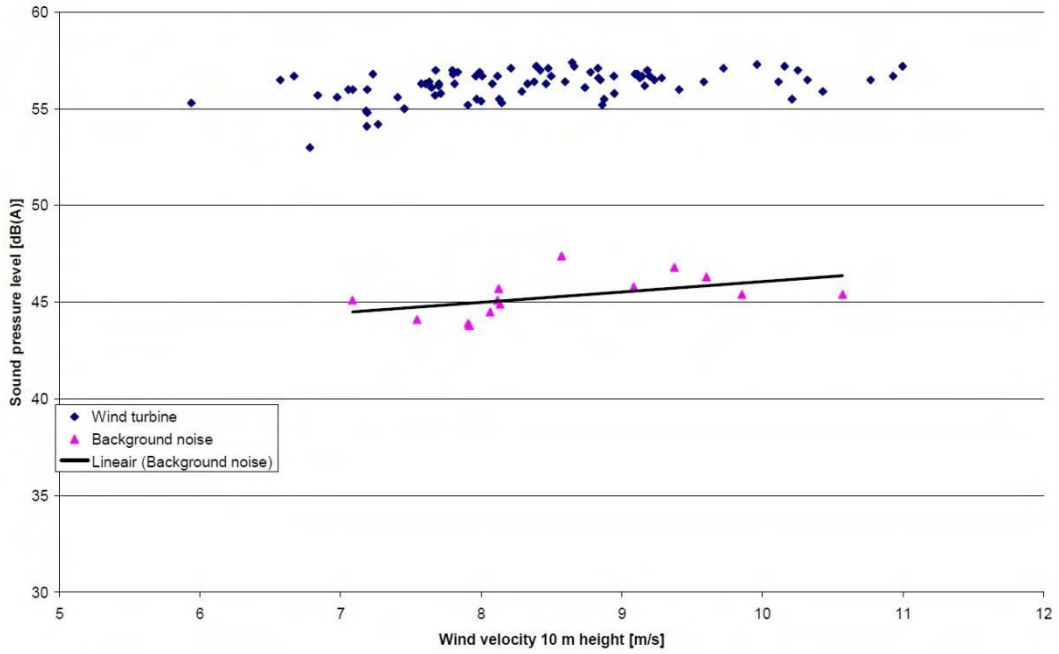

Figure 0.2 Measured sound pressure levels 15 February 2012

EWT	Emergya Wind Technologies BV
	Engineering

Category:	Specification	Page 1 / 2
Doc code:	S-1005020	

Created by:	TY	Creation Date:	07-12-11
Checked by:	MS	Checked Date:	07-12-11
Approved by:	TY	Approved Date:	07-12-11

Title:

Specification

Sound power warranty levels DW52/54 500kW

Revision	Date	Author	Approved	Description of changes
02	14-03-12	AB	TY	Modifications based on new IEC measurements
01	09-12-11	AB	TY	correction
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Sound power levels

The warranted sound power levels are presented with reference to IEC 61400-11:2002.

V_{wind} at 10m height	**DW52**	**DW54**
5 m/s	96,5 dB(A)	97.0 dB(A)
6 m/s	97.5 dB(A)	98.0 dB(A)
7 m/s	98.5 dB(A)	99.0 dB(A)
8 m/s	99.5 dB(A)	100.0 dB(A)
9 m/s	100.3 dB(A)	100.5 dB(A)
10 m/s	100.5 dB(A)	100.5 dB(A)

Sound power level Lw in dB(A)

The warranted sound power levels are based on actual measurements executed by an independent noise measurement institute according to the preferred methods set out in IEC-61400-11.

Uncertainty levels are included in the warranted sound power levels.

At 5m/s a maximum tonal noise penalty of 2,5dB shall be considered according to ETSU-R-97 guidelines.

The measured third octave sound power levels are available upon request.

The values given in the table are valid for normal operational mode (rotation speed 0-24 RPM)

The calculation of the standardized wind speed at 10m height according to IEC 61400-11 is based on a terrain roughness length Z_0=0,05m.

In case validation measurements have to be performed, they should be executed according to the preferred methods set out in IEC-61400-11 by an independent measurement institute which is accredited to ISO/IEC 17025 to conduct measurements of wind turbine noise emissions.

EWT reserves the right to make modifications or adjust settings in order to comply with the warranted sound power levels.