



Green Cat Renewables

CROFTS FARM WIND TURBINES

Environmental Statement

Crofts Farm Renewables Ltd

January 2014



Environmental Statement

Prepared for:

Crofts Farm Renewables Ltd.

CROFTS FARM WIND TURBINES

Prepared By:

Green Cat Renewables Ltd.



Edinburgh Office
Midlothian Innovation Centre
Roslin,
EH25 9RE

Tel: 0131 440 6150

Checked By: Glen Moon	Date: 10 th January 2014
Approved By: Cameron Sutherland	Date: 15 th January 2014

Preface

This Environmental Statement seeks to assess the environmental effects of the proposed Crofts Farm development, which comprises the installation and operation of two wind turbines no greater than 80 m to blade tip height.

This is an Environmental Statement for the purposes of the Planning EIA Regulations (the Environmental Impact Assessment (Scotland) Regulations 2011) covering the major environmental effects arising from this proposal.

Table of Contents

1	Project Summary.....	2
1.1	Introduction	2
1.2	Background	2
1.3	Aims of the Project.....	2
1.4	Scope of the Environmental Statement.....	2
2	The Proposed Development	4
2.1	Location and Project Layout	4
2.2	Description of the Proposed Wind Turbines	6
2.3	Purpose of the Development.....	8
2.4	Scottish Government Policy.....	9
2.5	Associated Infrastructure.....	9
2.6	Grid / Local Electrical Connection.....	10
2.7	Access to the Site	10
2.8	Construction Programme.....	11
2.9	Construction Traffic	11
2.10	Decommissioning.....	12
3	Planning and Environmental Policy Context.....	13
3.1	Context.....	13
3.2	National Planning Policy Guidance	14
3.3	Local Planning Policy	16
3.4	Conclusions	22
3.5	References	22
4	Local Economic Benefits	25
4.1	Construction / Decommissioning Phase Benefits.....	25
4.2	Operational Phase Benefits	25
4.3	The Rural Economy – Farm Diversification	26
4.4	Community Benefit.....	26
4.5	References	27
5	Project Design Considerations	29
5.1	Site Selection.....	29
5.2	Site Layout.....	29
6	Ecology and Ornithology	33
6.1	Introduction	33
6.2	Regulations and Guidance	33
6.3	Characterisation of Effects/Magnitude of Effect.....	36
6.4	Ornithology	41
6.5	Survey Results	42
6.6	Badgers	45
6.7	Bats.....	46
6.8	Habitat Survey Results	47
6.9	Phase 1 Habitat Survey	49
6.10	Assessment of Impacts	52
6.11	Summary of Impacts	54
6.12	Conclusion.....	55
6.13	References	56

7	Landscape and Visual Impact.....	57
7.1	Introduction	57
7.2	Guidance	58
7.3	Assessment Methodology.....	59
7.4	Landscape Design Considerations	66
7.5	Baseline Conditions.....	70
7.6	Assessment of Landscape Effects	77
7.7	Assessment of Visual Effects.....	85
7.8	Assessment of Cumulative Visual Effects	91
7.9	Summary of Assessment Conclusions.....	96
7.10	Summary of Effects	98
8	Noise	99
8.1	Introduction	99
8.2	Guidance	100
8.3	Approach.....	101
8.4	Background noise measurements	101
8.5	Wind turbine noise propagation model	110
8.6	Predicted wind turbine noise levels.....	113
8.7	Noise impact assessment.....	114
8.8	Conclusions	124
9	Cultural Heritage/Archaeology	127
9.1	Introduction	127
9.2	Guidance	127
9.3	Methodology.....	127
9.4	Baseline Data	129
9.5	Evaluation of Effects	136
9.6	Summary of Predicted Impacts and Effects.....	138
9.7	Mitigation Incorporated into the Proposed Development.....	139
9.8	Conclusion.....	139
10	Surface and Groundwater Hydrology	141
10.1	Introduction	141
10.2	Potential Impacts	141
10.3	Guidance	141
10.4	Methodology.....	142
10.5	Baseline	143
10.6	Predicted Impacts	145
10.7	Mitigation.....	147
10.8	Assessment of Residual Impact	149
10.9	Conclusion.....	150
11	Existing Infrastructure, Telecommunications, Television, Aviation and Electromagnetic Interference	151
11.1	Introduction	151
11.2	Guidance	151
11.3	Methodology.....	151
11.4	Assessment of Impact.....	152
11.5	Impacts, Issues and Mitigating Actions	153
11.6	References	154

12	Shadow Flicker	155
12.1	Background	155
12.2	Baseline and Methodology	156
12.3	Assessment	157
12.4	Summary and Conclusion	158
13	Climate Change	159
13.1	Introduction	159
13.2	Potential Impacts	159
13.3	Guidance	160
13.4	Carbon balance	161
13.5	Mitigation.....	163
13.6	Conclusions	163
13.7	References	164

Appendices

Appendix 1 – Phase 1 Habitat Map

Appendix 2 – LVIA Viewpoint Analysis

Appendix 3 – LVIA Residential Assessment

Appendix 4 – Cultural Heritage Figures

Appendix 5 – Hydrological Drawing

1 Project Summary

1.1 Introduction

The development would comprise the installation and operation of two wind turbines, no greater than 80m to blade tip height. The turbines would be located on land to the north of Crofts Farm, approximately 1km to the north-east of the village of Redford in Angus.

1.2 Background

Crofts Farm is owned by the McDonald family, who together have farmed in the Redford area for three generations. The farm comprises of 400 acres of owned land together with a further 750 acres of farmland rented from 18 local farming businesses. The business specialises in intensive vegetable production, annually producing and grading 1,500 tonnes of broccoli, 900 tonnes of cauliflower, 450 tonnes of brussel sprouts and 3,000 tonnes of potatoes. All produce from the farm is marketed to leading retailers through local companies including East of Scotland Growers, The Co-operative Farm facility in Carnoustie and Kettle Produce in Fife. Alongside the farm, the business runs an agricultural engineering enterprise building agricultural equipment for supply throughout the UK.

The business currently employs 8 full time members of staff, 4 part time and 80 seasonal workers during peak harvest periods.

1.3 Aims of the Project

The main aims of the project are to:

- Generate clean electricity. A portion of this will be used to power the farm's cold stores and the remainder will be exported to the National Grid;
- Generate an additional income stream for the business through the sale of any electricity not used by the farm; and
- Reduce the businesses' carbon footprint, which is of increasing importance to major suppliers.

1.4 Scope of the Environmental Statement

In line with the EIA Directive and the local planning policies, this Environmental Statement (ES) covers the key issues associated with the project, to a level of detail appropriate to the scale of the proposed development.

The structure of the ES is as follows:

- The Proposed Development (including Traffic and Transport);
- Planning and Environmental Policy Context;
- Local Economic Benefits;
- Project Design Considerations;
- Ecology and Ornithology;
- Landscape and Visual Impact;

- Noise;
- Cultural Heritage and Archaeology;
- Surface and Groundwater Hydrology;
- Existing Infrastructure, Telecommunications, Television, Aviation and Electromagnetic Safety;
- Shadow Flicker; and
- Climate change.

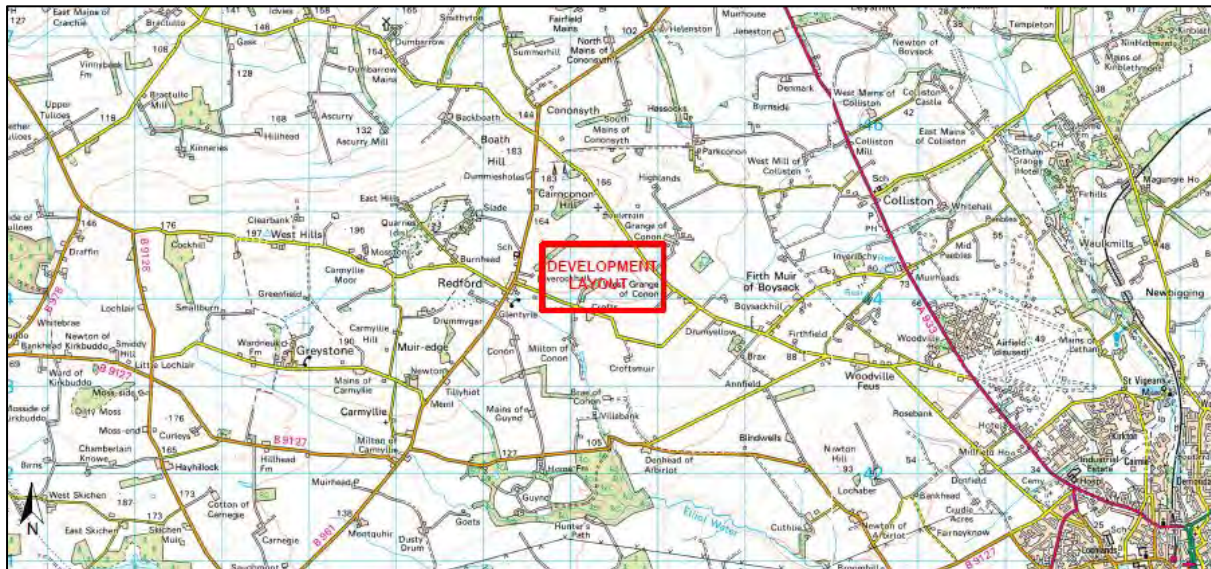
Other issues, more commonly relevant to larger scale wind projects, and not raised as potential issues by Angus Council during the scoping process, have been scoped out of the assessment:

- Geology;
- Socio-economic Impact and Tourism.

2 The Proposed Development

2.1 Location and Project Layout

The proposed development is located approximately 8 km north-west of Arbroath, and 1 km north-east of the village of Redford in Angus. The proposed development site is shown in **Figure 2.1**.



Reproduced from Ordnance Survey digital map data © Crown copyright 2013. All rights reserved. License number 010003167

Figure 2.1 – Proposed development location

The development would comprise the installation and operation of two wind turbines, no greater than 80m to blade tip height. The site is located on the south-eastern shoulder of Cairnconon Hill, which rises gently to a height of 183m. The turbines themselves would be located at 155m and 161m altitude respectively. The hill is bounded by the B961 to the west, which connects Redford to Carmyllie in the south and Friockheim in the north, and two further minor roads pass the site to the south and east. Two shelter belts of coniferous trees bound the site to the north-west and north-east respectively, and the communication masts on top of Cairnconon Hill are other noticeable features.

The centre of Redford itself is located approximately 950m to the south-west of the nearest turbine location. The village consists of around 40 properties, with numerous farmhouses, steadings and clusters of houses scattered throughout the local area. Carmyllie School is located on the B961 just to the north of the village centre, and there is an operational sawmill just to the west of the village centre.



Figure 2.1 – Photograph of the site from south of Redford on the B961

The landscape around the site is described within the ‘*Strategic Landscape Capacity Assessment for Wind Energy in Angus*¹’ as being gently rolling or undulating, with large arable fields in which boundaries have been removed or have become minimal, giving an open, simple character.

Ordnance Survey National Grid References for the two proposed turbines at Crofts Farm are presented in **Table 2.1**.

Table 2.1 – Crofts Farm turbine national grid references

Turbine	National Grid Reference
T1	357190 744555
T2	357325 744415

The turbines would be located on the broad ridgeline at the top of the hill, and would be accessed from the minor road to the south, which passes Crofts Farm. This would involve the widening of an existing field access, and the upgrade of an existing track which follows the eastern field boundary up the hill.

The proposed site layout is shown in **Figure 2.3**.

¹ November 2013



Reproduced from Ordnance Survey digital map data © Crown copyright 2013. All rights reserved. License number 010003167

Figure 2.3 – Site layout

The area taken by the proposed development is comparatively small and the existing land use, which is pasture farmland, would continue around the wind turbines and associated infrastructure.

2.2 Description of the Proposed Wind Turbines

A diagram of the principal dimensions of the Enercon E48, which is the most likely turbine for the development, is shown in **Figure 2.4**.

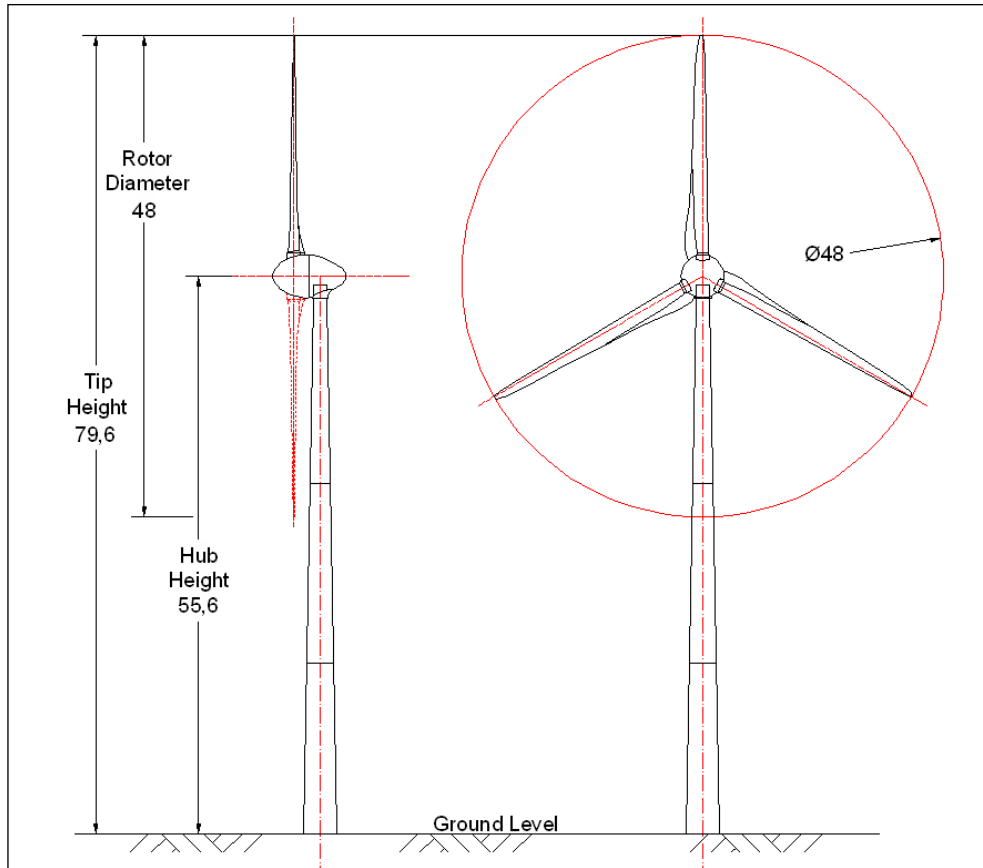


Figure 2.4 - Enercon E48 wind turbine showing principal dimensions

The key dimensions of the Enercon E48 are summarised in **Table 2.2**.

Table 2.2 – Key dimensions of the Enercon E48

Dimension	Length (m)
Hub height	56
Rotor diameter	48
Total height	80

The nacelle housing contains the generator and other operating equipment. The transformer of the candidate machine is contained inside the tower base. It is proposed that the finish of the wind turbines, towers and blades will be semi-matt and will be pale grey in colour.

Unlike some other makes of wind turbines that are programmed to stop when the wind speed exceeds 25m/s ('cut-out' wind speed), Enercon wind turbines are fitted with a storm control feature which enables the turbine to continue to operate in very high wind speeds; this avoids the need for sudden shutdowns and the resulting energy yield losses.

In the event of extreme wind speeds, in excess of those that the turbine can operate at (typically 10 minute averages of 25 m/s or a top value of 30 m/s), the turbines would shut down until the wind speed has dropped to a level where they can safely start operating again.

2.3 Purpose of the Development

Electricity generation

The production, packing and storage of fresh supermarket vegetables requires significant levels of energy consumption by the business. The business operates two on-site cold stores and a third off-site cold store, which together are required to maintain the freshness and quality of produce. These contribute to an annual electricity consumption of ~400MWh, which is one of the businesses' largest costs. As well as being connected to the National Grid, the proposed turbines will supply 'green' electricity directly to the farm, resulting in an efficient use of a natural resource, and significant financial savings.

Business Diversification

The development of the wind turbines will lead to an additional source of income for the business which will help to cushion it from market volatility caused by significant annual factors such as changes in the weather and fluctuating commodity prices. An increase in the sustainability and stability of the business will also help support both the existing employment and create new employment as the business continues to expand.

Carbon footprint

As a high energy user involved in the supply of fresh produce to the leading supermarkets, the business is seeking to improve its sustainability and reduce its carbon footprint. The need to demonstrate commitment to sustainability is increasing as supermarket customers demand higher environmental standards from their suppliers. Thus the development of renewable energy should increase the attractiveness of the farm's produce to suppliers through its sustainable production.

On an annual basis, the farm business consumes in excess of 155,000 litres of diesel which is considered to directly lead to 563 tonnes of CO₂ emitted per annum². The three cold stores are estimated to contribute a further 224 tonnes of CO₂ emitted, based upon grid mix electricity usage.

When taken together with the other main farm inputs such as fertiliser, produce packaging and transportation, the business is calculated to have a carbon footprint significantly in excess of **6,000 tonnes of CO₂ per annum**³. The two turbines are expected to directly offset the emission of approximately 1,300 tonnes of CO₂ for every year of operation. This is around 20% of the business' overall carbon footprint, and more than the CO₂ generated by the cold stores and diesel usage.

Summary

The development of wind energy at Crofts Farm will provide the business with a source of renewable energy to meet its growing energy demand whilst at the same time significantly reducing the business' carbon footprint. The sale of electricity would provide a steady income stream to provide stability to the business in a changeable marketplace. The

² <http://www.cffcarboncalculator.org.uk/carboncalc>

³ *ibid*

business also intends to share some of these financial benefits with the local community, and is proposing to offer an annual community benefit.

2.4 Scottish Government Policy

The Scottish Government is committed to reducing emissions through requirements set down in the Climate Change (Scotland) Act 2009 and the 2020 Route Map for Renewable Energy in Scotland. The Routemap, published in July 2011, includes the following relevant targets for renewable electricity generation in Scotland.

100% electricity demand equivalent from renewables by 2020 – the Routemap recognises that this is a ‘formidable’ goal but states the Scottish Government’s determination to pursue this for economic and carbon benefits. The Routemap acknowledges that this potential will need to be recognised in a UK-wide regulatory framework.

500MW community and locally-owned renewable energy by 2020 – The Routemap states that the Feed in Tariff and the Renewable Heat Incentive should be used as a springboard to increase the scale of local ownership of renewable projects, allowing communities and rural businesses to take advantage of the significant potential revenue streams.

Every wind turbine in a rural area contributes to the farming economy with the provision of additional income. However, a project such as this where the rural business is the developer rather than simply a landlord will provide an even greater benefit to both the business and the local economy.

Overall, this project will create a financial benefit to a local farm business, when agriculture is under significant pressure to diversify, and aid in the delivery of the Scottish Government’s renewable energy targets.

2.5 Associated Infrastructure

Site Tracks and Crane Hardstanding

As shown in **Figure 2.3**, approximately 750m of new and 360m of upgraded track would be required for the purposes of providing access to the wind turbines. The tracks would be typically 4.0 m wide with 0.5 m shoulders on each side and would consist of crushed stone to an average depth of up to 500 mm. On corners, it will be necessary to construct wider areas of track to reflect the minimum bend-radii for the longest construction loads (the blades).

Construction of the site tracks would involve the removal of the vegetation and top soil to a depth of approximately 200 mm. This would be stored adjacent to the tracks for later, partial reinstatement. Where necessary, a geotextile layer would be placed directly onto the exposed subsoil, upon which the crushed rock would be placed.

Appropriate drainage requirements would be incorporated where the site specific conditions make this necessary. If any areas of softer ground are encountered, the depth of crushed rock may need to increase to approximately 700 mm and a layer of geotextile material embedded within the structure would be used.

Crane platforms would be of similar construction to the access tracks, designed to withstand the maximum load bearing applied by the crane during the construction process.

Figure 2.5 shows the specification of the required crane hardstanding.

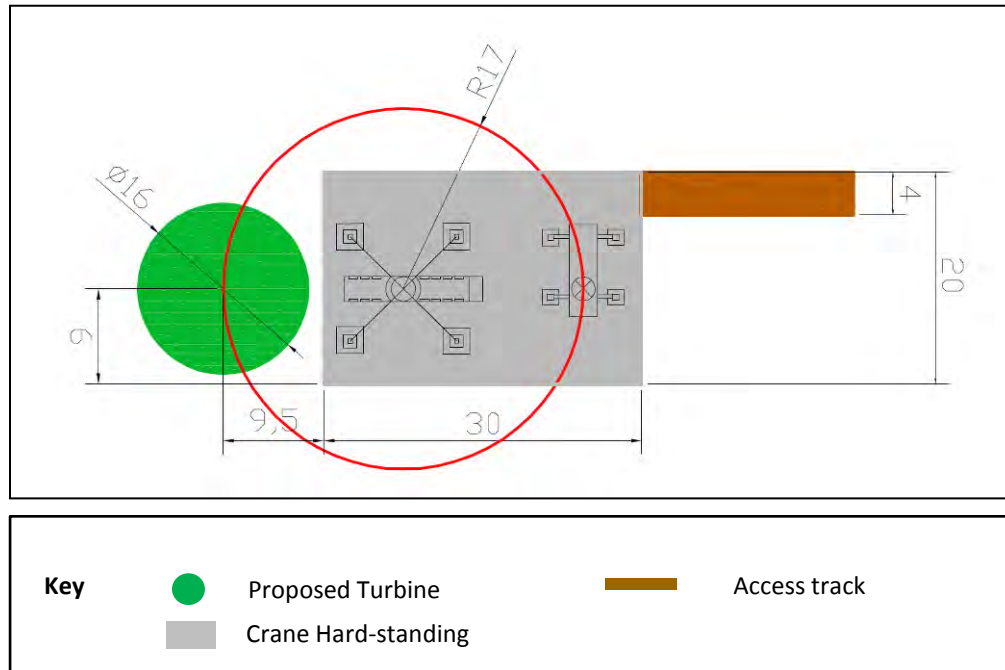


Figure 2.5 – Crane and hardstanding diagram

Any excess earth excavated during the construction phase would be stored behind the foundations. Reinstatement of the track verges and the areas of hardstanding will be undertaken where appropriate. As there would be a continuing need to use the site tracks, the tracks will be left in place for the lifetime of the development.

Construction Compound

The local ground works contractor would set up a small compound for site offices, welfare facilities and storage of tools, located near the site entrance.

Turbine Foundations

Depending on how high the groundwater table is, each turbine's foundations will be designed as either buoyant or non-buoyant. Buoyant foundations are larger and have been used as a conservative assumption in this assessment, though the hydrology assessment indicates that the need for a buoyant foundation is unlikely. **Figure 2.6** shows the typical dimensions of a buoyant turbine foundation. The foundation would have a diameter of up to 16 m, and a depth of approximately 1.7 m. When the foundations are excavated, a further metre around the foundation will be dug to allow access during construction. A thin layer, called a 'blinding layer', will be poured to provide a surface on which the foundation can be constructed. Conservatively, each foundation would comprise:

- 17 tonnes of steel reinforcement bars;

- 170 cubic metres of concrete; and
- 20 tonnes concrete blinding layer slab.

As can be seen in **Figure 2.6**, the turbine foundations will be covered by topsoil when construction is complete, leaving a plinth of about 5.5m in diameter just above the surface level, upon which the turbine would be bolted. Much of the excavated material will be used for this back-filling, and the topsoil would be reseeded.

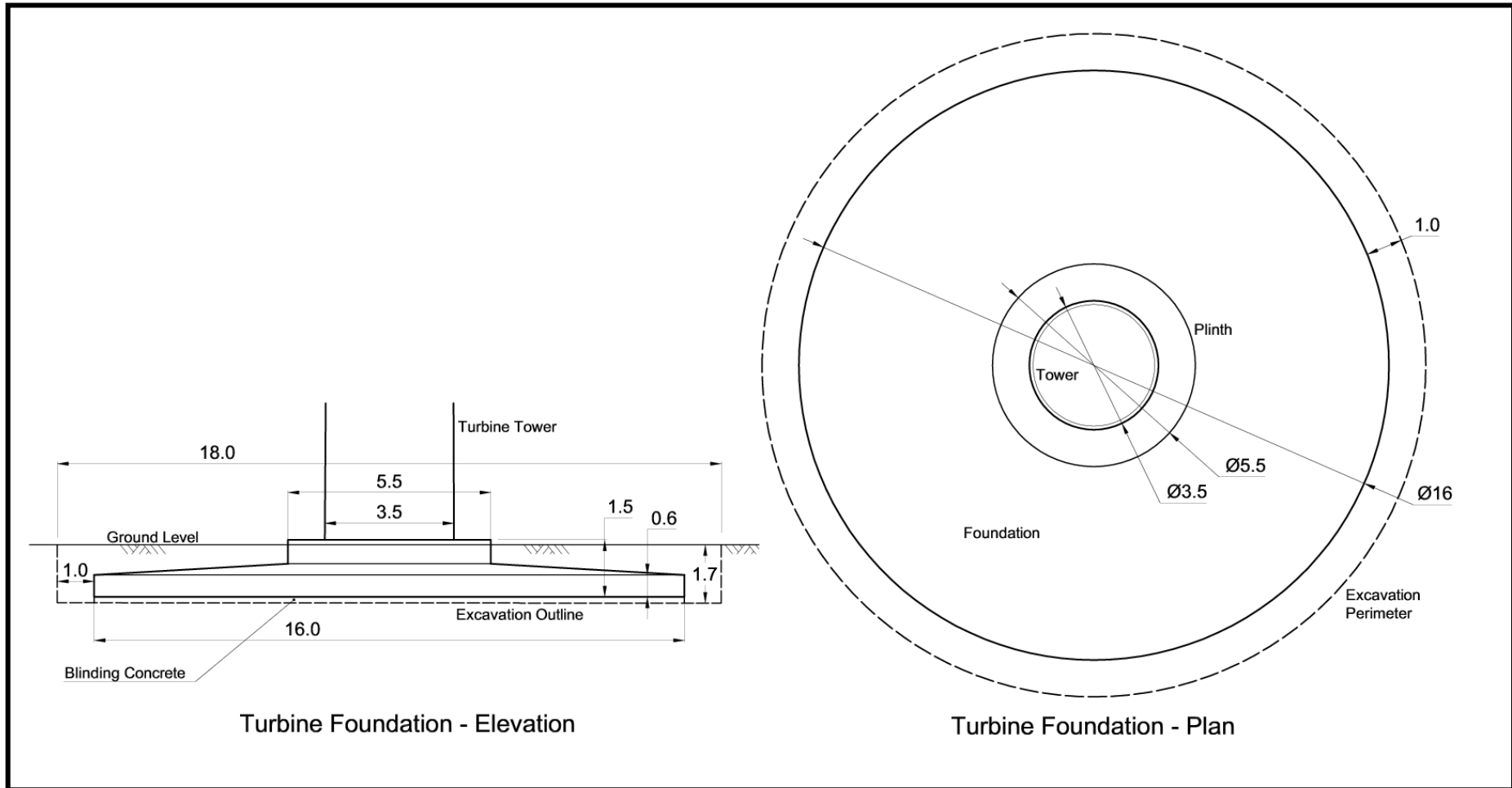


Figure 2.5 – Typical buoyant foundation dimensions for E48 turbine (m)

2.6 Grid / Local Electrical Connection

The wind turbines envisaged for use on this site produce electricity at 400 volts. This would be transformed to 11 kV or 33 kV (dependent upon the grid connection point) using a transformer within the turbines. Grid connection has been applied for, and an offer is expected from Scottish and Southern Energy (SSE) in March 2014.

From the transformer, underground cable runs will link each turbine to a substation building. This method has been adopted to avoid visual clutter on the site. Excavated material from the trench would be stored alongside the trench and replaced during back-filling. Topsoil would be stored separately and fully reinstated over the trench following construction.

There are two basic scenarios for the use of electricity generated by wind turbines:

- A stand-alone project where 100% of the electricity is exported onto the local electrical grid; or
- The turbine(s) supplies the on-site facility with electricity, with any excess energy being exported onto the local electrical grid.

Figure 2.6 shows the proposed scenario at Crofts Farm, where the turbines will supply electricity to the farm and export the excess onto the grid.

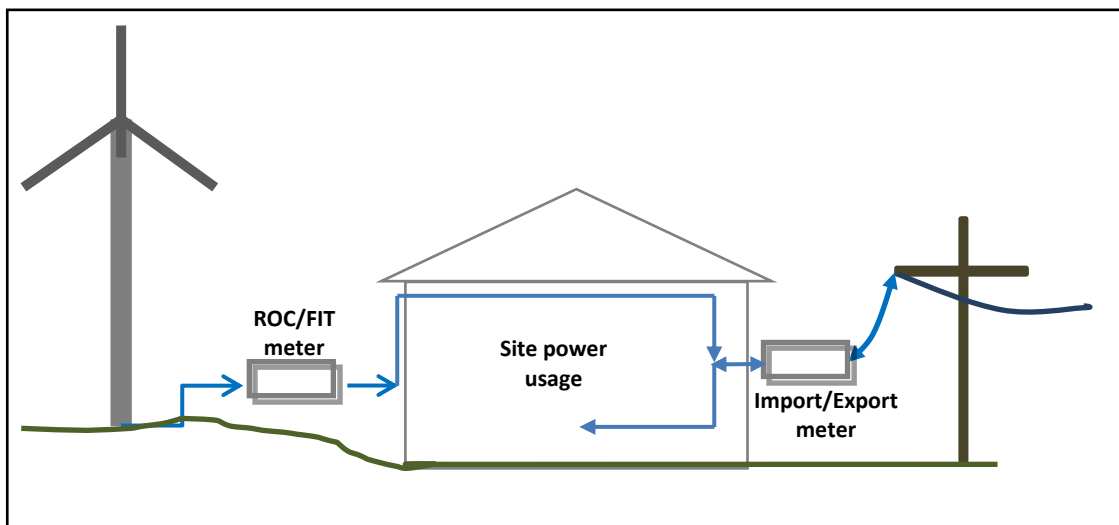


Figure 2.6 - Metering system schematic with on-site power usage

2.7 Access to the Site

It is intended that the turbines would be landed at Montrose and then transported east to the outskirts of Arbroath on the A92. Here they would head north-west on the A933 before reaching the site on the minor road that skirts the southern edge of the site.

It is intended to send all construction traffic to the site via this route to avoid construction vehicles passing through Redford.

The exact route will be confirmed in a 'Route Access Report' which will be submitted to the Council for approval prior to turbine construction and as part of a planning condition.

2.8 Construction Programme

The construction phase would start after the financial and due diligence process has been completed and would be on-going for approximately 5 to 7 months, from construction of the access track through to erection and commissioning of the wind turbines. **Table 2.4** presents an indicative programme.

Table 2.4 – Indicative construction programme

Activity	Duration	Timescale (months from planning decision)												
		1	2	3	4	5	6	7	8	9	10	11	12	
Roads, hard-standings and drainage	1 week													
Foundation excavation	2-4 days													
Foundation reinforcement	2-4 days													
Foundation structural concrete pour	3 days													
Sub-station construction	2-3 days													
On-site cabling	2-4 days													
Turbine delivery	1-2 days													
Turbine erection	2-4 days													
Turbine commissioning	1-3 days													

2.9 Construction Traffic

There are three distinct phases of the development in traffic terms:

- Construction;
- Operation; and
- Decommissioning.

Construction traffic

The traffic involved throughout the construction phase includes the turbine component delivery vehicles, lorries with aggregates for construction of new tracks and crane hardstandings, concrete deliveries, reinforcement steel and cabling, as well as personnel commuting. **Table 2.4** gives an estimate of the volume of traffic likely to be involved during the construction phase.

Table 2.4 – Construction Traffic

	Load	Number of deliveries
Aggregate for new and upgraded track and crane hardstanding	~1300 m ³	276
Concrete turbine foundations	~210 m ³	48
Reinforcement steel	34 tonnes	2
Cabling	Unknown	One lorry can carry several reels of cable, normally one lorry will provide for the whole project
Personnel	-	6-10 cars/vans a day at peak time
Turbine components	-	10 articulated lorries

Wind turbine components would be delivered to the site on articulated lorries. Extended trailers would be used to deliver the turbine blades which are up to 24 m in length.

The largest type of crane required is a Liebherr LTM 1500-8.1 mobile crane, which is 21.4 m long, 3.2 m wide and has a 500 tonne lift capacity. The crane has eight axles, all of which have axle loads of 12 tonnes, so the total vehicle weight is 96 tonnes.

Aggregate would be sourced from the most convenient quarry.

Operational traffic

Once erected the wind turbines would operate automatically. Typically, Enercon maintenance teams are scheduled to conduct quarterly checks on the operation of turbines. These are undertaken in light commercial vehicles such as vans, cars or similar vehicles

Decommissioning traffic

The amount of site traffic during decommissioning would be less than that during the construction stage.

2.10 Decommissioning

At the end of the development's operational life, the wind turbines would be decommissioned, the principal elements removed, and the site restored leaving little, if any, visible trace.

The wind turbines would be removed from the site and the foundations, tracks and hardstandings would be covered over with topsoil and reseeded. The cables would be de-energised and left in place, with any cable marker signs removed. The electrical substation building would be removed and the building demolished to ground level with the foundation covered with topsoil and reseeded.

The decommissioning process would take approximately two months to complete. A decommissioning programme would be agreed with the relevant authority prior to the commencement of decommissioning works.

3 Planning and Environmental Policy Context

An application for the development of a wind project should be assessed in the context of national policy and guidance; the local planning authority development plan; and supplementary planning guidance.

National planning policy and guidance is set out in the National Planning Framework (NPF); the Scottish Planning Policy (SPP); Circulars; the Scottish Historic Environment Policy (SHEP); Planning Advice Notes (PANs); and Design Advice Guidance.

3.1 Context

In 2009, the Scottish Government enacted the Climate Change (Scotland) Act 2009 which requires reductions in net Scottish emission for 2050 of 80% from the baseline, with interim targets of a reduction of 42% by 2020 (C13).

The Climate Change Act targets are more demanding than those required by the legally binding UK renewable energy target: A reduction in greenhouse gas emissions by 20% and an increase in the proportion of final energy consumption from renewable sources to 20% by 2020.

Together these requirements drive the Scottish Government's commitment to renewable energy, as set out in the 2020 Routemap for Renewable Energy in Scotland. This states that 100% of Scotland's electricity demand should be generated by renewable means by 2020, with an interim milestone of 50% by 2015.

The Routemap also sets out the related target for 500MW community and locally-owned renewable energy 2020, to allow communities and rural businesses to take advantage of the significant potential revenue streams.

The Routemap states that, *"The Government is committed to the continued expansion of portfolio of onshore wind farms to help meet renewables targets, with a robust planning system providing spatial guidance, a clear policy framework and together with a timely and efficient processing of Section 36 Electricity Act and planning applications"*.

One of the main challenges identified in meeting these targets relates to 'Planning and Consents', with the Routemap identifying that there is a *'need to continue to streamline systems and work for greater speed and transparency, without sacrificing proper consideration of the impacts on the local environment'*.

Progress towards these renewable energy targets is also driven by the series of Renewables Obligation (Scotland) Orders, which oblige electricity suppliers to provide an increasing proportion of their electricity generated from renewable sources and the Feed in Tariffs (FITs) scheme.

The renewable energy sector is a major contributor to the Scottish Government's principle objective of facilitating sustainable economic growth. This includes the encouragement and support of diversification and the growth of the rural economy.

3.2 National Planning Policy Guidance

National Planning Framework

The National Planning Framework for Scotland 2 (NPF2) 2009, expresses the spatial aspect of the Government's Economic Strategy and confirms the importance of renewable energy to Scotland's energy mix. This 2nd National Planning Framework for Scotland, *'takes forward the spatial aspects of the Scottish Government's policy commitments on sustainable economic growth and climate change, which will see Scotland move towards a low carbon economy'*. It is stated that the *'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'* and that *'the aim of national planning policy is to develop Scotland's renewable energy potential whilst safeguarding the environment and communities.'*

Scottish Planning Policy

Scottish Planning Policy (SPP) (CO1) is the statement of the Scottish Government's policy on nationally important land use planning matters. It sets out the Scottish Government's view of planning; the core principles for the operation of the system; statutory guidance on sustainable development and planning; concise subject planning policies; and expectations of the intended outcomes.

With regard to renewable energy the SPP states that *'the commitment to increase the amount of electricity generated from renewable sources is a vital part of the response to climate change'* and confirms that the target for 50% of Scotland's electricity to be generated from renewable sources by 2020 is not a cap (paragraph 182).

Following publication of the SPP, Scotland's renewable electricity target for the next decade was increased from 50% to 100% by First Minister Alex Salmond in July 2011. The Scottish Government has calculated that significantly higher levels of renewables could be deployed by 2020 with little change to the current policy, planning or regulation framework in Scotland. A separate study for industry body Scottish Renewables, published in September 2010 reported similar conclusions.

The SPP states that development plans are required to guide development to appropriate locations and should *'support all scales of development associated with the generation of energy and heat from renewable sources, ensuring that an area's renewable energy potential is realised and optimised in a way that takes account of relevant economic, social, environmental and transport issues and maximises benefits.'* (paragraph 184).

Specifically for wind developments (paragraph 187) the SPP sets out criteria which will be considered in deciding applications:

- Landscape and visual impact,
- effects on the natural heritage and historic environment,
- contribution of the development to renewable energy 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.

Scottish Historic Environment Policy

The Scottish Historic Environment Policy (SHEP) sets out the Scottish Minister’s policies for the historic environment. It complements and has the same authority as the SPP. Of relevance to this wind project is how the proposed development will affect the setting of the surrounding historic environment. The SHEP states (paragraph 1.8) that:

‘The protection of the historic environment is not about preventing change. Ministers believe that change in this dynamic environment should be managed intelligently and with understanding, to achieve the best outcome for the historic environment and for the people of Scotland.’

Other Relevant National Policy Documents

Circulars

- 3/2011 The Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011

Advice and Guidance Notes

- PAN 2/2011: Archaeology and Planning
- Scottish Government Web-Based Renewable Guidance. This online guidance superseded PAN45 in February 2011. The two most relevant documents are:
 - ‘Onshore Wind Turbines’, which sets out clear planning guidelines for local authorities, presenting technical information on wind turbine and assessment procedures;
 - ‘Process for preparing spatial frameworks for windfarms’, which provides guidance to local authorities on how to guide development through the production of spatial frameworks.’
- Planning Advice Note 1/2011: Planning and Noise
- PAN 58: Environmental Impact Assessment;
- PAN 60: Planning for Natural Heritage; and
- Managing Change in the Historic Environment guidance note series.

Conclusion - National

National policies encourage a holistic view of renewable energy developments. This requires an assessment of the contribution that the proposal can make to renewable energy targets alongside the potential benefits and disbenefits to communities and the environmental impacts.

The Scottish Government expects all parts of the planning system to work towards delivering its overarching aims: *'The Scottish Government believes that a properly functioning planning system is essential to achieving its central purpose of increasing sustainable economic growth. The way in which the planning system is structured and operated should be directed towards that purpose and to supporting the Scottish Government's five strategic objectives and fifteen national outcomes.'* (paragraph 4, C01).

Those strategic objectives include the development of renewable energy and specifically encourage locally owned community based renewable energy. The benefits of such to local sustainable economic development can be considerable (C10, SAC report).

3.3 Local Planning Policy

The key local development documents are:

- TAYplan (Approved 2012):
- Angus Local Plan Review (Adopted 2009)

In addition to the development plan a number of other publications are also particularly relevant to the consideration of the application. These include:

- Tayside Landscape Character Assessment (1998);
- Angus Council Implementation Guide for Renewable Energy Proposals (2012);
- Angus Windfarms Landscape Capacity and Cumulative Impacts Study (Ironsides Farrar, 2008);
- Strategic Landscape Capacity Assessment for Wind Energy in Angus (prepared by Ironsides Farrar for Angus Council and SNH, November 2013)

TAYplan: Scotland's SusTAYnable Region

In June 2012, TAYplan replaced the Dundee and Angus Structure Plan 2002 and became the statutory Strategic Development Plan. The plan embraces sustainability stating in the foreword *'We want to provide future generations with opportunities to improve their lives; what better legacy to leave our children. Therefore the mitigation of and adaptation to climate change, as the single greatest challenge facing humankind, is central to this Plan. We must shift to a low carbon and zero waste economy by using our land and resources more efficiently.'*

This is embodied in the Vision and Objectives which aims to 'support the switch to a low carbon and zero waste economy' and to *'strengthen the economic base to support the renewable energy and local carbon technology sectors'*.

Policy 6: Energy and Waste/Resource Management Infrastructure requires the Local Development Plans to identify areas suitable for different forms of renewable heat and electricity infrastructure with areas of search, allocated sites and decisions on proposals taking into account:

- *‘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;*
- *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’.*

The Angus Local Plan Review (Adopted 2009)

This is the local element of the statutory Local Development Plan and is therefore the prime policy against which applications are determined.

With regard to energy the Angus Local Plan Review states that *‘in terms of sustainable development, energy efficiency and non-polluting power generation are fundamental to establishing a stable and environmentally acceptable energy policy.’*

The Plan recognises that the Scottish Government’s target of electricity generation from renewable sources *‘will require major investment in commercial renewable energy production and distribution capacity throughout Scotland.’*

Policy S1: Development Boundaries states that:

- ‘(a) Within development boundaries proposals for new development on sites not allocated on Proposals Maps will generally be supported where they are in accordance with the relevant policies of the Local Plan.*
- (b) 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.*
- (c) Development proposals on sites contiguous with a development boundary will only be acceptable where there is a proven public interest and social, economic or environmental considerations confirm there is an overriding need for the development which cannot be met within the development boundary.’*

Policy S6: Development Principles states that:

‘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.'

Schedule 1 (b) of S6 requires that *'Proposals should not result in unacceptable visual impact'*.

Policy ER5: Conservation of Landscape Character Development states that:

'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.'*

It is stated that all forms of renewable energy production will be supported and assessed against 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.'*

Specifically for wind energy, proposals must also meet the requirements of 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’.*

The Crofts Farm site lies within ‘Area 2 Lowland and Hills’ geographic area, as defined within the Tayside Landscape Character Assessment and cited in the Local Plan Review.

The Local Plan places the site in the Lowland and Hills which is identified as being of the lowest sensitivity to wind turbine development, subject to local sensitivities such as small scale landscape, skyline and habitats. The ALPR states that, *‘The Lowland and Hills area is recognised as of generally lower sensitivity to turbines in terms of visual, landscape and natural heritage interests. However, there may be areas within the Lowland and Hills Area where large turbines would have an unacceptable impact, or where properly sited and designed wind energy development can be accommodated in areas of higher natural heritage, landscape and visual sensitivity’.*

In terms of site selection the plan states:

‘Applicants should present their rationale for site selection. There are an increasing number of sites being promoted for wind energy developments and the Council will consider the site selection process and project viability when assessing applications. Where a number of sites are before the Council, decisions on planning applications will seek to maximise output and minimise unacceptable impact.

Applicants should demonstrate that proposals are technically and financially feasible to prevent other deliverable proposals being blighted in the future by undeveloped consents’.

Tayside Landscape Character Assessment (TLCA)

The TLCA, published in 1999, identifies that the application site falls within the Dipslope Farmland Landscape Character Type (LCT), which extends over a large area from the Montrose Basin south-westwards as far as the countryside north of Dundee adjoining the Sidlaw Hills. Its key characteristics are its general slope from north-west to south-east; the dominance of productive agricultural land; low woodland cover, except on large estates and along river corridors; a variety of historic sites; and the limited visual impact of Dundee and Arbroath. The landscape is described as being of medium scale, semi-enclosed to open, with extensive arable production on very fertile land, medium to large fields and a scattered settlement pattern of hamlets and farmsteads.

Angus Windfarms Landscape Capacity and Cumulative Impacts Study (AWLCCIS)

The Study, published in September 2008, provides further information on the characteristics and capacity of the Dipslope Farmland LCT.

The Study suggests that *“the area is considered to have a medium landscape value. Together with a medium sensitivity this gives an **overall medium capacity for windfarm development**. Large or medium windfarms would not be appropriate in this area due to scale and visual sensitivity limitations. Any proposed development should be of limited scale and extent, reflecting the scale and pattern of the local landscape and would be limited by proximity of the settlements and scattered residential population”*.

The study defines a small/medium windfarm as *“A windfarm of more than three turbines up to 20MW output, the examples given being four turbines of over 50m, ten turbines of 2MW power or six turbines of 3MW power”*.

2MW turbines are typically 100m in height, and 3MW turbines around 125m in height. Set against these criteria, the proposed Crofts Farm development, with two turbines of 80m in height, would not be considered a large enough development to be a small/medium scale windfarm, and would fall below this threshold.

Angus Council Renewable Energy Implementation Guide

The Guide, which was approved on 14 June 2012, seeks to clarify existing development plan policy and to assist in considering proposals against those policies. The Guide describes the existing character of the Dipslope Farmland as a *‘Landscape with Views of Windfarms’*, and states that the Acceptable Character in a future scenario would be for a *‘Landscape with Occasional Windfarms’*, described as:

- *A landscape type or area in which windfarms or wind turbines are located or are very close to and visible. However they are not of such a size, number, extent or contrast in character that they become one of the defining characteristics of the landscape’s character; and*
- *Visual receptors would experience occasional close-quarters views of a windfarm or turbines and more frequent background views of windfarms or turbines. Some turbines may or may not be perceived as being located in the landscape character area. No overall perception of windfarms being a defining feature of the landscape.*

The guide states that the LCT is *‘Considered to have scope for turbines circa 80m in height’*.

Strategic Landscape Capacity Assessment of Wind Energy in Angus (November 2013)

The most recent guidance on landscape capacity is provided by the *‘Strategic Landscape Capacity Assessment (SLCA) for Wind Energy in Angus November 2013’*. This provides specific guidance on each Landscape Character Type within the Local Authority Area, and assesses the acceptable future level of change within each area. The Crofts Farm site is fully situated within the *‘Redford Farmland’* sub-section of the *‘Dipslope Farmland’* character type which is described as:

“Redford Farmland: This sub-area is higher and/or more open and exposed than neighbouring sub-areas. The plateau like landform of the highest northern part is gently rolling or undulating and has large arable fields in which boundaries have been removed or have become minimal, giving an open, simple character. Settlements are small and well separated. Farms and houses also appear well separated and farm buildings are often large. There are some areas of mature trees, most notably the very enclosed Guynd designed landscape. An electricity transmission line crosses the centre. Due to its openness, apparent larger scale and productive farmland character, the northern parts of this sub-area, separated from the coastal facing slopes by a low ridge or break in slope, would be less sensitive to wind energy developments. This area has the highest capacity for wind energy in the Dipslope Farmland and can accommodate medium/large turbines, subject to local constraints. Groupings should remain relatively small and well separated to avoid overwhelming the underlying character. Turbines should not interfere with the ridge that marks the break of slope above the A92. The largest size of turbines (medium/large) would be most suitable in the largest scale areas located in the centre and north of the sub-area.”

The Redford Farmland landscape character type is currently described as being ‘*Dipslope Farmland with occasional/No wind turbines*’. This Landscape Classification is described below:

“A landscape type or area in which windfarms or wind turbines are located and/or are close to and visible. Turbines are not of such a size, number, extent or contrast in character that they become one of the defining characteristics of the landscapes character. Visual receptors would experience occasional close-quarters views of a windfarm or turbines and more frequent background views of windfarms or turbines. Some of the turbines would not be perceived as being located in the landscape character type or area. No overall perception of wind turbines being a defining feature of the landscape.”

In accordance with the levels of acceptable landscape character change set out in Table 6.1(g) of the report, the Redford Farmland landscape character type has the potential to become a ‘*Dipslope Farmland with Wind Turbines*’. This is as set out in the Implementation Guide discussed previously.

The SLCA assesses the Redford landscape area as having a medium capacity for groups of 1-5 turbines up to circa 80m to tip, with a suggested minimum separation distance between clusters of wind turbines or windfarms of around 5-10km.

The SLCA states that, “*This (character type) has the highest capacity for wind energy in the Dipslope Farmland and can accommodate medium/large turbines, subject to local constraints. Groupings should remain relatively small and well separated to avoid overwhelming the underlying character. Turbines should not interfere with the ridge that marks the break of slope above the A92*”.

The SLCA also highlights the sensitive visual nature of The Guynd, which is a Garden and Designed Landscape located ~2.2km south of the Crofts Farm site at its nearest point.

3.4 Conclusions

Both the TLCA and AWLCCIS identify that the Redford area is potentially suitable for turbines of 80m in height, as currently proposed.

The scale of turbines proposed is in line with that deemed to be acceptable in the latest guidance available in the SLCA. Furthermore, the Crofts Farm site is located to the north of the ridge that marks the break of slope above the A92. The impact on The Guynd GDL has been assessed in detail within Section 7 of this report. The assessment found that there are no predicted views of the turbines from within the property or from the immediate surrounding gardens which form the GDL, and there would be no impact on the setting of the house or gardens. The proposed development would therefore seem to satisfy all of the criteria set out within the SLCA.

In terms of cumulative impact the nearest operational wind project is the single 67m turbine at North Mains of Cononsyth, approximately 2km to the north. There is one further consented project and approximately 8 projects at the planning stage within 10km of the site.

Cumulative impact has been assessed in detail within the ES. It has been found that the future character of the Dipslope Farmland will not exceed the acceptable 'Landscape with Occasional Windfarms' definition as set out within the Implementation Guide and SLCA.

The proposed development at Crofts Farm is therefore deemed to comply with national, regional and local policies relating to wind energy. The remainder of this report assesses the proposed development in more detail, looking at the site specific aspects of the proposal.

3.5 References

Angus Council (2012), *Renewable Energy Implementation Guide*, Angus Council.

Historic Scotland (2009), *Scottish Historic Environmental Policy*, Historic Scotland, Edinburgh.

Historic Scotland (2010), *Managing Change in the Historic Environment*, Historic Scotland, Edinburgh.

Ironside Farrar (2008), *Angus Windfarms Landscape Capacity and Cumulative Impacts Study*, Angus Council

Ironside Farrar (2013), *Strategic Landscape Capacity Assessment for Wind Energy in Angus*, Angus Council.

Land Use Consultants (1999), *The Tayside Landscape Character Assessment*, Scottish Natural Heritage.

Scottish Executive Development Department (1999), *Planning Advice Note - PAN 58 – Environmental Impact Assessment*, Scottish Executive.

Scottish Executive Development Department (2006), *Planning Advice Note 51 – Planning, Environmental Protection and Regulation*, Scottish Executive.

Scottish Executive Development Department (2008), *Planning Advice Note – PAN 51 – Planning for Natural Heritage*, Scottish Executive.

Scottish Government (2009), *National Planning Framework for Scotland 2*, Scottish Government.

Scottish Government (2010), *Scottish Planning Policy*, Scottish Government.

Scottish Government (2011), *Planning Advice Note 1/2011 – Planning and Noise*, Scottish Government.

Scottish Government (2011), *Planning Advice Note PAN 2/2011 – Planning and Archaeology*, Scottish Government.

Scottish Government (2011), *Circular 3/2011 – The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011*, Scottish Government.

Scottish Government (2012), *Online Wind Turbines*
<http://www.scotland.gov.uk/Topics/Built-Environment/planning/National-Planning-Policy/themes/renewables/Onshore> (accessed April 2012).

Scottish Government (2012), *Process for preparing spatial frameworks for wind farms*
<http://www.scotland.gov.uk/Topics/Built-Environment/planning/National-Planning-Policy/themes/renewables/spatialframework> (accessed April 2012).

4 Local Economic Benefits

4.1 Construction / Decommissioning Phase Benefits

The construction of the proposal would represent a large capital investment in the local area. Whilst the supply chain for turbine components is largely located in mainland Europe, the site preparation works required as part of the construction presents an opportunity to source materials, labour and plant from the local area.

Excluding the turbine component supply, the typical construction costs of a single turbine of the size and type proposed is in the region of £600,000, which would equate to a total of £1,200,000 for this project. A recent report from Biggar Economics (2012), which assesses the economic impacts of the onshore wind sector as a whole, suggests that 45 % of this would be spent in the UK. This report assesses the economic impacts of the onshore wind sector as a whole and figures are based on projects from across the UK ranging in scale from 1 to more than 150 turbines. However, past experience of projects of this size, in Scotland indicates that in fact around 50 % of construction expenditure occurs at a local level through the following:

- Contracts awarded to local firms for electrical works, civil engineering, fencing etc;
- Expenditure on hotels and services in the local area by contractors throughout the construction period; and
- Sourcing of appropriate materials such as crushed stone for the road surfaces and crane hardstandings from local suppliers.

Crofts Farm Renewables Ltd will actively seek out opportunities to work with other contractors and businesses in the local area prior to the construction phase. Preference will be given during any tendering procedures to local firms in order to maximise the extent to which the investment can be channelled into the local economy.

At the end of the turbines' 25 year life span, the decommissioning phase of the turbines will involve an operation similar in size and timescale to the construction phase and would therefore present a similar level of opportunity for economic benefit in the local area.

4.2 Operational Phase Benefits

The operational benefits of the turbines are:

- The turbines will generate ~2,900MWh of clean electricity every year, enough to power the equivalent of 650 homes.
- Electricity from the turbines will be used to directly power business operations at Crofts Farm, including two large cold stores, and indirectly a third, offsite cold store.
- The additional revenue from the sale of excess electricity will allow money to be re-invested into the business, providing more job security for existing employees and opening up the possibility of further employment through the expansion of the business.
- The project will co-exist alongside existing farming operations on the site.

- It is estimated that the project will save ~32,000 tonnes of CO₂ over its 25 year lifecycle, helping to contribute to the UK and Scottish Government’s environmental targets. More detail is provided in **Section 13**.
- A total community payment over the life of the project of £162,500 (details below).

As discussed in **Section 1.2**, the sale of electricity will lower business costs, increase the competitiveness of the business, allow further investment and safeguard existing jobs.

A portion of the income generated by the turbines can be expected to be recycled locally through the purchase of new agricultural equipment, new infrastructure and other expenditure linked to business development.

4.3 The Rural Economy – Farm Diversification

A report on ‘The economic benefits of on-farm wind energy clusters in Aberdeenshire’ was prepared by SAC Consulting in June 2010, the findings of which are relevant to this locally-owned project. A summary of the key findings are presented below:

- On farm wind power generation represents a major opportunity to support rural incomes and employment in Aberdeenshire. **These benefits are greatest where projects are locally owned and managed;**
- Per MW of capacity developed farmer owned projects are likely to have a lower visual and environmental impact but a greater local economic and employment benefits;
- As well as sustaining a farming family each turbine (where FIT funded) would also generate 1.47 additional local jobs through increased income and spending. By comparison where ownership of the turbine resides outside the area this turbine would support just 0.23 additional jobs locally;
- Wind projects on farms also have the benefit of protecting employment in existing farm businesses facing uncertainty over market returns and support payments.

4.4 Community Benefit

As a long-established business in the area, and with strong links to the local community, the applicant is keen to offer a community benefit package as part of the scheme.

It is intended to offer a sum of £5,000 per installed MW to the local community. This would amount to £162,500 over the 25 year lifetime of the project. This will be confirmed during the post-planning process.

Further discussions will be undertaken at the post-planning stage with the Council and Local Community Council to discuss the best way forward.

4.5 References

Biggar Economics (2012), *Onshore Wind: Direct and Wider Economic Impacts*, Department of Energy and Climate Change/RenewableUK.

Scottish Government (2010), *2020 Routemap for Renewable Energy in Scotland*, Scottish Government.

5 Project Design Considerations

5.1 Site Selection

The first project design stage involves confirmation of the site's overall viability. Initial assessments confirmed that there were no 'showstoppers' in terms of developing a turbine scheme. The site was confirmed as:

- Having a viable wind resource;
- Being a suitable location in terms of on-site and nearby planning designations;
- Having the potential to maintain an acceptable separation distances from nearby residences;
- Being unlikely to have a significant impact on on-site or off-site cultural heritage features;
- Having sufficient nearby local grid capacity; and
- Allowing for provision for access for delivery of wind turbine components;

The site has therefore been through a rigorous assessment before the decision was taken to progress to a planning application.

The site at Crofts Farm satisfied all of the above considerations. A potential aviation issue was identified with the radar at RAF Leuchars, and mitigation options have been investigated at an early stage. This is discussed in **Section 10**.

5.2 Site Layout

Initially, a three turbine development was considered for the Crofts Farm site with the anticipation of it meeting the above criteria. Upon further assessment, it was determined that a two turbine development would be more comfortably accommodated, taking into account the visual and noise considerations.

A two turbine layout reduces the horizontal extent of the view from properties to the east and west, thereby minimising the residential and landscape visual impact. Initial noise predictions for the three turbine layout also showed that cumulative noise impacts with the operational North Mains of Cononsyth might prove to be restrictive.

The on-site constraints and a resultant layout are shown in **Figure 5.1**.

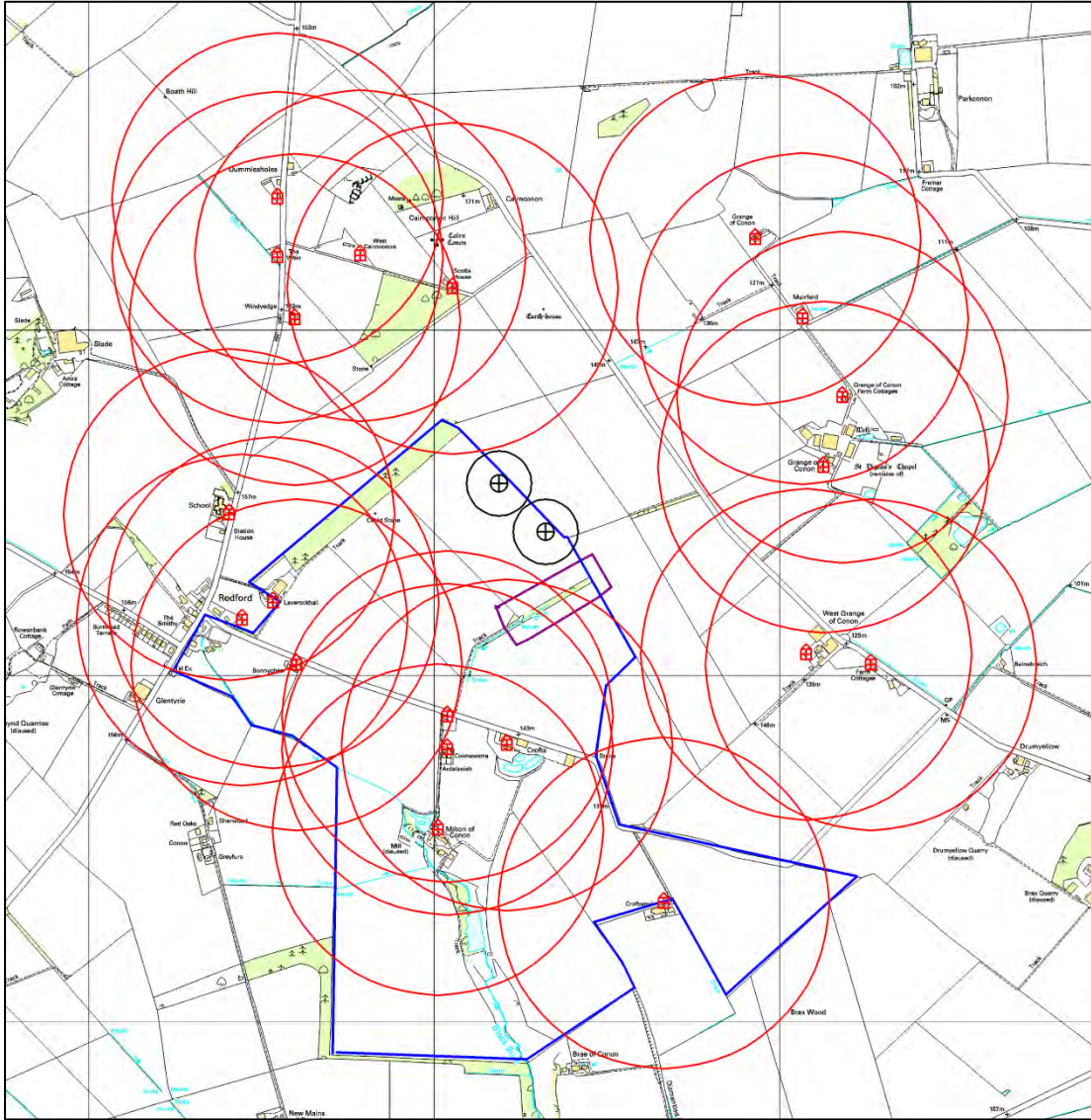
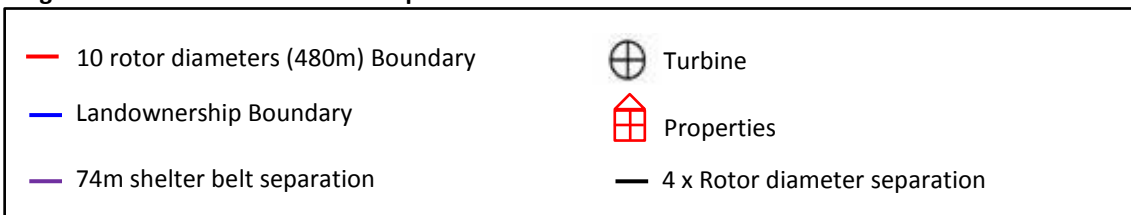


Figure 5.1 – On-site constraints map



Access

The access track would make use of an existing track, and will follow the eastern field boundary as much as possible to avoid visual clutter on the site, and reduce impacts on the farm.

Ecology

The turbine locations and the access tracks have been situated at least 74m away from the shelter belts to the north-west and to the south-east of the turbine locations to reduce the likelihood of impact on bats. The ecological impact of the turbines is considered in **Chapter 6**.

Landscape and Visual

The turbines have been located at the top of the low hill to the north of Crofts Farm. This is the most obvious location for them on the landholding, and makes the most sense in terms of landscape legibility. The layout of the turbines has been carefully designed to appear as a logical and coherent development when viewed from the majority of locations. A 10 rotor diameter exclusion zone (480m) from the closest properties was adhered to when designing the layout. The nearest property is Scotia House, which is 600m from the closest turbine. The landscape and visual impact of the turbines is considered in **Chapter 7**.

Noise

Noise monitoring was undertaken at three locations to establish background noise levels. Using this information, potential turbine locations and layouts were tested to ensure the development would meet the noise thresholds specified by the Council. Results are presented in **Chapter 8**.

Cultural heritage

The turbine locations avoid any direct impact on cultural heritage features. The cultural heritage impact of the turbines is considered in **Chapter 9**.

Distance from land ownership boundary

The turbines were located so that the blade swept paths do not over-sail the nearest third-party landholding to the north-east.

Turbine separation distance

A four rotor diameters (192m) distance between each turbine was adopted to minimise wake losses while preventing a large potential horizontal spread of turbines.

6 Ecology and Ornithology

6.1 Introduction

This section considers the potential effects of the proposed two wind turbines on the nature conservation interests on and around the site. It sets out the findings of the ecological surveys that have been carried out and provides an assessment of the impact on key sensitive species and habitats.

It concludes by assessing the residual impacts remaining after mitigation has been implemented.

These assessments were carried out by GLM Ecology, an established ecology consultancy with extensive experience of ecological assessments at wind farm sites.

6.2 Regulations and Guidance

This ecological impact assessment (EclA) pays explicit regard to the requirements of:

- Council Directive 79/409/EEC on the conservation of wild birds (the “Birds Directive”);
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the “Habitats Directive”);
- The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2007 (the “Habitats Regulations”, which translates the Birds Directive and Habitats Directive into UK law);
- The Wildlife and Countryside Act 1981, as amended;
- Nature Conservation (Scotland) Act 2004;
- ‘National Planning Policy Guideline (NPPG) 14: Natural Heritage’, The Scottish Office, 1999; and
- The UK Biodiversity Action Plan (BAP).

The EclA was carried out using the following documents:

- Siting and Designing Wind Farms in the Landscape, SNH 2009;
- Assessing the impact of small-scale wind energy proposals on the natural heritage, SNH 2011;
- Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage, 2013
- Wind farms and birds: Calculating a theoretical collision risk assuming no avoiding action, Scottish Natural Heritage, 2000;
- Avoidance rates for wintering species of geese in Scotland at onshore wind farms SNH 2013.
- Developing field and analytical methods to assess avian collision risk at wind farms, Band et al, 2007;
- Protection of Badgers Act 1992
- Assessing connectivity with Special Protection Areas (SPAs), SNH 2012;

- Assessing the cumulative impact of onshore wind energy developments SNH 2012;
- Technical Information Note 59 Bats and single large wind turbines: joint agencies interim guidance Natural England 18 September 2009; and
- Technical Information Note 51 Bats and onshore wind turbines Interim guidance Natural England February 2012.

Impact Assessment Methodology

The EclA has been carried out according to current guidance published by the Institute of Ecology and Environmental Management (2006), which is recognized as best practice. These guidelines set out a process of identifying the value of each ecological receptor and then characterizing the effects that are predicted, before discussing the effects on the integrity or conservation status of the receptor, proposed mitigation and residual effects.

Ecological Features Evaluation Criteria

A value or sensitivity has been assigned to each ecological receptor based on the following factors:

- Importance at a geographical scale, from local to international level;
- Designation status, e.g., SPA, SSSI, non-statutory designated sites, etc.;
- Biodiversity value, e.g., national BAP habitat/species, local BAP species, etc.; and
- Social, community and economic value.

The rationale for the valuation of sensitivity has been included for each receptor for which a significant effect is predicted. **Table 6.1** provides examples which are designed to give guidance as to how levels of sensitivity are typically derived. The value of sensitivity of an ecological receptor refers to land within the development area and a recognised 500m zone of effect.

Table 6.1 – Guideline definitions for the sensitivity of ecological receptors

Sensitivity of Receptor	Examples (Guidance to evaluation)
International	<p>An internationally designated site or candidate site (SPA, pSPA, SAC, pSAC, Ramsar site, Biogenetic Reserve) or an area which the country agency has determined meets the published selection criteria for such designation, irrespective of whether or not it has yet been notified.</p> <p>A viable area of a habitat type listed in Annex I of the Habitats Directive, EU 1992 or smaller areas of such habitat which are essential to maintain the viability of a larger whole.</p> <p>Any regularly occurring population of an internationally important species, which is threatened or rare in the UK, i.e. it is a UK Red Data Book species or listed as occurring in 15 or fewer 10km squares in the UK (categories 1 and 2 in the UK Biodiversity Action Plan (BAP)) or of uncertain conservation status or of global conservation concern in the UK BAP.</p> <p>A regularly occurring, nationally significant population/number of any internationally important species.</p>

Sensitivity of Receptor	Examples (Guidance to evaluation)
National	<p>A nationally designated site (SSSI, ASSI, NNR, Marine Nature Reserve) or a discrete area, which the country conservation agency has determined meets the published selection criteria for national designation (e.g. SSSI selection guidelines) irrespective of whether or not it has yet been notified.</p> <p>A viable area of a priority habitat identified in the UK BAP, or of smaller areas of such habitat, which are essential to maintain the viability of a larger whole.</p> <p>Any regularly occurring population of a nationally important species, which is threatened or rare in the region or county (see local BAP).</p> <p>A regularly occurring, regionally or county significant population/number of any nationally important species.</p> <p>A feature identified as of critical importance in the UK BAP.</p>
Regional	<p>Viable areas of key habitat identified in the Regional BAP or smaller areas of such habitat which are essential to maintain the viability of a larger whole.</p> <p>Viable areas of key habitat identified as being of Regional value in the appropriate Natural Area profile.</p> <p>Any regularly occurring, locally significant population of a species listed as being nationally scarce which occurs in 16-100 10km squares in the UK or in a Regional BAP or relevant Natural Area on account of its regional rarity or localisation.</p> <p>A regularly occurring, locally significant number of a regionally important species.</p> <p>Sites, which exceed the County-level designations but fall short of SSSI selection guidelines, where these occur.</p>
County	<p>Semi-natural ancient woodland greater than 0.25 ha.</p> <p>County/Metropolitan sites and other sites which the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves selected on County/metropolitan ecological criteria (County/Metropolitan sites will often have been identified in local plans).</p> <p>A viable area of habitat identified in County BAP.</p> <p>Any regularly occurring, locally significant population of a species which is listed in a County/Metropolitan “red data book” or BAP on account of its regional rarity or localisation.</p> <p>A regularly occurring, locally significant number of a County important species.</p>
District	<p>Semi-natural ancient woodland smaller than 0.25 ha.</p> <p>Areas of habitat identified in a sub-County (District/Borough) BAP or in the relevant Natural Area profile.</p> <p>District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves selected on District/Borough ecological criteria (District sites, where they exist, will often have been identified in local plans).</p> <p>Sites/features that are scarce within the District/Borough or which appreciably enrich the District/Borough habitat resource.</p> <p>A diverse and/ or ecologically valuable hedgerow network.</p> <p>A population of a species that is listed in a District/Borough BAP because of its rarity in the locality or in the relevant Natural Area profile because of its regional rarity or localisation.</p> <p>A regularly occurring, locally significant number of a District / Borough important species during a critical phase of its life cycle.</p>
Parish (Local)	<p>Areas of habitat considered to appreciably enrich the habitat resource within the context of the Parish or neighbourhood, e.g. species-rich hedgerows.</p> <p>A regularly occurring but low number of locally common protected species within or adjacent to the Development area.</p> <p>Local Nature Reserves selected on Parish ecological criteria.</p>
Very Local	<p>Areas of habitat that have a limited ecological value. Plant assemblages tend to be species poor, but may be utilised by a small number of faunal species.</p> <p>Those habitats that have an effect of enriching and complimenting the local natural environment to a small degree.</p>

Sensitivity of Receptor	Examples (Guidance to evaluation)
Low	Areas of habitats considered to be of very limited ecological value. They are not representative of natural habitats and are very species poor. Those habitats that do not enrich the local natural environment.
NB: Where species of habitats occur in more than one category, the highest value is applicable.	

6.3 Characterisation of Effects/Magnitude of Effect

The effects on individual receptors are described in relation to a range of factors. These include the magnitude, extent (either in area or population terms), duration, timing and frequency of the effect on the structure and function of the ecosystem. Effects in combination may have a cumulative effect that is greater than when the same effects occur in isolation. Combination effects include the separate effects of the scheme upon a feature (e.g., effects as a result of the construction and operation stage), or the combined effects of a number of schemes that affect the same receptor. Consideration is given to the longevity of effects, based on the life span of the Development and reversibility of the effect.

The criteria used to determine the character (magnitude, scale, duration, reversibility) of the ecological effects are given in **Table 6.2**.

Table 6.2 – Definition of terms relating to the Character of ecological effects

Character/ Magnitude	Definition
Very high	Total loss or very major alteration to key elements or features of the baseline conditions such that post development character, composition or attributes will be fundamentally changed and may be lost from the site altogether. For example the loss of a great crested newt breeding pond or loss/destruction of a maternity roost of a rare species of bat, loss/destruction of hibernation roost for bats, destruction of a Annex1 priority habitat or a statutory designated site. Generally irreversible and permanent. Guide: >80% of population or habitat lost
High	Major alteration to key elements or features of the baseline (pre-development) conditions such that post development character, composition or attributes will be fundamentally changed. For example the loss of a bat maternity roost, damage to a great crested newt breeding pond, pollution of a stream containing white clawed crayfish, damage to annex 1 priority habitat. Generally reversible after long period of time. Guide: 20-80% of population or habitat lost
Medium	Loss or alteration to one or more key elements or features of the baseline conditions such that post development character, composition or attributes of baseline will be partially changed. For example loss of optimal foraging habitat for great crested newts, death or injury to a low number of a locally rare species, loss of species rich ancient hedgerow, severance of a bat flight path, temporary abandonment of a bat roost. Generally reversible with mitigation on a short timescale Guide: 5-20% of population or habitat lost
Low	Minor shift away from baseline conditions. Change arising from the loss or alteration will be discernible but underlying character, composition or attributes of baseline condition will be similar to pre-development circumstances or patterns. For example loss of sub optimal foraging habitat for Great crested newt, loss of species poor hedgerow, death or injury of a very small number of common species of bat. Generally reversible without mitigation in short timescale. Guide: 1-5% of population or habitat lost.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the “no change” situation. Guide: <1% of population or habitat lost.

Significance Criteria

An ecologically significant effect is defined as an effect (adverse or positive) on the integrity of the site or ecosystem(s) and/or the conservation status of habitats or species within the identified zone of effect for the Development. The definitions of integrity and conservation used for this assessment are those detailed in the Institute of Ecology and Environmental Management (IEEM) Guidelines for Ecological Impact Assessment, namely:

- Integrity is the coherence of ecological structure and function, across a site's whole area, that enables it to sustain a habitat, complex of habitats and/or the levels of populations of species; and
- Conservation status for habitats is determined by the sum of the influences acting on the habitat and its typical species that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area.

The combined assessment of the effect characterisation and the sensitivity of ecological receptors have been used to determine whether or not an effect is significant with respect to the EIA Regulations. These two criteria have been cross-tabulated to assess the overall significance of the effect in **Table 6.3**. Effects with significance of moderate or major are considered to be significant in terms of the EIA Regulations.

Table 6.3 – Matrix used to assess the significance of potential effects upon ecological receptors.

Magnitude of effect	Sensitivity of receptor	High (International and National)	Medium (Regional and District)	Low (Parish/ (Local))	Negligible (Very Local/Low)
High		Major	Major	Moderate	Negligible
Medium		Major	Moderate	Moderate	Negligible
Low		Moderate	Moderate	Minor	Negligible
Negligible		Negligible	Negligible	Negligible	Negligible

Site Background and Context

Designated sites and associated protected species and habitats at a local and regional level have been identified through a desk based assessment and site walkover process. A description of the local area in relation to designated sites with ecological interests and the findings of an initial desk based review of the area are presented in the context of the following sections. The following resources were used:

- NBN Gateway¹
- RSPB sensitivity maps²;
- Scottish Natural Heritage (SNH) Sitelink³;
- The Scottish Biodiversity List⁴;
- Scottish Raptor Group⁵; and
- *Multi Agency Geographic Information for The Countryside*⁶.

Designated Sites

The following sites were identified within 20km from the site:

Table 6.4 – Ecological designations within 20km of the site

Site	Designation	Features
Montrose Basin	SPA	Designated for over wintering geese and waterfowl.
Tay Estuary	SPA	Designated for over wintering geese and waterfowl.
No sites were identified within 5km from the site:		
No sites were identified within 1km from the site:		

Scope of Ecological Assessments

The scope of the present EclA was derived from the initial site background and context study above, the local knowledge and experience of the ecologist and guidance from SNH. The EclA considers the following issues:

- Breeding Birds;
- Geese VPs
- Winter Walkovers
- Bats;
- Badgers;
- Phase 1 Habitat Survey.

The scope of ecological assessments was in accordance with the guidance given by SNH⁷ unless otherwise agreed with SNH.

Site Description

The gently sloping site is predominantly arable fields (**Figures 6.1, 6.2, 6.3**) with, in general, poor quality field margins, scattered trees and hedgerows present. Two shelterbelts of predominantly coniferous trees are present in the general area (**Figures 6.4, 6.5**). There are various small dry ditches on site. The two turbines are proposed in arable fields to the north of the minor road. No buildings are located within 500m of the turbine locations.



Figure 6.1 – Arable fields.



Figure 6.2 – Arable fields.



Figure 6.3 – Small scattered trees on field margins.



Figure 6.4 – Shelterbelt to the north-west of the proposed turbine locations.



Figure 6.6 – Coniferous shelterbelt

6.4 *Ornithology*

Generally, ornithological surveys on and around the site are required to assess potential impacts of birds throughout the year, which could arise due to:

- Potential loss, fragmentation and degradation of bird habitats arising from the construction of turbine bases, crane pads, access tracks, a sub-station and temporary construction compounds and power lines;
- Potential displacement of hunting or migrating birds through avoidance of turbines, work staff and machinery;
- Disturbance to birds due to noise from operating turbines;
- Potential disturbance to nesting birds (for example, displacement of birds from breeding habitats) resulting from the construction activities; and
- Potential for birds to collide with turbine blades and power lines.

It should be noted that the issues identified above are more likely to be significant for larger wind turbine developments; however, these were considered for this application.

Survey Scope & Methodology

To assess the presence of breeding birds on site and in the surrounding area breeding bird surveys were carried out.

Breeding Bird Survey

The area surveyed was the area 500m round the proposed turbine locations (SNH 2006) on ground owned by the developer. Other ground was surveyed by listening along the

boundary. The survey work was based on the standard BTO Common Bird Census (CBC) technique where the Survey Area is walked and the route varied each survey. The number of survey visits was the same as a BBS survey (three visits) rather than the number required for a full CBC survey (ten visits). There were three day visits in approximately late April, mid-May and early June.

This is a standard technique for breeding bird surveys as used for many years as per BTO's Breeding Bird Survey Instructions⁸ for their Common Birds Census⁹. This involves making a series of visits throughout the breeding season, during which all birds seen or heard in the area are recorded on large-scale maps using standard codes denoting their species and behaviour. The area was searched by walking transects along field edges, roads and paths. During each visit, the location of each bird was mapped. By aggregating these individual records, breeding territories were revealed (Bibby et al. 2000)¹⁰ for each species, the number of breeding territories were then recorded. Birds of conservation concern (Eaton et al. 2009)¹¹ were identified. The designations used were: Breeds (B) and Possible Breeder (PB).

Winter Walkovers

To survey the wintering bird populations a series of three winter walk-overs were carried out between October and March following the standard guidance from SNH. A pre-plotted route was taken that covered the entire site and starting points were varied for each visit. The survey area was within 500m of the proposed turbines. Transect lines were walked with all birds seen recorded. Care was taken not to record the same birds on consecutive transects.

Vantage Point Surveys

Data from Vantage Point (VP) surveys are utilised as part of the assessment of potential impacts including: species presence, density, distribution and behaviour. A VP was used that gave clear views of the whole site allowing all flights to be recorded in detail to 500m outwith the site. VP watches were 6 hours per month from October – March period in 2012. Primary target species were identified as all Special Protection Areas (SPA) qualifying species including wildfowl, waders and Schedule 1 raptors. The location, direction of flight and estimated height above the ground of each target species was recorded. VP times typically covered a period of three hours and covered a range of times between the dawn and dusk periods. During the VPs flight data for both primary and secondary target species were recorded. Details of species, number of birds, flight height (in bands), duration and direction were recorded. The following height bands were used in the surveys: A- <20m, B- 20-125m, C- >125m. Any flights recorded at band B and within 200m of the proposed turbine location were classified as being within the collision risk window.

6.5 Survey Results

Breeding Birds

Twenty-four species of birds were recorded as breeding within the survey area, with a further five recorded as possibly breeding (**Table 6.4**). All of the recorded birds are recorded locally as common residents or summer visitors whose populations are not threatened and are in favourable conservation status in Scotland. None are specially protected. The number

of breeding species is good due to mature trees and plantation edge on the periphery of the site. Nationally three species, song thrush, yellowhammer and linnet are on the red list of birds of conservation concern with another seven on the amber list (Eaton et al. 2009).

Table 6.4 – Breeding bird species list for Crofts Farm: April – June.

Species	Latin	April	May	June	Status
Buzzard	<i>Buteo buteo</i>	2	2	2	B
Sparrowhawk	<i>Accipiter nisus</i>	Male seen soaring high.		Female near Croftsmuir	PB
Oystercatcher	<i>Haematopus ostralegus</i>	Pair present	Pair present	Pair present	B
Red Legged Partridge	<i>Alectoris rufa</i>	Pair seen east of site		Pair near Redford	PB
Wood Pigeon	<i>Columba palumbus</i>	Present	Present	Present	B
Gt Spotted Woodpecker	<i>Dend. major</i>		1	1	B
Meadow Pipit	<i>Anthus pratensis</i>	1	2		PB
Skylark	<i>Alauda arvensis</i>	4	6	3	B
Wren	<i>Troglodytes troglodytes</i>	1	1	2	B
Pied Wagtail	<i>Motacilla alba</i>	2	1	3	B
Dunnock	<i>Prunella modularis</i>	1		1	B
Robin	<i>Erithacus rubecula</i>	1	2		B
Blackbird	<i>Turdus merula</i>	3	5	2	B
Mistle Thrush	<i>Turdus viscivorus</i>	2		4	B
Song Thrush	<i>Turdus philomelos</i>	2	1		B
Willow Warbler	<i>Phy. trochilus</i>	2	4	9	B
Blackcap	<i>Sylvia atricapilla</i>	1	2	3	B
Whitethroat	<i>Sylvia communis</i>		3	3	B
Goldcrest	<i>Regulus</i>	1	1	0	B

Species	Latin	April	May	June	Status
	<i>regulus</i>				
Coal Tit	<i>Parus ater</i>			2	B
Blue Tit	<i>Parus caeruleus</i>	1		3	B
Great Tit	<i>Parus major</i>	3	1	2	B
Jay	<i>Garrulus glandarius</i>		1	1	PB
Magpie	<i>Pica pica</i>		1		PB
Carrion crow	<i>Corvus corone</i>	2	5	3	B
Linnet	<i>Carduelis cannabina</i>	5	7		B
Chaffinch	<i>Fringilla coelebs</i>	4	6	4	B
Goldfinch	<i>Carduelis carduelis</i>	2	2		B
Yellowhammer	<i>Emberiza citrinella</i>	4	5	2	B

Schedule 1 Species

No species were recorded breeding which are fully protected under Schedule 1 of the Wildlife and Countryside Act, 1981.

Wintering Birds

In general there was a poor selection of birds recorded in the study area due to the predominant habitat of arable fields where very little was recorded. Common passerines recorded mostly around the plantations and wooded areas included flocks of finches, tits, fieldfare and redwing. Wood pigeon, rooks and jackdaws were frequently on and over site. No birds of conservation concern were recorded and no geese or swans were recorded foraging on site.

VP Surveys

The VP surveys recorded only two Schedule 1 raptors; a hen harrier in October and a peregrine falcon in December. Neither of these flights was at collision risk height. At various times numbers of flights of geese were recorded offsite. These were predominantly to the east and invariably travelling on an approximate north-south (or vice versa) bearing. A total of four flights of pink-footed goose (187) and one flight of greylag goose (23) were recorded across site normally at height. Only one of these flights was at collision risk height (27 pink-footed geese).

6.6 Badgers

Badger Legislation

Both badgers and their setts are protected by law. The Protection of Badgers Act 1992 (Scottish Version) brings together all of the previous legislation specific to badgers (except their inclusion on Schedule 6 of the 1981 Wildlife and Countryside Act as amended Nature Conservation (Scotland) Act 2004). As a result it is an offence to:

- Willfully kill, injure, take, possess or cruelly ill-treat a badger, or to attempt to do so;
- To intentionally or recklessly interfere with a sett;
- To disturb a badger when it is occupying a sett;
- Damage or destroy a sett; and
- To obstruct access to, or any entrance of a badger sett.

A badger sett is defined in the legislation as *'any structure or place, which displays signs indicating current use by a badger'*. *'Current use'* does not simply mean 'current occupation' and for licensing purposes it is defined as *'any sett within an occupied badger territory regardless of when it may have last been used'*. A sett therefore, in an occupied territory, is classified as in current use even if it is only used seasonally or occasionally by badgers, and is afforded the same protection in law.

Aims & Objectives

The aims of this assessment were:

- To assess whether badgers were present on site;
- If badgers are present to assess local population status and usage of the site;
- To recommend further survey work if required.

Survey Methodology

The surveys consisted of a walkover of the site and ground within 250m of its boundary to visually inspect and assess the site for its potential to support badgers. Badgers surveys were carried out according to recommended guidelines^{12, 13, 14 and 15}. Evidence of badger activity searched for included:

- Setts: badger setts typically have characteristic shapes and dimensions;
- Paw prints and badger hair caught on hedges and fences;
- Foraging signs: foraging badgers leave distinctive marks when foraging;
- Characteristic worn pathways; and
- Latrines: badgers defecate in pits, often clustering several pits into a latrine.

NBN Gateway recorded badger within the 10km grid square of the site. Possible signs of badger were recorded but no setts are present on site within the fields near the proposed turbine locations.

6.7 Bats

Bat Legislation

Bats of all species in Britain and their roosts are protected under the Conservation (Natural Habitats, &c) Amendment (Scotland) Regulations 2007. Following recent changes to legislation in Scotland under this law it is illegal intentionally or recklessly to kill or injure a bat, to disturb a roosting bat or to damage, destroy or obstruct access to any bat roost. This applies to both summer and winter roosts, which may be in different structures. Any action, which is likely to disturb or damage a bat roost, requires a license from the Scottish Executive.

Aims & Objectives

To determine what bat species are present on the site and whether the habitat is utilized for roosting, foraging or commuting by bats.

Data Review

A data search was carried out using NBN Gateway to determine if any bat species had been recorded in the 4km square of which Crofts is enclosed.

Survey Methodology

A habitat and bat assessment survey was carried out at the site in July 2013 followed by a bat detector surveys in July in accordance with guidance from the Bat Conservation Trust¹⁶ and Natural England¹⁷. The objectives of the bat surveys were to identify whether the site would be considered suitable for roosting bats and whether bats were present on site. The aim was to provide sufficient evidence so that the potential impacts of the proposed development on any local bat populations could be assessed and if appropriate, mitigation suggested.

Habitat Survey

The site was surveyed for potential flight lines/commuting routes, roosts and foraging areas and the habitat assessed for its overall suitability for bats. Any potential foraging areas were examined and linear features were assessed for their suitability as flight lines or commuting pathways. This survey was to evaluate the site, not a specific survey in finding roosts etc.

Bat Detector Surveys

Two visits were made with details of times and weather conditions below. The dusk survey was carried out from approximately 30mins before sunset to 2.0hrs after sunset. The dawn survey was from approximately two hours before sunrise to 30mins after sunrise (**Table 6.6**) The site was divided into a circular transect (blue line **Figure 6.7**) which was surveyed constantly by two individual surveyors starting at opposite ends of the transect on each visit.

Table 6.6 – Survey times and weather conditions

Survey	Survey Area	Date	Sun Set	Sun Rise	Time	Weather
Habitat Survey	Site	20/07/13			10.00-14.00	
	Dusk	20/07/13	21.45		21.10-23.50	E3.4/8.16C
	Dawn	21/07/13	04.55		03.15-05.30	SE2.8/8.12C

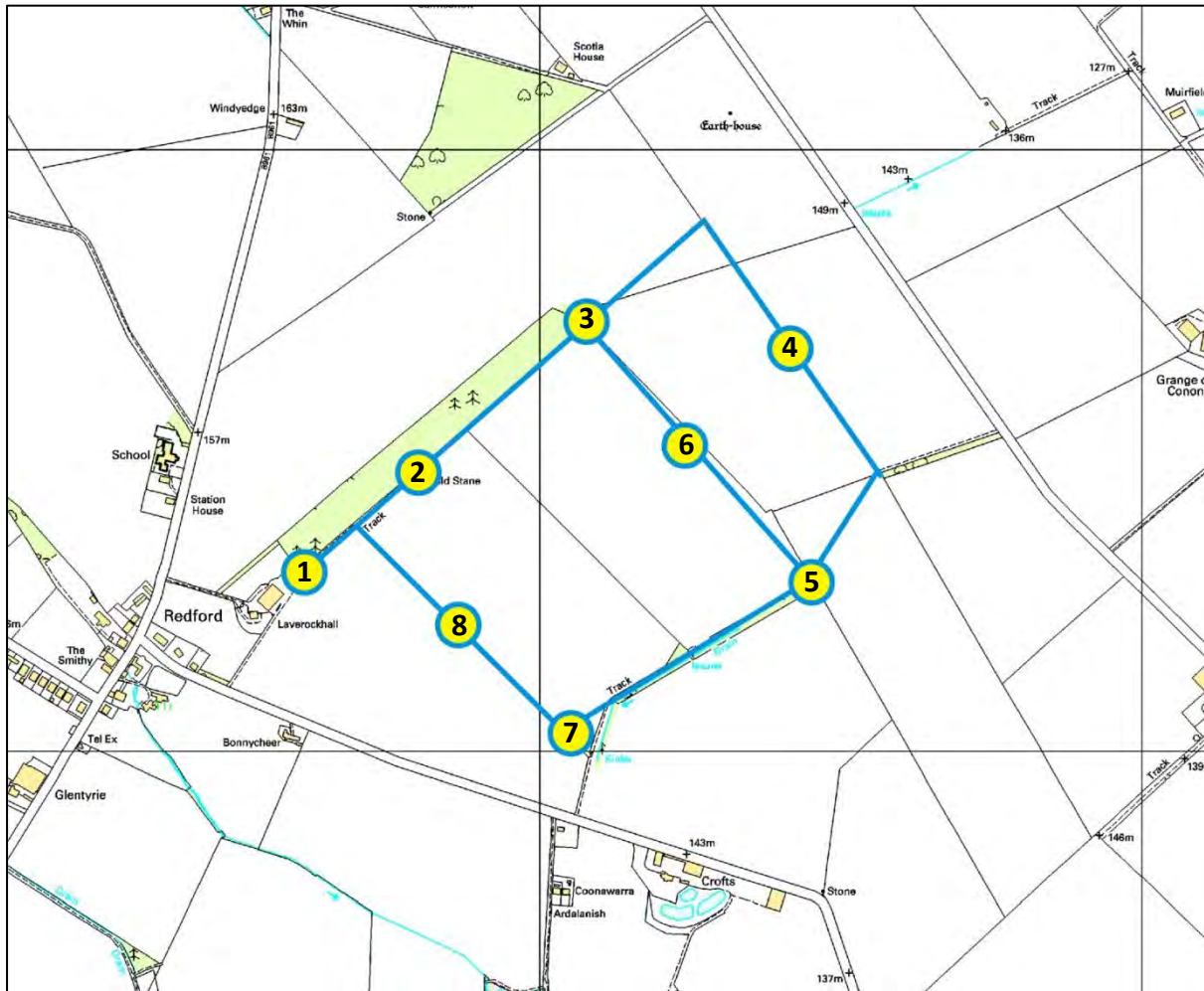


Figure 6.7 – Bat survey area



6.8 Habitat Survey Results

Buildings

There are no buildings within 500m of the proposed turbine locations.

Trees

There is very limited roost potential in the majority of spruce trees on site.

Foraging Areas

The majority of the site is arable farmland and this would not be considered good foraging habitat. It would be expected that foraging bats would utilize the areas of woodland and water to the south of the site at Milton of Conan near Black Burn.

Bat Detector Survey Results

The results reveal a very low usage of the site by bats. Only one species, a single soprano pipistrelle was recorded near Laverockhall Farm. No bats were recorded over open ground or near the proposed turbine locations.

Table 6.7– Bat survey results

Site	Crofts	Date	20.07.13	Sunset (time)	21.45		
Bat Passes Heard							
Station No	Time	45 Pip	55 Pip	<i>Myotis</i> BLE	Other	Notes	
1	22.09		1			Near farm	
2							
3							
4							
5							
6							
7							
8		3					

Site	Crofts	Date	21.07.13	Sunrise (time)	04.55		
Bat Passes Heard							
Station No	Time	45 Pip	55 Pip	<i>Myotis</i> BLE	Other	Notes	
1							
2							
3							
4							
5							
6							
7							
8							

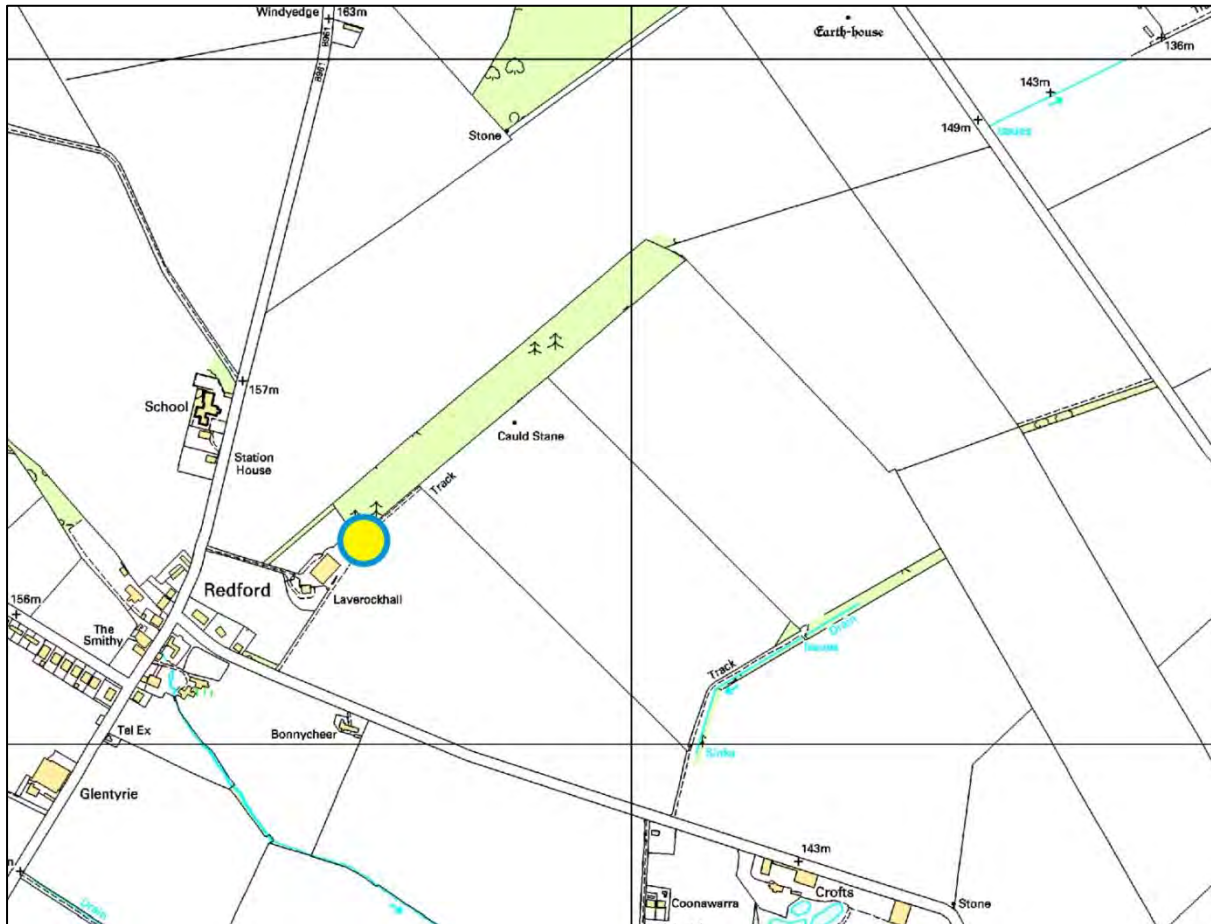


Figure6.8 – Stopping points where bats recorded

6.9 Phase 1 Habitat Survey

Legislation

Legislation exists to protect habitats and floral species from destruction, degradation and loss as a result of development activities and include:

- The Conservation (Natural Habitats, & C.) Regulations 1994;
- Wildlife & Countryside Act 1981 (as amended); and
- The Nature Conservation (Scotland) Act 2004.

Aims & Objectives

The Phase 1 Habitat Survey aimed to:

- Identify and record broad habitats within the vicinity of the development area;
- Provide a description of habitat distributions and highlight any areas of ecological constraints in relation to the proposed development; and
- Contribute towards informing planning processes.

Whilst not a full botanical survey, the Phase I method enables a suitably experienced ecologist to obtain sufficient understanding of the ecology of a site so that it is possible either:

- To confirm the conservation significance of the site and assess the potential for impacts on habitats /species likely to represent a material consideration in planning terms; or
- To ascertain that further surveys of some aspect(s) of the site’s ecology will be required before such confirmation can be made.

Survey Methodology

Phase I habitat survey is a standardised method of recording habitat types and characteristic vegetation, as set out in the Handbook for Phase I Habitat Survey – a technique for Environmental Audit¹⁸. The Phase I habitat survey undertaken in July 2013 covered the whole of the site and proposed turbine area and encompassed a 500m buffer envelope around this area where possible.

Field Survey

The habitats present within 500m of the proposed turbine and track survey area are presented in **Appendix 1**, and listed in **Table 6.8**.

Table 6.8–Habitats present in the survey area

Phase 1 Habitat Type
A1.2.2 Coniferous woodland - plantation
A1.3.1 Mixed woodland - semi-natural
A3.1 Broadleaved scattered trees
C3.1 Other tall herb and fern - ruderal
J1.1 Cultivated/disturbed land - arable
J2.3.1 Hedge with trees
J2.4 Fence
J2.5 Wall
J2.6 Dry ditch
J4 Bare farm ground
Farm Track & Road

Coniferous woodland plantation

The site has three areas of coniferous spruce (*Picea sitchensis*) plantation (**A1.2.2**) with sections of larch (*Larix decidua*). There is a long section of plantations to the south-east of the turbine locations, running from the end of the farm track and extending along a field boundary. A larger section of plantation is situated to the north west of the site which also contains the occasional broadleaved tree such as sycamore (*Acer pseudoplatanus*) and ash (*Fraxinus excelsior*) within this plantation and occasionally at the edges. There is an area of mixed woodland at the top corner of this site (**A1.3.1**), which also contains beech (*Fagus*

sylvatica). A smaller section of plantation, which is along a field line, is to the east of the site. The under growth within the plantations include wood sorrel (*Oxalis acetosella*), nettle (*Urtica dioica*), thistle (*Cirsium vulgare*), sheeps sorrel (*Rumex acetosella*), cow parsley (*Anthriscus sylvestris*), creeping buttercup, (*Ranunculus repens*), bracken (*Pteridium aquilinum*), foxglove (*Digitalis purpurea*), gorse (*Ulex europaeus*), broom (*Cytisus scoparius*) and blackthorn (*Prunus spinosa*).

Mixed woodland and scattered trees

A small area of mixed woodland (**A1.3.1**) is found at the end of the farm track enclosed in a stonewall boundary. The woodland consists of trees such as ash (*Fraxinus excelsior*), sycamore (*Acer pseudoplatanus*), spruce (*Picea sitchensis*), cherry (*Prunus avium*), willow (*Salix* sp.) and hawthorn (*Crataegus monygra*). The undergrowth consists of nettle (*Urtica dioica*), thistle (*Cirsium vulgare*), sheeps sorrel (*Rumex acetosella*), cow parsley (*Anthriscus sylvestris*), creeping buttercup, (*Ranunculus repens*), bracken (*Pteridium aquilinum*) and foxglove (*Digitalis purpurea*).

Along the field boundaries crossing the site there are established immature trees (**A3.1**) that have been planted some years ago. These trees consist of sycamore (*Acer pseudoplatanus*), and ash (*Fraxinus excelsior*). There is also scrub along this tree line of gorse (*Ulex europaeus*) and broom (*Cytisus scoparius*).

Tall herb and fern – ruderal

Along the farm track there are verges which consist of grasses and ruderals (**C3.1**) such as perennial ryegrass (*Lolium perenne*), cow parsley (*Anthriscus sylvestris*), creeping buttercup, (*Ranunculus repens*), pansy (*Viola tricolor*), common daisy (*Bellis perennis*), dandelion (*Taraxacum officinale*), sheeps sorrell (*Rumex acetosella*), milk thistle (*Silybum marianum*), thistle (*Cirsium vulgare*), nettle (*Urtica dioica*), bracken (*Pteridium aquilinum*), foxglove (*Digitalis purpurea*), yarrow (*Achillea millefolium*), white clover (*Trifolium repens*), purple vetch (*Vicia benghalensis*), yellow vetch (*Vicia lutea*), rapeseed (*Brassica napus*) and patches of tuberous comfrey (*Symphytum tuberosum*) close to the plantation edge. There is also occasional gorse (*Ulex europaeus*) and broom (*Cytisus scoparius*).

Arable Fields

The fields on the farmland on site are for arable use. The fields are bordered by either stone wall or fence and with conifer plantation as described previously.

Dry ditch system

A dry ditch system (**J2.6**) is located within the long section of coniferous plantation and partially down the right hand length of the farm track.

Boundaries and Hedges

There are stone walls (**J2.5**) and wire & posts fencing (**J2.4**) as boundaries to the fields and plantations. Along the road and as a boundary to a farm field there is a mature hedge

(J2.3.1) section consisting of beech (*Fagus sylvatica*), sycamore (*Acer psuedoplatanus*), horse chestnut (*Aesculus hippocastanum*), wild rose (*Rosa canina*) and hawthorn (*Crataegus monynga*).

Road and farm track

A farm track is situated on site that originates from the main road to the south. At the end of the farm track and adjacent to wooded area is an open bare ground (**J4**) area where farm equipment is stored.

6.10 Assessment of Impacts

Impacts on Breeding Birds

The surveys identified what is considered to be an average breeding species list due to the woodland on and around the periphery of the site. The species recorded would be considered as typical for the habitat and of low sensitivity. In the open areas very few breeding birds were recorded apart from skylark and a single pair of oystercatcher. No raptors are present apart from buzzard and possibly sparrowhawk. Considering the observations noted above, no significant impact on high sensitivity species could be expected, as the construction footprint will be on existing tracks and arable fields. No trees or scrub and groundcover will be removed. The magnitude of impact is considered to be negligible and overall the significance of impact to be no more than negligible.

Mitigation

No mitigation is deemed to be required.

Impacts on Wintering Birds

Common passerines, corvids and pigeons were recorded in the surrounding woodland as would be expected. No wintering wildfowl were recorded foraging on site during walkover or VP surveys at any time. The VP surveys recorded only two Schedule 1 raptors; a hen harrier in October and a peregrine falcon in December. Neither of these flights was at collision risk height. VP surveys revealed that only very small numbers of geese pass over site. A report by Mitchell 2012¹⁹ has identified all known geese feeding areas within connectivity distance of associated SPAs in Scotland. This data shows that the area around Crofts Farm is not utilised for foraging by geese. The loss of a small area of arable fields would not have an adverse effect on any wintering birds given the species present.

Mitigation

No mitigation is deemed to be required.

Impacts on Badgers

No setts or positive signs of badgers were recorded.

Mitigation

As badgers are known to be in the general area and often wander widely and expand their territories the following mitigation is proposed:

- All contractors should be made aware of badgers and their legal protection;
- All personnel are made aware that badgers may exist close to the site and are at risk from vehicles; On site speed restrictions will be put into place for all vehicles, including construction, maintenance and visitors to the site;
- All trenches dug during construction and exposed open pipes will be covered at the end of each working day to ensure no risk to badgers, otters or any other wildlife that may have the potential to be trapped; and
- Ramps will be located within the trenches or pits that can't be covered to allow an exit for any mammal that has gone into a trench or pit.

Impacts on Bats

Only a single soprano pipistrelle bat was recorded. It is expected that roosts are present in farm buildings in the general area; however these are over 500m distant from the proposed turbines. No trees or buildings are to be removed for construction and therefore no significant impact on bats is expected from two turbines. The proposed location of the wind turbines has been assessed against Natural England design guidance regarding wind turbines and bats (Natural England, 2012). Natural England advises that a 50m buffer should be maintained between the edge of the nearest feature (trees, hedge) and any part of a turbine.

The proposed turbine location is in arable fields that are not considered good bat foraging habitat. There is ample excellent foraging habitat around the periphery of the site and to the south where mature trees and water bodies are present. It is expected that bat usage of the site would therefore be low and generally restricted to commuting routes along existing hedgerows and linear features.

Mitigation

That the turbine is placed more than 50m from tip to hedgerows or tree lines in accordance with Natural England design guidance.

Impacts on Habitats

A total of seven habitats are present within the site survey area, of which the majority is arable fields or dense coniferous plantation. No nationally or internationally protected habitats were identified in this assessment.

There are occasional dry ditches on-site; however, no significant impacts on the aquatic environment are anticipated from the location of the proposed development infrastructure. There is the potential of a slight increase in run-off in to ditch systems through the ground disturbance of the construction phase but this is expected to be short lived, minor and further reduced through mitigation.

Some of the impacts predicted as a result of the proposed scheme can be considered generic impacts, which are typically associated with a development of this nature. The development of the wind turbine scheme at Crofts Farm has been assessed as posing no significant impacts on commonly occurring habitats found on site. Therefore no specific prescriptions are recommended other than the general measures recommended below.

Mitigation

The following mitigation measures are proposed:

- Good construction site management should be implemented to minimise generation of litter, dust, noise and vibration. This should be controlled and monitored through the Contractor's Environmental Management Plan. Through adhering to best practices during construction and operation phases, fragmentation, disturbance and pollution to habitats present can be minimised;
- During construction management of excavated soil will focus on preventing silt runoff into the water environment during rainfall periods through careful design and maintenance of drainage/silt traps.

6.11 Summary of Impacts

This assessment sought to identify all species and habitats on or near the Site that are protected under European and national legislation or which appear on national or local biodiversity action plans.

Following the criteria set out in **Tables 6.1, 6.2 and 6.3** the following table is an assessment of the impacts on flora and fauna at Crofts due to the proposed construction of the two turbines.

Residual Effects	Value of receptor	Magnitude of change	Duration	Nature	Significance
Loss of foraging or breeding habitat to badgers.	Parish (Local)	Low	Short term	Negative	Not significant
Loss of foraging or roosting habitat to bats	Parish (Local)	Low	Short term	Negative	Not significant
Bat mortality due to turbine collisions	Parish (Local)	Low	Short term	Negative	Not significant
Bird mortality due to turbine collisions	Parish (Local)	Low	Short term	Negative	Not significant
Loss of habitat to breeding birds	Parish (Local)	Low	Short term	Negative	Not significant
Loss of habitat to wintering birds	Parish (Local)	Low	Short term	Negative	Not significant
Loss of habitat/vegetation	Parish (Local)	Low	Short term	Negative	Not significant
Montrose SPA	International	Negligible	Short term	Negative	Not significant
Tay Estuary SPA	International	Negligible	Short term	Negative	Not significant

Survey work was completed across the Site and the immediately surrounding area, following best practice and industry guidance to identify the species and habitats present.

A comprehensive desktop study was carried out.

Badger is known to be in the general area and possible signs of badger traversing the area were noted. No badger setts were recorded on site.

A poor ecological range of habitats has been recorded on the site and the majority of habitat is arable fields and dense coniferous plantation. The main habitat lost will be arable fields. No trees or hedgerows are to be removed.

It is considered unlikely that the development will have any long-term impact on the integrity of the area's ornithological features or the conservation status of the species found here.

There are no notable uncertainties or limitations with the data collection. The survey timings were all optimal.

It is considered that the integrity of qualifying species and habitats for designated sites (SPA) within the specified distances as recommended by SNH would not be impacted upon. This refers specifically to Montrose Basin and Tay Estuary SPAs and its qualifying species; pink footed and greylag goose.

6.12 Conclusion

It is proposed to construct two wind turbines and associated infrastructure on an area of arable farmland situated at Crofts Farm, Redford, Angus. A range of ecological assessments have been undertaken to investigate the ornithological and other ecological interest of the site and it is concluded that potential for this to be adversely affected by the current proposal is extremely unlikely.

6.13 References

1. *National Biodiversity Gateway Database*: <http://data.nbn.org.uk/>
2. J. A. Bright et.al. 2006. Bird Sensitivity Map to provide locational guidance for onshore wind farms in Scotland. RSPB Research Report No 20. http://www.rspb.org.uk/Images/sensitivitymapreport_tcm9-157990.pdf
3. SNH Sitelink: <http://gateway.snh.gov.uk/sitelink/>
4. www.biodiversityscotland.gov.uk
5. <http://www.scottishraptorgroups.org/>
6. *Multi Agency Geographic Information for The Countryside*: <http://www.magic.gov.uk/website/magic/>
7. SNH. 2005. Survey Methods for Use in assessing the Impacts of Onshore Windfarms on Bird Communities. SNH, Inverness.
8. <http://www.bto.org>.
9. Marchant, J.H. (1983) Common Birds Census Instructions. British Trust for Ornithology, Tring.
10. **Bibby**, C.J., Burgess, N.D., Hill, D.A., and Mustoe, S.H. (2000). **Bird Census Techniques**, 2nd ed. Academic Press, London. BirdLife International (2000).
11. Eaton, M.A. et al. 2009. Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. *British Birds* 102:296-341.
12. Harris, S., Cresswell, P. & Jefferies, D. 1989. Surveying for badgers. Occasional Publication of the Mammal Society No. 9. Mammal Society, Bristol.
13. <http://www.badger.org.uk/Content/Home.asp>
14. Cresswell, P., Harris, S. and Jefferies, D.J. (1990). The History, Distribution, Status and Habitat Requirements of the Badger in Britain. Nature Conservancy Council, Peterborough.
15. Macdonald, D.W., Mace, G. & Rushton, S. 1998. Proposals for future monitoring of British mammals. Department of the Environment, Transport and the Regions, and Joint Nature Conservation Committee, London.
16. Bat Conservation Trust (2007). *Bat Surveys – Good Practice Guidelines*. Bat Conservation Trust, London.
17. Natural England Technical Information Note TIN051. (2009) Bats and onshore wind turbines: Interim Guidance.
18. Joint Nature Conservation Council (1988) *Handbook for Phase 1 Habitat Survey*.
19. Mitchell, C. (2012). Mapping the distribution of feeding Pink-footed and Iceland Greylag Geese in Scotland. Wildfowl & Wetlands Trust.

7 Landscape and Visual Impact

7.1 Introduction

This section reports on the potential landscape and visual effects of the proposed Crofts Farm Wind Turbines. A Landscape and Visual Impact Assessment (LVIA), including a Cumulative LVIA, has been undertaken for this project in accordance with the relevant EIA Regulations. The proposed development comprises two turbines measuring up to 80m to blade tip, located within an area of farmland to the north of Crofts Farm.

The aim of the design and assessment process is to promote the best “environmental fit” for the development through consideration of the existing landscape resource, the potential landscape and visual effects and design alternatives. This assessment process will refer to landscape value, and in particular landscape designations and related planning policy, as well as landscape character and the capacity for wind turbine development at this site. Included as part of this chapter are accompanying figures, illustrating potential visibility and, photomontaged examples from a range of receptors, descriptions of which can be found in **Crofts Farm Wind Turbines Landscape Figures** which accompany the Environmental Statement.

Summary of Scope

The scope of the assessment, as shown in **Table 7.1**, has been established on the basis of professional judgement and through the consultation process. A meeting was held with Angus Council on the 13th December 2012 to agree the scope of the Landscape & Visual Assessment.

Table 7.1 Scope of the Landscape and Visual Assessment

Landscape Issues	Description
Landscape Character	The effects of the proposed development on the landscape character and quality of the site area, as defined by the <i>Tayside Landscape Character Assessment</i> and site survey.
Landscape Elements	Direct or physical effects on landscape elements.
Landscape Designations	Views from Areas of Great Landscape Value, National Scenic Areas and Gardens and Designed Landscapes as well as views from other areas of landscape character as perceived by people
Visual Issues	Description
Local Community	Views from local communities, particularly from residential properties near the site and from local settlements which lie within the ZTV. Views from roads and popular tourist / walker destinations and hilltops will also be taken into consideration.
Tourist Destinations	Views from popular outdoor tourist destinations which entail an appreciation of the landscape, where the setting of landscape features provide the visitor experience.
Major Transport Routes	Transport routes including the B961 as well as any popular walking routes in the area.
Cumulative Issues	Description
Cumulative Assessment	The cumulative assessment includes viewpoint assessment within the Study Area where simultaneous and/or successive views of more than one wind energy development may be achieved, and sequential cumulative assessment, where more than one wind energy development may be viewed along transport routes (simultaneous or successive).

7.2 Guidance

The methodology for the landscape and visual impact assessment (LVIA) and the cumulative landscape and visual assessment (CLVIA) has been undertaken in accordance with the methodology set out below and conforms with *The Guidelines for Landscape and Visual Impact Assessment*, Third Edition (Landscape Institute and IEMA, 2013).

Additional guidance has been taken from the following publications:

- *The Tayside Landscape Character Assessment*, Land Use Consultants, 1999;
- *Fife Landscape Character Assessment*, David Tyldesley and Associates, 1999;
- *South and Central Aberdeenshire Landscape Character Assessment*, Environmental Resources Management, 1998;
- *Strategic Landscape Capacity Assessment for Wind Energy in Angus, November 2013*;
- *Siting and Designing Windfarms in the Landscape*, Scottish Natural Heritage, Version 1, December 2009;
- *Visual Representation of Windfarms Good Practice Guidance*, prepared by Horner + MacLennan and Envision for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning, March 2007
- *Landscape Character Assessment: Guidance for England and Scotland* (Countryside Agency and Scottish Natural Heritage publication, produced by the University of Sheffield and Landuse Consultants), 2002;
- *Guidance: Cumulative Impacts of Onshore Wind Developments*, Scottish Natural Heritage Advisory Service, Version 3, March 2012;
- *Landscape Character Assessment Topic Paper 6 - Techniques and Criteria for Judging Capacity and Sensitivity*, Countryside Agency and Scottish Natural Heritage, 2004;
- *Photography and Photomontage in Landscape and Visual Assessment*, Landscape Institute Advice Note 01/2011, 2011;

7.3 Assessment Methodology

Defining the Study Area

An overall Study Area of 35km radius from the site centre has been established following consultation with Angus Council. This is as specified in the Council's Implementation Guide. The study area was further defined for each part of the assessment process as follows:

Landscape and Visual Impact Assessment (LVIA) – the study area was restricted to the application site, access routes, and the potential Zone of Theoretical Visibility (ZTV) from where there may be a view of the development at up to 35km distance from the site centre. The main focus of the assessment is on the area within 10km, which would be the distance within which significant effects of the proposed development are most likely to be experienced. This has been informed with reference to the findings of field surveys and viewpoint analysis, as well as from professional experience by previous assessments.

Cumulative Landscape and Visual Impact Assessment (CLVIA) - considered existing wind energy development proposals that have permissions, and those that are currently the subject of undetermined applications within a search area of 60km radius of the site centre. An initial assessment of the cumulative visibility of these windfarms within the Cumulative Search Area was then undertaken in order to determine which have the potential to contribute to a significant cumulative effect following addition of the Crofts Farm Wind Turbines. Many of these more remote developments were scoped out of the assessment at this stage due to the lack of combined visibility or their distance to the site. The detailed assessment, therefore, focuses on those sites with potential for significant cumulative effects in combination with the Crofts Farm turbines. These windfarms are considered to be those within a 10km radius from the site, as mapped on **Figure 7.7**.

A Zone of Theoretical Visibility (ZTV) was created using the ReSoft © Wind Farm computer software to identify areas that have potential visibility of any part of the proposed wind turbines calculated to blade tip and hub-height. The ZTV however, does not take account of built development and vegetation, which can significantly reduce the area and extent of actual visibility in the field and as such provides the limits of the visual assessment study area.

Figure 7.4 illustrates the ZTV to a hub height of 56m at 1:250,000 scale. **Figure 7.5** illustrates the ZTV to a tip height of 80m at this scale. **Figure 7.6** illustrates the ZTV segments to blade tip at a more detailed scale.

Baseline Landscape and Visual Resource

This part of the LVIA refers to the existing landscape character, quality or condition and value of the landscape and landscape elements on the site and within the surrounding area, as well as general trends in landscape change across the study area. A brief description of the existing landscape character and land use of the area which includes reference to settlements, transport routes, vegetation cover, as well as landscape planning designations, local landmarks, and tourist destinations.

Assessing Landscape Effects

Landscape Effects are defined by the Landscape Institute as “*changes to landscape elements, characteristics, character, and qualities of the landscape as a result of development*”. The potential landscape effects, occurring during the construction and operation period, may therefore include, but are not restricted to, the following:

- Changes to landscape elements: the addition of new elements or the removal of trees, vegetation, and buildings and other characteristic elements of the landscape character type;
- Changes to landscape quality: degradation or erosion of landscape elements and patterns, particularly those that form characteristic elements of landscape character types;
- Changes to landscape character: landscape character may be affected through the incremental effect on characteristic elements, landscape patterns and qualities and the cumulative addition of new features, the magnitude of which is sufficient to alter the overall landscape character type of a particular area; and
- Cumulative landscape effects: where more than one wind farm may lead to a potential landscape effect.

The development may have a direct (physical) effect on the landscape as well as an indirect effect or effect perceived from out with the landscape character area. Landscape effects are assessed by considering the sensitivity of the landscape against the degree of change posed by the development. The sensitivity of the landscape to a particular development is based on factors such as its quality and value and is defined as high, medium or low. Examples of landscape sensitivity and criteria are described below:

High Sensitivity – This would primarily be rare landscapes, or landscapes which have been afforded either a national or local designation such as National Parks, National Scenic Areas or Areas of Great Landscape Value. These landscapes can be fairly dramatic in terms of scale and may feature a number of attractive landscape features, including mature woodland, intricate gorges and river valleys, prominent summits or features of cultural heritage. Man-made features or modifications to the landscape will be minimal and the landscape may have a wild or remote feeling to it;

Medium Sensitivity – This would include landscapes which are still relatively attractive and generally rural but do contain some man-made elements. It may be landscapes which have been modified to accommodate farming practices and landscapes which include more prominent settlement pattern and road networks. These landscapes may also contain woodland including plantation forestry and shelterbelts; and

Low Sensitivity – This would only be reserved for landscapes which may be deemed unattractive due to heavy modification and prominent man made features, such as industrial units.

The magnitude, or degree of change, considers the scale and extent of the proposed development, which may include the loss or addition of particular features, and changes to

landscape quality, and character. Magnitude can be defined as high, medium, low or negligible, examples of magnitude are shown below:

High Magnitude – This would be a major change to baseline conditions, where the character of the landscape may be altered from its existing state into a landscape with windfarms;

Medium Magnitude – This would be a noticeable change in the baseline condition but not necessarily one which would be enough to alter the character of the landscape and will generally diminish with distance;

Low Magnitude – This would be a minor change to the baseline conditions where the development would be readily missed by a casual viewer and any character of the landscape would remain intact; and

Negligible Magnitude – This would be a change which would be difficult to notice and the baseline conditions are likely to remain almost as they were.

The level of effect is determined by the combination of sensitivity and magnitude of change as shown in **Table 7.2**.

Table 7.2 Magnitude and Sensitivity Matrix for assessing Overall Level of Effect

Sensitivity	Magnitude of Change			
	High	Medium	Low	Negligible
High	Major	Major/Moderate	Moderate	Moderate/Minor
Medium	Major/Moderate	Moderate	Moderate/Minor	Minor
Low	Moderate	Moderate/Minor	Minor	Minor/Negligible

Assessing Visual Effects

Visual effects are recognised by the Landscape Institute as a subset of landscape effects and are concerned wholly with the effect of the development on views, and the general visual amenity. The visual effects are identified for different receptors (people) who will experience the view at their places of residence, during recreational activities, at work, or when travelling through the area. These may include:

- Visual effect: a change to an existing view, views or wider visual amenity as a result of development or the loss of particular landscape elements or features already present in the view; and
- Cumulative visual effects: the cumulative or incremental visibility of similar types of development may combine to have a cumulative visual effect. Either:
 - Simultaneously - where a number of developments may be viewed from a single fixed viewpoint simultaneously within the viewer's field of view without moving;

- Successively - where a number of developments may be viewed from a single viewpoint successively by turning around at a viewpoint, to view in other directions; and
- Sequentially - where a number of developments may be viewed sequentially or repeatedly from a range of locations when travelling along a route.

The general principles adopted for the assessment of visual effects were taken from *The Guidelines for Landscape and Visual Impact Assessment* Third Edition, produced by the Landscape Institute, 2013. This guidance outlines the approach to define a 'sensitivity' for a given view and a 'magnitude of change' that would be caused by the development in question over its lifetime. A matrix in the Guidance is then used to assess the overall 'level of effect'. This matrix is the same format as used to understand landscape effects and can be seen in **Table 7.2**. Examples of visual sensitivity are highlighted below:

High Sensitivity – These include residential receptors, such as views from individual properties or views from within settlements. Views from both recreational locations, such as hill summits, long distance footpaths, cycle paths and tourist locations such as castles and visitor centres are also considered to be of high sensitivity;

Medium Sensitivity – This would include most other visual receptors such as views from roads, other areas of landscape which would not be classed as recreational areas and views from areas within settlements which would not be considered residential; and

Low Sensitivity – This would cover views experienced by people at work and views where the existing view is already dominated by significant man made features.

In the context of this project, the effects during operation are always direct and long term (reversible after 25 years). Effects may also be non-cumulative or cumulative. None of the visual effects relating to this project have been considered positive in order to present a worst case view of any effects, although it should be noted that surveys have consistently shown that the majority of people are positively disposed to wind farm development once it is built.

Viewpoint Analysis Method

Viewpoint analysis is used to assist the LVIA from selected viewpoints within the study area. The purpose of this is to assess both the level of visual impact for particular receptors and to help guide the assessment of the overall effect on visual amenity and landscape character. The assessment involves visiting the viewpoint location in good weather and viewing wireframes and photomontages prepared for each viewpoint location. Illustrated turbines always face the viewer to give a worst case impression of the development under consideration. As far as possible the viewpoints have been selected to meet the following criteria:

- A balance of viewpoints to the north, south, east and west;
- A range of near middle and distance views of the development;
- A proportion representing areas known locally where people use the landscape, such as prominent hill tops or footpaths; and
- A proportion representing designated areas.

A wide range of viewpoints have been studied as part of this assessment and 18 viewpoints have been illustrated with photomontages to assist the assessment for the proposed development. **Table 7.3** below provides a summary of the viewpoint locations and rationale for their selection.

Table 7.3 Summary of locations selected for Viewpoint Assessment

Viewpoint	Reason for Initial Selection	Distance
1: The Guynd	Located at the side of the B9127 to the south of the proposed development. The view was chosen to represent local residents and visitors to the Guynd of Angus Garden and Designed Landscape.	2.3km
2: B961 near Newton	Located at the side of the B961 near the settlement of Redford. The viewpoint was chosen to represent road users, Given its proximity to Redford this is likely to include local residents. .	1.6km
3: A933 near Colliston	Located at the side of the A road near the settlement of Colliston. The viewpoint was chosen to represent road users.	3.2km
4: B9127 near Woodville	Located at the side of the B9127 near Woodville Feus Farm. The Viewpoint was chosen to represent local road users and residents within the area.	2.8km
5: Arbroath	Located at the side of Seaton Road to the north-east of Arbroath. The viewpoint was chosen to represent local residents of Arbroath and users of the National Cycle network.	8.1km
6: Friockheim	Located on the access road to the local cemetery. The viewpoint was chosen to represent a worst case scenario for local residents.	5.7km
7: Dodd Hill	Located at the summit of Dodd Hill on the edge of the Sidlaws. The viewpoint is representative of hill walkers in the area.	12.9km
8: Tentsmuir	Located on the north-eastern coast of Fife. The viewpoint is representative of visitors to the Special Landscape Area, which is popular with walkers, cyclists and other recreational users.	19.5km
9: Kirriemuir Hill	Located at the summit of this local hill to the east of the settlement of Kirriemuir. The viewpoint is representative of both walkers and residents.	20.6km
10: White Caterthun	Located at the summit of the ancient fort settlement. The viewpoint represents visitors to the white and brown Caterthun forts as well as hill walkers in the area.	21.6km
11: Crombie Park	Located at the side of the B961 to the south of the proposed development. The Viewpoint was chosen to represent road users and visitors to the nearby Crombie Park.	5.1km
12: Pitmuies House	Taken from the side of the A932, near the entrance to Pitmuies House and Guthrie Castle. The viewpoint was selected to represent road users and visitors to the nearby gardens.	5.3km
13: A92 Inverkeilor	Located at the side of the A92 to the south of Inverkeilor. The viewpoint was selected to represent the views of road users.	9.6km
14: Balmashanner Hill	Located at the war monument at Balmashanner Hill to the south east of Forfar. The viewpoint was selected to represent visitors to the monument.	12.4km
15: Turin Hill	Located at the summit of Turin Hill. The viewpoint was chosen to represent hill walkers as well as the impact on the hill fort.	10.6km
16: North of Drummyellow	Located at the side of the local minor road to the north of the dwellings at Drummyellow.	1.2km

Viewpoint	Reason for Initial Selection	Distance
	The viewpoint was chosen to represent local residents within 2km of the proposed development.	
17: South of Parkconnon	Located to the south of the nearby settlements at Parkconnon. The viewpoint was chosen to represent local residents within 2km of the proposed development.	1.6km
18: Redford	Located at the side of Burnhead Terrace within the settlement of Redford, this is the most populated area of the settlement. The viewpoint was chosen to represent the views of residents.	1.1km

Methodology for Production of Visualisations

With the view selected, the locations were confirmed and then photographed with a digital Single Lens Reflex (SLR) camera set to produce photographs equivalent to that of a manual 35 mm SLR camera with a fixed 50mm focal length lens. In accordance with the SNH guidance *Visual Representation of Windfarms Good Practice Guidance*, panoramic images were produced from these photographs to record a 76° angle of view illustrating the typical extent of view that would be experienced by the viewer at the viewpoint when facing in one direction and also provides an indication of the visual context of the proposed development. The wider 360° of each view were also taken into account, particularly for the hill summit viewpoints. As well as these photomontages, Angus Council also requested single frame visualisations equivalent to those of a 70mm manual SLR which have been included in the visualisation production.

Each view was illustrated using a panoramic photograph, a wireline and, in some cases, a photomontage. Wirelines and photomontages were produced using Resoft© WindFarm software and utilising 50m² Ordnance Survey Digital Terrain Mapping (DTM) height data covering the study area.

The Landscape and Visual Impact Assessment has been undertaken using a candidate turbine, the Enercon E48.

Visual Assessment of Settlements and Residential Properties

All settlements within the study area have been assessed with regards to the level of visual impact the development will have on them. The sensitivity for each of the settlements is considered to be high in accordance with *Guidelines for Landscape and Visual Impact Assessment, 2013*.

An assessment of the visual amenity of residential properties within 1km of the wind turbine was undertaken. Residential properties situated between 1km and within 2km have been assessed in outline and considered through reference to a number of viewpoints from the surrounding areas, which represent these local residents. Individual residential properties have been assessed from public roads and footpaths within the area and the assessment represents a 'best estimate' of the likely visual effects. In line with the guidance from the Landscape Institute⁴, the views from upper floor windows are considered to be of lesser importance. Views from gardens and public areas have also been considered. In

⁴ Paragraph 6.36 page 114 in 'Guidelines for Landscape and Visual Impact Assessment'. Third Edition.' Landscape Institute and Institute of Environmental Management and Assessment. April 2013.

addition to this all settlements within the study area have been assessed and level of effect noted.

Visual Assessment of Main Transport Routes

A route assessment has been undertaken which explores the visual impact of the development on views experienced by road users along major transport routes in the area and assumes that the viewer would be travelling at speed.

It also includes assessment of any National Cycle Routes, Long Distance Footpaths and locally valued footpaths which fall within the study area. This part of the assessment has been considered cumulatively along with all other wind energy development within the study area.

Cumulative Landscape and Visual Assessment

In addition to the Landscape Institute methodology for LVIA, the cumulative landscape and visual assessment (CLVIA) has considered the emerging guidance from Scottish Natural Heritage's *Assessing the Cumulative Impact of Onshore Wind Energy Developments*, Scottish Natural Heritage, March 2012. The CLVIA is however, not a substitute for individual wind farm landscape and visual impact assessment.

Predicting Cumulative Landscape Effects

The assessment considers the extent to which the proposed development, in combination with others, may change landscape character through either incremental effect on characteristic elements, landscape patterns and quality, or by the overall cumulative addition of new features. Identified cumulative landscape effects are described in relation to each individual Landscape Character Area and for any designated landscape areas that exist within the study area.

Predicting Cumulative Visual Effects

The assessment of cumulative visual effects involves reference to the cumulative visibility ZTV maps and the cumulative viewpoint analysis. Cumulative visibility maps are analysed to identify the residential and recreational locations and travel routes where cumulative visual effects on receptors (people) may occur as a result of the proposed development.

With potential receptor locations identified, cumulative effects on individual receptor groups are then explored through viewpoint analysis, which involves site visits informed by wireline illustrations that include other wind developments. Travel routes are driven to assess the visibility of different wind developments and inform the assessment of sequential cumulative effects that may occur along a route or journey.

Cumulative Viewpoint Analysis

Each viewpoint has been assessed cumulatively in order to understand whether or not the proposed development introduces a cumulative impact on the view from that location. All visible operational, consented and undetermined planning application wind energy projects are considered along with the Crofts Farm Wind Turbines development and a level of cumulative magnitude is assigned. The level and significance of cumulative visual effects is

determined in the same manner as the main LVIA, using the previous matrix shown in **Table 7.2**.

7.4 Landscape Design Considerations

Project Description

The Crofts Farm project would include the construction of two turbines in the ‘*Dipslope Farmland*’ landscape to the north of Crofts Farm. The proposed turbines are 56m in height to hub and up to 80m to blade tip.

Landscape Design Considerations

In accordance with SNH’s *Strategic Locational Guidance for Onshore Wind Farms*, the site location would lie within Zone 1, which is described as follows:

Zone 1: Lowest natural heritage sensitivity identifies areas at the broad scale with least sensitivity to wind farms, with the greatest opportunity for development, within which overall a large number of developments could be acceptable in natural heritage terms, so long as they are undertaken sensitively and with due regard to cumulative impact.

However, this assessment is the result of a broad based study and provides an indication only. The Crofts Farm Wind Turbines site has been subject to LVIA in accordance with the relevant EIA Regulations.

Angus Local Plan Review

The Guide, which was approved on 14 June 2012, seeks to clarify existing development plan policy and to assist in considering proposals against those policies. The Guide describes the existing character of the Dipslope Farmland as a ‘*Landscape with Views of Windfarms*’, and states that the Acceptable Character in a future scenario would be for a ‘*Landscape with Occasional Windfarms*’, described as:

- *A landscape type or area in which windfarms or wind turbines are located or are very close to and visible. However they are not of such a size, number, extent or contrast in character that they become one of the defining characteristics of the landscape’s character; and*
- *Visual receptors would experience occasional close-quarters views of a windfarm or turbines and more frequent background views of windfarms or turbines. Some turbines may or may not be perceived as being located in the landscape character area. No overall perception of windfarms being a defining feature of the landscape.*

The guide states that the LCT is ‘Considered to have scope for turbines circa 80m in height’.

Strategic Landscape Capacity Assessment of Wind Energy in Angus (November 2013)

The most recent guidance on landscape capacity is provided by the ‘*Strategic Landscape Capacity Assessment (SLCA) for Wind Energy in Angus November 2013*’. This provides specific guidance on each Landscape Character Type within the Local Authority Area, and assesses the acceptable future level of change within each area. The Crofts Farm site is fully

situated within the ‘Redford Farmland’ sub-section of the ‘Dipslope Farmland’ character type which is described as:

“Redford Farmland: This sub-area is higher and/or more open and exposed than neighbouring sub-areas. The plateau like landform of the highest northern part is gently rolling or undulating and has large arable fields in which boundaries have been removed or have become minimal, giving an open, simple character. Settlements are small and well separated. Farms and houses also appear well separated and farm buildings are often large. There are some areas of mature trees, most notably the very enclosed Guynd designed landscape. An electricity transmission line crosses the centre. Due to its openness, apparent larger scale and productive farmland character, the northern parts of this sub-area, separated from the coastal facing slopes by a low ridge or break in slope, would be less sensitive to wind energy developments. This area has the highest capacity for wind energy in the Dipslope Farmland and can accommodate medium/large turbines, subject to local constraints. Groupings should remain relatively small and well separated to avoid overwhelming the underlying character. Turbines should not interfere with the ridge that marks the break of slope above the A92. The largest size of turbines (medium/large) would be most suitable in the largest scale areas located in the centre and north of the sub-area.”

The Redford Farmland landscape character type is currently described as being ‘*Dipslope Farmland with occasional/No wind turbines*’. This Landscape Classification is described below:

“A landscape type or area in which windfarms or wind turbines are located and/or are close to and visible. Turbines are not of such a size, number, extent or contrast in character that they become one of the defining characteristics of the landscapes character. Visual receptors would experience occasional close-quarters views of a windfarm or turbines and more frequent background views of windfarms or turbines. Some of the turbines would not be perceived as being located in the landscape character type or area. No overall perception of wind turbines being a defining feature of the landscape.”

In accordance with the levels of acceptable landscape character change set out in Table 6.1(g) of the report, the Redford Farmland landscape character type has the potential to become a ‘*Dipslope Farmland with Wind Turbines*’. This is described as:

“A landscape type or area in which a windfarm, windfarms or wind turbines are located and/or visible to such an extent that they become one of the defining characteristics of the landscape character. However, they are clearly separated and not the single most dominant characteristic of the landscape. Visual receptors would experience frequent views of wind farms or wind turbines as foreground, mid-ground or background features, affecting their perception of the landscape character. However, there would be sufficient separation between windfarms and turbines and sufficient areas from which wind turbines are not

visible such that they would not be seen as dominating the landscape over all other landscape features.”

The SLCA assesses the Redford landscape area as having a medium capacity for groups of 1-5 turbines up to circa 80m to tip, with a suggested minimum separation distance between clusters of wind turbines or windfarms of around 5-10km.

The SLCA states that, *“This (character type) has the highest capacity for wind energy in the Dipslope Farmland and can accommodate medium/large turbines, subject to local constraints. Groupings should remain relatively small and well separated to avoid overwhelming the underlying character. Turbines should not interfere with the ridge that marks the break of slope above the A92”.*

The SLCA also highlights the sensitive visual nature of The Guynd, which is a Garden and Designed Landscape located ~2.3km south of the Crofts Farm site at its nearest point.

Design Objectives

SNH’s guidance *‘Siting and Designing Windfarms in the Landscape’* has been used to inform the layout and design of the scheme and it is considered that the proposed development is in accordance with its key principles, as laid out below:

Scale - turbine size and number has been chosen to ‘fit’ with the scale of the landscape and not diminish the scale and setting of the surrounding countryside. Using turbines of a similar style to those present or consented within the wider area, such as North Mains of Cononsyth, will help the development to fit with the pattern and scale of development in the wider landscape.

Skylines – the turbines avoid dominating the major proportion of skyline and maintain a consistent position where they are rarely a prominent feature of the skyline. The initial development investigated a three turbine cluster at this location, however, it was felt that as a well-balanced two turbine scheme the development would have less impact on the skyline and would not become overbearing or dominate views.

Aesthetics – The location was chosen to work best with the surrounding landscape, as a simple and balanced two turbine scheme, similar in scale and size to the nearby North Mains of Cononsyth without creating any visual confusion when the schemes appear together in occasional views.

Layout Design

The proposed, broad location has been chosen as it is considered to represent the best compromise between the technical and environmental considerations set out above. The design in terms of layout composition and turbine height was developed to integrate with the immediate landscape surrounding the site.

Turbine Selection

The LVIA has been assessed on the basis of two turbines up to a maximum height of 80m. Other likely design considerations include the following:

- A modern turbine will be used that has a simple and balanced appearance with three blades and tapered, non-lattice towers; and
- The turbine will be semi-matt and pale grey in colour to reduce its contrast with the background sky under most weather conditions;

Construction Activities

Temporary landscape and visual effects would occur during the construction period, and would result from the visibility of construction activity, use of lay down areas, and site compounds. The landscape and visual effects would be of a low to negligible magnitude of change and not significant.

The lay down area and compound would be located in a field adjacent to the proposed turbines. During the construction period the landscape and visual effects would be significant due to the movement and contrast of workers and machinery in this area. These effects would be temporary and fully restored on completion.

All disturbed areas resulting from the construction (around the turbine bases, access tracks and on site compounds and lay-down areas) will be restored upon completion of the construction period. Specific mitigation measures necessary during construction would include:

- Colour and finish of substation/control building to be agreed with Angus Council prior to construction;
- Land clearance and occupation will be limited to the minimum necessary for the works;
- Vegetation removal will be minimised as far as possible; and
- Valued features, such as peat land, wetland, historic features and field boundaries are protected and fencing will be used to keep contractors out of areas where damage could result.

Decommissioning

All of the visible, above-ground structures (turbines, transformer, substation and grid connection) will be removed upon decommissioning, thus rendering the landscape and visual effects of the development as reversible. There would therefore, be no landscape and visual effects remaining after decommissioning.

7.5 Baseline Conditions

Broad Landscape Context

The study area for the proposed development is located within the Tayside Landscape Character Assessment. Located within a broad area of primarily arable farmland, the landscape is rural in character with large rectilinear fields the predominant land cover. To the north-west runs the Strathmore Valley a significant valley that sits between the Highland Boundary Fault and the coastal landscapes to the east. Man-made features include farm infrastructure, minor roads, communication masts and electricity pylons. **Figure 7.2** illustrates the various Landscape Characters Types, which have been classified by Scottish Natural Heritage and their consultant landscape architects. It can be seen from **Figure 7.2** that the site study area is covered by three different area reports; Tayside, south and central Aberdeenshire and Fife.

The proposed development site is located in the Dipslope Farmland Landscape Character Type (LCT) as defined by the Tayside Landscape Character Assessment document. The Dipslope Farmland is a fairly extensive LCT which runs along much of the southern section of Angus, between Birkhill and Auchterhouse in the west all the way to Montrose in the east.

In addition to this landscape there are also a number of other landscape character areas that lie within the study area. **Table 7.4** summarises all the landscape character areas that are situated within the study area. Any areas highlighted in green are not within the ZTV.

Table 7.4 - Key Characteristics of Landscape Character Types

Name	Key characteristics
Tayside Landscape Character Assessment	
Coast With Sand	Located between Broughty Ferry and Carnoustie, including Barry Links, where a rounded peninsula of sand dunes extends southwards into the Firth of Tay. Woodland is confined to hedgerows trees and shelterbelts on farmland adjoining the coast. Arable farming tends to occur along the coastal strip with pasture lands on the dune slack and along the lower sections of the river valleys. Fields are bound by hedges and walls with occasional fences.
Coast With Cliffs	Located north of Carnoustie, between Arbroath and the southern end of Lunan Bay. Woodland is absent except on field boundaries and shelterbelts along the coastal strip. Some arable farming takes place on the coastal strip, with medium rectilinear fields where the topography allows. Fields tend to be bound by hedges and walls where they occur.
Broad Valley Lowlands	Located south of the Highland boundary Fault lie five broad lowland valleys or straths. These share a range of common characteristics which set them apart from other valleys and glens. The five areas of Broad Valley lowland are: Strathmore, Strathearn, Strathalan, Lower south and north Esk river valleys and the Pow Water Valley between Gask Ridge and Keillour Forest. Valleys such as Strathmore had comprised extensive areas of rough grazing, scrub woodland and unproductive wetland. Overtime large rectilinear fields were created as the area became predominant in agriculture.
Firth Lowlands	Lying along the northern side of the Firth of Tay, between Perth and Dundee, Bound to the north by the steep Sidlaw Hills, the area forms one of the most fertile parts of Scotland. The area is principally an agricultural area and the landscape is dominated by large, geometric fields. Field boundaries within parcels of land are often absent, the distinction between different fields being marked by drainage ditches or simply changes in crop.
Low Moorland Hills	The Low Moorland hills are formed by a series of east-west ridge like hills with a sharply defined northern edge and gentler eastern slopes. Woodland is limited to the extensive plantation centred on Montreatmont Moor. Agriculture is primarily pasture, much of it occurring on the poorer soils of the upper slopes. Field boundaries where they occur are marked with a variety of hedgerows, stone walls and post-and-wire fences.

Name	Key characteristics
Highland Foothills	This is a complex geological structure resulting from its position along the line of the Highland Boundary Fault. It features whale backed hills, winding gorge like main river valleys and is a gateway to the Angus Glens. A complex landscape which features glimpses of the Highlands and lowland areas.
Igneous Hills	The Igneous Hills are a generally open landscape of almost conical summits dominated by grass moorland. Though there are areas of improved pasture and even some cultivation within the more sheltered glens, the land is generally of low fertility. Where they occur field boundaries are marked by a combination of stone dykes and post-and-wire fences, occasionally marked by isolated Scots Pine in upper areas and deciduous species in more sheltered parts. The Ochils have a considerable amount of coniferous forestry, however, the most extensive woodlands are located in the heart of the eastern Ochils. The effect is to transform the sparse, open landscape of the Ochil summits, and to create a sense of enclosure which is absent elsewhere on the hills.
Mid Highland Glens	These are the mid sections of the principle Highland Glens and contain a concentration of agricultural activity on narrow but distinct valley floors. There is a predominance of rough grazing, bracken, heather moorland with substantial areas of commercial coniferous forestry.
Highland Summits and Plateaux	Are areas of upland separating the principal glens with vegetation patterns that closely reflect the altitude and exposure, including heather, grassland, blanket bog and arctic alpine plant communities. There is little or no settlement and most of the area is managed as open moorland. This area is one of the most remote and wildest landscapes within the UK.
Upper Highland Glens	The upper glens are of comparatively small scale. With little or no floodplain, the valley sides rise steeply so that the glen as a whole is little more than 1 to 1.5km wide at the crest of the enclosing hills. While valley floors are typically between 200 and 250 metres AOD. In the east, these summits are generally rounded. In the west they are craggier and more clearly defined. In both areas it is the mountains and the upland character that extends throughout the glen that shapes perceptions and appreciation of the landscape.
Lowland Basin	The Montrose Basin is a large, rounded estuarine basin formed near the mouth of the River South Esk. The basin is tidal, revealing extensive mudflats at low tide with an area of low lying, drained farmland which extends inland, while the basin is separated from the sea by Montrose, and located on a low peninsula split of land less than 2km wide.

Fife Landscape Character Assessment

Coastal Hills	Located around the coast of Fife, the Coastal Hills are mainly located above the Coastal Cliffs, Braes and terraces, which slope gradually towards the sea offering panoramic views of the Firths. They are characterised by their strong association with the sights, sounds and smells of the coast and usually comprise large, undulating, regular, open, arable landscapes with few hedges but some linear shelterbelts and policy plantings. These are medium to large-scale, often open or exposed coastal landscapes where the character is always influenced by the sea. Generally a simple, sloping, balanced, active, organised, tended, farming landscape with regular or geometric patterns. These hills mark the transition between coastal and landward areas of Fife sharing characteristics of both.
Coastal Terrace	The Coastal Terraces are mostly flat or gently sloping towards the coast. They are extensively built upon or relatively undeveloped comprising large, open, undulating, arable fields with infrequent or more regular steadings. They have little vegetation cover except policy planting and shelter-belts around the large houses and designed landscapes, or on the steeper slopes often above burns. There are few field boundaries, limited to some hedgerows, stone dykes or post-and-wire fencing primarily around the larger houses and farmsteads. These are coastal landscapes where the character is always influenced by the sea and typically they are a simple, undulating, balanced landscape with muted colours, varied textures and slow movement.
Coastal Flats	The Coastal Flats on the south coast are very flat, low-lying coastal landscapes claimed from the Firth of Forth. On the north east coast they are developed on blown sands and old dune systems and covered by a variety of land uses such as the afforestation at Tentsmuir Forest, the airfield at Leuchars and the world famous golf courses at St Andrews. Therefore they have a diversity of landscape character but their close association with the sea is ever present in these very flat, low-lying, horizontal, open, large-scale, exposed coastal landscapes. Typically, intensively cultivated, geometrically laid out, large to medium-scale, predominantly arable fields or forestry plantations with rectilinear, fenced enclosures.
Lowland Dens	The Lowland Dens are deeply incised sometimes narrow gorges or valleys cut by fast flowing burns across gently rolling Coastal Hills and Terraces on the north, east and south-east coasts of Fife. Often they have extensive semi-natural woodland with broadleaved trees and few buildings other than occasional steadings or large houses with policies. These are confined, small-scale, intimate, sheltered, textured, colourful, balanced and calm landscapes.
Lowland Hills and Valleys	The Upland Foothills of the Ochils, Lomond and Cleish Hills are very conspicuous, often defining the edge of other landscape types and the extent of views across the lowlands. The natural slopes of the landform of the

Name	Key characteristics
Lowland Open Sloping Farmland	<p>Foothills are gentler and less pronounced than the Upland Slopes but usually steeper and higher than the Lowland Hills. They too form distinctive backdrops to other landscape types. The Foothills have several conspicuous point features, providing each area with its own identity. They are characterised by a combination of steep sided, rugged, open landform and land cover on the upper foothills, and shallower, smoother, more vegetated or developed landform lower down.</p> <p>Located in eastern Fife the Lowland Open Sloping Farmland comprises predominantly large, open, sloping, arable fields, often with no field boundaries or with mainly wire fences, low hedges or some stone dykes and little other vegetation cover with relatively few plantations and shelterbelts. This is a large-scale, open or exposed landscape where the character is strongly influenced by the weather conditions and views of the sky. It is a simple, sloping, balanced, active, organised, tended, and farming landscape with regular geometric patterns.</p>
Upland Foothills	<p>The Upland Foothills of the Ochils, Lomond and Cleish Hills are very conspicuous, often defining the edge of other landscape types and the extent of views across the lowlands. The natural slopes of the landform of the Foothills are gentler and less pronounced than the Upland Slopes but usually steeper and higher than the Lowland Hills. They too form distinctive backdrops to other landscape types. There is a lack of settlements but a general abundance of farmsteadings which, along with the many types of woodland are well related to landform, often in association with the frequent burns running down gullies or folds or narrow glens. The Foothills have several conspicuous point features, providing each area with its own identity. They are characterised by a combination of steep sided, rugged, open landform and land cover on the upper foothills, and shallower, smoother, more vegetated or developed landform lower down. These are medium to large-scale, open, simple, sloping, curved, quiet and balanced landscapes with smooth or varied textures and muted colours.</p>
Pronounced Volcanic Hills & Craigs	<p>The Pronounced Volcanic Hills and Craigs form conspicuous, pronounced, often distinctive and recognisable hills or hill ranges sometimes protruding high above the lowlands or extending the uplands or foothills. They form important backdrops to the lowlands. Their distinctive shapes, silhouettes and skylines, with recognisable shapes, peaks and slopes give Fife a strong sense of place and direction. The farmsteadings and woodlands are well related to landform and there is a variety of other individual buildings and structures, sometimes associated with the burns and contributing to the identity of the area. The upper slopes of these Hills and Craigs can be steep sided, rugged and open, contrasting with the shallower, smoother, more open, simple, sloping, curved, quiet and balanced landscapes with smooth or varied textures and muted colours.</p>
Lowland Glacial Meltwater Valleys	<p>The Lowland Glacial Meltwater valleys are 'U' shaped, flat bottomed channel-like valleys with distinctive often pronounced and frequent eskers, kames and mounds deposited by melting glaciers. Typically used for intensive arable cultivation, the valley floor and lower slopes contrast with the mixed farming or grazing land on the rising slopes. There are medium to large-scale geometric field patterns enclosed by low, gappy hedges or post and wire fences. Steadings are located along distinct lines of transition from fertile valley soils to the poorer soils of hill slopes. They have small, sinuous often inconspicuous burns or small rivers which appear to be too small for the size of the valley. In parts, there are extensive conspicuous sand and gravel quarries disrupting an otherwise generally well organised, tended, balanced, open, locally busy and diverse landscape with regular patterns, smooth textures and seasonally variable colours.</p>
South & Central Aberdeenshire Landscape Character Assessment	
Kincardine Links	<p>To the south of Inverbervie, the land is distinctly flat and farm land rises gradually from the Kincardine Links to form a gently sloping apron of land that extends into the more pronounced relief of Garvock and Glenbervie. The wide coastal fringe is the most distinctive element of this landscape character area. Immediately south of Inverbervie it merges with farmland directly or across low steps that mark the edge of the raised beaches. South of St Cyrus they form an enclosed platform, backed by the prominent cliff line, and encompass a considerable tract of farmland as well as areas of saltmarsh and dune close to the North Esk Estuary.</p>
Garvock & Glenbervie	<p>The Garvock & Glenbervie landscape character area include an extensive area of rolling farmland which encompasses not only Garvock Hill in the south west of the area, but the farmland around Glenbervie at the edge of Highland Boundary Fault. The character of the area stems essentially from its relief, a series of sweeping, rolling hills that present distant views and draw the eye up and down the terrain. The area has a bold geometric field pattern. The few coniferous plantations are generally small and although they may be prominent on top of hills, their influence on landscape character is slight.</p>
Howe of the Mearns	<p>The Howe of the Mearns encompasses some of Scotland's most fertile soils. Its relief is emphasised by the steep moorland slopes which rise abruptly behind it marking the line of the Highland Boundary Fault. It is a colourful landscape; vivid fields of red soil are juxtaposed with the bright greens of pasture or young cereals, while at other times fields of rape, daffodils and tulips present a startling patchwork of colours. As with other lowland farmlands, the distinctive character of this landscape derives from its large pattern of fields, crops and woods and, while this is obscured from low level views in its midst, it can be seen from elevated locations such as the moorland ridge to the north or the Garvock Hills to the south.</p>

Name	Key characteristics
The Mounth	The Mounth character area forms a large expanse of Moorland Plateaux, where the foothills of the Grampians extend almost to the coast at Stonehaven. Its location emphasises the relief of this unbroken ridge which looms over the flat farmland of Howe of the Mearns to the south. Its eastern foothills, which tumble down to the coast, are less dramatic and form a more gradual transition with surrounding farmland. Lower slopes are forested but the plateau itself is covered by a pelt of heather moorland which extends westwards into the Cairngorms revealing a strong, rolling relief whose ridges recede into the distance across interlocking horizons. The plateau is an exposed and wild landscape, but rarely inhospitable enough to escape human influence.

Land use and Landscape Change

The Crofts Farm site is surrounded by farmland, which is predominantly mixed arable use, with some grazing land. The site is located within a field currently utilised for arable farming. The landscape is defined by large scale farming practices, similar to the expansive Strathmore Valley located to the north-west of the site. The settlement of Redford lies to the west of the site, which consists primarily of low rise housing of a variety of ages. The main transport links in the area are the B961 which runs past the site through the nearby settlement of Redford and the A933 Arbroath to Brechin road. The Sidlaw Hills are situated to the south-west. These are popular with walkers as well as housing a number of communications masts that are visible on prominent hill tops, such as Gallow Hill and Craigowl Hill.

Dipslope Farmland Landscape Character Type

The site is completely located within the Dipslope Farmlands as defined by SNH in the Tayside Landscape Character Assessment and is described below:

“The area falls from up to 180 metres in the north-west to about 50 metres along the coastal strip. The Dipslope blends almost imperceptibly into the southern slopes of the Sidlaws and Montreathmont Hills.

This is one of the most fertile and productive agricultural areas in Scotland, with much of the land being categorised as Classes 1 or 2. It is not surprising, therefore, that intensive agriculture, based on cereals, is the dominant land use. Fields tend to be large and rectilinear. Woodland cover is low or even absent in some areas, particularly closest to the coast, creating an open, exposed landscape in places. Elsewhere, particularly on some of the larger estates more extensive woodland survives, comprising a mixture of shelterbelts and hedgerow trees. Where these survive, the landscape is enclosed and structured. Often the trees are wind trimmed and bent slightly away from the coast. Semi natural woodland is limited to steeper valley sides. A dense scatter of more isolated farmsteads is supplemented by a number of isolated houses, reflecting the proximity to Dundee and Arbroath. Both settlements are, however, relatively well hidden in this otherwise open landscape. Dundee is screened by a ridgeline running parallel to the Firth of Tay, while Arbroath occupies lowland at the mouth of a shallow valley.”

Local Landscape Character

The landscape immediately around the site is heavily characterised by the large scale arable farmland that defines much of the area. The landscape slopes gently from the nearby summit of Cairnconon Hill towards the south-east. Land cover is predominantly arable with varying crop plantations. Shelterbelts break up the fields and surround some of the nearby properties. The rolling nature of the local landscape allows for enclosed views to be quickly followed by open views when travelling through the area. The flatter nature of the landscape to the north-west and east allows for some more long distance views, particularly towards the coast in the east and towards the Strathmore valley in the west. There are a number of man-made features present in the local landscape ranging from individual farmsteads with outbuildings and other farm infrastructure to the local roads which cross the area. Electricity pylons and the operating turbine at North Mains of Cononsyth add vertical features to the local landscape. Overall the landscape feels relatively settled and semi-rural.

Landscape Elements and Features

Landscape elements are the component parts of the landscape, such as trees, woodlands and lochs that combine to form areas of landscape character. Often these characteristic elements may be distinctive to a particular regional area of landscape character or a more localised area of landscape character type. The main elements of landscape character across this area include large scale arable and pasture farmland, areas of coniferous plantation as well as smaller sections of coniferous woodland. In addition to this there are numerous farmsteads which are dotted across the Dipslope landscape which provide a distinct element to the character, typically seen with their farmhouse set adjacent to larger scale farm buildings. Man-made elements such as local roads, communication masts and the operating turbine at North Mains of Cononsyth also add distinct features to the landscape.

Broad Visual Context

The landscape in this area slopes gently from west to east towards the coast. The terrain local to the site appears similar, consisting of gently sloping agricultural land, occasionally interrupted by tree plantations of various kinds or small clusters of trees surrounding the farm steadings and dispersed settlement which dots the countryside. Electricity pylons and communications wires frequently cross the landscape. Long distance views are possible, particularly on the slightly elevated areas of slope to the north and west, these tending to look towards the sea or inland to the south-west and the hills of Fife and eastern Perthshire. To the west, the Sidlaw Hills tend to constrain views further to the north and north-west. The relatively vegetation poor tops or forestry covered areas of the Sidlaw Hills provide a slightly enclosing backdrop to views from the lower dipslope farmland, and large communications masts are obvious features on the horizon. From the Sidlaws themselves, views from mountain, in the north, to sea, to the south, are possible.

Weather conditions

Changing weather patterns and local climatic conditions will influence the visibility of the in terms of the extent of view, the colour and contrast of the turbines and the number of turbines visible and thus the perceived visual impact. There will be periods of low visibility (fog, low cloud, and bright sunny conditions that are accompanied by haze generated by temperature inversions) as well as periods of high visibility in clear weather. In some instances and from some locations they may be ‘back-lit’ (e.g. appearing darker in colour

during sunset/sunrise and periods of pale or white blanket cloud) and in other circumstances may appear to be ‘up-lit’ (e.g. during stormy periods that combine dark clouds and bright sunshine).

Landscape Planning Designations

The study area for the proposed development as shown in **Figure 7.1** is located primarily within the Angus Council area, with areas of Fife and Aberdeenshire also included. The local development plans contain a number of policies which seek to protect landscape resources. The site itself is not located within any designated landscape, however, there are other landscapes within the study area which are designated. The key landscape planning designations are illustrated in **Figure 7.3**.

Landscape planning designations and policies are considered in the determination of the sensitivity of landscape receptors as they provide an indication of value ascribed to the landscape resource.

Those designated landscapes that overlap the ZTV (and may potentially have views of the proposed development) have been considered as part of this assessment and are listed in **Table 7.5**. Other planning policies and designated landscapes located out with the ZTV have been excluded from further study as they will not experience any effects from the proposed development.

Table 7.5 Landscape Planning Designations

Designation	Description
Fife Council - Special Landscape Areas (SLA)	<p>Tay Coast. The SLA is made up of a long band of low hills and coastal landscapes that border the southern shores of the Firth of Tay and extend from Newport on Tay to Newburgh. The western boundary is formed by the slopes containing the basin of Lindores Loch, while the south-western boundary follows the foot of Dunbog Hill. The A92 forms the southern boundary before heading towards the coast at the foot of hills to Wormit. In the east of the area, the southern boundary again follows lower hill slopes around St Fort and minor roads on the boundary of the Scotsraig Estate. The designation is located ~25.8km to the south-west of the proposed development and is covered by Policy E19 in the St. Andrews and East Fife Local Plan.</p> <p>Tentsmuir Coast. The SLA comprises the coastal dunes and long sandy beach of Tentsmuir Sands extending from the River Eden estuary to Tayport. The western boundary of this area is drawn just inside the edge of the extensive Tentsmuir Forest. It is situated 17.6km from the development to the south-west and is covered by Policy E19 in the St. Andrews and East Fife Local Plan.</p> <p>Tarvit and Ceres. The SLA comprises the valley of the Ceres and Craigrothie Burns and the softly rolling hills which contain it. Extending from the A914 at Cupar to the B940 at Pitscottie in the west, to Falfield, New Gilston and east to the A916. The designation is situated 31.4km to the south-west of the turbine and covered by Policy E19 in the St. Andrews and East Fife Local Plan.</p> <p>St Andrews Links. The SLA is located on the western coast of Fife to the north of the settlement of St Andrews, covering the world famous St Andrews Golf Courses and West Sands. The designation is situated 26.1km to the south-west of the proposed development and is covered by Policy E19 in the St. Andrews and East Fife Local Plan.</p> <p>Craigtoun. The SLA includes the Kinness, Claremont, Lumbo and Cairns Dens which extend from the south west of St Andrews broadly from the B939 to the A919 and incorporating the wooded valleys which lie within this area and Craigtoun Country Park. It is situated 30.2km distance from the development to the south-west and covered by Policy E19 in the St. Andrews and East Fife Local Plan.</p>

St Andrews and Fife Ness. The SLA incorporates the coastal edge which extends from the urban edge of St Andrews at the junction of the A917 and the B9131 incorporating Boarhills, Kingbarns and the policies of Cambo and extending around the coastal edge of Fife Ness to Crail. The designation is located 29.4km to the south and covered by **Policy E19** in the St. Andrews and East Fife Local Plan.

Aberdeenshire Council - Area of Landscape Significance (ALS)

Johnshaven Coast ALS is a small area around the settlements of Johnshaven and St Cyrus. This designation covers a narrow strip of landscape along the coast and is located ~24.1km to the north-east of the proposed site. This designation is covered by **Policy Env 12** in the Aberdeenshire Local Plan.

Marr ALS is a large area of landscape covering both the Dee Valley and the uplands south of this. It covers much of the north-western half of the study area and is located ~26.8km to the north of the proposed site. This designation is covered by **Policy Env 12** in the Aberdeenshire Local Plan.

Gardens and Designed Landscapes (GDL)

(Listed in the Inventory of GDL for Scotland) are designated for their unique combinations of horticultural, landscape, scenic and historic interest. There are 25 Gardens and Designed Landscapes within the study area, which are located within the various council areas. The GDL's are covered by **Policy ER20** in the Angus Local Plan, **Policy E15** in the St Andrews and East Fife Local Plan, **Policy 13** in the Aberdeenshire local Plan and **Policy 16** in the Dundee Local Plan. A list of all GDL's within the study area is provided below:

The Guynd	Rossie Priory	Edzell Castle
Cambo	Drumkilbo	The Burn
St Andrews Links	Glamis Castle	Fasque House
Craigtoun	Airlie Castle	Kinnaird Castle
Earlshall	Ascreavie	House of Dun
Naughton	Cortachy Gardens	Craig house
Baxter Park	House of Pitmuies	Dunninald
Balgray Park	Guthrie Castle	
Camperdown House	Brechin Castle	

Visual Baseline and Receptors

Visual receptors would include anyone who may have visibility of the turbines, such as people who may work in the area, residents or tourists. The table below identifies all visual receptors that were considered as part of the assessment.

Table 7.6 Landscape Planning Designations

Visual Receptor	Description
Residents	There are a number of properties located within 2km of the development these include Crofts Farm, Laverockhall and Scotia House.
Settlements	Settlements that will be assessed include Redford, Friockheim and Arbroath. Photomontages have been produced for a number of these settlements. Settlements outwith 10km are unlikely to experience significant visual effects.
Road Users	The A933 and the B961 have been assessed both with regards to the impact of Crofts Farm Wind Turbines and any potential sequential cumulative effects.
Recreational	Recreational receptors in the area mostly refer to hill walkers using the Sidlaw Hills in the area, as well as The Caterthuns and Balmashanner Hill.

Construction Stage: Assessment of Landscape and Visual Effects

The visual effects of the development during the construction period would mostly be limited to ‘close-range views’ from where it would be possible to view noticeable ground-based activities and the movement of construction vehicles. The main receptors with visibility of ground-based construction activities would be limited to the immediate properties such as Crofts Farm and Cottage, Bonnycheer and Coonawarra which will see construction vehicles accessing the site. The impact on Bonnycheer and Crofts Cottage would be slightly more as the access would be in close proximity to these properties, although there will be no visibility of any ground based activity.

The visual effects of the construction would begin with the establishment of a Contractor’s compound and increase incrementally over the construction period with the most obvious effects associated with the erection of the turbines. The construction activity would be limited to a relatively small area. The specific construction activities have been assessed earlier as part of the Landscape Design Considerations and no significant negative residual effects are anticipated on any receptors.

7.6 Assessment of Landscape Effects

Landscape Effects are defined by the Landscape Institute as “*Change in the elements, characteristics, character, and qualities of the landscape as a result of development.*” These effects are assessed by considering the landscape sensitivity against the magnitude of change. The matrix used to guide the evaluation or level of effect as illustrated in **Table 7.2**. The type of effect may also be described as temporary or long term/permanent, direct or indirect, cumulative and positive, neutral, or negative.

Direct Effects on Landscape Fabric

Landscape Sensitivity of Local Landscape Character

The local landscape is located within the Redford Dipslope Farmland, and has been significantly modified over time, the enlarging of fields and shifting boundaries to accommodate large scale farming practice. In the wider landscape around the site there are a small number of farms, outbuildings and some individual properties scattered across the landscape. These properties are well separated from one another, relate well to the simple open character of the surrounding landscape and tend to be located at the edge of or set back from the minor roads which cross the area. Shelterbelts run along many of the field edges, breaking up views within the landscape, although longer distance views particularly towards the coast in the east are possible from the more open parts of the local area. An area of more dense mature woodland surrounds the designed landscape of the Guynd to the east. Settlement is sparse, limited to the hamlet of Redford, the centre of which is located ~950m to the south-west of the turbines and various individual steadings and scattered farmhouses. The single turbine of North Mains of Cononsyth sits 2.5km to the north-west of the site. while wooden electricity poles criss-cross the landscape associated with the local properties. These elements add to the vertical features present in the local landscape, without defining the character. As an area of intense arable farming the landscape quality is generally medium.

In terms of landscape value, within the study area, the landscape area is not designated, although it is valued locally, which would indicate a medium landscape value.

The overall sensitivity of the local landscape character to wind turbine development is considered to be medium.

Magnitude of Change

During operation the Crofts Farm wind turbines would directly affect a limited area of the local landscape character leading to a low overall magnitude of change. The views from this local area are considered in greater detail in **Viewpoints 1, 2, 4, 16, 17 & 18** which have all been taken within ~3km of the proposed turbines. There would be some loss of landscape features in relation to the loss of an area of arable farmland. The area is characterised by large open geometric fields and along with the landscape in the surrounding area is characterised as an area of arable farming. There are a number of man-made features present within the local landscape including wooden pole electricity pylons and the single operating turbine to the north-west located at North Mains of Cononsyth. As well as these features there are a number of local roads which cross the area, linking the individual properties to the outlying suburban areas of Arbroath, Forfar and Dundee. Although visible from throughout much of the local landscape, the turbines would never appear as a dominant feature and are typically viewed against the sky. The height of the turbines (80m) has been chosen to respect the surrounding topography with the two turbines creating a well-balanced development, which does not dominate or limit longer distance views where they occur. The development does not feel out of scale with this local landscape nor does it alter its perceived character. The magnitude of change for direct landscape effects as a result of the development on the local landscape character resource would be low, resulting in a **moderate/minor** level of effect which would be long term (reversible) and negative.

Indirect Effects on the Dipslope Farmland LCA

Landscape Sensitivity of the Dipslope Farmland LCA

The Dipslope Farmland area covers a large section of the study area surrounding the site and running east to west where it stretches all the way to Montrose. The low lying character area is dominated by arable farming practice, and with little in the way of woodland, the land cover is predominantly large rectilinear fields as it stretches between the Sidlaw Hills and the Forfar Hills. The condition/quality of the landscape is generally medium.

The landscape area is not designated, and is defined by large scale agriculture. Numerous man-made features such as the A90, communication masts and pylons are present throughout the area. Taking these factors into account, the overall landscape value of the Dipslope Farmland is considered to be medium

Magnitude of Change

During operation, the Crofts Farm Wind Turbines would occupy and directly affect a negligible to minor area of the Dipslope Farmland area, however they may be visible from across the character area indirectly affecting its character (and similarly affecting a small proportion indirectly). The wider area has been considered in greater detail from a number of viewpoints within the accompanying landscape figures with 12 of the 18 viewpoints taken

from within this landscape character area. The ZTV indicates that other than the landscape immediately around the site inside ~5km, as well as an area to the north-east, much of this landscape is actually free from visibility. The operational wind turbine at North Mains of Cononsyth is a more recent addition to the landscape, while consent has been granted for a small number of further developments within the wider character area. Typically the development appears as only a small scale feature of a fairly busy, open and far reaching landscape. The magnitude of change on the Dipslope Farmland resource would be low, resulting in a **moderate/minor** level of effect, which would be long term (reversible), direct/indirect and negative.

Indirect Effects on Neighbouring Landscape Character Areas

Neighbouring areas of landscape character are formed by coastal landscapes, lowlands and uplands.

None of these areas would be directly affected by the wind turbines and there would be no direct effects on the key physical characteristics that form the areas' landscape character or their quality and integrity. However, the turbines may be visible from these areas and as such could indirectly affect the landscape character where particular views or scenic qualities are noted as a key characteristic of the landscape. Alternatively, the wind turbines could be frequently visible and particularly prominent in the landscape such that the addition of this new feature affects the character of the area. In this instance the development is not located on a prominent summit, and views will be restricted to the immediate landscape and to the south and east of the development.

Table 7.7 - Indirect Landscape Effects on Neighbouring Landscape Character Areas

Landscape Character Area	Assessment
Tayside Landscape Character Assessment	
Coast With Sand	<p>The Coast with Sand character area occurs in four distinct locations within the study area, the closest zone is located ~6.4km to the south-east of the proposed turbines. The ZTV indicates theoretical visibility over much of this area and another to the north of Arbroath. The turbines appear theoretically visible on the distant horizon from these locations, with the lower tower sections screened from view by the intervening landscape, the visible portions would be viewed solely against the sky. The main vistas from these coastal locations face away from the proposed development which is located inland.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be low and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Coast With Cliffs	<p>The Coast with Cliffs landscape occurs in three distinct locations within the study area, similar to the Coast with Sand type. The closest area is located ~7.4km to the south of the proposed development. The ZTV indicates theoretical visibility around East Haven and the surrounding landscape. The turbines would be viewed on the horizon where visible, the turbines appearing solely against the sky where visible. At this distance views would be further limited by intervening landscape features including shelterbelt and built features. It is unlikely that the views of the development would be significant from these coastal locations which offer open views in the opposite direction up and down the eastern coastline and out over the sea.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be low and the overall level of effect would be moderate, indirect, negative and reversible.</p>
Broad Valley Lowlands	<p>The Broad Valley Lowlands character area is located ~9.1km to the north-west of the proposed development. The ZTV indicates some intermittent areas of theoretical visibility across this large scale valley landscape. Viewpoint 9 is taken from within this landscape area near the settlement of Kirriemuir and shows the relative lack of visibility of the proposed turbines from within this character area. The rising landscapes to the east limiting views to the blade tips of the turbines, which over this distance would not be easily discernible in the</p>

Landscape Character Area	Assessment
	<p>wide open vista of the Strathmore Valley.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Firth Lowlands	<p>There are no views of the development from within this landscape character area. Therefore there would be no indirect effects on its character.</p>
Low Moorland Hills	<p>The Low Moorland Hills landscape character area is located ~6.7km to the north-west of the proposed development. The ZTV indicates theoretical visibility primarily across the south-eastern half of the area. The views from this character area have been considered in greater detail in Viewpoints 14 & 15, Balmashanner and Turin Hill. These elevated locations within the character area show the turbines would be primarily viewed on the distant horizon, appearing solely against the sky. The turbines would have a negligible impact on the setting and scale of this character area.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be low and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Highland Foothills	<p>The Highland Foothills landscape character area is located ~19.8km to the north-west of the proposed turbines. The character type occurs in three distinct areas within the study area, the character area forms a boundary between the Strathmore Valley landscape and the highlands to the north-west. The ZTV indicates theoretical visibility from the more elevated locations within this character area, the views from within the area have been considered in greater detail in Viewpoint 10 which was taken from the summit of the White Caterthun. The viewpoint shows the turbines would appear on the distant horizon from within this area. The turbines would not be an easily discernible feature over this distance.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be minor, indirect, negative and reversible.</p>
Igneous Hills	<p>The Igneous Hills landscape character area is located ~7.9km to the west of the proposed development. The ZTV indicates two theoretical areas of visibility within the large scale landscape, around the eastern fringes and border with the Dipslope landscape area and the other around Gallow Hill and the upland landscape to the north. The views from within this character are considered in greater detail in Viewpoint 7 located at the summit of Dodd Hill. The view from this location shows the turbines would be viewed on the distant horizon, at this distance they would be viewed completely back dropped by the sky, with the grand vista largely uninterrupted with long distance views in all directions.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be minor, indirect, negative and reversible.</p>
Mid Highland Glens	<p>The Mid Highland Glens character area occurs in several areas on the north-western edges of the study area, the closest section of this landscape is located ~22.5km from the proposed development. The ZTV indicates an area of theoretical visibility on the upper slopes of Glen Moy around Mile Hill and the Arlie monument. At this distance it is unlikely that the proposed turbines will be an easily discernible feature within the wider view.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Highland Summits and Plateaux	<p>The Highland Summits and Plateaux landscape character area occurs in several areas to the north west of the study area, generally interspersed with the Mid Highland Glens landscape areas. The closest area of landscape is located ~22.8km to the north west of the proposed turbines. The ZTV indicates small patches of theoretical visibility around the most elevated summits in these areas. It is unlikely that the views towards the development will be significant over these distances, with the turbines barely discernible to the viewer.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Upper Highland Glens	<p>There are no views of the development from within this landscape character area. Therefore there would be no indirect effects on its character.</p>
Lowland Basin	<p>The Lowland Basin landscape character area is located ~9.3km to the north of the proposed development. The ZTV indicates theoretical visibility over the north-western sections of the character area. The turbines would theoretically be viewed on the horizon from within this character area, back dropped by the sky where visible. Visibility would be limited by features within the wider landscape including shelterbelt woodland running alongside the main roads in the area and other vegetation present in the wider landscape, it is unlikely that the turbines would become prominent features in the view from within this area of landscape.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be low and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>

Fife Landscape Character Assessment

Landscape Character Area	Assessment
Coastal Hills	<p>The Coastal Hills landscape character area occurs in several areas throughout Fife on the northern and eastern coasts. The closest area is situated ~19.3km to the south-west of the Crofts Farm turbines around Tayport on the northern coast of Fife. Views from these areas on the north coast would be extremely limited with no visibility predicted. On the eastern coast around St Andrews, the turbines are theoretically visible on the very distant horizon, however, in reality these views will occur over a distance of ~28.7km. At this distance it is unlikely that the turbines, viewed against the sky will be an easily discernible feature in this view.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Coastal Terrace	<p>The Coastal Terrace landscape occurs in several locations on the eastern coast of Fife, generally set back from the immediate coast, except for the area around Cambo and Fife Ness. This character area is situated ~29km to the south of the proposed development. With the primary views from this area facing east towards the sea and south towards the Firth of Forth, it is unlikely that the proposed development will be an easily discernible feature in any views.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Coastal Flats	<p>The Coastal Flats character type occurs predominantly on the north eastern coast of Fife around Tentsmuir. The ZTV indicates theoretical visibility across much of the area, however, due to the wooded nature of the surrounding views would be extremely limited to the coastal edges of the area. Viewpoint 8 is taken from the northern edge of this area and shows the turbines would be heavily screened by the intervening landscape, at this distance it is unlikely that the turbines will be an easily discernible feature, with views further limited by woodland features in the wider landscape.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Lowland Dens	<p>The Lowland Dens character area occurs in several areas across Fife. The ZTV indicates theoretical visibility from many of the more elevated parts of these character areas. Due to their location significant views from within these areas are unlikely. The closest area is situated ~29.1km from the proposed development. The intervening built features and vegetation would likely combine to completely screen any views.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Lowland Hills and Valleys	<p>The Lowland Hills and Valleys character type occurs in several locations within Fife. The ZTV indicates some theoretical visibility from the more elevated locations within these areas. Although in reality views are unlikely to occur. A combination of distance and other features in the wider landscape such as woodland and built features combining to restrict any views.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be minor, indirect, negative and reversible.</p>
Lowland Open Sloping Farmland	<p>The Lowland Open Sloping Farmland character area sits to the far south of the study area, located ~31.7km from the proposed development. The ZTV indicates theoretical visibility over much of the character area. In reality at this distance views of the turbine are not likely to be possible. Intervening features including the built environment and vegetation would combine to screen any potential views.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be minor, indirect, negative and reversible.</p>
Upland Foothills	<p>The Upland Foothills landscape occurs in three distinct areas within the study area, around the north of Fife. The ZTV indicates some theoretical visibility over the northern and eastern fringes of the character areas. Located over 19km from the proposed development it is unlikely that there will be any significant views possible towards the development.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Pronounced Volcanic Hills & Craigs	<p>The Pronounced Volcanic Hills & Craigs character areas occur in several locations throughout Fife, located over 30km from the proposed development. The ZTV indicates some minimal patches of visibility within these areas, however, at this distance it is unlikely that any significant views of the proposed development will occur, the features in the wider landscape including settlements, vegetation and other built features combine to screen views.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Lowland Glacial	<p>There are no views of the development from within this landscape character area. Therefore there would be</p>

Landscape Character Area	Assessment
Meltwater Valleys	no indirect effects on its character.
South & Central Aberdeenshire Landscape Character Assessment	
Kincardine Links	There are no views of the development from within this landscape character area. Therefore there would be no indirect effects on its character.
Garvock & Glenbervie	<p>The Garvock and Glenbervie character area is located ~23.7km to the north-east of the proposed development. The ZTV indicates theoretical visibility around Lochside and Dykeside. Views of the development would be extremely limited from these areas, particularly towards the coast where visibility is limited to the blade tips of the proposed turbines, located between 25 and 30km from the proposed turbines it is unlikely that the proposed development will create an easily discernible feature in the view from this landscape.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be minor, indirect, negative and reversible.</p>
The Mounth	<p>Located on the northern edge of the study area the Mounth character area is situated almost 30km from the proposed development at the nearest point. The ZTV indicates an area of theoretical visibility from within the area, however, in reality the views are unlikely to have any impact on the setting or character of the area.</p> <p>The landscape character area is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor, indirect, negative and reversible.</p>
Howe of the Mearns	<p>The Howe of the Mearns landscape character area is located ~22.7km to the north of the proposed development. The ZTV indicates theoretical visibility around the western edge of the character area. Views from this area would be limited to the very blade tips of the proposed turbines, located almost 27km from the development the intervening landscape features would in reality screen any of these potential views.</p> <p>The landscape character area is considered to be of medium sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be minor, indirect, negative and reversible.</p>

Direct and Indirect Effects on Landscape Planning Designations

The site area is not designated and there would be no direct effects on any designated landscape areas. Any landscape effects therefore would be limited to indirect effects on the views and visual character experienced from within these areas, whilst viewing towards the wind turbines. The assessment below considers if these effects on the views would lead to an indirect effect on the landscape character and valued features and characteristics for which these areas are designated.

The assessment of the overall indirect effects experienced by people viewing the windfarm from within these areas is provided in **Table 7.8**. The sensitivity of all designated landscapes considered as part of this assessment has been considered as high.

Table 7.8 - Indirect Landscape Effects on Landscape Planning Designations

Designation	Assessment
Fife Council - Special Landscape Areas (SLA)	
Tay Coast SLA	At its closest point this designation would be ~19.6km to the south-west of the proposed development covering the coastal areas and upland foothills of northern Fife. The ZTV indicates there will be very little visibility from within this relatively large designation, with potential views restricted to an area of the north-east coast around Tayport and some intermittent views from the most elevated areas within the designation. At this distance, the views of the proposed development are extremely limited, with only the upper sections of the turbines theoretically visible. It is unlikely that there will be any significant views of the proposed turbines from within this SLA.

	<p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Tentsmuir Coast SLA	<p>The Tentsmuir Coast is situated on the north-east coast of Fife ~17.7km to the south of the proposed development. From this coastal area there are theoretical views of the proposed development to the north-east, these views are considered in greater detail in Viewpoint 8. The turbines are heavily screened from this location and over this distance views are likely to be significantly screened by the built features and other features such as woodland and farming infrastructure in the wider landscape.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Tarvit and Ceres SLA	<p>The Tarvit & Ceres designation is located over 30km to the south-west of the turbines covering the Hill of Tarvit and the settlement of Ceres. The ZTV indicates a minimal area of theoretical visibility around the most elevated areas within the designation. At this distance it is unlikely that there will be any significant views of the proposed development.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
St Andrews Links SLA	<p>This designation is located ~25.9km to the south-west of the proposed development. The ZTV indicates theoretical visibility over the designation. The turbines appear theoretically visible to the north, sitting on the distant horizon they would be completely back dropped by the sky from this location. At this distance it is unlikely that the two turbines will be prominent in features in the coastal vistas offered from the designation.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Craigtoun SLA	<p>Located inland from St Andrews, Craigtoun is situated ~30.1km from the proposed turbines. The ZTV indicates theoretical visibility over the whole designation, however, in reality views are unlikely to occur over this distance. Features present within the landscape including vegetation, woodland and other built features combining to screen any potential views of the development from within this landscape.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
St Andrews and Fife Ness SLA	<p>The St Andrews and Fife Ness SLA is located ~28.9km to the south of the proposed development. The ZTV indicates theoretical visibility over much of the designation. At this distance the turbines would be a barely discernible feature, amongst the developed coast to the north, with other features including woodland also present in any views.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>

Aberdeenshire Council - Area of Landscape Significance (ALS)

Johnshaven Coast ALS	<p>There is no visibility of the development predicted from this designation and as such there will be no impact on its unique character as an ALS.</p>
Marr ALS	<p>The Marr ALS is located on the northern boundary of the study area ~32km from the proposed development. The ZTV indicates some theoretical visibility from within this area, however, at this distance it is unlikely that the turbines will be an easily discernible feature within the open landscapes to the south.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>

Gardens and Designed Landscapes (GDL)

The Guynd	<p>At its nearest point The Guynd GDL is located ~2.3km to the south of the proposed development. The GDL is set within an area of mature woodland, and the turbines are not visible from within this area. Viewpoint 1 is taken from the access road to The Guynd, which is outside GDL on its northern edge, and represents a worst case scenario for visitors to the GDL. There are no predicted views from within the property or the immediate surrounding gardens which form the GDL, there would be no impact on the setting of the house or gardens. Views from the area surrounding the property would be completely screened by the intervening</p>
-----------	--

	<p>woodland and there would be no direct impacts on the character or setting of the GDL.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Cambo	<p>Cambo is located ~32km to the south of the proposed development. The ZTV indicates theoretical visibility over the whole designation, at this distance it is unlikely that there will be any views of the proposed turbines.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
St Andrews Links	<p>Similar to the designation that also covers the area, there may be some potential visibility of the proposed development from this location, however, the turbines are located ~25.9km from the designation which overlooks the St Andrews Coastline and offers long distance views over the North Sea. Views up the coast would be limited by coastal development and vegetation.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Craigtoun	<p>The GDL is heavily screened by woodland, which would limit any potential views of the development. Similar to the wider designation, views are unlikely to occur and over this distance any views would not be significant.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Earlshall	<p>Earlshall is located on the eastern fringes of Leuchars ~25.6km to the south of the proposed development. The castle and gardens are set within an area of woodland with some views towards the coast to the east. It is unlikely that there will be any views of the proposed development from the grounds and surrounding areas.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
House of Pitmuies	<p>The House of Pitmuies is located ~5.2km to the north of the proposed development. The ZTV indicates theoretical visibility over the whole GDL. In reality the heavily wooded nature of the surroundings would completely screen any potential views of the wind turbines. Viewpoint 12 is located at the side of the A933 to the east of the entrance to the gardens and provides a worst case scenario view from the area to the east of the GDL.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Guthrie Castle	<p>Located on the opposite side of the A932 from House of Pitmuies ~5.7km to the north of the turbines. The Castle is set within in an area of woodland which limits the potential for views over the wider landscape from within the castle grounds. The A932 is also bound by shelterbelt woodland as it passes between the neighbouring GDL's further limiting potential views.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Fasque House	<p>Fasque House is located over 30km from the proposed development within the Marr ALS. The Gardens are set within an area of woodland that would limit any potential views towards the proposed turbines. Over this distance there would be little if any impact on the setting of the GDL due to the construction of the proposed turbines.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>
Kinnaird Castle	<p>Kinnaird Castle is located ~12.7km to the north of the proposed development. The ZTV indicates theoretical visibility over the southern half of the GDL. The castle and grounds are bound by areas of dense mature woodland which would severely restrict views over the wider surrounding landscape. It is unlikely that there will be any views of the proposed developments from the grounds surrounding the castle.</p> <p>The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be moderate/minor and not significant.</p>

House of Dun

The House of Dun is located to the north-west of the Montrose Basin ~17.8km to the north-east of the proposed development. The GDL is set within an area of woodland, which would restrict views from within the area out over the surrounding landscape. Where views do occur they would be limited to the blade tips over the wider landscape. It is unlikely that there will be any views of the proposed development from within the GDL.

The landscape designation is considered to be of high sensitivity. Overall the magnitude of change would be negligible and the overall level of effect would be **moderate/minor** and not significant.

7.7 Assessment of Visual Effects

Visual effects are recognised by the Landscape Institute as a subset of landscape effects and are concerned wholly with the effect of the development on views, and the general visual amenity. The assessment has been conducted in periods of fine weather and assumes good visibility and limited seasonal leaf cover.

ZTV and Visual Receptors

A blade tip ZTV is illustrated in **Figure 7.5** and indicates the maximum potential visibility of the wind turbine, assuming there are no trees, woodland or buildings within the area (i.e. a bare earth scenario). It is likely that this visibility would be reduced further by the screening effect of trees, woodland, and buildings on the ground, particularly in relation to settlements.

The pattern of ZTV coverage is influenced by the larger scale topography to the north-west and west of the development, with the landscape becoming more elevated as it rises from the Dipslope Farmland into the Igneous Hills which restricts visibility in these directions. The most prominent areas of visibility would be in the immediate ~5km around the site, with visible areas spreading out to the north-east towards the eastern coast of Angus. **Figure 7.6** illustrates the ZTV in a more detailed fashion, divided into six sections, each focusing on a different part of the study area.

The key visual effects to be addressed include the following:

- Visual effects on the views experienced by local communities;
- Visual effects on the views experienced by users of footpaths and general recreational areas/ tourist destinations; and
- Visual effects on the views experienced by road users along the main transport routes.

Viewpoint Analysis

Viewpoint analysis has been undertaken for each of the viewpoints and is reported in **Appendix 2**. A summary of the results of the viewpoint analysis is provided in **Table 7.9** and this analysis reveals that significant visual effects would only occur from three viewpoints; this would be from some of the closest visual receptors within 1.6km.

Table 7.9 Summary of Viewpoints Analysis

Location	Assessment			Distance from Development
	Sensitivity	Magnitude	Overall Impact	
1. The Guynd	High	Low	Moderate	Viewpoint located at ~2.3km distance
2. B961 near Newton	High	Low	Moderate	Viewpoint located at ~1.6km distance
3. A933 near Colliston	Medium	Low	Moderate/Minor	Viewpoint located at ~3.2km distance
4. Minor Road near Woodville	High	Low	Moderate	Viewpoint located at ~2.8km distance
5. Arbroath	High	Low	Moderate	Viewpoint located at ~8.1km distance
6. Friockheim	High	Low	Moderate	Viewpoint located at ~5.7km distance
7. Dodd Hill	High	Negligible	Moderate/Minor	Viewpoint located at ~12.9km distance
8. Tentsmuir	High	Negligible	Moderate/Minor	Viewpoint located at ~19.5km distance
9. Kirriemuir Hill	High	Negligible	Moderate/Minor	Viewpoint located at ~20.6km distance
10. White Caterthun	High	Negligible	Moderate/Minor	Viewpoint located at ~21.6km distance
11. Crombie Park	Medium	Low	Moderate/Minor	Viewpoint located at ~5.1km distance
12. Pitmuies House	High	Negligible	Moderate/Minor	Viewpoint located at ~5.3km distance
13. A92 Inverkeilor	Medium	-	-	Viewpoint located at ~9.6km distance
14. Balmashanner Hill	High	Negligible	Moderate/Minor	Viewpoint located at ~12.4km distance
15. Turin Hill	High	Low	Moderate	Viewpoint located at ~10.6km distance
16. North of Drumyellow	High	Medium	Major/Moderate	Viewpoint located at ~1.2km distance
17. South of Parkconon	High	High	Major	Viewpoint located at ~1.6km distance
18. Redford	High	Medium	Major/Moderate	Viewpoint located at ~1.1km distance

Visual Effects during Operation

Post-construction and during operation, the appearance of the development site would recover a calmer visual character with negligible levels of maintenance activity visible on site from the nearest visual receptors, and no significant visual effects likely.

The visibility of the turbines, however, would extend over the study area affecting a range of visual receptors including residents, road users, tourists, and people undertaking recreational activity. The visual effects of the wind turbines on views and visual amenity during operation are assessed in the following sections.

Residential Properties and Settlements

The following assessment considers the views from settlements, and the likely visual effects that could be experienced from the main living rooms and garden areas of residential properties, but excludes rooftops and upper windows. The illustrated viewpoints have been selected to represent views from where the wind turbine would be most visible within the villages or along the edges of the villages. All settlements and residential properties have been judged to be of high sensitivity.

Visual Effects on Settlements

Many of the settlements within the study area will gain very limited, or no views of the windfarm due to the concentration of buildings and other urban features and the landform

of the area. Of the 13 settlements within 10km that were assessed, 5 of these are not within the ZTV and will therefore receive no views of the development. Settlements that have been predicted to receive views are likely to only get views of the development from open areas, prominent hill tops within the settlement or from the edges of the settlement, as it is likely that woodland and the built environment will screen outward views.

Table 7.10 Visual effects on settlements within the ZTV

Settlement	Distance	Visual Assessment
Settlements <5km from Crofts Farm Wind Turbines		
Redford	950m	<p>The centre of the settlement of Redford is situated ~950m to the south-west of the proposed development. The ZTV indicates theoretical visibility across the whole settlement. The settlement is clustered around the B961, with properties either side of the road, generally bound by shelterbelt trees that mark property boundaries. The dwellings tend to face in a generally south-eastern or south-westerly direction away from the proposed turbines, with the exception of properties on Burnhead Terrace which face north-north-west. This is the part of the settlement which will have the most open views of the development, and this is considered in greater detail in Viewpoint 18, which is taken from Burnhead Terrace. The viewpoint shows that the intervening shelterbelt around the site will have some screening properties, and that the turbines will be seen in the same view as the operational sawmill. Viewpoint 2 is taken from the B961 to the south of the settlement and shows the turbines on the horizon, occupying a fairly minor extent of the open vista. These views would be experienced by the residents of Redford as they travel from Arbroath or other destinations from the south towards the settlement.</p> <p>Overall the magnitude of change for the settlement is considered to be medium which would result in a major/moderate level of effect which would be significant.</p>
Greystone	3.6km	There are no views of the proposed development from this settlement.
Arbirlot	4.6km	<p>The small hamlet of Arbirlot is situated 4.6km to the south-east of the proposed development. The ZTV indicates intermittent visibility across the whole settlement. However, the settlement is bound by bands of mature woodland alongside the Elliott Water which runs by the settlement on its way towards the coast. These areas of woodland enclose the settlement to the east and north and would screen any potential views for the residents of Arbirlot.</p> <p>Overall the magnitude of change for the settlement is considered to be negligible which would result in a moderate/minor level of effect which would not be significant.</p>
Settlements between 5-10km from Crofts Farm Wind Turbines		
Friockheim	5.5km	<p>The settlement of Friockheim is situated 5.5km to the north-north-east of the proposed development. The ZTV indicates theoretical visibility across much of the settlement will be possible. Views from within the settlement were found to be extremely limited due to a dense band of mature woodland which runs to the south of the settlement. The views from Friockheim are considered in greater detail in Viewpoint 6 which is taken on the track to the cemetery. This is the only area of the settlement expected to experience any views towards the proposed turbines. In this view the turbines are partially screened by the intervening landscape and vegetation limiting their prominence in the view, they would appear in keeping with the scale of other features already present in the view, occupying a negligible extent of both the horizontal and vertical views.</p> <p>Overall the magnitude of change for the settlement is considered to be negligible which would result in a moderate/minor level of effect which would not be significant.</p>
Arbroath	5.6km	<p>The settlement of Arbroath is the largest population centre within 10km of the proposed development. The coastal settlement is located 5.6km to the south-east of the proposed development. The ZTV indicates theoretical visibility is possible across much of the settlement. In reality due to the built up nature and density of buildings views are unlikely to be possible for the majority of residents, with views limited to the north-western edges of the settlement or more elevated locations within the town. Viewpoint 5 has been taken on the north eastern edge of the settlement at the side of Seaton Road, offering views across the lower lying settlement, which can be observed in the middle ground of the view, towards the proposed development. The viewpoint represents a worst case scenario for the residents' of the settlement. Where views occur from this and any similar locations the turbines would be viewed on the horizon completely back dropped by the sky, they would occupy a negligible extent of both the horizontal and vertical vista, which retains its openness and grand scale.</p> <p>Overall the magnitude of change for the settlement is considered to be negligible which would result in a moderate/minor level of effect which would not be significant.</p>

Settlement	Distance	Visual Assessment
Letham	5.7km	There are no views of the proposed development from this settlement.
Guthrie	5.9km	<p>The small hamlet of Guthrie is located to the west of Guthrie Castle and is located 5.9km to the north of the proposed development. The ZTV indicates theoretical visibility across much of the settlement; however, much of the settlement to the south is bound with mature woodland, with more open views occurring towards the north-eastern edges of the settlement. Viewpoint 12 is taken from the side of the A932 to the south of the settlement. From this area the turbines may appear on the distant horizon. The simple two turbine cluster would be viewed against the sky, while the intervening landscape would partially screen the tower sections from view, reducing the vertical extents of the proposed development. The vista from this area of the town is open and grand in nature. The proposed turbines would occupy and affect a negligible extent of both the horizontal and vertical view for these residents.</p> <p>Overall the magnitude of change for the settlement is considered to be negligible which would result in a moderate/minor level of effect which would not be significant.</p>
Muirdrum	7.1km	There are no views of the proposed development from this settlement.
Carnoustie	8.8km	<p>The settlement of Carnoustie is situated 8.8km to the south of the proposed development on the Angus Coastline. The ZTV indicates an area of theoretical visibility over the north eastern edge of the settlement. Views from this area are extremely limited with only the blade tip of the proposed turbine theoretically visible over the horizon. In reality these views would be further reduced by the intervening landscape features such as woodland and other shelterbelts. It is not predicted that there will be any significant impacts on the settlement of Carnoustie.</p> <p>Overall the magnitude of change for the settlement is considered to be negligible which would result in a moderate/minor level of effect which would not be significant.</p>
Monikie	9.3km	<p>The settlement of Monikie is situated 9.3km to the south west of the proposed development. The ZTV indicates theoretical visibility across the southern sections of the settlement. Potential views of the development from within the settlement are extremely limited with only the blade tips theoretically visible from this area. The settlement is located next to the Monikie Reservoirs which are heavily wooded on the western edges, screening views of the nearby reservoir from within the settlement. It is not expected that there will be any views of the development from within the settlement.</p> <p>Overall the magnitude of change for the settlement is considered to be negligible which would result in a moderate/minor level of effect which would not be significant.</p>
Settlements between 10-15km from Crofts Farm Wind Turbines		
Inverkeilor	10.3km	<p>The settlement of Inverkeilor is located 10.3km to the north-east of the proposed development. The ZTV indicates theoretical visibility across much of the settlement. Views from within the settlement are extremely limited, due to the built up nature of the surrounding area. Views are only predicted to occur from a small area on the main road as it exits the settlement. From this location the turbines appear at distance on the horizon, they would be viewed solely against the sky and at this distance it is unlikely that the proposed turbines will feature prominently in these fleeting views. The remainder of the settlement will remain free from any views of the proposed development.</p> <p>Overall the magnitude of change for the settlement is considered to be negligible which would result in a moderate/minor level of effect which would not be significant.</p>
Forfar	12.2km	There are no views of the proposed development from this settlement.
Monifieth	13.3km	There are no views of the proposed development from this settlement.
Settlements beyond 15km are unlikely to suffer any significant effects		

Visual Effects on Residential Properties

A total of twenty-two residential properties have been assessed within a radius of 1km of the turbines. The assessment has looked at the theoretical visibility in conjunction with the properties' primary and secondary views as well as views from the garden area, taking into account any vegetation or woodland which may surround the property. A summary of the assessment of all residential properties within 1km of the nearest turbine is provided in **Table 7.11** and the full assessment can be found in **Appendix 3**.

Table 7.11 Predicted Visual Effects on Residential Properties

Property	Distance	Magnitude of Change	Level of Effect
1. Muirfield	970m	Negligible	Moderate/Minor
2. Grange of Conon Farm Cottages (2 clusters of two properties)	960m and 1020m	Low	Moderate
3. Grange of Conon	850m	Medium	Major/Moderate
4. West Grange of Conon	860m	Low	Moderate
5. Crofts Farm*	630m	Negligible	Moderate/Minor
6. Crofts Cottage*	620m	Low	Moderate
7. Ardalanish	710m	Low	Moderate
8. Coonawara	710m	Low	Moderate
9. Milton of Conon Farmhouse* (3 properties in total, one financially interested)	930m	Negligible	Moderate/Minor
10. Bonnycheer	790m	Low	Moderate
11. Laverockhall*	730m	Low	Moderate
12. Windyedge	770m	Low	Moderate
13. The Whin	930m	Low	Moderate
14. West Cairnconon	810m	Negligible	Moderate/Minor
15. Scotia House	600m	Negligible	Moderate/Minor
16. Station House	810m	Low	Moderate
17. School House	820m	Negligible	Moderate/Minor

Properties marked with an asterisk in the above table are either owned by the business, or occupied by family members of the business.

In summary, out of the properties detailed in **Table 7.11** above only one out of 22 is predicted to experience significant effects. The effects would be in relation to views from the primary windows and garden areas, although it should be noted even when visible the turbines are never overbearing features and would not constitute an unacceptable change to the quality of living for the residents.

Assessment of Major Tourist and Transport Routes

A detailed assessment of the potential for visual effects from the B961 between Newbigging and the A933 has been undertaken. This route can be seen on **Figure 7.8**.

Other routes such as the A933, A92 and the A932 were considered and viewpoints have been investigated from these routes. Views representing a worst case from each of these routes are considered in **Viewpoints 3, 12 & 13** respectively.

B961 Newbigging to A933

The B961 is a local road serving the residents of Redford and the surrounding communities, linking with Arbroath, Brechin and Forfar. The road leaves Newbigging travelling in a

generally north-easterly direction, passing by the Monikie Reservoirs and Crombie Country Park. This part of the route is heavily enclosed by woodland, associated with the nearby reservoirs and other planting. The route crosses the B9126 to the north-east of Crombie Park. The route travels through the gently rolling farmland landscape which spreads out in all directions from the roadside. Open views occur on all sides of the road for much of the journey. Shelterbelt woodland on the horizons and throughout the wider landscape helps to break up the views, limiting even longer distance views. The route dips slightly as it passes through Carmyllie, rising again on the northern side of the hamlet, before arriving at the settlement of Redford. Passing through Redford the views open up to the north due to the topography of the landscape. To the north there are open views towards the Sidlaws and the upland landscapes beyond the Strathmore Valley. Continuing on, the route passes several individual properties although, like the other properties along the route, they are set further back from the roadside. At its closest point the route is ~1km distance from the proposed turbines. The section assessed runs for ~15km and is considered to be of medium sensitivity, as a local commuter route.

The ZTV indicates that the turbines will first come into view for northbound traffic as the route passes by the Monikie Reservoirs although views along much of this section of the route would be screened by intervening woodland. When visible the turbines would appear in front of the road user, located on the distant horizon.

It is only as the route crosses the B9126 that the turbines will theoretically come into view. The potential views from this section of the route are considered in **Viewpoint 11**. The views would be fairly direct, with the turbines appearing slightly to the right of the roadside.

The turbines remain in the view over much of the route as it continues northwards towards Redford, with views becoming more direct to the south of Redford, similar to the views experienced in **Viewpoint 2**, located just to the south of the settlement. As the route passes through Redford the turbines would move to the rear of the viewer.

Travelling in the opposite direction from the A933, the turbines are initially screened by the intervening landscape, with the surrounding woodland at Muirpark Wood further restricting any potential views over the opening ~1km.

As the road passes by the Knockhill crossroads the turbines would first come into view, appearing on the horizon, where the turbines would be viewed in the primary view for ~1km, visible against the sky during this section.

Approaching North Mains of Cononsyth, the turbines begin to move to the left of the viewer, becoming more oblique. The intervening landscape also rises, screening the lower portions of the turbine towers from view. This part of the route is also subject to some screening with some mature shelterbelt running along the roadside for ~1km.

The landscape rises slightly between North Mains of Cononsyth and Cononsyth. The turbines would be heavily screened over this section of the route, with only the blades theoretically visible, the intervening woodland around Hill of Cairnconon would further limit these views.

As the road passes Cononsyth it changes direction, heading south towards the proposed site and the settlement of Redford. Over the opening part of the route the development will be heavily screened from view by Hill of Cairnconon and other woodland features, with only one hub and the blades of the other turbine theoretically visible.

As the road passes by the Hill of Cairnconon, there would be oblique views of the proposed turbines for ~500m. The turbines would appear partially screened by the intervening landscape, with the upper tower sections, hubs and blades viewed against the sky, before they move to the rear of the viewer as the road approaches Redford.

The magnitude of change for the route as a whole would be **low**, resulting in a **moderate/minor** level of effect which would not be significant.

7.8 Assessment of Cumulative Visual Effects

Wind Energy Development Included in the CLVIA

The cumulative assessment includes existing wind energy developments (those operating or under construction), proposals with planning permission, and those that are currently the subject of undetermined applications within a 60km radius of the Crofts Farm site. Other known pre-application wind energy development proposals have been identified as part of the assessment process and considered in outline only, due to the more limited information available in connection with these proposals.

For the purpose of the assessment, consideration was given to turbines over 50m to blade tip, in line with SNH guidance.

The list of other wind energy development sites to be included in the assessment has been confirmed with Angus Council and SNH and compiled from known wind energy development planning applications and formal requests for scoping opinions held by the various planning authorities.

All wind energy developments included or referred to in this assessment out to 60km are illustrated on a plan in **Figure 7.7**. Listed below in **Table 7.12** are the key projects, primarily within 10km of the development, which are likely to have some level of cumulative impact with Crofts Farm turbines, potentially appearing simultaneously or successively in views.

Table 7.12 Summary of key Wind Energy Projects within 10km (Cumulative Study Area)

Development Name	Scale of Project (Single turbine, Cluster or Windfarm)	Tip Height (m)	Distance to Project (approx. in km)
Operational Projects			
North Mains of Cononsyth	Single Turbine	67m	2.5km
Michelin	Cluster	100m	18km
Tullo	Windfarm	100m	35km
Drumderg	Windfarm	107m	40km
Consented Projects			

Pickerton	Single Turbine	84.5m	7.5km
Govals	Windfarm	87m	15km
Frawney	Windfarm	100m	14.5km
Projects in Planning			
Cuthlie	Single Turbine	77m	2.2km
Hillhead of Ascurry	Single Turbine	77m	4.0km
Greenhillock	Single Turbine	67m	7.4km
Dubton Farm	Single Turbine	77m	7.7km
Upper Balmachie	Single Turbine	77m	8.2km
Stotfaulds	Single Turbine	77m	8.7km
Bolshan	Single Turbine	77m	8.7km
New Downie	Single Turbine	55.5m	10.0km

The Michelin turbines located ~18km to the south-west of the proposed development were initially considered as part of the assessment but views where the two developments appear together were found to be extremely limited. As such the Michelin turbines were not considered further as part of the cumulative assessment.

Two or more windfarms are required for the occurrence of a cumulative visual effect. This assessment has therefore considered the development of Crofts Farm turbines in addition to the other windfarm sites in the landscape in order to test the landscape capacity of the area and provide conclusions for the CLVIA relevant to this proposal.

Figure 7.7 shows the location of all of the windfarms currently operational, consented and in planning within a 60km radius of the proposed turbine locations at Crofts Farm.

From this, it can be observed that there are only two operational developments within 20km of the proposed development site, the single turbine at North Mains of Cononsyth and the two turbines at the Michelin Tyre Factory in Dundee. Outwith Angus, larger scale developments are more common and are mostly located within upland landscape types. To the west, the larger windfarm of Drumderg sits within the upland landscape, while Tullo and St John's Hill are situated to the north-east. In the areas to the south and south-west of the proposed development projects tend to be smaller scale clusters and single turbines. The Crofts Farm Wind Turbines would therefore fit into the existing pattern of development within the Dipslope Farmland.

A series of potential cumulative ZTV's (based on submission status) is illustrated in **Figure 7.7** showing the potential cumulative ZTV for each of the key windfarms. The findings from the analysis of the cumulative visibility maps and cumulative viewpoint assessment have been used to form a conclusion as to the level of overall cumulative visual effects during operation as experienced by various receptors.

Cumulative Viewpoint Assessment

Each viewpoint assessed as part of the viewpoint assessment has also been considered cumulatively with all other wind energy projects identified within the 60km cumulative study area. A summary of potential cumulative visibility assessment from each of the viewpoints is provided in **Table 7.13**. Further detail can be found in the viewpoint assessment located in **Section 7.12**.

Table 7.13 Summary of Cumulative Viewpoint Analysis

Viewpoint No.	Sensitivity	Magnitude	Level of Effect
Viewpoint 1: The Guynd			
Crofts Farm Wind Turbines and Operational Wind farms	High	-	-
Crofts Farm Wind Turbines and Operational, Consented Wind farms		-	-
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		-	-
Viewpoint 2: B961 near Newton			
Crofts Farm Wind Turbines and Operational Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 3: A933 near Colliston			
Crofts Farm Wind Turbines and Operational Wind farms	Medium	Negligible	Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms		Negligible	Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Minor
Viewpoint 4: Minor Road near Woodville			
Crofts Farm Wind Turbines and Operational Wind farms	High	-	-
Crofts Farm Wind Turbines and Operational, Consented Wind farms		-	-
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 5: Arbroath			
Crofts Farm Wind Turbines and Operational Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 6: Friockheim			
Crofts Farm Wind Turbines and Operational Wind farms	High	-	-
Crofts Farm Wind Turbines and Operational, Consented Wind farms		-	-
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		-	-
Viewpoint 7: Dodd Hill			
Crofts Farm Wind Turbines and Operational Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 8: Tentsmuir			
Crofts Farm Wind Turbines and Operational Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 9: Kirriemuir Hill			
Crofts Farm Wind Turbines and Operational Wind farms	High	-	-
Crofts Farm Wind Turbines and Operational, Consented Wind farms		-	-
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		-	-
Viewpoint 10: White Caterthun			

Viewpoint No.	Sensitivity	Magnitude	Level of Effect
Crofts Farm Wind Turbines and Operational Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 11: Crombie Park			
Crofts Farm Wind Turbines and Operational Wind farms		-	-
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	-	-
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 12: Pitmuies House			
Crofts Farm Wind Turbines and Operational Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 13: A92 Inverkeilor			
Crofts Farm Wind Turbines and Operational Wind farms		-	-
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	-	-
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		-	-
Viewpoint 14: Balmashanner Hill			
Crofts Farm Wind Turbines and Operational Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 15: Turin Hill			
Crofts Farm Wind Turbines and Operational Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 16: North of Drummyellow			
Crofts Farm Wind Turbines and Operational Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 17: South of Parkconon			
Crofts Farm Wind Turbines and Operational Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor
Viewpoint 18: Redford			
Crofts Farm Wind Turbines and Operational Wind farms		Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms	High	Negligible	Moderate/Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Negligible	Moderate/Minor

Cumulative Assessment of Major Tourist and Transport Routes

An assessment of the potential for cumulative effects on the B961 between Newbigging and the A933 has been undertaken. A summary of significance of impact is outlined in **Table 7.15** at the end of the assessment.

B961 Newbigging to A933

Operational

Travelling northwards towards Redford there are oblique distant views towards the Tullo wind turbines, although at this distance and the fact they are oblique mean they are unlikely to be easily discernible features over this section of the route. Travelling in the opposite direction the single turbine at North Mains of Cononsyth appears in the same view as the proposed turbines, featuring more prominently due to its proximity to the road side. The Crofts Farm turbines are also partially screened by the intervening landscape, while the woodland that surrounds the summit of Cairnconon Hill and shelterbelt around South Mains of Cononsyth and Hassocks would further limit the visibility of the proposed turbines over this stretch of the road. These views occur for ~2km before the North Mains of Cononsyth turbine moves to the rear of the view and quickly and becomes screened as the route passes Cononsyth. The cumulative magnitude of change when considering operational projects is **negligible**.

Consented

There are no cumulative views between the Crofts Farm turbines and any consented projects regardless of direction of travel on this route. The cumulative magnitude of change when considering consented projects will remain **negligible**.

In Planning

Travelling north towards Redford, the Cuthlie turbine appears to the right of the view. Sharing a similar view to the proposed turbines, the single turbine appears alongside Crofts Farm for ~2km. As the route approaches Carmyllie the Cuthlie turbine begins to move to the right of the view. Successive views will occur for a short time before the turbine moves to the rear of the view. There are other theoretical intermittent views towards developments to the north such as Nathro Hill, however, these turbines are located over 30km from the viewer and are unlikely to be noticeable from the route. On approach to Redford there are some theoretical successive views to the north-west with Frawney, and Govals all theoretically visible. Intervening woodland and other features would limit these potential views significantly.

Travelling southwards, the majority of the planned development is located behind the viewer, such as Dubton Farm and Bolshan. Both the single turbines at Hillhead of Ascurry and Greenhillock appear in direct views for a short time, with both developments appearing in successive views with the Crofts turbines, which are located to the south of the road. The Hillhead of Ascurry turbine passes to the rear of the view, alongside other theoretically visible development such as Nathro Hill and Newmill of Balgavies, which are located to the north. The cumulative magnitude of change will become **low**.

Table 7.14 Summary of Cumulative Viewpoint Route Analysis

Route	Sensitivity	Magnitude	Level of Effect
B961 Newbigging to A933			
Crofts Farm Wind Turbines and Operational Wind farms	Medium	Negligible	Minor
Crofts Farm Wind Turbines and Operational, Consented Wind farms		Negligible	Minor
Crofts Farm Wind Turbines and Operational, Consented, Planned Wind farms		Low	Moderate/Minor

7.9 Summary of Assessment Conclusions

Introduction

The proposed Crofts Farm turbines are located in an area of arable farmland which is predominantly characterised by the agricultural nature of the landscape. This landscape has been identified as having medium landscape capacity for the proposed turbines (circa 80m in height) according to the *Strategic Landscape Capacity Assessment for Wind Energy in Angus*. The Crofts Farm development has been designed to create a balanced two turbine development and to minimise the visual impact on the nearby residential properties. The methodology for the landscape and visual impact assessment (LVIA) adopted the guidelines set out by the Landscape Institute and the Institute for Environmental Management and Assessment.

Landscape Design

The project would include two turbines with a typical hub height of 56m and a typical turbine height of 80m to blade tip.

The associated infrastructure of site access tracks and substation have been designed and located sensitively to minimise visual impact. There will be no significant effects resulting from the construction and operation of the associated infrastructure, although negative effects are anticipated during the construction period. These would be restored and mitigated on completion of the construction period. The development would be located within the Redford Farmland area of the wider Dipslope Farmland, which is outlined as having capacity for a development of this scale by the *Strategic Landscape Capacity Assessment for Wind Energy in Angus*. The Crofts Farm development complies with the recommended scale of development presented in this guidance, as well as other design considerations outlined within the documents, such as being located away from the ridge that marks the break of the landscape between the coastal area around the A92.

Landscape Assessment

The proposed Crofts Farm Wind development is located within the Angus Lowlands and Hills Character Type, specifically within the Dipslope Farmland Landscape Character Area, within the Tayside Landscape Character Assessment and would affect a proportion of part of this area. As an area of intensive farming practice, this area has a medium to low landscape sensitivity and there would be no unacceptable effects on the wider landscape character area.

The *Strategic Landscape Capacity Assessment for Wind Energy in Angus* states that this landscape area has a medium capacity for a development of this scale. The landscape is described as having the capacity to absorb well-sited developments, particularly in the north and central areas. The acceptable level of change within this landscape is from a landscape with occasional/no windfarms to a landscape with wind turbines. The addition of the proposed two turbine development within this landscape does not introduce an overbearing or dominant feature into the local landscape, and the assessment has found that the proposed acceptable future scenario would not be exceeded by the introduction of the Crofts Farm turbines.

Considering the wider area, the assessment has concluded that there would be no significant indirect effects from any of the other landscape character types or within the study area.

Effects on Designated Landscapes

The landscape of the site area is not designated and as such there will be no direct effects on any designated landscape and any effects would be as a result of indirect landscape effects from designated areas within the study area. The assessment has concluded that there would be no significant indirect landscape effects on designated landscape areas including Areas of Great Landscape Value, Special Landscape Areas and Gardens and Designed Landscapes.

Visual Assessment

The viewpoint analysis is contained in **Section 7.12** and indicates that there would be no significant visual effects occurring beyond ~1.6km from the proposed turbines. Out of the eighteen viewpoints assessed only three were found to have significant effects. The conclusions from the viewpoint assessment have been used to form a view as to the level of overall visual effects within the study area.

Visual Effects: Construction Period

There will be no significant visual effects resulting from the construction period and visibility of the ground based activity. Views of concentrated areas of construction could however lead to a temporary and negative effect that in some cases may appear more disruptive than the finished development. Post-construction, the appearance of the site would recover a calmer visual character with negligible levels of activity visible on site from the nearest visual receptors.

Visual Effects: Operational Period

There would be some significant visual effects from the nearby settlement of Redford as well as from one of the nearby properties within 1km of the proposed development. The views however, were not found to be overbearing or dominant; the effects arise from the addition of two tall, vertical features into the local landscape.

Cumulative Landscape and Visual Effects

The Crofts Farm turbines would rarely be seen in conjunction with other wind turbines, with only one operational turbine located within almost 20km of the proposed development and one consented development within 10km. Cumulative views do occur from the more

elevated areas and hill tops in the region, however, from these locations the Crofts Farm Wind Turbines will rarely appear as significant or prominent features in these views.

Certain Impact

The North Mains of Cononsyth turbine is the only operational turbine within 15km of the proposed development. While there are some areas from where both developments are visible, these were found to be extremely limited due to intervening topography between the developments. Simultaneous views of both developments tend to be limited to more elevated areas to the west such as Turin Hill and Balmashanner Hill. It is considered that the overall level of cumulative effect due to Crofts Farm would be negligible, which would not be significant.

Likely Impact

Considering the introduction of the proposed Crofts Farm Wind Turbines and the effects it will have on operational and consented projects in the study area, it is considered that the overall level of cumulative effect due to Crofts Farm would remain negligible, due again in part to the small numbers of development in proximity to the proposed turbines. The nearest consented project is located over 5km from Crofts Farm and any cumulative effects would not be significant.

Uncertain Impact

In addition to the above, when considering all the currently planned developments, levels of intervisibility would become low, with development in the immediate vicinity limited to single turbine development similar in size to the proposed Crofts Farm development.

7.10 Summary of Effects

Typically the two proposed turbines at Crofts Farm would form a linear balanced layout which would relate well to both the scale of the landscape and the form of the topography. Assessed significant effects are isolated, only occurring within ~1.6km of the turbines. These relate to the visual impact at one property and to three of the assessed viewpoints. Effects outside this distance quickly diminish, which indicates localised impacts that are not widespread.

The turbines would be introduced to an area of landscape which is already busy and does not have a wild or remote nature, being characterised by its agricultural nature as well as by the upland landscape to the north-west. This area of the Dipslope Farmland has been identified by the *Strategic Landscape Capacity Assessment for Wind Energy in Angus* as having the most potential for a development of this scale. The development of two turbines to create a small wind cluster at this site will have a limited impact on both the local landscape and the wider region.

8 Noise

8.1 Introduction

This section considers the potential noise impacts and effects associated with the operation of the proposed wind turbines at Arbikie Farm.

Potential Impacts

Noise can have an effect on the environment and on the quality of life enjoyed by individuals and communities. The impact of noise can therefore be an important consideration in the determination of planning applications. Noise impacts can arise from three distinct areas of the wind development:

- The construction of the wind cluster;
- During operation of the wind cluster; and
- Resulting from increased traffic flow during the construction and operation stages.

Given the relatively small scale of the development, construction noise will be short term and in the most part will not increase background noise levels beyond the recommended limits set out by the World Health Organisation and the former Department of the Environment. As such we do not believe that it should be necessary to assess the construction phase noise.

Terminology

The symbols used for noise levels in this report are:

- L_{WA} is the A-weighted sound power level – a measure of the total sound energy emitted by a source of noise;
- $L_{A,eq}$ is the A-weighted equivalent continuous sound pressure level, which is a measure of the total ambient noise at a given place at a given time; and
- $L_{A90,10min}$ is the A-weighted sound pressure level exceeded for 90% of the time in the averaging time period specified – in this case 10 minutes – and is the index most widely used for background noise level measurements.

ETSU-R-97 states that the $L_{A90,10min}$ noise descriptor should be adopted for the noise assessment and that 2dB(A) should be subtracted from $L_{A,eq}$ values, when converting them to $L_{A90,10min}$ values.

Wind speeds referred to in this report:

- V_{10} values are derived from wind speeds measured at a 10m height on a 10m met mast installed at the site of the proposed turbines for the duration of the background noise survey. On-site wind shear cannot be measured effectively by a 10m mast and therefore the simplified wind shear correction method is adopted: for turbines up to a hub height of 60m, predicted turbine noise levels are required to be reduced by 2ms^{-1} relative to standardised 10m wind speeds, as a worst case assumption. V_{10} wind speeds are therefore wind speeds measured at 10m height and

increased by 2ms^{-1} . These adjusted 10m values are used in the scatter plots in order that levels remain referenced to standardised rather than measured 10m wind speeds. This approach is compliant with section 4.5 of the IOA 'A good practice guide...'⁵

8.2 Guidance

Guidance for assessing operational noise from wind farms is given in:

- 'ETSU-R-97: the Assessment and Rating of Noise from Wind Farms (1997)'; The Department of Trade and Industry. (usually referred to as the Noise Working Group Recommendations); and
- 'Guidelines for Community Noise', World Health Organisation, 1999.

Whilst the Noise Working Group Recommendations remains the most authoritative guidance document on assessing noise from wind farms, the WHO Guidelines on acceptable night time noise levels have led to a slight tightening of the accepted night time noise levels. We have followed the Noise Working Group methodology accounting for this reduced noise level.

The Institute of Acoustics has since provided clarity on requirements for noise assessment of wind turbines in an attempt to encourage a standardised approach to this type of measurement:

- 'Prediction and assessment of wind turbine noise – agreement about relevant factors for noise assessment from wind energy projects', Acoustics Bulletin, March/April 2009, IOA
- More recently; 'A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise', May 2013, IOA

In September 1996, the Noise Working Group published its recommendations in ETSU-R-97. The report describes a framework for the measurement of wind farm noise and includes suggested noise limits, derived with reference to standards and guidance relating to the emission of noise from various sources existing at that time.

The ETSU-R-97 guidelines recommend that the wind turbine noise should be limited to an absolute lower limit, in this case 35dB(A) [$L_{A90,10\text{min}}$] for quiet daytime periods and 43dB(A) for night-time periods, or 5dB(A) above the background noise levels, whichever the greater. However, the night time period lower limit has been set to the more stringent 38dB(A) level to reflect the World Health Organisation guidelines on sleep disturbance⁶.

The quiet daytime periods (amenity hours), are defined as:

⁵ Institute of Acoustics, "A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise", p23, 2013

⁶ World Health Organisation, "Guidelines for Community Noise", p40, 1999

- 18:00 – 23:00 – Monday to Friday
- 13:00 – 23:00 – Saturdays
- 07:00 – 23:00 – Sundays

Night time periods are: 23:00 – 07:00 – every day

8.3 Approach

In order to assess the likelihood of noise related complaints and to establish noise related planning conditions for the proposal should it be consented, a background noise survey has been carried out at three properties representative of the nearest noise sensitive receptors to the development. The monitoring locations were agreed in consultation with Angus Council during a site visit on Tuesday 26th February 2013. These were; Crofts Cottage, Scotia House and Grange of Conan Farm.

The assessment has been carried out in accordance with the recommendations of ETSU-R-97, The Assessment and Rating of Noise from Wind Farms and guidelines presented in the Institute of Acoustics (IOA) Bulletin, March/April 2009. Although the surveys were conducted prior to the release of the IOA's 'A good practice guide...'⁷, this assessment is compiled in light of these recommendations.

Detailed predictions of the operational noise of two variants of the Enercon E48 turbine, the most likely candidate machine for the site, have been made and compared with the measured background noise levels used to derive noise related constraints for the project. Using this data, an assessment of the likelihood of the project to meet the derived noise limits has been undertaken.

8.4 Background noise measurements

Prior to the noise survey, a three turbine layout was tabled for Crofts Farm. The resulting 35dB L_{A90} noise contour generated from this layout identified the properties lying within or close to this contour which, under guidance from Angus Council, should be referenced in the noise impact assessment. Since then, updated guidance from the IOA⁸ has resulted in the requirement to make more conservative assumptions in the Noise Impact Assessment, particularly in relation to the method of accounting for on-site wind shear. These more conservative assumptions have tightened the noise constraints, further constrained by potential cumulative turbine noise effects with North Mains of Cononsyth, such that a two turbine layout is now proposed.

Location map

Figure 8.1 shows the 35dB L_{A90} noise contour (the extent of the shaded area) generated for the two turbine layout and follows the updated IOA guidance detailed in later sections. **Figure 8.1** also shows the locations of the proposed wind turbines, the 10m met-mast and

⁷ Institute of Acoustics, "A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise" — issued 05-2013

⁸ Institute of Acoustics, "A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise", 2013

the nearest potential noise sensitive receptors. The 35dB(A) contour is inclusive of a cumulative contribution from the Enercon E33 turbine located at North Mains of Cononsyth [T3].

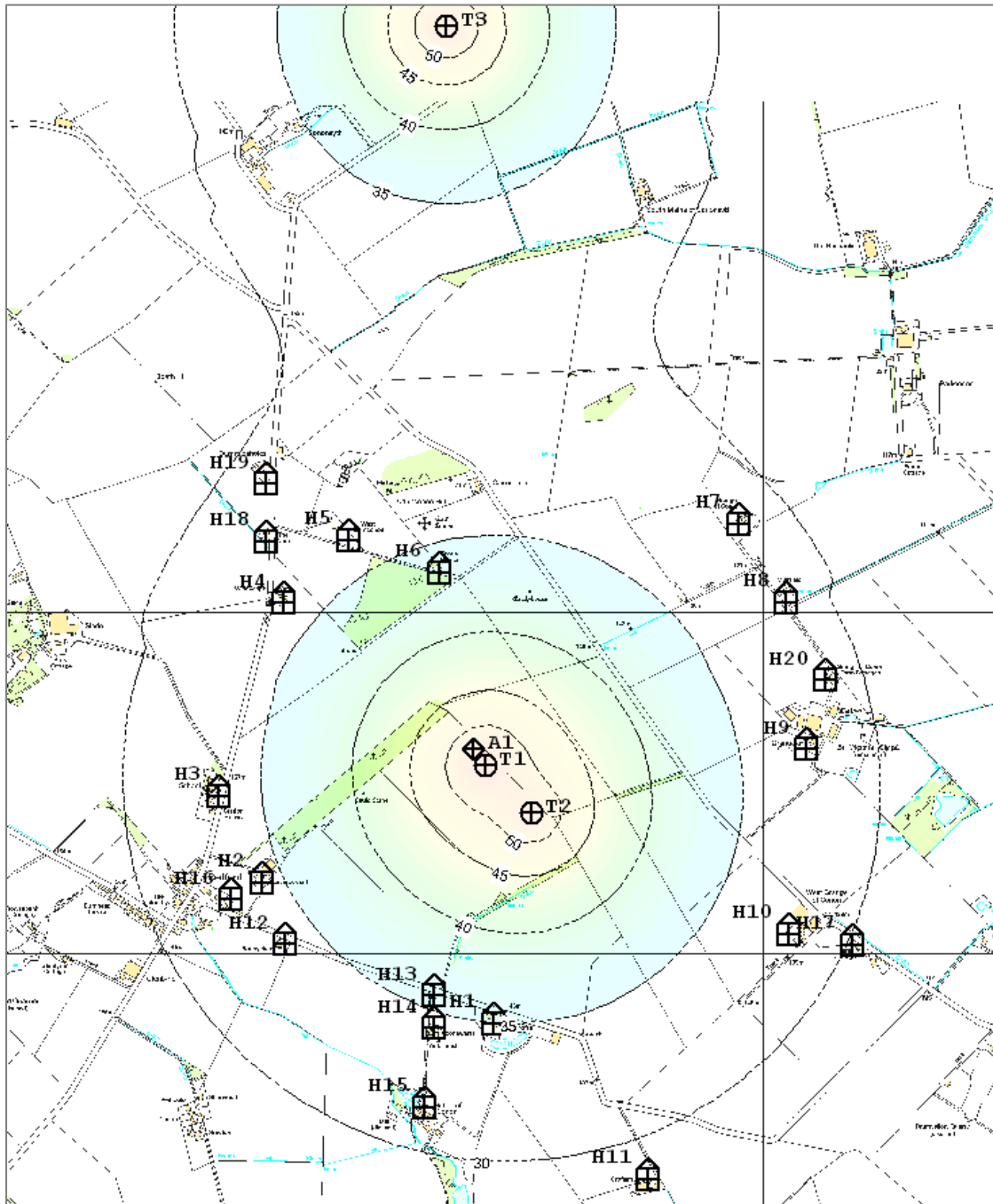


Figure 8.1 – Map showing turbines and potential noise receptors in relation to the cumulative 35dB noise contour.

Key:

Proposed Crofts Farm wind turbines: ⊕ T1, T2

Built North Mains of Cononsyth turbine: ⊕ T3

10m met-mast ⊕ A1

The nearest potential noise sensitive receptors. 🏠 H1-20

Noise monitoring was conducted at three locations to characterise the prevailing background noise environment representative of the nearest noise sensitive receptors. These locations were representative of the outdoor amenity areas at Scotia House (H6), Crofts Cottage (H13) and Grange of Conon Farmhouse (H9). Measurements were made between the 1st and the 27th of March 2013.

In setting applicable noise limits, the potential noise receptors identified in **Figure 8.1** were apportioned the noise limit criteria shown in **Table 8.1**, based on consultation with Angus Council.

Table 8.1 – Potential noise receptors, survey locations and representative background criteria

House ID	Name	Easting	Northing	Monitored	Representative of:
1	Crofts Farm (Developer)	357212	743798		45 + 5 dB(A) ⁹
2	Laverockhall	356535	744210		
3	Station House	356408	744465		
4	Windyedge	356597	745031		
5	West Cairnconon	356787	745215		
6	Scotia House	357055	745120	Y	
7	Grange of Conon Cottage	357932	745262		
8	Muirfield	358071	745032		
9	Grange of Conon Farmhouse	358131	744602	Y	
10	West Grange of Conon	358079	744060		
11	Croftsmuir	357667	743341		35dB(A) (Fixed)
12	Bonnycheer	356602	744030		
13	Crofts Cottage	357041	743879	Y	
14	Ardalanish and Coonawarra	357040	743784		
15	Milton of Conon Farmhouse	357012	743552		35dB(A) (Fixed)
16	Redford - Three properties	356444	744161		
17	West Grange of Conon Farm Cottages	358267	744029		35dB(A) (Fixed)
18	The Whin	356548	745211		
19	Dummiesholes	356548	745380		
20	Grange of Conon Farm Cottage	358186	744804		

Table 8.1 shows where the measured background noise survey data was used to set noise limits. Properties Croftsmuir (H11), Milton of Conon Farmhouse (H15) and West Grange of Conon Farm Cottages (H17) are considered sufficiently distant from the development for a fixed 35dB(A) L_{A90} limit to be appropriate.

Monitoring position 1 at H13-Crofts Cottage

Crofts Cottage is located off the minor road that runs east from Redford in the direction of Crofts Farm. The dwelling is the most northerly of those on the access track running south from Crofts Cottage down past Croftburn (H14) to Milton of Conon Farmhouse (H15). **Figure 8.2** shows the dwellings near Crofts Cottage in relation to the noise monitoring position.

⁹ Crofts Farm has a financial interest in the project so a higher noise limit is applicable at this property, defined as 45dB(A) or 5dB above background, whichever is the greater.

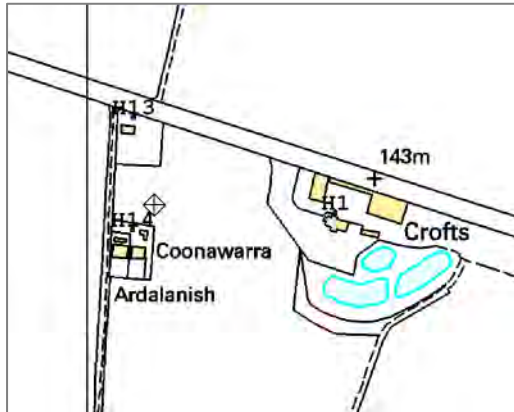


Figure 8.2 – Map showing Crofts Farm, Crofts Cottage, Ardalanish and Coonawarra and monitoring position 1.

Key

Monitoring position 

Occupied dwellings H1,H13,H14

The noise monitoring equipment was positioned in a paddock between Crofts Cottage and Coonawarra, at its eastern edge, where it was secured to the boundary fence as shown **Figure 8.3**. The location was chosen in order it be further from the road than Crofts Cottage as it was anticipated that the road was likely to be a source of noise during certain times of the day. The monitoring position is evenly exposed to winds from all directions except during conditions downwind of either of the two nearby properties. During both installation and subsequent site visits, the noise environment was relatively quiet with only distant traffic and occasional activity at Crofts Farm audible. Livestock were not present in the paddock or adjacent field during the monitoring period.



Figure 8.3 – Noise monitoring kit at position 1 looking east.

Details of the monitoring equipment used at position 1 are shown in **Table 8.2**.

Table 8.2 – List of equipment used at position 1

Equipment List	
<i>Sound Level Meter (IEC 651 Type 1):</i>	<i>NL-52 00610175</i>
<i>Sound Level Calibrator (BS7189 Type 1):</i>	<i>NC-74 35125826</i>
Microphone:	<i>Instrument standard</i>
Tripod:	<i>Single integrated pole (1.2m)</i>
Wind Shield:	<i>Double skin Rion WS-15</i>
Environmental Case:	<i>Yes</i>
Tripod/measurement GPS position:	<i>357058,743805</i>
Nearest reflecting elements & distances from microphone:	<i>Nothing within 20m</i>

Monitoring position 2 at H6-Scotia House

Scotia House sits towards the summit of Cairnconon Hill at an altitude 40m higher than Crofts Cottage and is more exposed. The property is sheltered to the southwest by a triangle of trees that is about 250m wide on its northern side, facing the property. It was vital to the assessment that this location was monitored, so in the absence of timely permission to monitor at Scotia House, a proxy position was located nearby. Permission did come from the resident, but at a later time toward the end of the monitoring period. The amenity area at Scotia House is relatively compact and it would have been challenging to find a suitable position within the curtilage that was beyond the influence of the facades of the house and large garage.

The noise monitoring equipment was positioned near the northern corner of the field to the south of the property and trees, and approximately 75m southwest of the property. This position is sheltered from winds arriving from west through northwest. It was anticipated that, under windy conditions, the noise produced by the trees would dominate the noise environment. As there are fewer trees within 20m of the monitoring position than within 20m of the properties amenity area, it was considered improbable that noise from the trees would influence the monitoring position more than a position within the amenity area at Scotia House. On this basis, the position was deemed to be representative of the property if not actually conservative. **Figure 8.4** shows a map of the relative positions of the property and monitoring position.

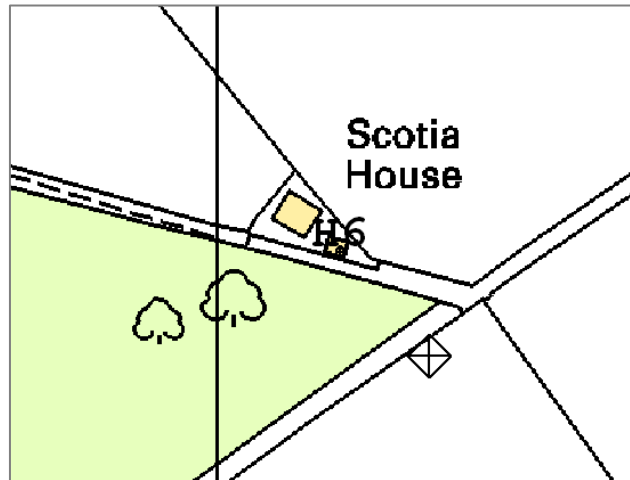


Figure 8.4 – Map showing Scotia House and monitoring position 2.

Key

Monitoring position 

Figure 8.5 shows the monitoring position in relation to the property.



Figure 8.5 – Noise monitoring kit at position 2 looking northeast toward Scotia House.

Details of the monitoring equipment used at position 2 are listed in **Table 8.3**

Table 8.3 – List of equipment used at Scotia House

Equipment List	
Sound Level Meter (IEC 651 Type 1):	NL-52 00810303

Sound Level Calibrator (BS7189 Type 1):	NC-74 35125826
Microphone:	<i>Instrument standard</i>
Tripod:	<i>Single integrated pole (1.2m)</i>
Wind Shield:	<i>Double skin Rion WS-15</i>
Environmental Case:	Yes
Tripod/measurement GPS position:	357120,745063
Nearest reflecting elements & distances from microphone:	<i>No flat surfaces.</i>

Monitoring position 3 at H9-Grange of Conon Farmhouse

Lying to the east of the site, Grange of Conon Farmhouse is the first property on a network of lanes that run east towards Colliston. This is a working farm on which there were anticipated to be a number of potential noise sources. The amenity area lies to the west of the property where some screening from the many farm buildings is provided by a head-height box hedge and the farmhouse itself.

The noise monitoring equipment was positioned centrally to the amenity area, the perimeter hedge providing significant shelter while remaining more than 5m distant. Some machinery operating at the time of deployment contributed to an L_{Aeq} of around 40 dB(A). There was less bird activity evident here than at the other locations. **Figure 8.6** shows a map of the relative positions of the property and monitoring position.

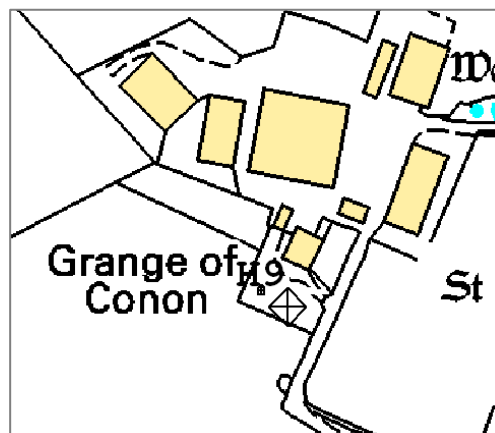


Figure 8.6 – Map showing Grange of Conon Farm and monitoring position 3.

Figure 8.7 shows the monitoring position in relation to the farmhouse.



Figure 8.7 – Noise monitoring kit at position 3; Grange of Conan Farmhouse.

Details of the monitoring equipment used at Grange of Conon Farmhouse are listed in **Table 8.4**.

Table 8.4 – List of equipment used at position 3

Equipment List	
Sound Level Meter (IEC 651 Class 1):	NL-52 00810307
Sound Level Calibrator (BS7189 Class 1):	NC-74 35125826
Microphone:	<i>Instrument standard</i>
Tripod:	<i>Single integrated pole (1.2m)</i>
Wind Shield:	<i>Double skin Rion WS-15</i>
Environmental Case:	<i>Yes</i>
Tripod/measurement GPS position:	358126,744581
Nearest reflecting elements & distances from microphone:	<i>Property façade 14m, 1.2m garden walls >5m</i>

Noise monitoring

Noise levels were recorded using Rion NL-52 Class 1 integrating sound level meters housed in an environmental case, set to log $L_{A90,10min}$ and $L_{Aeq,10min}$ throughout the monitoring period. A double skin wind shield was fitted to the microphone to ensure continued accuracy at the higher wind speeds. Acoustic calibration of the device was carried out before, during and after the monitoring period using a Rion NC-74 Acoustic Calibrator. The acoustic calibrator is calibrated every year, while the sound level meter is calibrated by an external body every two years. This ensures BS EN 61672 Class 1 compliance.

A 10m Met-mast was installed at 357153,744602 using a Logic Energy data logger and NRG sensors. This location was representative of the most northerly turbine of a previous three turbine layout proposal and the highest point on-site. A more central position was unavailable due to crop planting activity in that part of the field. This location was approximately 130m from the nearest of a strip of trees to the north. The trees may have sheltered the mast from winds arriving from between 250° and 320° from north but these

directions only made up 6% of the logged data, and therefore the effect of the trees is considered to be very limited. **Table 8.5** shows the met-mast sensors and calibration dates.

Table 8.5 – Met-mast sensors and calibration dates

Sensor	Model	Serial number	Date of last calibration
10m Anemometer	NRG #40C	1795-00200236	20/03/2012
9m Anemometer (optional)	NRG #40C	1795-00202774	16/04/2012
Vane	NRG 200P		N/A
Rain G	Davis-II		N/A

The NRG#200P wind vane was checked for zero point alignment on-site before deployment. Measurements were made over a sufficient period for an appropriate range of wind speeds to be recorded. Rainfall was also logged at the met-mast using a Davis II tipping bucket rain gauge with 0.02mm resolution. 10 minute data was logged throughout the monitoring period.

Exclusions – Atypical data

Rainfall data recorded at the met-mast was used to flag the presence of rain in the area and elevated levels recorded at the monitoring positions around that time were excluded. All monitoring positions evidenced a dawn chorus to varying degrees. Elevated levels deemed attributable to the dawn chorus were removed on a day-by-day basis. Time histories of the noise levels recorded at both properties were interrogated for atypical noise levels that may be time dependent or be one-off events that appeared not to be associated with the wind conditions. The data from Crofts Cottage and Scotia House appeared to show some evidence of traffic noise at certain times of the day. The data from Grange of Conan Farmhouse showed the presence of a process that became intermittently active during night-time periods. These data were also removed. Excluded atypical data appear on the resulting scatter plots for information but do not affect the regression analysis.

Data reduction

To establish the applicable noise limits, the remaining data were then plotted against the concurrent v_{10} wind speeds derived from the 10m met-mast and best fit correlations of noise levels to wind speed were established using regression analysis of up to fourth order as required by the ETSU-R-97 methodology. Both the function and correlation coefficient (R^2) values are stated on the relevant figures.

8.5 Wind turbine noise propagation model

Propagation model

The International Standard ISO 9613, 'Acoustics – Attenuation of Sound During Propagation Outdoors - Part 2', noise propagation model has been used for the turbine noise calculations. L_{Aeq} noise propagation was modelled using WindFarm v4.2.1.7 by ReSoft. L_{A90} levels were derived by subtracting two decibels from the L_{Aeq} values as per the ETSU-R-97 guidance.

The following input parameters are assumed and are consistent with current guidance. Octave band calculations were carried out with measured noise levels obtained via the turbine manufacturer assuming atmospheric attenuation coefficients corresponding to 10°C and 70% humidity, a ground attenuation factor of $G=0.5$ (representing semi-soft ground), and a receptor height of 4m.

Sound Power Levels

The proposed candidate turbine model is the Enercon E48 with a hub height of 56m. It is proposed that T1 is run at full capacity (800kW) while T2 operates in the curtailed 500kW mode. The sound power levels for the Enercon E33 on a 50m tower are also shown. **Tables 8.6, 8.7 and 8.8** show the measured octave band levels for each turbine.

Table 8.6 – Measured octave band noise levels as a function of wind speed (values in italics are extrapolated)

E48 - 800kW - 55m ¹⁰							
Reference V ₁₀ wind speed (ms ⁻¹)	4	5	6	7	8	9	10
Octaveband (Hz)	Measured sound power levels [dB(A)]						
63	<i>70.4</i>	<i>74.9</i>	<i>78.6</i>	<i>81.1</i>	<i>79.4</i>	<i>79.6</i>	<i>78.6</i>
125	<i>76.1</i>	<i>80.6</i>	<i>82.7</i>	<i>85.8</i>	<i>85.8</i>	<i>87.1</i>	<i>84.4</i>
250	<i>83.1</i>	<i>87.6</i>	<i>89.6</i>	<i>93.3</i>	<i>94.9</i>	<i>95.9</i>	<i>93.3</i>
500	<i>83.8</i>	<i>88.3</i>	<i>91.9</i>	<i>95.2</i>	<i>96.9</i>	<i>97.3</i>	<i>96.8</i>
1000	<i>81.4</i>	<i>85.9</i>	<i>91.7</i>	<i>93.6</i>	<i>95.3</i>	<i>94.9</i>	<i>97.9</i>
2000	<i>77.6</i>	<i>82.1</i>	<i>86.5</i>	<i>88.5</i>	<i>88.9</i>	<i>89.8</i>	<i>92.7</i>
4000	<i>73.8</i>	<i>78.3</i>	<i>82.7</i>	<i>85.6</i>	<i>85.6</i>	<i>88.6</i>	<i>87.6</i>
8000	<i>70.1</i>	<i>74.6</i>	<i>79.3</i>	<i>83.1</i>	<i>83.4</i>	<i>86.9</i>	<i>84.6</i>

Table 8.7 – Measured octave band noise levels as a function of wind speed (values in italics are extrapolated)

E48 - 500kW - 55m ¹¹ (Octaveband values for 8ms ⁻¹ have been scaled by their warranted broadband values)							
Reference V ₁₀ wind speed (ms ⁻¹)	4	5	6	7	8	9	10
Octaveband (Hz)	Measured sound power levels [dB(A)]						
63	<i>73.4</i>	<i>77.8</i>	<i>82.0</i>	<i>83.6</i>	<i>84.2</i>	<i>84.2</i>	<i>84.2</i>
125	<i>78.1</i>	<i>82.5</i>	<i>86.7</i>	<i>88.3</i>	<i>88.9</i>	<i>88.9</i>	<i>88.9</i>
250	<i>79.5</i>	<i>83.9</i>	<i>88.1</i>	<i>89.7</i>	<i>90.3</i>	<i>90.3</i>	<i>90.3</i>
500	<i>81.5</i>	<i>85.9</i>	<i>90.1</i>	<i>91.7</i>	<i>92.3</i>	<i>92.3</i>	<i>92.3</i>
1000	<i>84.2</i>	<i>88.6</i>	<i>92.8</i>	<i>94.4</i>	<i>95.0</i>	<i>95.0</i>	<i>95.0</i>
2000	<i>80.8</i>	<i>85.2</i>	<i>89.4</i>	<i>91.0</i>	<i>91.6</i>	<i>91.6</i>	<i>91.6</i>
4000	<i>73.5</i>	<i>77.9</i>	<i>82.1</i>	<i>83.7</i>	<i>84.3</i>	<i>84.3</i>	<i>84.3</i>
8000	<i>64.3</i>	<i>68.7</i>	<i>72.9</i>	<i>74.5</i>	<i>75.1</i>	<i>75.1</i>	<i>75.1</i>

¹⁰ WICO E48 Noise 439SEC04_07 OM I Report

¹¹ MBBM M69 130_1 E-48 500 kW Bericht

Table 8.8 – Measured octave band noise levels as a function of wind speed (values in italics are extrapolated)

E33 - 330kW - 50m ¹²							
Reference V ₁₀ wind speed (ms ⁻¹)	4	5	6	7	8	9	10
Octaveband (Hz)	Measured sound power levels [dB(A)]						
63	64.3	66.2	71.4	78.3	80.0	79.6	79.6
125	85.1	87.0	92.2	90.3	89.6	89.5	89.5
250	79.9	81.8	87.0	90.3	91.7	91.4	91.4
500	82.8	84.7	89.9	93.1	94.3	94.0	94.0
1000	85.1	87.0	92.2	95.1	96.0	95.9	95.9
2000	83.7	85.6	90.8	92.8	93.6	93.8	93.8
4000	78.3	80.2	85.4	86.6	88.0	88.3	88.3
8000	70.6	72.5	77.7	80.1	81.9	82.6	82.6

To reflect measurement uncertainty, a 2dB safety factor has been added to the calculated noise levels at each property.

Atmospheric attenuation

The attenuation of noise as it travels through the air varies with frequency. The atmospheric attenuation coefficients are tabulated below in **Table 8.9**:

Table 8.9 – Attenuation coefficients used for the noise propagation model

Octave Band (Hz)	63	125	250	500	1000	2000	4000	8000
Attenuation Coefficient	0.0001	0.0004	0.0010	0.0019	0.0037	0.0097	0.0328	0.1170

Modelled distances

'Line of sight' distances have been assumed and are calculated using the horizontal distance from the turbine to a position at the property closest to the development. This may be different from the monitoring location and represents a minimum distance from turbine to receptor, shown in **Table 8.10**.

Distances may also differ slightly from those presented in **Table 7.11** (the residential visual assessment) as the distances below represent the amenity areas, rather than the physical properties themselves.

¹² Report no.:P8.008.04, Acoustica – Carl Bro

Table 8.10 – Distances from the proposed turbines

Name	House ID	Horizontal Distance (m)
Crofts Farm	1	630
Laverockhall	2	740
Station House	3	790
Windyedge	4	760
West Cairnconon	5	770
Scotia House	6	580
Grange of Conon Cottage	7	1020
Muirfield	8	970
Grange of Conon Farmhouse	9	830
West Grange of Conon	10	830
Croftsmuir	11	1130
Bonnycheer	12	790
Crofts Cottage	13	610
Ardalanish and Coonawarra	14	690
Milton of Conon Farmhouse	15	920
Redford – three properties	16	840
West Grange of Conon Farm Cottages	17	1020
The Whin	18	920
Dummiesholes	19	1050
Grange of Conon Farm Cottage	20	940

Cumulative impact

The predicted propagation of noise from the E33 at North Mains of Cononsyth has been limited to a range of 2km, effectively restricting it to the properties that could reasonably be considered to have the possibility of a cumulative noise impact. These properties are H4,5,6,7,8,18,19, as shown previously in **Figure 8.1**. For these properties, the resulting predicted noise levels listed are inclusive of a contribution from all three turbines.

8.6 Predicted wind turbine noise levels

Table 8.11 shows the predicted cumulative turbine LA90,10min noise levels in dB(A) for v10 wind speeds of 5ms-1 to 10ms-1.)

The levels presented are inclusive of the +2dB safety factor. The ISO 9613-2 standard is used along with recommended input parameters to obtain realistic predictions of turbine noise during worst case propagation conditions (i.e. sound speed gradients due to downwind conditions or temperature inversions).

Table 8.11 – Predicted wind turbine noise levels (LA90,10min) at nearby properties

ID	Name	Easting	Northing	5	6	7	8	9	10
1	Crofts Farm	357212	743798	27.5	31.5	33.7	34.7	34.9	35.0
2	Laverockhall	356535	744210	26.3	30.1	32.5	33.7	34.0	34.1
3	Station House	356408	744465	25.4	29.2	31.7	32.9	33.2	33.2
4	Windyedge	356597	745031	25.7	29.6	32.1	33.3	33.6	33.7
5	West Cairnconon	356787	745215	25.7	29.6	32.1	33.3	33.6	33.6
6	Scotia House	357055	745120	28.3	32.2	34.7	35.9	36.2	36.3
7	Grange of Conon Cottage	357932	745262	23.7	27.7	30.0	31.1	31.3	31.3

8	Muirfield	358071	745032	24.0	28.0	30.3	31.4	31.6	31.6
9	Grange of Conon Farmhouse	358131	744602	24.9	28.8	31.1	32.1	32.4	32.3
10	West Grange of Conon	358079	744060	24.5	28.4	30.6	31.7	31.9	31.8
11	Croftsmuir	357667	743341	21.5	25.3	27.6	28.7	28.9	28.8
12	Bonnycheer	356602	744030	25.9	29.8	32.1	33.3	33.6	33.6
13	Crofts Cottage	357041	743879	28.1	32.1	34.3	35.4	35.6	35.6
14	Ardalanish / Coonawarra	357040	743784	26.8	30.7	33.0	34.0	34.3	34.3
15	Milton of Conon Farmhouse	357012	743552	23.9	27.8	30.1	31.2	31.4	31.4
16	Redford - Three properties	356444	744161	25.0	28.8	31.2	32.4	32.7	32.7
17	West Grange of Conon Farm Cottages	358267	744029	22.5	26.4	28.6	29.7	29.9	29.8
18	The Whin	356548	745211	24.1	28.1	30.5	31.7	32.0	31.9
19	Dummiesholes	356548	745380	23.2	27.2	29.6	30.7	31.0	30.9
20	Grange of Conon Farm Cottage	358186	744804	23.7	27.6	29.9	31.0	31.3	31.2

The table shows a maximum turbine noise level prediction of 36.2 dB(A), at Scotia House for a v_{10} wind speed of 10ms^{-1} .

8.7 Noise impact assessment

Wind data

Figure 8.8 shows the measured 10m wind speeds logged during the monitoring period. A direction of zero degrees equates to a northerly wind, $90^\circ = \text{E}$, $180^\circ = \text{S}$, $270^\circ = \text{W}$ etc.

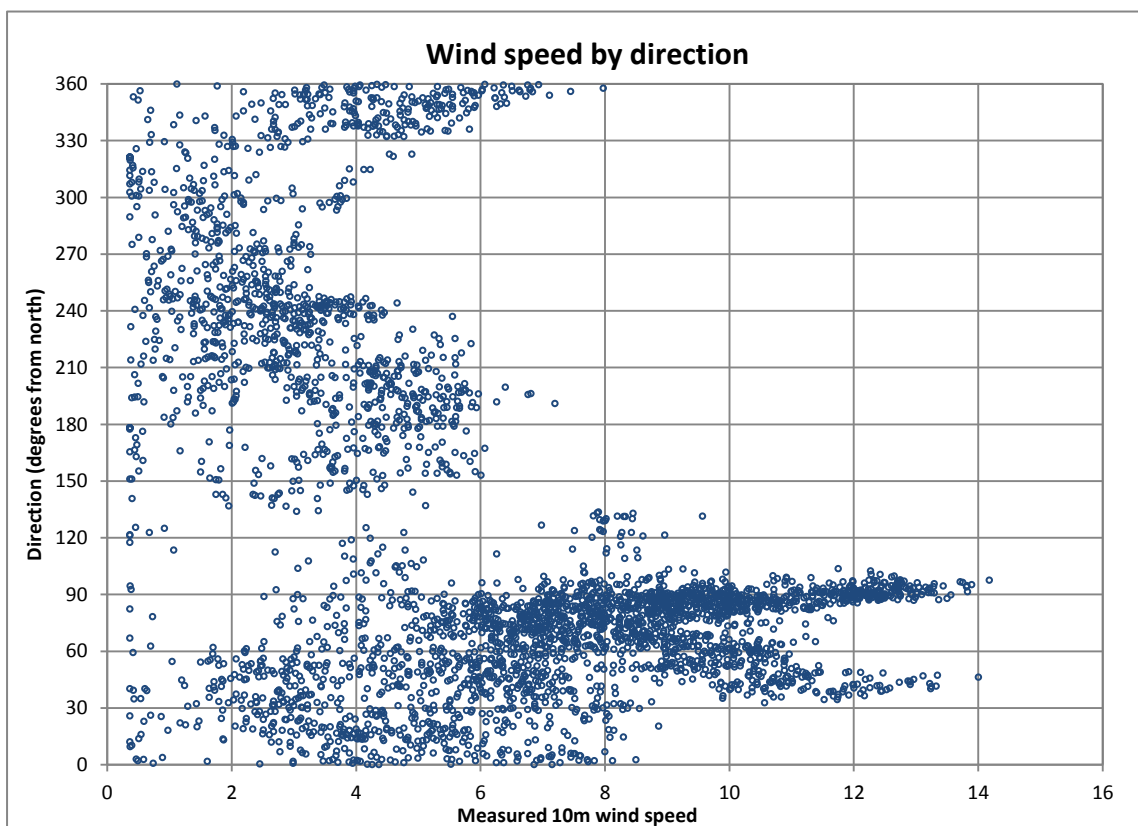


Figure 8.8 – Wind Speed Variation with Direction

NB. Due to exclusions, the analysis is based on a sub-set of the data shown in Figure 8.8.

The following figures and associated tables show the measured $L_{A90,10min}$ background noise levels as a function of standardised v_{10} wind speeds. The data are represented by best fit polynomial regression functions from which the noise limits are derived. The figures show the predicted turbine noise levels in relation to the derived limits.

In all cases, the plots are consistent with those measured in a quiet rural area. $L_{A90,10min}$ levels as low as 17dB(A) were recorded during night-time periods and remained below 40dB(A) for wind speeds up to 10ms^{-1} . The recorded background levels at each property are consistent with each other, Scotia House being marginally louder at higher wind speeds due to its elevated position and, potentially, the presence of trees.

Results – Crofts Cottage

Figure 8.9 shows background levels, derived limits and predicted turbine noise levels for Crofts Cottage during night-time periods.

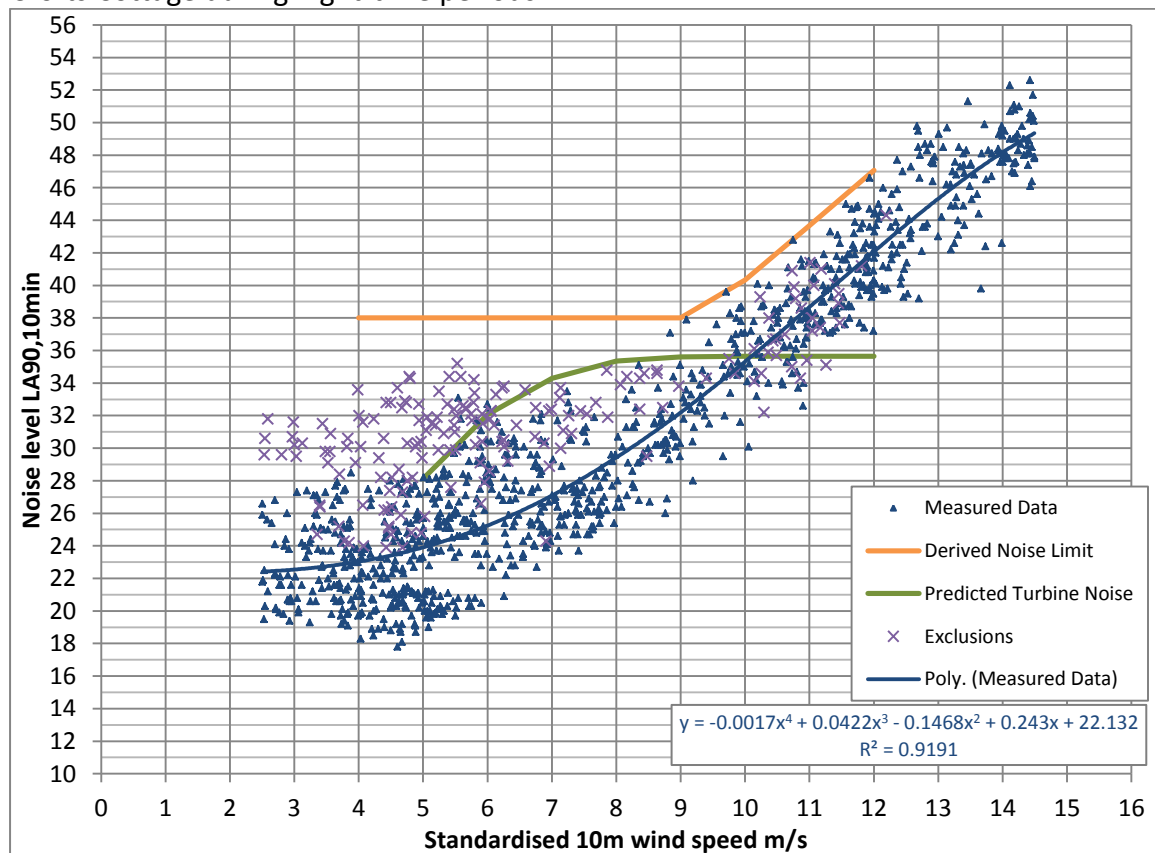


Figure 8.9 – background levels, derived limits and predicted turbine noise levels for Crofts Cottage during night-time periods.

The tabulated results for Crofts Cottage during night-time periods are shown in **Table 8.12**.

Table 8.12 – background levels, derived limits and predicted turbine noise levels for Crofts Cottage during night-time periods.

Standardised Wind speed	ms ⁻¹	4	5	6	7	8	9	10	11	12
Background Noise										
Number of values	-	110	156	99	81	60	57	48	80	92
Average value L _{A90,10min}	dB(A)	23.0	23.9	25.2	27.1	29.4	32.2	35.3	38.7	42.1
Calculated Constraint										
Average value L _{A90,10min}	dB(A)	38.0	38.0	38.0	38.0	38.0	38.0	40.3	43.7	47.1
Predicted Turbine Noise										
Average value L _{A90,10min}	dB(A)	-	28.1	32.1	34.3	35.4	35.6	35.6	35.6	35.6
Level Difference										
Exceedence	dB(A)	-	-9.9	-5.9	-3.7	-2.6	-2.4	-4.7	-8.0	-11.4

The results show that the predicted turbine noise level could be up to 7.2dB above the prevailing background level at a v₁₀ wind speed of 7ms⁻¹ when the turbines may be audible from time to time under certain wind conditions. In terms of the calculated noise constraints, the most critical wind speeds are 8 and 9ms⁻¹ when the turbines are predicted to be 2.6 – 2.4dB below the noise limit for night time periods. The turbines are less likely to be audible at v₁₀ wind speeds above 10ms⁻¹.

Figure 8.10 shows background levels, derived limits and predicted turbine noise levels for Crofts Cottage during quiet daytime hours.

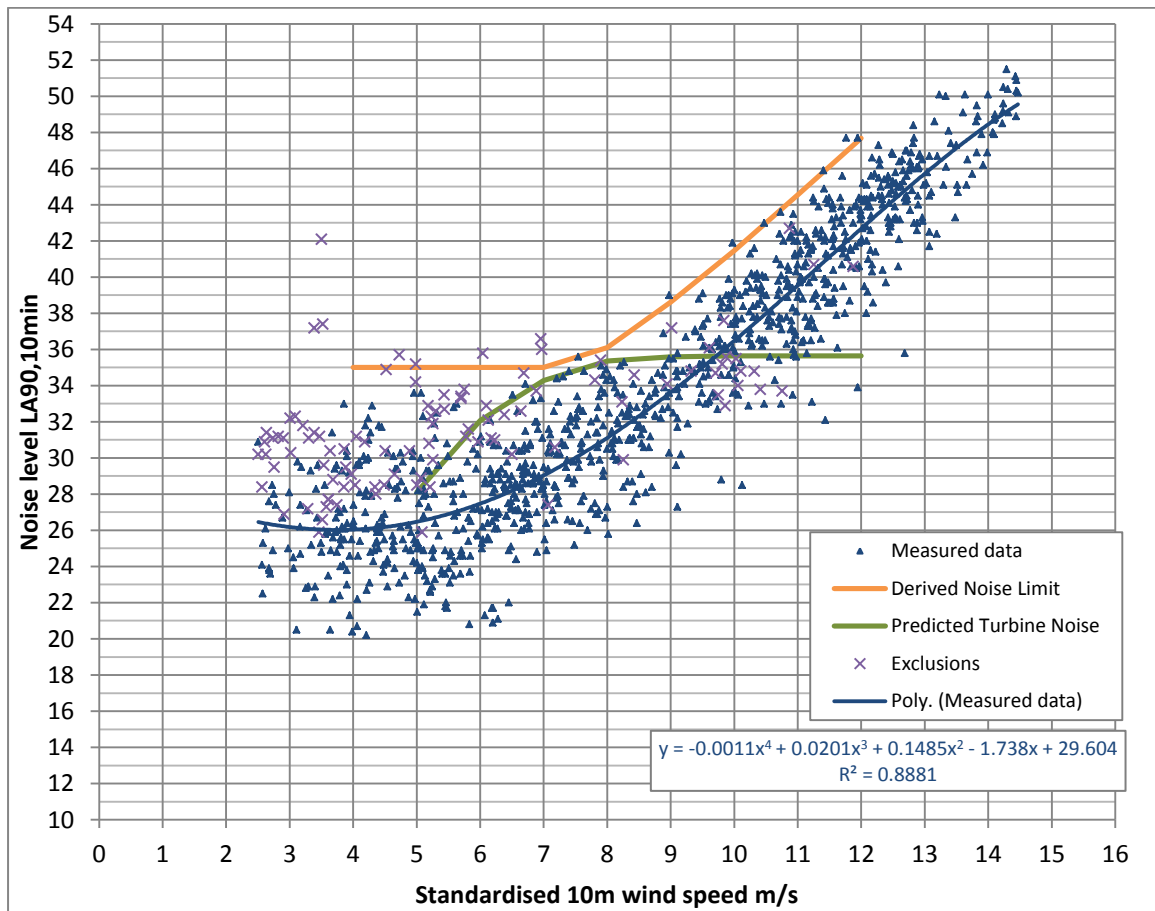


Figure 8.10 – background levels, derived limits and predicted turbine noise levels Crofts Cottage during quiet daytime hours.

The tabulated results for Crofts Cottage during quiet daytime hours are shown in **Table 8.13**.

Table 8.13 – background levels, derived limits and predicted turbine noise levels for Crofts Cottage during quiet daytime hours.

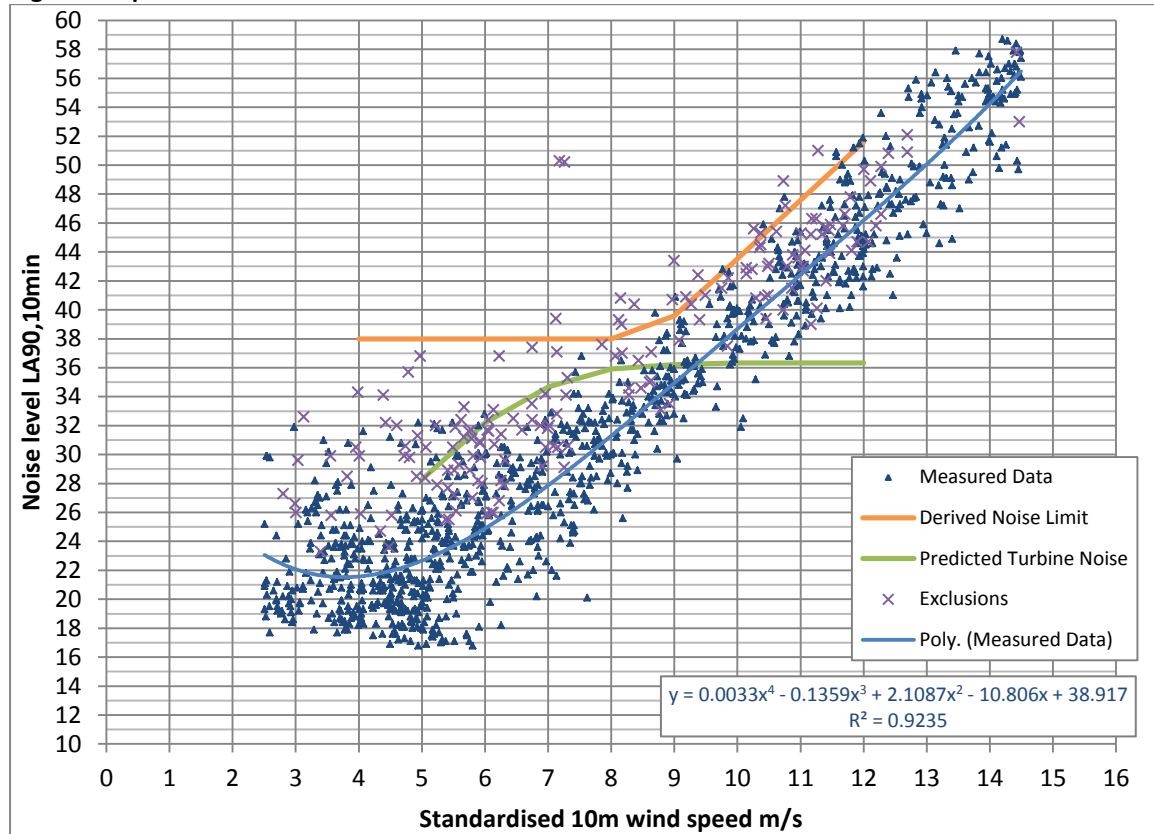
Standardised Wind speed	ms ⁻¹	4	5	6	7	8	9	10	11	12
Background Noise										
Number of values	-	87	88	96	112	90	63	94	118	105
Average value L _{A90,10min}	dB(A)	26.0	26.5	27.5	29.0	31.1	33.6	36.5	39.5	42.7
Calculated Constraint										
Average value L _{A90,10min}	dB(A)	35.0	35.0	35.0	35.0	36.1	38.6	41.5	44.5	47.7
Predicted Turbine Noise										
Average value L _{A90,10min}	dB(A)	-	28.1	32.1	34.3	35.4	35.6	35.6	35.6	35.6
Level Difference										
Exceedence	dB(A)	-	-6.9	-2.9	-0.7	-0.8	-3.0	-5.8	-8.9	-12.0

The results show that the predicted turbine noise levels could be up to 5.3dB above the prevailing background level at a v₁₀ wind speed of 7ms⁻¹ when the turbines may be audible from time to time under certain wind conditions. In terms of the calculated noise constraints, the most critical wind speeds are 7 and 8ms⁻¹ when the turbines are predicted to be 0.7 – 0.8dB below the noise limit for night time periods. The turbines are less likely to be audible at v₁₀ wind speeds above 10ms⁻¹.

Results – Scotia House

Figure 8.11 shows background levels, derived limits and predicted turbine noise levels for Scotia House during night-time periods.

Figure 8.11 – background levels, derived limits and predicted turbine noise levels for Scotia House during night-time periods



The tabulated results for Scotia House during night-time periods are shown in Table 8.14.

Table 8.14 – background levels, derived limits and predicted turbine noise levels for Scotia House during night-time periods.

Standardised Wind speed	ms ⁻¹	4	5	6	7	8	9	10	11	12
Background Noise										
Number of values	-	127	178	97	82	75	71	48	74	82
Average value L _{A90,10min}	dB(A)	21.8	22.9	24.9	27.6	30.9	34.6	38.5	42.6	46.6
Calculated Constraint										
Average value L _{A90,10min}	dB(A)	38.0	38.0	38.0	38.0	38.0	39.6	43.5	47.6	51.6
Predicted Turbine Noise										
Average value L _{A90,10min}	dB(A)	-	28.3	32.2	34.7	35.9	36.2	36.3	36.3	36.3
Level Difference										
Exceedence	dB(A)	-	-9.7	-5.8	-3.3	-2.1	-3.4	-7.2	-11.3	-15.3

The results show that the predicted turbine noise level could be up to 7.3dB above the prevailing background level at a v₁₀ at 6ms⁻¹ when the turbines may be audible from time to time under certain wind conditions. In terms of the calculated noise constraints, the most critical wind speed is 8ms⁻¹ when the turbines are predicted to be 2.1dB below the noise limit for night time periods.

Figure 8.12 shows background levels, derived limits and predicted turbine noise levels for Scotia House during quiet daytime hours.

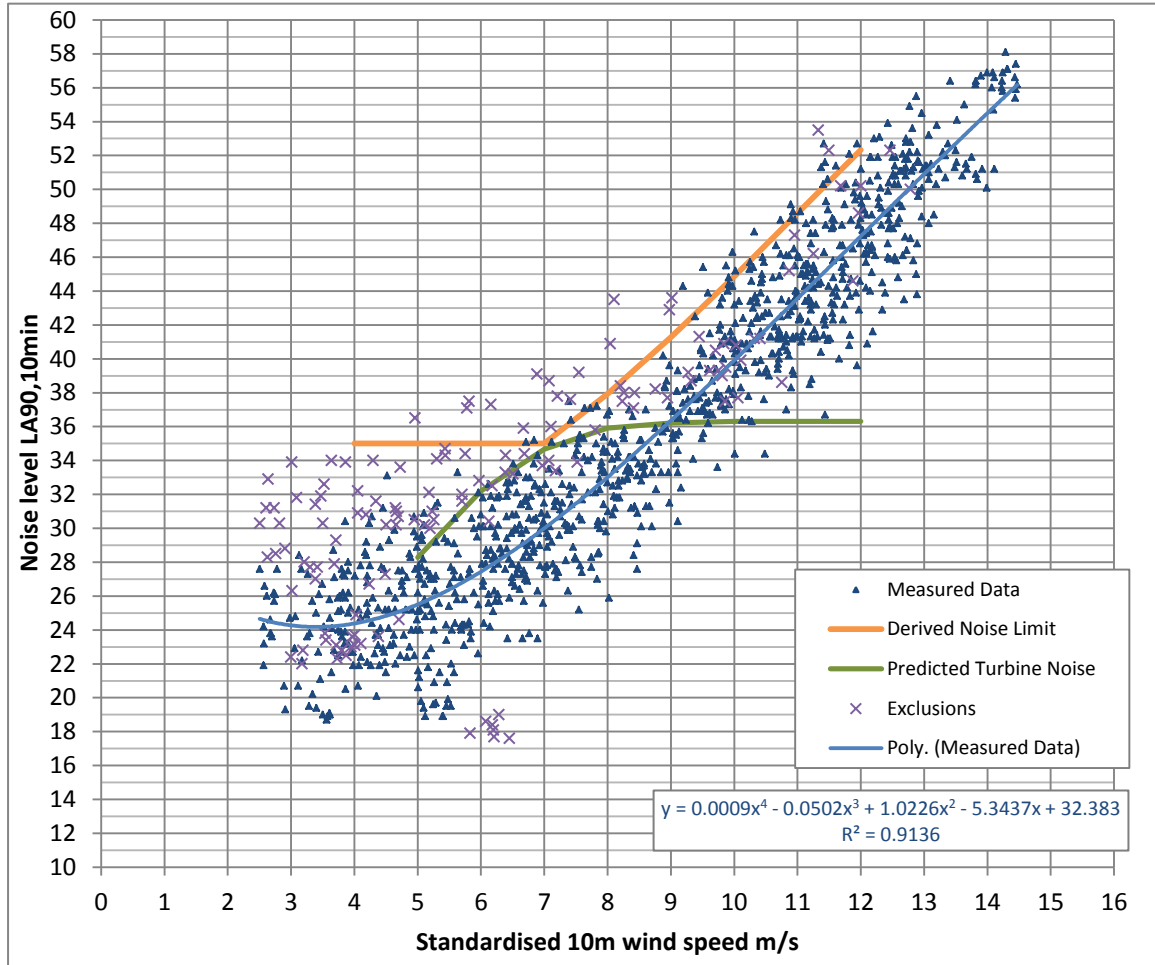


Figure 8.12 – background levels, derived limits and predicted turbine noise levels Scotia House during quiet daytime hours.

The tabulated results for Scotia House during quiet daytime hours are shown in Table 8.15.

Table 8.15 – background levels, derived limits and predicted turbine noise levels for Scotia House during quiet daytime hours.

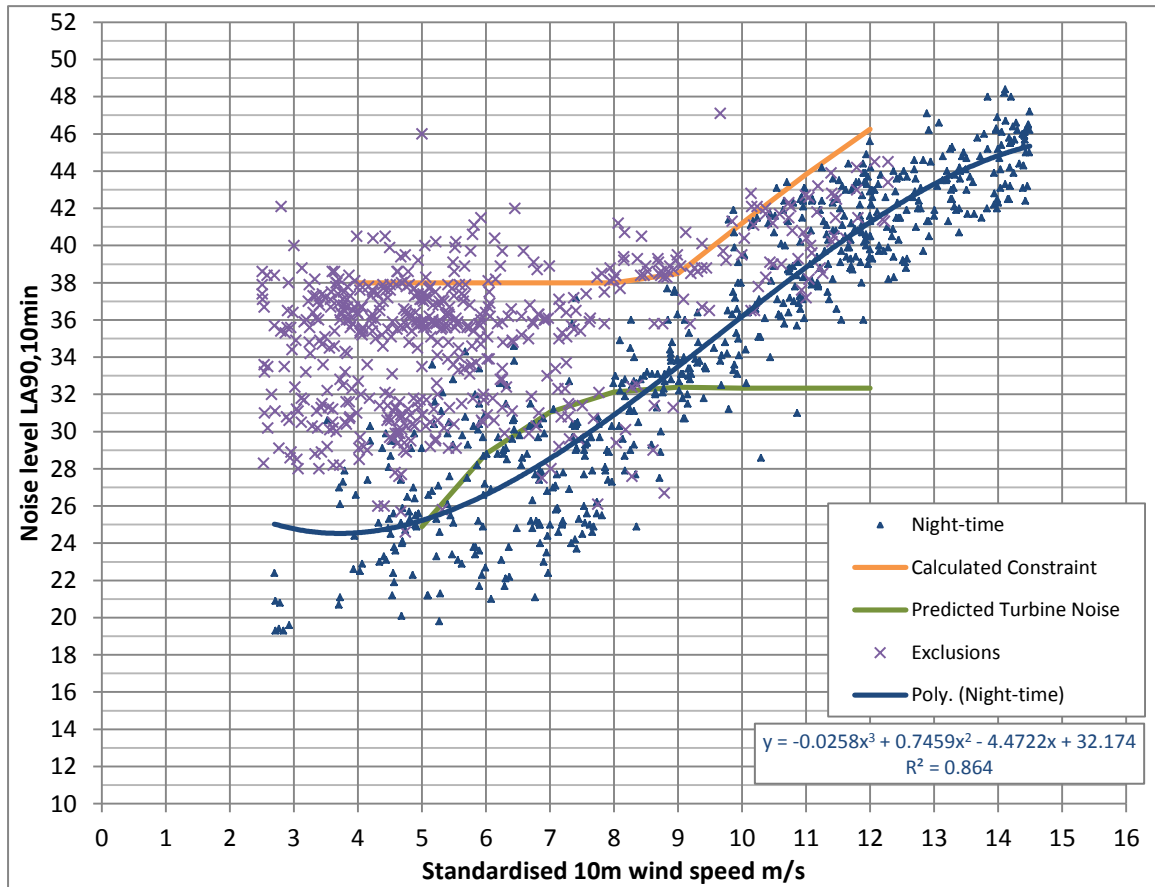
Standardised Wind speed	ms ⁻¹	4	5	6	7	8	9	10	11	12
Background Noise										
Number of values	-	81	90	90	109	86	69	104	122	103
Average value L _{A90,10min}	dB(A)	24.4	25.6	27.5	30.0	32.9	36.3	39.9	43.6	47.3
Calculated Constraint										
Average value L _{A90,10min}	dB(A)	35.0	35.0	35.0	35.0	37.9	41.3	44.9	48.6	52.3
Predicted Turbine Noise										
Average value L _{A90,10min}	dB(A)	-	28.3	32.2	34.7	35.9	36.2	36.3	36.3	36.3
Level Difference										
Exceedence	dB(A)	-	-6.7	-2.8	-0.3	-2.0	-5.1	-8.6	-12.3	-16.0

The results show that the predicted turbine noise level could be up to 4.7dB above the prevailing background level at v₁₀ wind speeds of 6 and 7ms⁻¹ when the turbines may be audible from time to time under certain wind conditions. In terms of the calculated noise constraints, the most critical wind speed is 7ms⁻¹ when the turbines are predicted to be 0.3dB below the noise limit for quiet daytime hours.

Results – Grange of Conan Farmhouse

Figure 8.13 shows background levels, derived limits and predicted turbine noise levels for *Grange of Conan Farmhouse* during night-time periods.

Figure 8.13 – background levels, derived limits and predicted turbine noise levels for Grange of Conan Farmhouse during night-time periods.



The tabulated results for *Grange of Conan Farmhouse* during night-time periods are shown in **Table 8.16**.

Table 8.16 – background levels, derived limits and predicted turbine noise levels for Grange of Conan Farmhouse during night-time periods.

Standardised Wind speed	ms ⁻¹	4	5	6	7	8	9	10	11	12
Background Noise										
Number of values	-	24	55	52	58	56	53	44	72	85
Average value L _{A90,10min}	dB(A)	24.6	25.2	26.6	28.6	30.9	33.5	36.2	38.8	41.2
Calculated Constraint										
Average value L _{A90,10min}	dB(A)	38.0	38.0	38.0	38.0	38.0	38.5	41.2	43.8	46.2
Predicted Turbine Noise										
Average value L _{A90,10min}	dB(A)	-	24.9	28.8	31.1	32.1	32.4	32.3	32.3	32.3
Level Difference										
Exceedence	dB(A)	-	-13.1	-9.2	-7.0	-5.9	-6.1	-8.9	-11.5	-13.9

The results show that the predicted turbine noise level could be up to 2.5dB above the prevailing background level at a v₁₀ wind speeds of 7ms⁻¹ suggesting that the turbines are unlikely to be audible in the majority of wind conditions. In terms of the calculated noise constraints, the most critical wind speeds are 8 and 9ms⁻¹ when the turbines are predicted to be 5.9 – 6.1dB below the noise limit for night time periods.

Figure 8.14 shows background levels, derived limits and predicted turbine noise levels for Grange of Conan Farmhouse during quiet daytime hours.

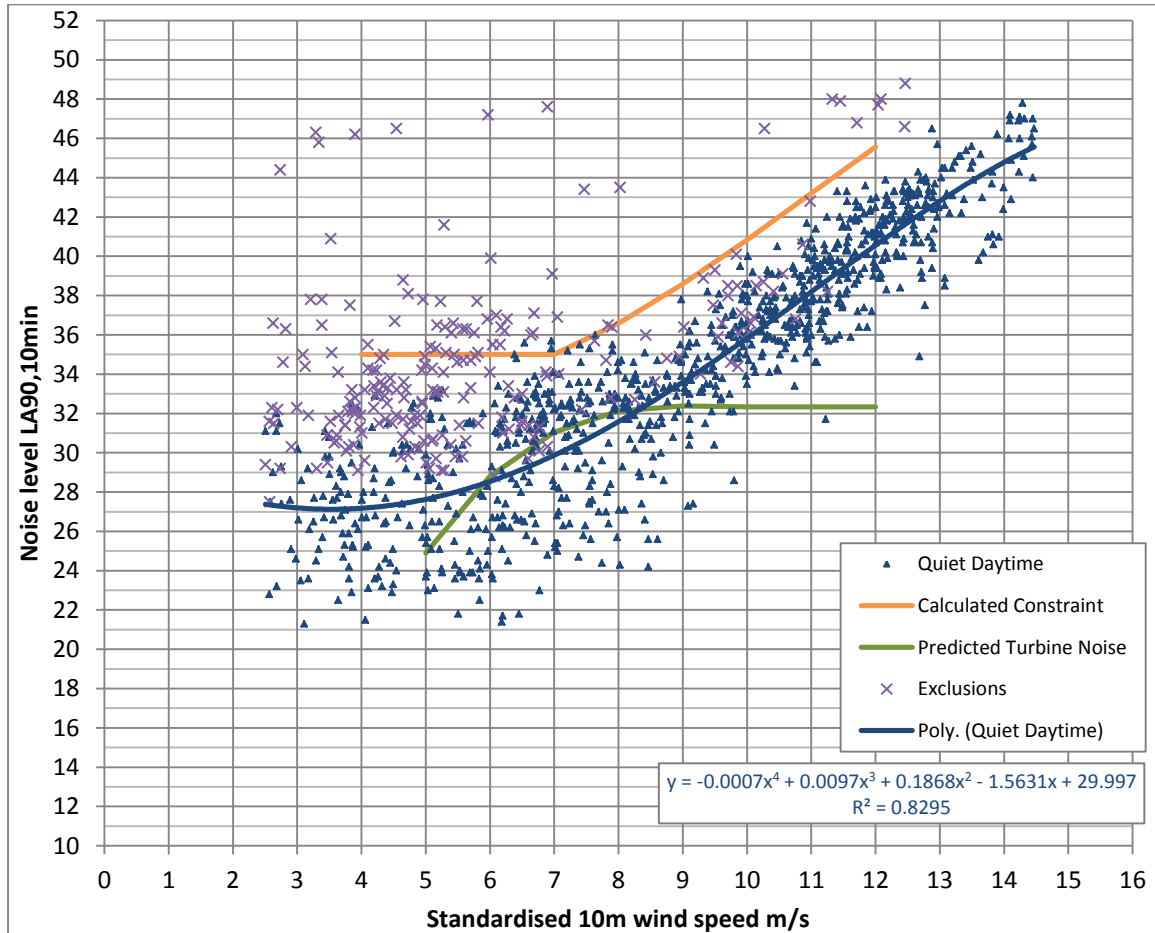


Figure 8.14 – background levels, derived limits and predicted turbine noise levels Grange of Conan Farmhouse during quiet daytime hours.

The tabulated results for Grange of Conan Farmhouse during quiet daytime hours are shown in Table 8.17.

Table 8.17 – background levels, derived limits and predicted turbine noise levels for Grange of Conan Farmhouse during quiet daytime hours.

Standardised Wind speed	ms ⁻¹	4	5	6	7	8	9	10	11	12
Background Noise										
Number of values	-	59	53	76	102	88	68	99	121	103
Average value LA90,10min	dB(A)	27.2	27.6	28.5	29.9	31.6	33.6	35.8	38.2	40.6
Calculated Constraint										
Average value LA90,10min	dB(A)	35.0	35.0	35.0	35.0	36.6	38.6	40.8	43.2	45.6
Predicted Turbine Noise										
Average value LA90,10min	dB(A)	-	24.9	28.8	31.1	32.1	32.4	32.3	32.3	32.3
Level Difference										
Exceedence	dB(A)	-	-10.1	-6.2	-4.0	-4.5	-6.2	-8.5	-10.9	-13.2

The results show that the predicted turbine noise level could be up to 1.2dB above the prevailing background level at a v10 wind speeds of 7ms-1 suggesting the turbines are

unlikely to be audible in the majority of wind conditions. In terms of the calculated noise constraints, the most critical wind speeds are 7 and 8ms⁻¹ when the turbines are predicted to be 4.0 – 4.5dB below the noise limit for quiet daytime hours.

Tabulated exceedences for all properties during night-time periods

The exceedences (dB) are shown in **Table 8.18**. Colours denote applicable limits, no colour shows where a fixed 35dB(A) noise limit was applied. Negative numbers show levels below the derived noise limits.

Table 8.18 – Tabulated exceedences (dB) for all properties during night-time periods

House Name	Standardised v10 Wind Speed (m/s)							
	5	6	7	8	9	10	11	12
Crofts Farm	-17.5	-13.5	-11.3	-10.3	-10.1	-10.1	-10.1	-12.1
Laverockhall	-11.8	-7.9	-5.5	-4.3	-4.0	-6.3	-9.6	-13.0
Station House	-12.6	-8.8	-6.3	-5.1	-4.8	-7.1	-10.4	-13.8
Windyedge	-11.7	-7.7	-5.3	-4.1	-5.5	-9.4	-13.5	-17.5
West Cairnconon	-11.5	-7.4	-5.1	-3.9	-5.3	-9.3	-13.3	-17.3
Scotia House	-9.7	-5.8	-3.3	-2.1	-3.4	-7.2	-11.3	-15.3
GoC Cottage	-13.4	-9.2	-7.0	-6.0	-6.3	-9.0	-11.7	-14.1
Muirfield	-13.3	-9.2	-7.1	-6.0	-6.3	-9.1	-11.7	-14.1
GoC Farmhouse	-13.1	-9.2	-7.0	-5.9	-6.1	-8.9	-11.5	-13.9
West GoC	-13.5	-9.6	-7.4	-6.3	-6.6	-9.4	-12.0	-14.4
Croftsmuir	-13.5	-9.7	-7.4	-6.4	-6.1	-6.2	-6.2	-6.2
Bonnycheer	-12.1	-8.3	-5.9	-4.7	-4.4	-6.7	-10.1	-13.5
Crofts Cottage	-9.9	-5.9	-3.7	-2.6	-2.4	-4.7	-8.0	-11.4
Croftburn	-11.2	-7.3	-5.1	-4.0	-3.7	-6.0	-9.4	-12.8
Milton of Conon Farmhouse	-11.1	-7.2	-4.9	-3.8	-3.6	-3.6	-3.6	-3.6
Redford - three properties	-13.1	-9.2	-6.8	-5.6	-5.3	-7.6	-11.0	-14.4
West GoC Farm Cottages	-12.5	-8.6	-6.4	-5.3	-5.1	-5.2	-5.2	-5.2
The Whin	-12.9	-8.7	-6.5	-5.4	-6.7	-10.7	-14.8	-18.8
Dummiesholes	-13.4	-9.0	-6.9	-5.8	-7.2	-11.3	-15.3	-19.3
GoC Farm Cottage	-14.3	-10.4	-8.1	-7.0	-7.2	-10.0	-12.6	-15.1

Table 8.18 shows that the predicted noise levels at all properties remain more than 2dB below the derived noise limits.

Tabulated exceedences for all properties during quiet daytime periods

The exceedences (dB) are shown in **Table 8.19**. Colours denote applicable limits, no colour shows where a fixed 35dB(A) noise limit was applied.

Table 8.19 – Tabulated exceedences (dB) for all properties during quiet daytime periods

House Name	Standardised v10 Wind Speed (m/s)							
	5	6	7	8	9	10	11	12
Crofts Farm	-17.5	-13.5	-11.3	-10.3	-10.1	-10.1	-10.1	-12.7
Laverockhall	-8.8	-4.9	-2.5	-2.4	-4.6	-7.4	-10.5	-13.6
Station House	-9.6	-5.8	-3.3	-3.2	-5.4	-8.2	-11.3	-14.5
Windyedge	-8.7	-4.7	-2.3	-4.1	-7.2	-10.7	-14.5	-18.2
West Cairnconon	-8.5	-4.4	-2.1	-3.9	-7.0	-10.6	-14.3	-18.1
Scotia House	-6.7	-2.8	-0.3	-2.0	-5.1	-8.6	-12.3	-16.0
GoC Cottage	-10.4	-6.2	-4.0	-4.5	-6.4	-8.7	-11.0	-13.4
Muirfield	-10.3	-6.2	-4.1	-4.6	-6.4	-8.7	-11.1	-13.4
GoC Farmhouse	-10.1	-6.2	-4.0	-4.5	-6.2	-8.5	-10.9	-13.2
West GoC	-10.5	-6.6	-4.4	-4.9	-6.7	-9.0	-11.4	-13.7
Croftsmuir	-13.5	-9.7	-7.4	-6.4	-6.1	-6.2	-6.2	-6.2
Bonnycheer	-9.1	-5.3	-2.9	-2.8	-5.0	-7.9	-11.0	-14.1
Crofts Cottage	-6.9	-2.9	-0.7	-0.8	-3.0	-5.8	-8.9	-12.0
Croftburn	-8.2	-4.3	-2.1	-2.1	-4.3	-7.2	-10.3	-13.4
Milton of Conon Farmhouse	-11.1	-7.2	-4.9	-3.8	-3.6	-3.6	-3.6	-3.6
Redford - three properties	-10.1	-6.2	-3.8	-3.7	-5.9	-8.8	-11.8	-15.0
West GoC Farm Cottages	-12.5	-8.6	-6.4	-5.3	-5.1	-5.2	-5.2	-5.2
The Whin	-9.9	-5.7	-3.5	-5.3	-8.5	-12.1	-15.8	-19.5
Dummiesholes	-10.4	-6.0	-3.9	-5.7	-9.0	-12.6	-16.3	-20.1
GoC Farm Cottage	-11.3	-7.4	-5.1	-5.6	-7.3	-9.7	-12.0	-14.4

Table 8.19 shows that the predicted noise levels at all properties remain more than 2dB below the derived noise limits with the exception of Scotia House and Crofts Cottage where the margins below the limits are 0.5dB(A) and 0.7dB(A) respectively.

8.8 Conclusions

Assessment of noise impact

It has been demonstrated that the project would meet ETSU-R-97 guidance derived noise constraints in the absence of any mitigating factors at the nearest sensitive receptors, and therefore at all properties surrounding the Crofts Farm site. Therefore, it is expected that the proposed wind turbines could be accommodated in this area in noise terms, even when considered cumulatively with the turbine at North Mains of Cononsyth, without unacceptable impact on surrounding properties.

The assessment is compiled in light of the updated IOA guidance that is significantly more conservative in the method of accounting for wind shear than previously where no on-site wind shear data is available.

The smallest exceedences were reported during quiet daytime periods, when a lower fixed limit of 35dB(A) applies, however, this is under the assumption of ‘worst case’ wind shear. Our empirical evidence of wind farm sites in Scotland is that the largest wind shear relative to standard conditions recorded was equivalent to a wind speed shift of up to 1.1ms^{-1} during night-time periods. Working hours have tended to produce wind shears close to standard conditions whereas quiet-daytime periods produce a value between these extremes. It would be counter to all experience if the wind shear during quiet daytime periods, relative to standard conditions, was equivalent to a wind speed shift of more than 1ms^{-1} . It can be determined from the scatter plots that if a 1ms^{-1} had been applied during quiet daytime

periods, rather than the 2ms^{-1} required by the guidance, exceedences during these periods would have been greater by 2dB(A) or more.

These predictions of turbine noise also assume worst case propagation conditions (i.e. sound speed gradients due to downwind conditions or temperature inversions).

Mitigation

The project is predicted to meet the noise related constraints required, therefore, no mitigation is proposed.

Summary

Using conservative assumptions, noise constraints have been derived for the closest properties to the proposed wind turbines, based on the variation of background noise with wind speed. It has been demonstrated that these constraints would be met during both night-time and daytime amenity hours.

It is recommended that, if the project is to go ahead, suitable planning conditions are formulated based on the background noise constraints derived above.

9 Cultural Heritage/Archaeology

9.1 Introduction

Cultural heritage is represented by a wide range of features, both above and below ground, which result from past human use of the landscape. These include standing buildings, many still in use, sub-surface archaeological remains and artefact scatters. These also include earthwork monuments as well as landscape features such as field boundaries and industrial remains.

9.2 Guidance

- SPP – Historic Environment
- Scottish Historic Environment Policy (SHEP) 2009
- Managing Change in the Historic Environment guidance note series –Setting
- PAN 2/2011 – Planning and Archaeology

9.3 Methodology

In the preparation of this assessment, a range of historical and technical data was collected and analysed. It is becoming normal practice to include a review of other potential issues that fall under the umbrella term of cultural heritage, such as historic buildings and landscapes, in addition to purely archaeological factors. The following sources were consulted:

- Sites and Monuments Record (SMR).
- National Monuments Record Scotland (NMRS).
- Aerial photograph collection held by the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS).
- National Library of Scotland (Map Library).

A phased approach to the assessment was adopted:

- **Direct Impact:** The area most at risk of direct impact was assessed to be land 50m either side of the access track and within 200m from the turbine locations (**Figure 9.1**).
- **Indirect Impact** on the setting, character and historical integrity of known cultural heritage sites: ‘A’ and ‘B’ listed buildings; Conservation Areas; Gardens and Designed Landscapes (GDLs); Scheduled Ancient Monuments (SAMs); World Heritage Sites; and Inventory Battlefields were considered **up to 2km** from the nearest turbine (**Figures 9.2**).
- **Indirect Impact** on the setting, character and historical integrity of known nationally designated cultural heritage sites, such as: Scheduled Ancient Monuments (SAMs); ‘A’ listed buildings; Inventory Battlefields; World Heritage Sites; and GDLs were further considered within a **5km study radius (Figure 9.3)**.

Analysis of a computer model of the proposed wind turbines, and existing landform (DTM) was used to produce a zone of theoretically visibility (ZTV). The ZTV was used to assess the

likelihood and severity of potential indirect visual impacts of the wind turbines at the cultural heritage sites identified within the study area. However, the ZTV is a bare earth model that does not take into account screening from the natural and built environments, therefore visibility of the development from areas within the ZTV may not always be possible.

Assessment Criteria

The following general criteria outlined in **Tables 9.1** and **9.2** have been used in the assessment of significance of any direct or indirect impact on any site of cultural heritage importance.

Table 9.1– Sensitivity of built and cultural heritage features

Sensitivity	Definition
High	Category A listed buildings Scheduled Ancient Monument Non-statutory List of sites likely to be of national importance Gardens and Designed Landscapes World Heritage Sites Inventory Battlefields
Medium	B and C(S) listed building Archaeological sites on the Sites and Monuments Record (of regional and local importance) Conservation Areas
Low	Archaeological sites of lesser importance Non-Inventory Gardens and Designed Landscapes

Table 9.2- Magnitude of built and cultural heritage effects

Magnitude	Definition
High	Any number of wind turbines and/or ancillary development that would result in: <ul style="list-style-type: none"> the removal or partial removal of key features, areas or evidence important to the historic character and integrity of the site, which could result in the substantial loss of physical integrity; and/or a substantial obstruction of existing view by the addition of uncharacteristic elements dominating the view, significantly altering the quality of the setting or the visual amenity of the site both to and from.
Medium	Any number of wind turbines and/or ancillary development that would result in: <ul style="list-style-type: none"> the removal of one or more key features, parts of the designated site, or evidence at the secondary or peripheral level, but are not features fundamental to its historic character and integrity; and/or a partial obstruction of existing view by the addition of uncharacteristic elements which, although not affecting the key visual and physical relationships, could be an important feature in the views, and significantly

	alter the quality of the setting or visual amenity of the site both to and from.
Low	Any number of wind turbines or ancillary developments that may result in: <ul style="list-style-type: none"> a partial removal/minor loss, and/or alteration to one or more peripheral and/or secondary elements/features, but not significantly affecting the historic integrity of the site or affect the key features of the site; and/or an introduction of elements that could be intrusive in views, and could alter to a small degree the quality of the setting or visual amenity of the site both to and from.
Negligible	Any number of wind turbines or ancillary developments that may result in: <ul style="list-style-type: none"> a relatively small removal, and/or alteration to small, peripheral and/or unimportant elements/features, but not affect the historic integrity of the site or the quality of the surviving evidence; and/or an introduction of elements that could be visible but not intrusive in views, and the overall quality of the setting or visual amenity of the site would not be affected both to and from.

The level of an effect is determined by the combination of sensitivity and magnitude of change. The following matrix is used to determine the overall significance of effect.

Table 9.3 – Significance of impact matrix

Magnitude	Sensitivity		
	High	Medium	Low
High	High	High	Medium
Medium	High	Medium	Low
Low	Medium	Low	Negligible
Negligible	Low	Negligible	Negligible
Key:		Significant in terms of the EIA Regulations	
		Not Significant	

9.4 Baseline Data

Documentary Sources

Cultural Heritage Figures

Wirelines from each of the identified features found to be within the ZTV are presented within **Appendix 4**.

Historic Maps

Historic maps held at the National Library of Scotland (Map Library) and aerial photographs were consulted as part of the desk based assessment.

Table 9.4- Historic maps of the proposed wind turbine locations

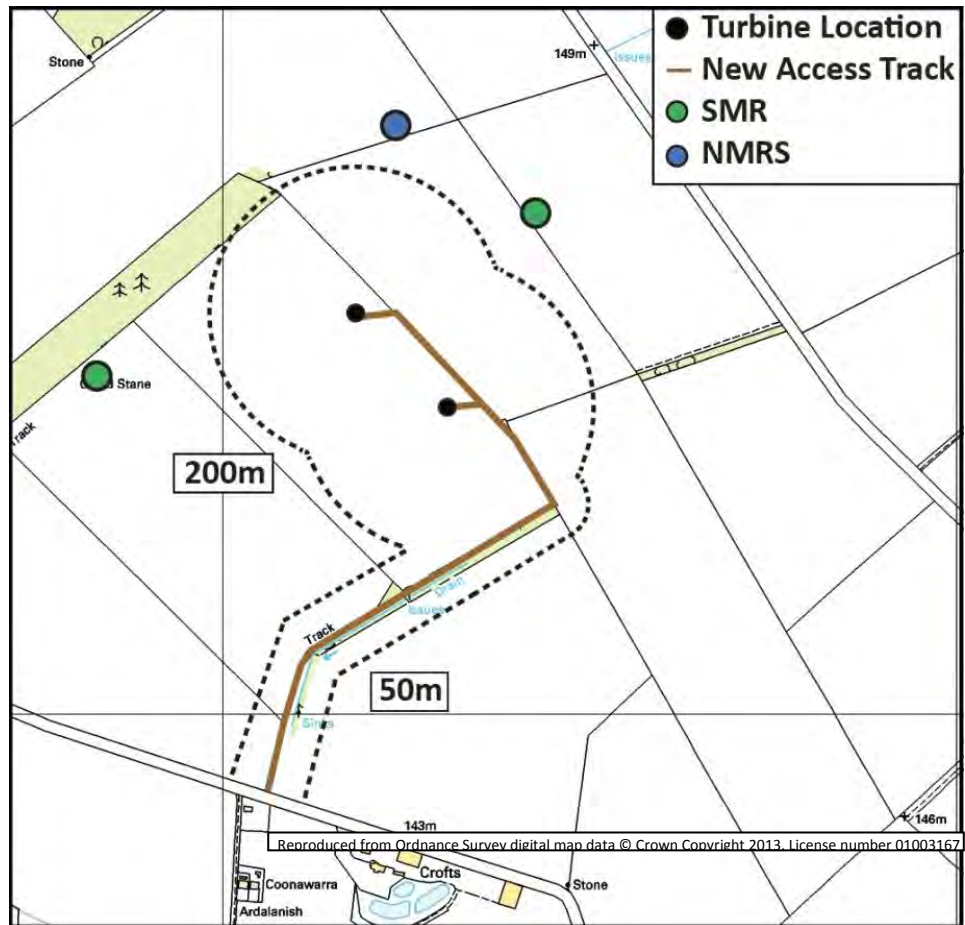
Map	Date	Notable Historic Changes
Roy Highlands	1747-52	Area is not depicted on the map.
OS Six Inch	1843-1882	Redford and Crofts Farm are depicted on the map. Modern agricultural field boundaries are shown.
OS One Inch - Outline	1855-1900	No changes discernible.
OS One Inch - Hills	1855-1903	No changes discernible.
OS Six Inch	1892-1905	The woodland shelter belt to the north-west of the project is shown. The Cauld Stone is located in the field containing the proposed wind cluster. An old quarry in the field that lies immediately adjacent to the east of the development is marked on the map.
Bartholomew Half Inch	1897-1907	No changes discernible.
Bartholomew Survey Atlas	1912	No changes discernible.
Bartholomew Half-Inch	1926-1935	No changes discernible.
OS 1: 25, 000	1937-61	An electricity pylon is shown to cross the site on a north north-east to south south-west axis.
Air Photos	1944-1950	No changes discernible.
OS One Inch	1945-1948	No changes discernible.
OS One Inch	1955-61	No changes discernible.

Information Gaps

An attempt has been made to consult all readily available documentary sources. However, it is possible that there may be other documentary sources held by RCAHMS and the National Archives of Scotland, which have not been consulted as part of this assessment. The site has not been visited by a qualified Archaeologist as part of this assessment.

Features of Historical Significance within 200m

Figure 9.1 – Features of historical significance within 200m



No features of historical significance were found to be within 200m of the turbines or 50m of the access track. The closest feature to the development was the NMRS West Grange of Conan located ~250m to the north-east of the most northerly turbine. The NMRS (NO54SE 14) has been recorded as, “The upper stone of a circular rotary quern, 52.5cm in diameter, found in the field which lies to the S of that containing souterrain NO54NE 12, is now in Dundee Museum (1970-10).”

Features of Historical Significance within 2km



Figure 9.2 – Features of Historical Significance within 2km

The study has found that there are 3 'B' listed buildings within 2km of the site. No, Conservation Areas, 'A' listed buildings, GDLs, World Heritage Sites, or Inventory Battlefields were found to be located within 2km of the proposed development. The locations of the listed buildings are shown in **Figure 9.2** above and are briefly described in **Table 9.5** below.

Table 9.5 – Cultural heritage features within 2km

LB/SAM no.	HBNUM/ Index no	Distance	Name	Listing & Description	
LB 1	4588	~0.8km	Carmyllie East Parish School	'B'	Baronial, L-plan, rubble and slate, with bell-turret in re-entrant angle C.1872.
LB 2	4741	~0.5km	Earth-House, Cairn Connan	'B'	Entry and 66 ft. long curved gallery with branch to small inner-chamber. Iron Age Date.
LB 3	4590	~1.9km	Conansyth Farmhouse	'B'	Classic, small two-storey mansion house, harl and slate. Early 19th cent.

As shown in **Figure 9.2**, each of the three listed buildings were found to lie within the ZTV. The ZTV is a bare earth model that does not take into account screening from the natural

and built environments. The settings of each of the 'B' listed buildings found to fall within the ZTV are described in more detail below:

- Carmyllie East Parish School (LB 1): the current setting of the 19th century School, which is still in use, is amongst its associated buildings and walled playground. The main façade of the listed building is orientated to the south south-west. There is an intervening shelter belt of coniferous woodland to the east of the listed building.
- Earth-House, Cairn Connan (LB 2): the current localised setting of the souterrain is within a modern agricultural field. The cairn appears to be covered by grass and turf, creating a secluded private setting.
- Conansyth Farmhouse (LB 3): the building's main façade is orientated to the south-south-east with views out across the surrounding farmland. There are two intervening shelter belts to the south of the 19th century mansion.

Features of Historical Significance within 2-5km

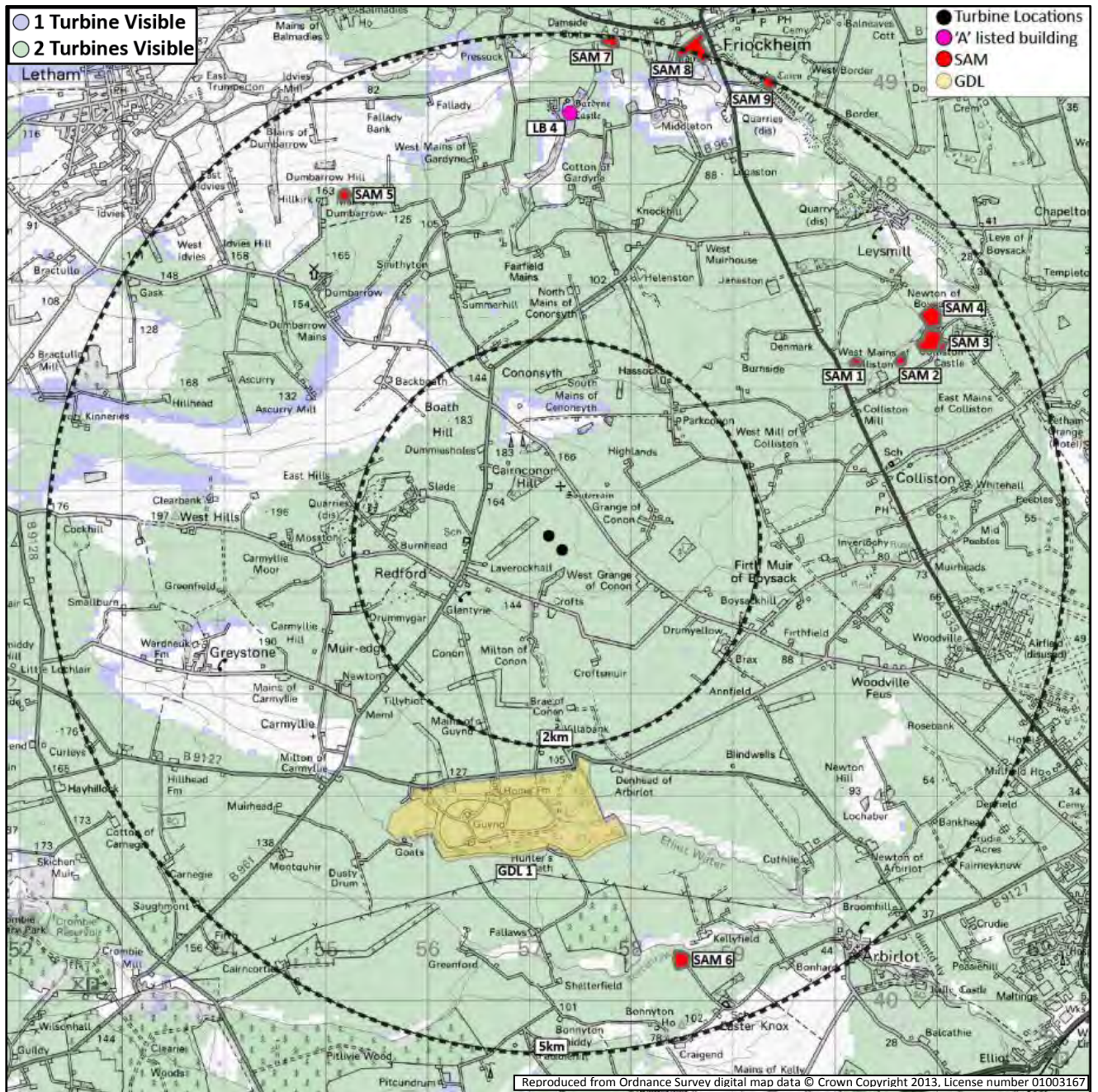


Figure 9.3 – Features of Historical Significance within 2-5km, showing area of theoretical visibility

Between 2-5km of the project, 1 'A' listed building, 9 SAMs and 1 GDL were identified. No Inventory Battlefields or World Heritage Sites were found to be located within this study radius. Their locations are shown in Figure 9.3 and brief details given in Table 9.6.

Table 9.6 – ‘A’ listed buildings, GDLS, and SAMs within 2-5km of the project

LB/SAM/GDL no.	HBNUM/ Index no.	Distance	Name	Listing & Description
LB 4	11914	~4.3km	Gardyne Castle	‘A’ Small three-storey L-plan with vaulted basement and battlemented angle Turrets. Inset armorial stone 1568.
SAM 1	6130	~3.4km	West Mains of Colliston, enclosure	Remains of an enclosed settlement of prehistoric date represented by cropmarks on oblique aerial photographs.
SAM 2	6124	~3.8km	Mains of Colliston, enclosure	Remains of an enclosed settlement of prehistoric date represented by cropmarks on oblique aerial photographs.
SAM 3	6125	~4.0km	Colliston Castle, enclosure	Remains of an enclosure, a souterrain, a pit alignment and a series of ring ditches, of prehistoric date represented by cropmarks on oblique aerial photographs.
SAM 4	6131	~4.2km	Newton of Boysack, ring ditch	Remains of a series of ring ditch houses, a pit circle and a souterrain, all of prehistoric date, represented by cropmarks on oblique aerial photographs.
SAM 5	3076	~3.9km	Dumbarrow Hill, fort	Remains of a circular homestead. Formerly marked on both the 1st and 2nd edition OS maps (c.1867 and c.1888) as a fort. Subsequently reclassified as a dun (of the small house sub-category) and currently regarded as a circular homestead.
SAM 6	6625	~4.2km	Kellyfield, enclosure	Remains of a palisaded enclosure of prehistoric date represented by cropmarks on oblique aerial photographs.
SAM 7	5998	~4.9km	Damside Cottages, pit circle	Remains of a pit circle and associated features of prehistoric date represented by cropmarks on oblique aerial photographs.
SAM 8	6092	~4.9km	Friock Mains, settlement	Remains of an enclosed settlement and pit alignment of prehistoric date represented by cropmarks on oblique aerial photographs.
SAM 9	6093	~4.9km	Cairn Knap	Remains of a burial cairn of Neolithic or Bronze Age date represented by a turf-covered stony mound surrounded by a modern wall.
GDL 1	N/A	~2.3km	The Guynd	The 153ha gardens are the associated GDL for the 19 th century, ‘B’ listed Guynd House. The gardens comprise of modern agricultural fields at the heart with mature woodland policy borders. Tributaries of the Elliot Water flow through the garden’s policies. The B9127 forms a manmade border to the north of the gardens.

All of the features within the 2-5km were found to fall within the ZTV. The settings of all these features are described in more detail below:

- **SAMs (1-4 and 6-8):** are located within modern agricultural fields to the north-east, and north-north-east of the proposal. Each of these SAMs consists of subsurface remains that are only discernible as cropmarks on oblique aerial photographs.
- **Dumbarrow Fort (SAM 5):** the fort’s localised setting is upon the summit of Dumbarrow Hill. The SAMs hill top setting gives rise to open panoramic views.
- **Gardyne Castle (LB 4):** the main façade of the 16th century castle is oriented to the north-north-east. The localised setting of the castle is within its associated gardens, with views out across the surrounding farmland. The house’s associated grounds comprise of manicured lawns with dense pockets of mature woodland to the east

and south. A tributary of the Lunan Water flows to the immediate south-east of this iconic building.

- **The Guynd (GDL 1):** the GDL comprises of modern agricultural fields and lawns bordered by mature woodland policies. The GDL is located to the immediate south of the B9127. The gardens encompass 3 'B' listed buildings including its associated 19th century Guynd House, which lies at the heart of the gardens. The gardens house is orientated to the south south-east with views across the GDL towards the tree-lined Elliot Water. The wider setting of the gardens is among modern agricultural farmland.

9.5 Evaluation of Effects

Direct Effects

Table 9.7 - Effects and Evaluation of Significance: Direct Effects

Effect	Probability	Sensitivity	Magnitude	Significance	Comment
Direct effects on known features within the site	Unlikely	N/A	N/A	N/A	There are no known cultural features within the 200m of the proposed turbines & 50m of the access track. The nearest feature of cultural heritage interest is the NMRS West Grange of Conan located ~250m from the nearest turbine.
Direct effect on presently unrecorded archaeology	Unlikely	Unknown	Unknown	Unknown	The small area of intrusive works is unlikely to have a significant impact on archaeological remains.

Indirect Effects within 2km

Wirelines from each of these features discussed in **Table 9.7** below are provided in **Appendix 4** of this report.

Table 9.8– Effects and Evaluation of Significance: Indirect Effects within 2km

Name	Distance	Sensitivity	Magnitude	Significance	Comment
LB 1- Carmyllie East Parish School 'B' listed building	~0.8km	Medium	Negligible	Negligible	The towers of both turbines are theoretically visible in views to the east of the primary school. The main façade of the building is orientated to the south south-west. An intervening woodland shelter belt will screen views of the development, with only a single blade tip being visible in views to the east of the school. No significant adverse impacts upon the current setting of the school are predicted.
LB 2- Earth-House, Cairn Connan 'B' listed building	~0.5km	Medium	Negligible	Negligible	The full extent of the proposed development is theoretically visible from the cairn. The cairn is currently covered by vegetation; creating a secluded setting with no long distance views available from the feature itself. The current setting of the cairn is within a modern agricultural field. No adverse

					impacts upon the current setting or historical integrity are predicted.
LB 3- Conansyth Farmhouse 'B' listed building	~1.9km	Medium	Negligible	Negligible	One hub and a blade are predicted to be visible from the 'B' listed building. The proposed development is expected to be visible in views to the south, with the building's main façade being orientated to the south-east. An intervening pocket of mature woodland is expected to partially screen views of the development.

Indirect Effects within 2-5km

Table 9.8- Effects and Evaluation of Significance: Indirect Effects Features 2-5km

Name	Distance	Sensitivity	Magnitude	Significance	Comment
LB 4- Gardyne Castle 'A' listed building	~4.3km	High	Negligible	Low	The tips of the development are expected to be visible from ground level from the rear of the castle. The castle's associated woodland polices are expected to screen ground level views of the development. Views of the project from the upper floors will appear in an oblique view to the south. At this distance the development is expected to appear as part of the wider landscape. No adverse impacts upon the setting or historical integrity of the monument are predicted.
SAMs: 1-4 & 6-8	~3.4- 4.9km	High	Negligible	Low	Each of these SAMs is only discernible as a crop mark on oblique aerial photographs. There will be intervisibility between the sites and the proposed turbines; however the scheduled sub-surface remains themselves will not be impacted as they lack the required visual setting. No significant adverse impacts upon setting or historical integrity are predicted.
SAM 5 Dumbarrow Hill, Fort	~3.9km	High	Negligible	Low	The comparatively elevated position of the SAM gives rise to panoramic views. The towers of the proposed wind cluster will occupy a narrow extent of the available view to the south-east. At this distance it is expected that the proposal will appear as part of the wider landscape. No adverse impact upon the current setting or historical integrity of the SAM is predicted.
SAM 9 Cairn Knap	~4.9km	High	Negligible	Low	The proposed wind cluster is expected to be visible in views to the south-south-west of the turf covered mound. At this distance the development is expected to appear as part of the wider landscape. No significant adverse impacts upon the current setting or historical integrity of the SAM are predicted.

Name	Distance	Sensitivity	Magnitude	Significance	Comment
GDL 1 The Guynd	~2.3km	High	Negligible	Low	The proposed wind cluster is theoretically visible across the GDL. The GDLs associated mature woodland polices are expected to screen the proposed development from within the gardens. The design of the gardens is such that the main views are into the gardens themselves. No significant adverse impact upon the setting or historical integrity of the GDL are predicted.

9.6 Summary of Predicted Impacts and Effects

Direct Impact

No direct impact has been identified on any feature of cultural heritage interest, according to current proposals. The closest feature to the development is the NMRS West Grange of Conan at a distance of ~250m from the nearest turbine. Due to the intermittent distance, this feature is not considered to be at risk of direct impact.

Indirect Impact

Within 2km of the proposed single turbine, 3 'B' listed buildings were found to be located. No 'A' listed buildings, SAMs or GDLs were identified within the 2km study area. At ~0.5km from the development the Earth-House Cairn Connan (LB 2) is the closest feature of historical significance to the development. The current setting of the cairn is within a modern agricultural field, and the cairn is covered by vegetation and turf preventing long distance views from the feature itself. One hub and a blade tip are predicted to be theoretically visible from Conansyth Farmhouse (LB 3) however an intervening pocket of mature woodland is predicted to screen views of the development. The towers of both turbines are expected to be theoretically visible in views to the east of Carmyllie East Parish School (LB 1). An intervening mature woodland shelter belt is expected to screen views of the proposed wind cluster, with only a single blade tip being visible from the School (LB 1).

Between 2km and 5km of the proposed development, 1 'A' listed building, 9 SAMs, and 1 GDL were identified. All of the features of historical significance were found to be situated within the ZTV.

The tips of the proposed development are expected to be visible at ground level in views to the south of Gardyne Castle (LB 4). The castle's associated mature woodland polices are predicted to screen views of the development from ground level. From the upper floors of the castle the development is expected to occupy a narrow extent of the horizontal views available.

SAMs 1-4 and 6-8 are only discernible as cropmarks on oblique aerial photographs. Consequently the proposed development is not expected to have an adverse indirect visual impact upon these SAMs.

The comparatively elevated position of Dumbarrow Hill fort (SAM 5) is such that it has an open setting with panoramic views. The proposed wind cluster is expected to occupy a

narrow extent of the horizontal views available to the south-east, and at a distance of ~3.9km the development is expected to appear as part of the wider landscape. Cairn Knap (SAM 9) is currently covered by vegetation, thus there are no long distance views available from this feature.

The magnitude of indirect visual impact on cultural sites beyond 5km from the wind turbines is assessed to be negligible. The intervening distance will result in the project appearing as part of the wider landscape where the quality of the setting could be altered to a minor degree.

9.7 Mitigation Incorporated into the Proposed Development

Planning guidance (SPP – Historic Environment) states that it is Government policy to protect and preserve archaeological sites and monuments *in situ* wherever feasible. Where preservation *in situ* is not possible planning authorities should ensure that an appropriate level of excavation, recording, analysis, publication and archiving is carried out before and/or during development.

Permanent Land-take and Operation

Current proposals indicate that the turbine locations, road routes and other aspects of development avoid the locations of known features of cultural heritage interest and as such no direct impact has been identified.

While this assessment has found no indication of the survival of any archaeological features or deposits that are not visible above ground level, it is nevertheless possible that such features do exist within the application area.

In the event that archaeological features are encountered, a suitable program of archaeological works will be implemented to the satisfaction of the planning authority.

Restoration

No restoration measures are currently proposed.

9.8 Conclusion

No direct effect has been identified on any known features of cultural heritage interest as a result of the proposed development. The potential for development to encounter previously unrecorded features is considered to be unlikely being limited by the small extent of intrusive works associated with the proposed development.

The assessment has found that the proposed development would give rise to a negligible magnitude of change for both Carmyllie East Parish School (LB 1), and Earth- House Cairn Connan (LB 2) resulting in a **negligible** significance of impact on their settings. The significance of impact on all other cultural features within 5km of the proposed wind cluster was assessed to be **low**.

10 Surface and Groundwater Hydrology

10.1 Introduction

This chapter presents the impact assessment of the proposed development on the water environment. The assessment has considered the development impacts on water quality, drainage and flood risk.

Understanding surface and groundwater environments is critically important to designing a successful project. **Surface water** includes watercourses, water bodies and run-off. It provides important water resources for potable and other supply, amenity, aesthetic value, conservation, ecological environments and importantly, recharge to groundwater systems.

Groundwater includes all water stored in permeable underground strata (or aquifers). It is also an important resource, providing more than a third of the potable water supply in the UK. In addition it provides essential baseflow to rivers and wetland areas, often supporting important ecological systems.

Although hydrological issues are likely to be relatively minor at this site, the risk of pollution or disruption of watercourses, groundwater bodies and private water sources within or near the site needs to be assessed and appropriately mitigated where necessary.

10.2 Potential Impacts

The potential impacts this development could have on the water environment of the site and the area around are broadly summarised as follows:

- Disruption to existing water courses and run-off paths;
- Sedimentation, erosion, and silt laden run-off;
- Chemical pollution of watercourses or groundwater;
- Increase in run-off; and/or
- Lowering of the water table.

These impacts could occur during the construction, operational lifetime, and decommissioning of the development, and can potentially have an adverse impact on ecology and human amenity.

10.3 Guidance

Statutory, general, national and local guidance consulted during this assessment is listed as follows:

- SPP7: Flooding & Drainage
- SEPA Policy No.19: Groundwater Protection Policy for Scotland
- SEPA Pollution Prevention Guidance Notes (PPG):
 - PPG 1: General guide to the prevention of water pollution;
 - PPG 2: Above Ground Oil Storage Tanks;

- PPG 5: Works in, near or liable to affect watercourses;
- PPG 6: Working at construction and demolition sites;
- PPG 21: Pollution incident response planning;
- SEPA Water quality classification interactive database (2009 data);
- CIRIA Report C532: Control of Water Pollution from Construction Sites; and
- CIRIA Report C502: Environmental Good Practice on Site.

10.4 Methodology

The method adopted to assess the impact on the water environment was:

- Determination of the baseline hydrological conditions and the sensitivity of the site and adjacent receptors;
- Review of the proposed development to determine the predicted impacts posed by the development itself;
- Evaluation of the significance of predicted impacts taking into account impact magnitude (before and after mitigation) and baseline environmental sensitivity.

The assessment is based on:

- A desk-based study using information from published material:
 - Ordnance survey 1:10,000 map data;
 - BGS – Hydrogeological Map of Scotland 1:625,000; and
 - BGS – Groundwater Vulnerability Map of Scotland 1:625,000;
- Consultations with statutory bodies, principally SEPA and the Local Planning Authority;
- The land owner's knowledge of the site; and
- A site walkover undertaken by a suitably qualified engineer to support these findings and to check for any hydrological features on site that may be missing from the desk-based study.

An area of 1.2km radius around the turbine has been used in this assessment. Given the scale of the development this is considered to be a conservative study boundary. All sensitive receptors within this 1.2km study boundary, which can be seen in **Figure 10.1 (Appendix 4)**, have been identified and the impacts assessed.

The analysis of the significance of each impact is based on its magnitude, scale and the likelihood of occurrence. A significance rating of 'High', 'Medium', 'Low' or 'Negligible' is then given to each impact. By conducting this analysis before and after mitigating factors are taken into account, the significance of the predicted impact and the residual impact is determined.

10.5 Baseline

This section presents an overview of the baseline water environment at the site, including: the location and quality of surface and groundwater resources, drainage, and flood risk. **Figure 10.1** shows the local context of the site.

Terrain description

The land around the site comprises of arable and grazing land. The Cairnconon Hill, the summit of which lies 750m to the north of the site at an elevation of 182m above sea level, is the dominant terrain feature in the area. The site is positioned on the south face of a shoulder of this hill. The track and turbines lie at elevations of between approximately 140m and 160m above sea level. There are slopes down from the site of up to 5% to the south-east down the face on the shoulder.

Hydrology

Any runoff generated by rainfall on the proposed track hard standing areas currently tends to flow downhill to the south, as can be seen in the runoff catchment area shown on **Figure 10.1**. The runoff flows towards and into a system of field drains that join to form the Black Burn which issues approximately 973m west of the site at its nearest point. The Black Burn discharges into the Elliot Water approximately 3.3km downstream and south of the site. There are a number of field drains located throughout the study boundary. The site is dry underfoot at the proposed turbine locations.

From the OS 1:10,000 map data, and through discussions with the landowner and the local Council, two wells were identified within the study boundary. These are depicted in **Fig 10.1**, and their nature of use given in **Table 10.1**.

Table 10.1. Wells and Springs within 1.2km of development

Well/Spring	NGR	Nature of use
Well A	357380, 745460	Extinct
Well B	358230, 744690	Used for irrigation only

Local water supplies

All properties within 1.2km of the proposed development have been identified and are mains fed. The properties identified are shown in **Appendix 5** and listed in **Table 10.2**.

Table 10.2. Water Supplies to Properties within 1.2km of development

ID	Property	NGR
1	Grange of Conon	357940, 745280
2	Muirfield	358060, 745060
3	Grange of Conon Farm Cottages 3 & 4	358200, 744810
4	Grange of Conon Farm Cottages 1 & 2	358340, 744690
5	Grange of Conon	358150, 744630
6	West Grange Farm Cottages	358277, 744020
7	West Grange of Conon	358110, 744080
8	Grange Views	358310, 744000
9	Farm Cottages	358350, 743980
10	Studio	358360, 743950

11	Oslin	357690, 743320
12	The Steading	357650, 743320
13	Croftsmuir	357630, 743300
14	Crofts Farm	357210, 743790
15	Foxton Lodge	357050, 743470
16	Milton of Conon	357030, 743520
17	Property 17	357000, 743500
18	Coonawarra	357050, 743770
19	Ardalanish	357030, 743770
20	Crofts Cottage	357040, 743870
21	Property 21 (disused)	356910, 743530
22	Bonnycheer	356580, 744030
23	Laverockhall	356530, 744230
24	Amra Cottage	355940,- 744910
25	Windyedge	356600, 745040
26	Scotia House	357040. 745140
27	The Whin	356550, 745230
28	West Cairnconon	356750, 745250
29	Property 29	356520, 745430
30	Dummiesholes	356550, 745430

Surface and Groundwater Classification

The Scottish Environment Protection Agency (SEPA) classifies all significant waters in Scotland. There are no classified surface water features located within the 1.2km study boundary. The nearest classified surface water feature has been identified as the Elliot Water located approximately 3.3km to the south of the proposed turbines.

SEPA have classified the Elliot Water as ‘Bad’. This means SEPA have “*classified this water body as having an overall status of Bad ecological potential with Medium confidence in 2008 with overall ecological status of Bad and overall chemical status of Pass*”.

SEPA also classifies significant groundwater bodies which at the proposed site are “*Carnoustie bedrock and localised sand and gravel aquifers*”. The quality of this groundwater has been classified as ‘Poor’ with ‘High’ confidence. The quantity of groundwater has been classified as ‘Poor’ with ‘Medium’ confidence in 2008.

Flooding Risk

From the Indicative River & Coastal Flood Map (available on the SEPA website) it can be seen that there are small areas deemed to be at risk from flooding within the study boundary. The nearest area deemed to be at risk from flooding is a small area along the banks of the Black Burn located approximately 910m to the south of the easternmost turbine location. The project is unlikely to have any impact on the flooding risk of these areas.

Hydrogeology

The BGS groundwater Vulnerability Map of Scotland 1995 (1:625000) indicates that the strata beneath the site are classified as highly permeable.

The BGS Hydrogeological Map of Scotland 1988 (1:625000) indicates that the project is located in a region underlain by ‘Lower and Middle Old Red Sandstone’. “*There are*

widespread outcrops of fine - to medium-grained sandstones, in places flaggy, with siltstones, mudstones and conglomerates as well as interbedded lavas. In Caithness, groundwater is largely confined to a shallow zone of weathered rock. The groundwaters are dominantly calcium-bicarbonate type, but some are sodium dominant and others chloride dominant". The 'Geology of Britain viewer' available on the BGS website (www.bgs.ac.uk) indicates that, more specifically, the site is underlain by Arbuthnott-Garvock Group - Sandstone with Subordinate Conglomerate, Siltstone and Mudstone. This is lithologically described as: "Sandstone predominates, interbedded with clast-supported conglomerate with well-rounded boulders, cobbles and pebbles predominantly of lava, psammite and quartzite in the northeast and adjacent to the Highland Boundary Fault. Siltstone and mudstone are interbedded with the sandstone, e.g. in the Dundee area and Strathallan. Piles of andesitic, basaltic and rhyolitic lavas, locally very thick, are interbedded with conglomerate and sandstone in many areas. Lenses and thicker formations of volcanoclastic sandstone are interbedded with conglomerate in the Stonehaven area and are associated with lavas elsewhere".

The 'Geology of Britain viewer' indicates that there is a superficial layer of diamicton, specifically Devensian Till, in the region.

Confirmation of baseline conditions

Intrusive ground investigations will be completed prior to turbine construction to gain site specific information such as groundwater levels, soil permeability and geology.

10.6 Predicted Impacts

This section presents an assessment of impacts on the water environment which may occur during the construction, operational and decommissioning phases of the development. The sensitive receptors are identified and the predicted impacts are assessed and their significance rated.

Details of the site and the works to be conducted can be found in Chapter 2: The Proposed Development. **Figure 10.1** provides a plan of the development.

Sensitive Receptors

The identification of sensitive receptors, taking into account baseline conditions, is summarised in **Table 10.3** below. It should be noted that a distinction has been made between properties that draw water from the water table, and the overall condition of the water table itself.

Table 10.3 – Sensitive Receptors

Receptor	Comment
Watercourse	The Black Burn has local ecological significance, but it is a diminutive watercourse and has not been classified by SEPA. The Elliot Water, which is of bad water quality, is quite far downstream.
Groundwater	The region is located in an area underlain by highly permeable strata.

Predicted Construction Impacts

The most disruption, and therefore the greatest risk of impact to the water environment, will occur during the construction phase of the project.

Disruptions to flow paths

The development does not require the crossing of any streams or other surface watercourses, and so there is no risk of a watercourse being hydraulically impeded. As such, a drop in hydraulic gradient of a watercourse is predicted to be of negligible significance.

However, there could be active subsurface field drains around the site which may be affected during track excavation and construction. Furthermore, the track and associated drainage could impede existing surface runoff routes, particularly during periods of heavy rainfall. The impact caused by these disruptions to flow is predicted to be of medium significance.

Sedimentation and Erosion

It is predicted there may be an impact caused by erosion of track and hard-standing surfaces and of excavated spoil material. This could lead to sediment being carried with the runoff and reaching a watercourse. Cable laying also has the potential to damage soils and introduce new drainage pathways which could generate silt laden run-off. The amount of the resultant suspended solids pollution will be greater during heavy rainfall events, although the dilution potential of the watercourses is also at its greatest during these periods. At times of low flow, it is very unlikely that silt could reach a watercourse. The significance of this impact is considered to be low.

Increase in runoff

Construction of the access tracks, sub-station and crane hard-standings will result in localised changes to the surface water hydrology. The cambered tracks may interrupt natural flow paths. The new track will also shed water more quickly than the existing ground. An increase in runoff in the area can compound various other predicted impacts, such as chemical pollution, erosion and sedimentation. Furthermore, increased runoff could add to a flood risk in the area.

Due to the small area of tracks and hardstanding in the site, there will be only a very slight increase to runoff. It is unlikely any runoff would affect the small flood areas on the banks of the Black Burn that passes to the south of the site. The magnitude of the impact is taken to be low.

Chemical Pollution

There are several potential sources of chemical pollution to both surface water and groundwater during the construction phase of the development. The spillage or leakage of construction associated oil, grease, fuel, concrete, cement, foul water or other chemicals can have a serious negative impact on the quality of surface water and/or groundwater. Runoff or groundwater could also carry spills or leakages resulting in pollution of a sensitive receptor. Local topography limits the potential for polluted runoff to travel, so polluted runoff contaminating a watercourse is predicted to be of medium significance.

Due to the high permeability of the strata beneath the site, groundwater travel is likely, so polluted runoff contaminating groundwater is predicted to be of medium significance.

Lowering of the water table

Given what is known about the ground conditions in the area and the extents of the excavation works, groundwater is not expected to enter the foundation excavations. As such, dewatering should not be required and therefore the groundwater table would not be affected by the works. Furthermore, General Binding Rule (GBR) 15 (from the Water Environment (Controlled Activities) (Scotland) Regulations 2005) states that “(d) groundwater shall not be abstracted from any excavations, well or borehole that are within 250 metres of any abstraction that is not for the sole purpose of dewatering an excavation”. Therefore, any private water supply outwith a 250m ‘dewatering boundary’ is not predicted to suffer an impact. There is a presumption that cable trenches and access roads may disrupt the groundwater flow directions by creating shallow drainage and preferential pathways and, as such, a further boundary of 100m around cable trenches and access tracks has been applied.

Predicted Operational Impacts

There will be a few on-site activities during operation of the wind turbines relating to regular maintenance or repair of the machines. During these activities there will be a need to bring small quantities of oil, greases and other materials on to the site. The sub-station, access tracks and crane hard-standings will result in localised changes to the surface water hydrology for the duration of the project, with the potential effects of erosion, sedimentation and increased runoff as discussed in Construction Impacts.

Predicted Decommissioning Impacts

The activities during decommissioning are broadly similar to those during construction, however, the level of activity will be less as some of the roads and sub-surface elements will be left in place.

10.7 Mitigation

The potential impact of the project on water quantity is minimal, so the mitigation measures focus on preventing water pollution. There are a number of recognised best practices and measures to mitigate and eliminate the predicted impacts previously discussed. A full intrusive ground investigation will be carried out to provide data for designing appropriate mitigating measures before construction begins.

Construction

The following measures will be implemented to manage the predicted impacts at the site during the construction phase. Construction will be carried out according to SEPA and CIRIA guidance for site works.

Disruption to existing flow

There are no crossings of burns or streams required in the development, and there will be no impeding of a surface watercourse. Should subsurface field drains be discovered during track excavation, there will be a design in place for drains to run across the track, thereby minimising disruption to existing field drainage paths.

Sedimentation and Erosion

During construction of the track, drainage will be controlled by placing drainage ditches on the uphill slopes. All earth bunds, soil and waste material storage areas will be located as far as possible from site watercourses and will be well managed to minimise runoff and erosion. The project drainage will be designed such that access tracks will be cambered to shed surface water into a suitable drainage system.

Adoption of sustainable drainage principles, such as making use of vegetation to slow water flows and filter sediments, should minimise the risk of sediments reaching watercourses. The new drainage network will be kept separate from the existing field drain network to avoid any potentially contaminated runoff from the new infrastructure discharging into local watercourses. If this is not practical, drains will be installed along the length of the tracks which would feed into a soak-away. The soak-away would incorporate an overflow for periods of heavy rainfall. A possible drainage layout solution is shown on **Figure 10.1**. Methods incorporated are designed to be sustainable and to cope with storm events.

To minimise disturbance impacts, cables will be laid in small trenches along the side of the access tracks as far as possible. Trenches will be dug during drier periods, as far as practicable, and spoil material will be temporarily placed on the uphill slope to reduce the likelihood of runoff entering the excavations. The electric cables will be laid quickly and backfilled to minimise water ingress to the trenches. Their actual impact in terms of creation of new drainage pathways, or damage to soil profile, is likely to be negligible provided the best practice methods are followed.

Chemical Pollution

Construction traffic will use specified roads and parking areas at all times, where practicable, to reduce compaction and associated run-off in the wider area. Appropriate control measures, such as shallow vegetated channels, will be installed to convey haul road and hardstanding runoff and treat pollutants.

Concrete will be delivered in ready-mix wagons which will only be allowed to 'wash-out' in designated areas where suitable control measures are in place. Full details of the foundation construction will be provided in the construction method statement. We anticipate this being required as a planning condition. Once construction is complete and the soil has been replaced over the foundation and reseeded, the change to surface water runoff and risk of pollution is predicted to be negligible.

A pollution incident response plan will be developed in accordance with SEPA PPG 21. Spill response measures will be put in place to ensure that any accidental spillages at the surface can be contained and quickly removed from site.

All fuel and other chemicals will be stored and managed in accordance with best practice procedures. Best practice is included in SEPA Pollution Prevention Guidance Notes (PPGs). All fuel will be stored in a bunded container. Oil and oil spill kits will be stored in the site office. All other oils, greases and chemicals will be stored in a locked bunded container near the site office. Where oils and diesel are brought on to site for refuelling or maintenance, these operations will be carried out in designated areas of hardstanding located at least

20m from the nearest watercourse or drain. Standard methods will be adopted within these designated areas that minimise the risk of spillage. Contingency plans will also be in place for dealing with any spillage that may occur.

Any contaminated material encountered during construction will be dealt with according to environmental best practice, following suitable chemical analysis. Such material will be contained, treated, or disposed of, to a suitably licensed disposal facility.

Implementation of the procedures described above will mitigate the significance of a chemical pollution impact to low.

Increase in runoff

Adoption of sustainable drainage, as discussed in the Sedimentation and Erosion section above, will allow for the capture of runoff from the site, and render impacts caused by runoff negligible.

Lowering of the water table

Should planning permission be granted, an intrusive investigation will be carried out and groundwater monitoring standpipes installed at the locations of each of the turbines. The investigation will include an assessment of the ground permeability and water potential. Mitigating measures for any potential dewatering and disposal of groundwater will be provided in a method statement.

Operation

The proposed mitigation for the construction of the access roads will continue to function through the life of the project. Routine maintenance for the roads will be carried out in summer months when the tracks are dry. Operational best practice procedures will continue to be adopted, with the risk of water pollution from such activities considered to be negligible.

The proposed mitigation for fuels and chemicals used during the construction phase would be applied at all relevant times during the lifetime of the project. The concrete used will be of a high grade that is not prone to leaching alkalis. As such the ongoing risk of pollution on the site after construction is considered to be very low.

Decommissioning

It is envisaged that detailed method statements, in compliance with relevant current legislation, will be drawn up prior to decommissioning. However, similar mitigation methods to those employed during construction (updated to take account of legislation current at the time of decommissioning) are likely to be appropriate.

10.8 Assessment of Residual Impact

The residual impacts after mitigating factors have been taken into account are analysed with respect to their significance. **Table 10.4** below includes a summary of the residual impacts, and it can be seen that there are no residual impacts of major significance expected to occur as a result of the development.

Table 10.4 - Summary of Impact Assessment

Project Element	Effect	Sensitive Receptor	Initial Significance	Description of Mitigation	Residual Significance
Crossing of a watercourse	Drop in hydraulic gradient	Watercourses	Negligible	No crossings of a watercourse are required - no mitigation required.	Negligible
Access Track & cabling; Hardstandings	Disruption to field drainage flow paths	Watercourses	Medium	Incorporating lateral drainage across tracks in design	Negligible
	Erosion and the generation of silty runoff	Watercourses	Low	Implementation of a Sustainable Drainage system to capture runoff. Adherence to best practice procedures.	Negligible
	Increase in runoff adding to flooding	Watercourses	Low	Implementation of a Sustainable Drainage system to capture runoff.	Negligible
Keeping and using concrete, chemicals/ fuel onsite; refuelling.	Polluted runoff contaminating a watercourse	Watercourses	Medium	Implementation of a Sustainable Drainage system to capture runoff. Adherence to best practice procedures in the handling, use and storage of fuel, oils and chemicals. Concrete will be delivered in ready mix wagons. Wagons only to 'wash-out' in areas where suitable control measures are in place.	Low
	Polluted runoff contaminating groundwater	Groundwater	Medium	Implementation of a Sustainable Drainage system to capture runoff. Adherence to best practice procedures in the handling, use and storage of fuel, oils and chemicals. Concrete will be delivered in ready mix wagons. Wagons only to 'wash-out' in areas where suitable control measures are in place.	Low

10.9 Conclusion

A desk-based study and site walkover were conducted to establish the baseline water environment of the site, whereby predicted impacts caused by the development were identified. The majority of potentially significant negative impacts on water quality are only predicted to occur in the short term through potential increased sedimentation and pollution during the construction phase. The same would apply to the risk of contamination of groundwater. It is anticipated that the adoption of best practice management and control procedures by all site personnel, and the implementation of the mitigation methods proposed, will bring these risks down to acceptable levels.

11 Existing Infrastructure, Telecommunications, Television, Aviation and Electromagnetic Interference

11.1 Introduction

Operational wind turbines have the potential to interfere with:

- Communication networks that use electromagnetic signals;
- Civil aviation radars;
- Safeguarding radars operated by the MOD; and
- Other types of infrastructure such as high pressure gas, water pipes or electricity lines and cables.

The potential impact of the proposed wind turbines on this infrastructure is considered in this chapter.

11.2 Guidance

Guidance for assessing the potential impact of wind turbines on electromagnetic infrastructure is given in:

- Scottish Planning Policy, Subject Policy: *Renewable Energy*, Scottish Government, 2010;
- Tall structures and their impact on broadcast and other wireless systems, Ofcom, 2009; and
- Wind farms assessment tool, BBC

Guidelines and publications for assessing potential impact on aviation activities are:

- Wind Energy and Aviation Interim Guidelines, BWEA, 2002;
- CAP 428 - Safety Standards at Unlicensed Aerodromes, CAA, 2004; and
- CAP 764 – Policy and Guidelines on Wind Turbines, CAA, 2012.

11.3 Methodology

A list of consultees with aviation, telecommunications, television and other infrastructure interests in the area was identified based upon advice given in Scottish Planning Policy. These consultees are listed in **Table 11.1**.

Table 11.1 – Infrastructure, telecommunications and other infrastructure consultation

Consultee	Response Received	Comments
Aviation		
CAA	No	No longer comment pre-application
MOD	No	No longer comment pre-application
BAA	No	No longer comment pre-application
NATS	No	No longer comment pre-application
Telecommunications		
Ofcom	Yes	Identified the interested operators below
JRC	Yes	No objection
Ericsson	Yes	No objection
BT	Yes	No objection
Atkins	Yes	No objection

11.4 Assessment of Impact

Civil aviation

The British Aviation Authority (BAA), the Civil Aviation Authority (CAA) and National Air Traffic Systems (NATS) now no longer comment on proposals at the pre-application stage.

An independent aviation study commissioned by the client has established that there are not expected to be any conflicts with civil aviation.

Ministry of Defence (MOD)

An independent aviation study has identified that both turbines are likely to be visible to the radar at RAF Leuchars, which may trigger an initial objection.

Should this be the case, it is proposed that an in-fill radar solution be developed by a specialist aviation consultancy and agreed with the MoD. This approach was successfully adopted for the Govals Windfarm, with the MoD content to make the successful implementation of such a scheme a condition of planning.

Telecommunications

Ofcom identified four companies with links in the vicinity of the proposed development. All the identified link providers were consulted with the details of the proposal and responded with no objections.

Other infrastructure

No underground services or overhead power lines have been identified within the vicinity of the proposed wind turbines.

Television

The digital switchover for the whole of the UK has been completed.

A 2009 Ofcom report stated that:

“Digital television signals are much better at coping with signal reflections, and digital television pictures do not suffer from ghosting. However a digital receiver that has to deal with reflections needs a somewhat higher signal level than one that has to deal with the direct path only. This can mean that viewers in areas where digital signals are fairly weak can experience interruptions to their reception should new reflections appear.

Over time, this problem is expected to diminish as the power of transmitters is increased as digital switchover continues across the UK. However, higher transmitter powers will not be a solution in all situations which means that reflections may still affect digital television reception in some areas, although the extent of the problem should be far less than for analogue television.”

There are a number of technical solutions available should interference be proven as an issue as a result of the turbines. If in the unlikely event that there are any impacts, these would be of a temporary nature until a technical alternative can be put in place. Overall, any potential effects on television are considered to be negligible.

11.5 Impacts, Issues and Mitigating Actions

There is a possibility that the MoD is likely to object to the turbines based upon the potential impact to the radar at RAF Leuchars. Negotiations with the MoD will be undertaken post-submission, if required. There is a high level of confidence that suitable mitigation measures can be agreed, as was successfully taken forward for the Govals Windfarm.

11.6 References

British Wind and Energy Association (BWEA), Civil Aviation Authority (CAA), Department of Trade and Industry (DTI), (2002), *Wind Energy and Aviation Interests – Interim Guidelines*, BWEA, CAA, DTI.

Civil Aviation Authority (2004), *CAP 428 – Safety Standard at Unlicensed Aerodromes (Including Helicopter Landing Sites)*, Civil Aviation Authority.

Civil Aviation Authority (2012), *CAP 764 – CAA Policy and Guideline on Wind Turbines*, Civil Aviation Authority.

digitaluk <http://www.digitaluk.co.uk/> (accessed October 2013)

Ofcom (2009), *Tall structures and their impact on broadcast and other wireless services*, Ofcom.

Scottish Government (2010), *Scottish Planning Policy*, Scottish Government.

12 Shadow Flicker

This section of the report looks at the possible effects on local amenity caused by shadow flicker at residential properties.

12.1 Background

Tall structures such as wind turbines cast shadows. The shadows vary in length according to the sun's altitude and azimuthal position. Under certain combinations of geographical position and time of day, the sun may pass behind the rotor of a wind turbine and cast a moving shadow over neighbouring properties. Where this shadow passes over a narrow opening such as a window, the light levels within the room affected will decrease and increase as the blades rotate, hence the shadow causes light levels to 'flicker' - an effect commonly known as 'shadow flicker'.

Whilst the moving shadow can occur outside, the shadow flicker effect is only experienced inside buildings where the shadow passes over a narrow window opening. The seasonal duration of this effect can be calculated from the geometry of the machine and the latitude of the site. A single window in a single building is likely to be affected for a few minutes at certain times of the day for short periods of the year. The likelihood of this occurring and the duration of such an effect depend upon:

- The direction of the residence relative to the turbine(s);
- The distance from the turbine(s);
- The turbine hub-height and rotor diameter;
- The time of year;
- The proportion of day-light hours in which the turbine operates;
- The frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon); and
- The prevailing wind direction.

The further the observer is from the turbine the less pronounced the effect will be. There are several reasons for this:

- There are fewer times when the sun is low enough to cast a long shadow;
- When the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation; and,
- The centre of the rotor's shadow passes more quickly over the land reducing the duration of the effect.

At a distance, the blades do not cover the sun but only partly mask it, substantially weakening the shadow. This effect occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a weak effect is observed at a distance from the turbines.

12.2 Baseline and Methodology

Identification of Receptors

The former PAN45¹³, now replaced by the Scottish Government’s web based renewables advice, suggests that shadow flicker should not pose problems beyond 10 rotor diameters, which is 480m in the case of the Crofts Farm project. There are no properties within 480m of the turbines. The nearest property to a turbine is Crofts Cottage, which is located 620m to the south of the site.

Angus Council’s ‘Implementation Guide for Renewable Energy Proposals (2012) cites the Scottish Government guidance and states that, “*Turbines should generally be a minimum of 10 times rotor diameter from sensitive properties to avoid the potential effects of shadow flicker*”.

These sensitive properties include residential properties including care homes; educational buildings, hospitals, cemeteries; some visitor facilities and accommodation; and proposed development areas.

Significance Criteria

Northern Ireland’s Best Practice Guidance to Renewable Energy¹⁴, which has been approved by DECC¹⁵, states that an acceptable shadow flicker level at residential properties is 30 hours per year.

Methodology

Although there are no properties within ten rotor diameters of the turbines, a shadow flicker map has been produced using ReSoft’s WindFarm software to assess whether any properties could potentially experience more than 30 hours of shadow flicker per year.

The software models shadow flicker effects by using simple 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 turbine that may cast the shadows. The model adopts a conservative approach by assuming that:

- Turbines are facing the sun at all times of the day;
- It is always sunny;
- The turbines are always operating; and
- There is no local screening.

¹³ Scottish Executive Planning Advice Note, PAN45 (revised 2002): Renewable Energy Technologies, Wind Power, <http://www.scotland.gov.uk/library/pan/pan45-04.asp>, para. 64, 01/11/05

¹⁴ Best Practice Guidance to Planning Policy Statement 18: Renewable Energy, Department of the Environment (Northern Ireland), (2009).

http://www.planningni.gov.uk/index/policy/policy_publications/planning_statements/planning_policy_statement_18_renewable_energy_best_practice_guidance.pdf

¹⁵ Update of UK Shadow Flicker Evidence Base, DECC (2011)

<http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/Energy%20mix/Renewable%20energy/ORED/1416-update-uk-shadow-flicker-evidence-base.pdf>

12.3 Assessment

Figure 12.1 shows the predicted area where theoretical shadow flicker impacts are predicted to exceed 30 hours per year, in relation to the turbine locations and the nearest properties.

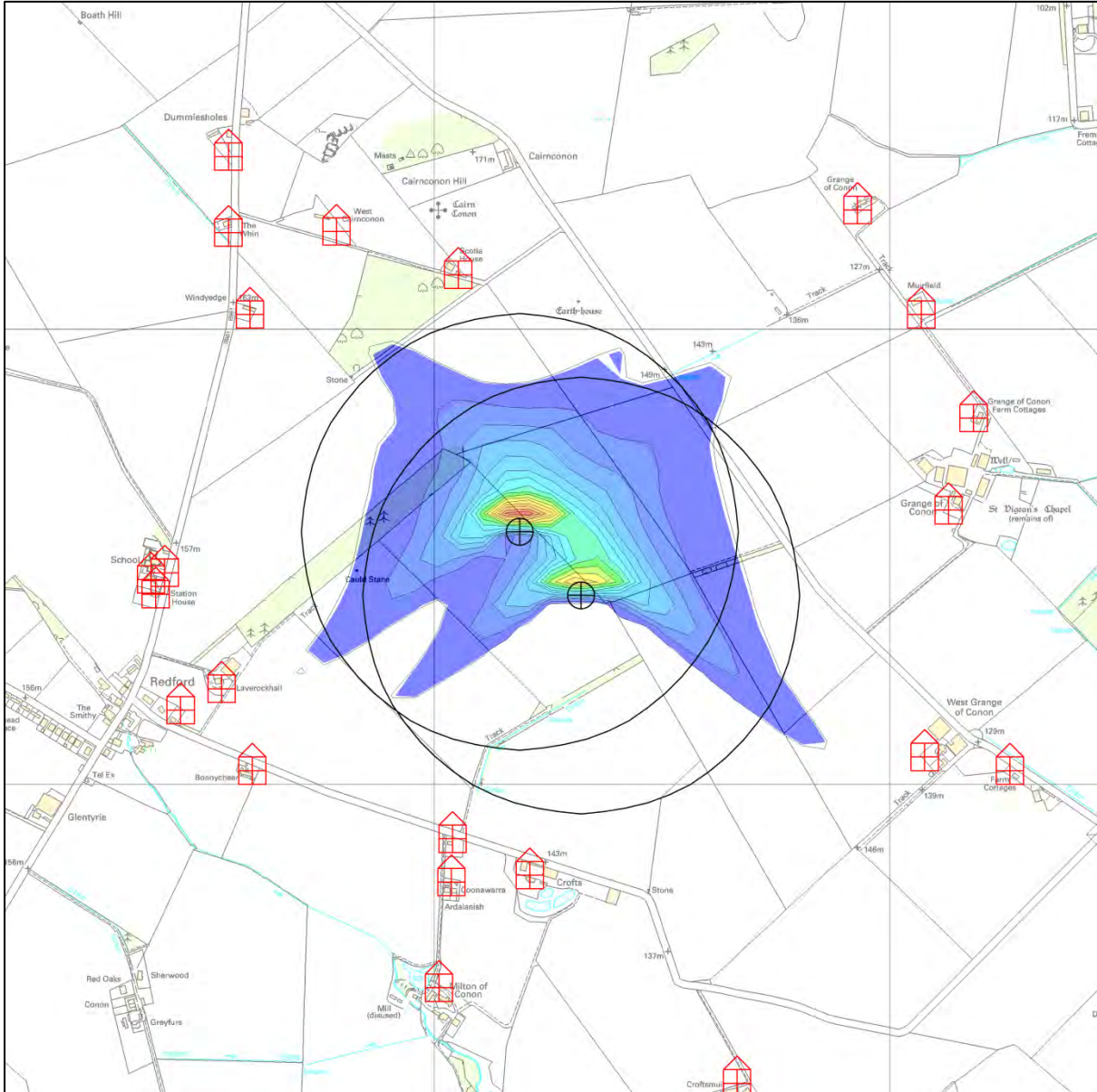


Figure 12.1 – Shadow Flicker Map

Key:			
—	10 rotor diameters (480m) Boundary	⊕	Turbine
🏠	Receptors	📊	>30 hours per year of theoretical shadow flicker

The map shows that the area predicted to receive >30 hours of annual shadow flicker impact is primarily limited to within 480m of the turbines, and that no properties are

located within this area. In reality, actual impacts would be less than this as a result of the following factors:

- The average sunlight hours for the Redford area which is ~1,564 hours. This has been estimated from the 1981-2010 met office data for Leuchars. Therefore, on average it is sunny for ~35% of the daylight hours.
- The rotor of a modern wind turbine can be expected to turn approximately 90% of the time.
- According to the Danish Wind Energy Association website, shadow flicker is reduced to 63% of the maximum possible if the wind turbine is assumed to be randomly yawed relative to the sun position.

More realistic shadow flicker impacts are therefore 20% of the theoretical totals ($0.35 \times 0.90 \times 0.63 = 0.20$). This means that if a receptor was expected to experience 30 hours of theoretical shadow flicker per year, in reality it would be more likely to experience around 6 hours.

This further supports the assessment that the nearest properties will not be adversely affected by shadow flicker from the two turbines.

12.4 Summary and Conclusion

DECC's guidance suggests that an acceptable level of shadow flicker at residential properties is 30 hours per year. Scottish Government guidelines suggest that shadow flicker impacts should not be problematic beyond a distance of 10 rotor diameters from a wind turbine.

A shadow flicker map has been produced for the Crofts Farm turbines, based on conservative assumptions, which demonstrates that:

- There are no properties located within 480m of the turbine locations; and
- No properties are likely to experience shadow flicker in excess of 30 hours per year as a result of the development.

Given these findings, it is not expected that shadow flicker will be problematic as a result of the development.

13 Climate Change

This section considers the impact of the proposed wind turbines on climate change.

13.1 Introduction

The UK and Scottish Governments have developed ambitious targets for tackling climate change:

- The UK Government in the 2008 Climate Change Act made a commitment to reduce the UK's emissions of CO₂ by 34% (on 1990 levels) by 2020 and 80% by 2050.
- The Climate Change (Scotland) Act 2009 sets in statute the Government's Economic Strategy target to reduce Scotland's emissions of greenhouse gases by 80% by 2050 (on 1990 levels), with an interim reduction target of at least 42%. These targets will be achieved through an investment in energy efficiency and clean technologies such as renewable energy generation.

The Scottish Government has developed a Climate Change Programme which sets a goal of generating the equivalent of 100% of Scotland's electricity demand by renewable means by 2020, with an interim target of 50% by 2015¹⁶. The vast majority of this new target is still expected to be met by hydro and by onshore wind.

New developments will continue to be implemented through the Renewables Obligation (Scotland) on all licensed electricity suppliers in Scotland, and through other incentives such as the Feed in Tariff (FiT).

13.2 Potential Impacts

The main greenhouse gas pollutants associated with conventional power stations include: carbon dioxide (CO₂); sulphur dioxide (SO₂); and oxides of nitrogen (NO_x).

The following table, which has been adapted from SNH guidance, summarises the potential CO₂ savings and costs associated with different aspects of each wind development:

Table 13.1 – Carbon savings / losses associated with wind developments

Potential Carbon Savings	Potential Carbon Losses
Carbon emission savings when compared to emissions from different power sources	Production, transportation, erection, operation and decommissioning of the windfarm
Improvement of habitat	Requirement for backup power generation
	Loss of carbon fixing potential of peatland
Loss and/or saving of carbon stored in peatland (by peat removal or changes in drainage)	
Loss and / or saving of carbon fixing potential as a result of forestry clearance	

In assessing the overall impact of the project on climate change, the full lifecycle of the wind turbines need to be considered. The remainder of this section quantifies each of the different elements presented above.

¹⁶ Renewable Routemap for Scotland - Update October 2012, The Scottish Government.

13.3 Guidance

This section has been written with reference to the following technical guidance:

- SNH Technical Guidance Note, 2.0.1, 2011¹⁷; and
- ‘Onshore Wind Energy Figures’¹⁸, Renewables UK (Accessed: November 2013).

SNH published a Technical Guidance Note in 2003 for calculating carbon ‘payback’ times for wind farms. The 2003 guidance adopted a relatively simple approach towards impacts on peatland hydrology and stability. The 2011 Technical Guidance Note presents a more comprehensive approach towards these issues.

Baseline Data

The annual carbon dioxide emissions saving of a wind turbine are estimated as:

$$CO_2 \text{ emissions saving} = \frac{\text{total electricity generation expected } MWh}{\text{Emission Factor of Displaced Generation } [tCO_2/MWh]}$$

The SNH Technical Guidance Note states that, “**in most circumstances it is not possible to define the electricity source for which a renewable electricity project will substitute**”, although it does state that as nuclear power generation is not affected by renewable energy generation “**this suggests that carbon emission savings from wind farms should be calculated using the fossil fuel sourced grid mix as the counterfactual**” SNH’s Technical Note presents result for each of the three sets of figures, as shown in **Table 13.2**.

Energy	Emission Factor (tCO ₂ per mWh) ¹⁹
Grid Mix	0.43
Coal Fired	0.86
Fossil Fuel Mix	0.607

Table 13.2 – Counterfactual emission factors

Within this section, the predicted carbon savings against both the Grid Mix and the Fossil Fuel Mix are presented. The Grid Mix figures present a more conservative estimate of CO₂ emission savings.

¹⁷ <http://www.scotland.gov.uk/Resource/Doc/917/0120448.pdf>

¹⁸ Renewable website –Onshore Wind Energy Figures, <http://www.renewableuk.com/en/renewable-energy/wind-energy/onshore-wind/index.cfm>, accessed November 2013

¹⁹ Table 2, SNH Technical Guidance Note, 2.0.1, 2011

Capacity Factor

A wind project capacity factor has to be determined in order for the total electricity generation of the wind project to be calculated. This is the ratio of the actual energy generated to the theoretical amount that the machine would generate if running at full rated power during a given period of time. The average capacity factor observed for the onshore wind farms in the UK between 2007 and 2012 is 26.0%²⁰. The Scottish average is believed to be better thanks to more frequent and higher wind speeds. It is believed that, for this location, a figure of 30% represents a realistic estimate. In order to present a conservative assessment, the UK average has been used in the calculations below.

13.4 Carbon balance

Project CO₂ emission savings

The calculation was carried out in accordance with SNH Technical Note version 2.0.1, 2011²¹, using the overall grid mix and fossil fuel sourced grid mix figures to produce the counterfactuals for comparison. Results are presented in **Table 13.3**.

Power Generation Characteristics	
Number of turbines	2
Total installed capacity	1.3MW
Capacity Factor	26%
Lifetime	25 years
Annual Energy Output	~2,970 MWh/yr

Counterfactual Emissions Factors	
Overall 'grid' mix generation	0.43 tCO ₂ /MWh
Fossil fuel sourced mix	0.607 tCO ₂ /MWh

Project estimated CO ₂ emission savings over:	tCO ₂ /yr	tCO ₂ /25yr
Grid mix generation	1,270	32,000
Fossil fuel mix generation	1,800	45,000

Assuming 1 tCO₂ = 0.27 tC:

Total Project Estimated Carbon saving over:	tC /yr	tC /25yr
Overall 'grid' mix generation	344	8,600
Fossil fuel mix generation	486	12,100

Table 13.3 – Calculated CO₂ emission savings

Based upon an average Scottish electricity consumption of 4,577 kWh per household²², the Crofts Farm turbines are expected to provide enough electricity to power **~650** homes.

²⁰ Digest of UK Energy Statistics 2013 (DUKES) Table 6.5 - Load factors for renewable electricity generation, November 2013

²¹ <http://www.scotland.gov.uk/Resource/Doc/917/0120448.pdf>

Projected carbon savings and costs

The potential carbon savings and carbon costs associated with wind farm development are as follows:

- Carbon emission savings (based on emissions from different power sources);
- Loss of carbon due to production, transportation, erection, operation and decommissioning of the wind farm;
- Loss of carbon from backup power generation;
- Loss of carbon-fixing potential of peatland;
- Loss and/or saving of carbon stored in peatland (by peat removal or changes in drainage);
- Carbon saving due to improvement of habitat; and
- Loss and/or saving of carbon-fixing potential as a result of forestry clearance.

An assessment of the Crofts Farm Wind Cluster against each of these elements is presented below.

Production, transportation, erection, operation and decommissioning of the windfarm

In the absence of a specific life cycle assessment for the turbine, the SNH Technical Guidance Review recommends using the following equations:

For turbines <1MW: $L_{life} = (517.62 * C_{turbine}) - 0.1788$

For turbines >1MW: $L_{life} = (934.35 * C_{turbine}) - 467.55$

Where $C_{turbine}$ is the capacity of each machine.

Using this formula, the lifecycle CO₂ emissions of the two turbines can be estimated to be **673 tonnes** which corresponds to a payback time of around **6.3 months** against the grid mix generation. This corresponds to **182 tonnes** of carbon.

Requirement for backup power generation

Wind generated energy is inherently variable, which means that some degree of backup power generation is required to provide a stable supply to the consumer. The SNH Technical Guidance Review states that the extra capacity required for backup power generation is estimated to be 5%, if wind energy contributes more than 20% to the national grid.

The guidelines estimate that the contribution of wind power to the national grid will not exceed 20% until 2038, therefore no additional CO₂ loss from back up generation requirements can be attributed to the project.

Peat

No areas of peat will be affected by the proposal, either through direct impacts or indirectly through impact upon drainage.

Forestry

²² Sub-national local authority electricity consumption statistics 2005 to 2012, DECC worksheet, updated 2013

No areas of forestry are expected to be cleared as a result of the proposal.

Results

The following table summarises the overall carbon balance of the development over its 25 year lifecycle, based upon the overall grid mix counterfactual, which represents a conservative estimate.

Element:	Predicted lifetime savings / losses (tC)
Projected carbon savings compared to grid mix	-8,600
Production, transportation, erection, operation and decommissioning	+182
Requirement for backup power generation	0
Peat losses / savings	0
Forestry losses / savings	0
Total	-8,418

Table 13.3– Predicted carbon savings / losses

Table 13.3 shows that over its 25 year lifecycle the project is expected to result in a carbon saving of **~8,400 tonnes**.

Other Polluting Gas Emissions Savings

Other gas emissions resulting for fossil fuel sourced electricity generation are sulphur dioxide (SO₂) and nitrogen dioxide (NO_x), both responsible for acid rains. Emissions savings relating to the project can be calculated using the BWEA guidance. This suggests that the SO₂ and NO_x emissions savings are, respectively, 10 and 3 kg per MWh. This translates to emissions factors of 0.01 and 0.003 [tonnes/MWh] respectively.

Project total emission savings of:	
Sulphur dioxide SO ₂	~741 tonnes /25yr
Nitrogen dioxide NO _x	~222 tonnes /25yr

13.5 Mitigation

As the development as a whole is expected to have a small beneficial effect on climate change in terms of offsetting greenhouse gas emissions, no mitigating actions are suggested.

13.6 Conclusions

It is concluded from the above that the development would have an overall small positive effect in reducing UK greenhouse gas emissions.

Besides reducing CO₂ emissions, the development of clean, low carbon methods of generating electricity will also help the UK to diversify its energy supply away from non-sustainable fossil fuels. Furthermore, the harnessing of national renewable energy resources can be seen as a wise strategic move in that it reduces the UK's dependency on energy imports from foreign countries.

13.7 References

Department of Energy and Climate Change (2013), *Regional and local authority electricity consumption statistics: 2005 to 2013*.

The Scottish Government (2013), *Energy Statistics Summary*, The Scottish Government.

The Scottish Government (2009), *Climate Change (Scotland) Act 2009*, The Scottish Government.

The Scottish Government (2013), *2020 Routemap for Renewable Energy in Scotland - Update*, The Scottish Government.

UK Government (2008), *Climate Change Act 2008*, UK Government.

Appendix 1 – Phase 1 Habitat Map

Appendix 2 – LVIA Viewpoint Assessment

Figure 7.12	Viewpoint 1: The Guynd	
Description	<p>Viewpoint 1 is taken from E356680 N742221, at the entrance to Mains of Guynd by the side of the B9127 which serves as access for a small number of local properties including Mains of Guynd and the Guynd. The view faces northwards towards the turbines which are located ~2.3km from the viewer.</p> <p>The view is fairly enclosed from this location. The landscape rises gently moving away from the viewer, with the horizon limiting potential views to the north. The view overlooks an arable landscape. The land cover is dominated by several large rectilinear fields, while the access road to the nearby farm can be seen running along the field edge to the left of the view, before it bends to the left and disappears from view. Significant areas of shelterbelt woodland run along the field boundaries on the opposite field edges to the viewer. The shelterbelts provide a significant amount of screening, further enclosing the view. The field boundaries are also marked by post-and-wire fencing. A small number of properties are visible in the view, amongst and beyond the tree line, these add a further man made element to the view. A series of wooded electricity poles also run through the landscape along the opposite field edges from the viewer, these appear back dropped by the nearby woodland in this view.</p>	
Sensitivity	The viewpoint represents some of the closest visual receptors and visitors to the Guynd and as such is considered to be of high sensitivity.	
Magnitude of Change	<p>Receptors of this view would be ~2.3km from the proposed turbines.</p> <p>From this location the two turbine development would appear theoretically on the horizon, viewed in full against the sky. In reality the woodland features in the view would provide a great deal of screening, limiting views to the very upper portions of the turbines which would appear over the tree line. In times of lesser leaf cover the turbines would become slightly more visible, but the trees would still provide a great deal of screening. The turbines would occupy a negligible extent of both the horizontal and vertical view from this vantage point</p> <p>The overall magnitude of change for the development is considered to be low, leading to a moderate level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are no operational turbines visible from this location.</p> <p>The cumulative magnitude of change for operational projects would be none.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location.</p> <p>The cumulative magnitude of change for consented projects would remain none.</p> <p><u>Operational, Consented, In Planning</u></p> <p>There are no planned projects visible from this location.</p> <p>The cumulative magnitude of change for planning projects would remain none.</p>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a low magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Low</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Moderate

Figure 7.13	Viewpoint 2: B961 near Newton	
Description	<p>Viewpoint 2 is taken from E355915 N743506, at the side of the B961 to the south of the settlement of Redford. The view faces north-east towards the proposed development which is located 1.6km from the viewer.</p> <p>The view is fairly open from this location. Overlooking a gently rolling arable farmland landscape which typifies much of the surrounding area. Due to the rolling nature of the landscape and the elevated location of the viewer, longer distance views occur to the right of the view, with the coast and North Sea visible, giving a real sense of openness to this vista. Inland the land cover is dominated by large rolling predominantly rectilinear fields. The varying colours of grass and cereals create a patchwork effect on the countryside. The fields are bound by post-and-wire fencing and shelterbelt woodland which runs along many field edges creating natural barriers and helping to break up the landscape. There are a number of dwellings, primarily farm properties, scattered throughout the landscape, along with associated outbuildings and other features. Wooden electricity poles associated with these properties criss-cross the landscape, at times breaking the horizon such as in the foreground where it adds a vertical structure to the close in view. The view is pleasant and typical of the local surrounding area, the working landscape has been heavily man modified over time as farming practice has demanded.</p>	
Sensitivity	<p>The viewpoint represents road users travelling northwards on the B961, primarily local residents of the nearby settlement and other nearby dwellings and as such is considered to be of high sensitivity.</p>	
Magnitude of Change	<p>Receptors of this view would be ~1.6km from the proposed turbines.</p> <p>From this location the turbines would appear in full on the horizon. The two turbine cluster would appear as a balanced development, occupying a negligible extent of the open horizontal vista and low extent of the vertical view. The development would not obstruct views towards the coast, appearing within an area of the landscape dominated by farming use and has already been heavily modified by the hand of man. The development is in keeping with the scale of the view, it does not serve to dominate or control the vista.</p> <p>The overall magnitude of change for the development is considered to be low, leading to a moderate level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are theoretical successive views with the North Mains of Cononsyth turbine from this location, the single turbine is heavily screened by the intervening landscape, with the intervening shelterbelt further limiting these potential views from this location. It is unlikely that the turbine will be visible from this viewpoint.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>The blade tips of the proposed Arbikie wind cluster are theoretically visible to the left of the proposed turbines, in reality these are unlikely to be visible from this location. The single turbine at Cuthlie appears predominantly against the landscape to the right of the view, the turbine would also be heavily screened by intervening vegetation from this location.</p> <p>There are theoretical successive views with the Nathro Hill windfarm appearing on the distant horizon to the left of the view, it is unlikely that the development will be visible from this location.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	<p>On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a low magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.</p>	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Low</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Moderate

Figure 7.14	Viewpoint 3: A933 near Colliston	
Description	<p>Viewpoint 3 is taken from E360213 N745713, at the side of the A933 near Colliston Mill. The view faces south-west towards the proposed turbines which are located 3.2km from the viewer.</p> <p>The view is fairly enclosed from this location, with the camber of the fields in the surrounding landscape enclose the views quickly. The view is dominated by a large arable field which stretches from the roadside to the horizon, covering the majority of the foreground of the view and the left hand side of the horizon. The landscape changes slightly to the right of the view, retaining its arable feel, the landscape is interspersed with areas of shelterbelt planting, while the horizon is populated by areas of denser policy woodland which further limit views over the surrounding landscape. There are a number of manmade features present in the view, alongside the road. The landscape as a working landscape is constantly changing with varying field coverings. A series of wooden electricity pylons can be seen running up the field edge to the right of the view, these are viewed breaking the horizon, before the rising landscape beyond provides a back drop. A number of properties can be seen in the view, these tend to be isolated farmsteads, set within the landscape, the dwellings are associated with the other man made features such as the electricity pylons.</p>	
Sensitivity	The viewpoint represents road users travelling northwards on the A933, and as such is considered to be of medium sensitivity.	
Magnitude of Change	<p>Receptors of this view would be ~3.2km from the proposed turbines.</p> <p>From this location the turbines would be viewed obliquely from the roadside, sitting on the horizon. The visible portions of the turbines would appear against the sky. The lower sections of the turbine towers are screened from view by a combination of landscape and vegetation, reducing the vertical extents of the turbines slightly. From this location the proposed turbines would occupy a low extent of both the horizontal and vertical view, appearing alongside mature woodland and electricity infrastructure already present in the view.</p> <p>The overall magnitude of change for the development is considered to be low, leading to a moderate/minor level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are theoretical successive views between the Crofts Farm turbines and the North Mains of Cononsyth turbine from this location. The single turbine would be subject to a significant amount of screening by the intervening woodland and it is unlikely that it will appear in this view.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>There are no planned projects visible in the same view as the Crofts Farm turbines from this location. Views of the Cuthlie turbine are limited by the intervening topography to a theoretical view of a blade tip; this is unlikely in reality.</p> <p>To the rear of the view there are successive views with the Bolshan, Renmure and Arbikie turbines, the Arbikie turbines would be viewed on the horizon, back dropped by the sky while the single turbines appear breaking the horizon, none of the developments are predicted to be overly prominent features in the view..</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a low magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Low</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Moderate/Minor

Figure 7.15	Viewpoint 4: Minor Road near Woodville Feus	
Description	Viewpoint 4 is taken from E359897 N743342 , at the side of a local minor road near Woodville Feus. The views faces north-west towards the proposed turbines which are located 2.8km from the viewer. The view is fairly enclosed from this location. The surrounding landscape rises gently as it moves away from the viewer limiting potential long distance views over the wider landscape. The road itself is heavily screened, passing behind the hedgerow which can be seen running the length of the field to the left of the view. To the right, the large arable field dominates the view, running all the way up to the horizon in the right of the view. Around the centre of the view the views are slightly more open offering a glimpse of the surrounding fields, although a significant area of woodland sits on the horizon in this direction and limits any further views. To the right of the view there is a significant series of farm buildings, spread across the horizon on the opposite side of the fields. Another property sits amongst an area of woodland in the centre of the view, heavily screened by the surrounding trees. Shelterbelts run along the majority of the horizon, adding a vertical line of features to the horizon.	
Sensitivity	The viewpoint represents local residents in the area, travelling along the minor roads from Arbroath, and as such is considered to be of high sensitivity.	
Magnitude of Change	<p>Receptors of this view would be ~2.8km from the proposed turbines.</p> <p>The turbines appear on the horizon from this location. The turbines appear solely against the sky, with the lower sections of the turbines screened by the intervening landscape. Despite the theoretical visibility the significant amount of woodland present in the view would significantly screen the potential views of the proposed development. Views would be limited the blades of the turbines only, appearing over the tree line.</p> <p>The overall magnitude of change for the development is considered to be low, leading to a moderate level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are no operational turbines visible from this location.</p> <p>The cumulative magnitude of change for operational projects would be none.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location</p> <p>The cumulative magnitude of change for consented projects would remain none.</p> <p><u>Operational, Consented, In Planning</u></p> <p>Successive views occur to the left of the view, with the single turbine at Cuthlie appearing on the horizon. The single turbine sits slightly more prominently in this view, located closer to the viewer than the proposed Crofts turbines. The single turbine would be subject to similar screening conditions from this location and it is unlikely that it will be fully visible at any point around this area. The lack of visibility of the Crofts turbines means there will be little cumulative impacts on this view.</p> <p>The cumulative magnitude of change for planning projects would become negligible.</p>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a low magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Low</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Moderate

Figure 7.16	Viewpoint 5: Arbroath	
Description	<p>Viewpoint 5 is taken from E365197 N742431, at the side of Seaton Road to the north-east of the settlement of Arbroath; the road also forms part of the National Cycle Network Route 1. The view faces north-west towards the proposed development which is located 8.1km from the viewer.</p> <p>The view is very open from this location. The landscape rolls away from the viewer over the foreground, rising beyond the middle ground to form a gently undulating horizon that limits significantly longer distance views to the west, however, longer distance views do occur towards the hill ranges in the north-west. The foreground landscape is heavily man modified, with the expansion of the settlement of Arbroath portrayed by the new build properties which are currently under construction, sitting in the view alongside existing development, meanwhile to the left of these properties the school playing fields are fenced off from the neighbouring agricultural field. The middle ground of the view is marked by several rows of mature shelterbelt plantation, screening views of the nearby A92 and further views of the settlement. Beyond the settlement and other infrastructure the landscape becomes more rural taking on a calmer appearance, with a covering of large, predominantly rectilinear fields, dominating the view. There is patchwork feel to this area of the landscape, created by the varying field textures. Woodland also becomes a more noticeable feature within this landscape, the dark shelterbelts help to break up the view, running along field edges and around intermittent properties dispersed throughout the countryside. Over the higher areas there are a few examples of policy plantation woodland, running over the distant horizon.</p>	
Sensitivity	<p>The viewpoint represents residents of Arbroath and is one of the only areas of the settlement likely to experience any visibility of the proposed development. It also represents the views of recreational users travelling along NCR 1 and as such is considered to be of high sensitivity.</p>	
Magnitude of Change	<p>Receptors of this view would be 8.1km from the proposed turbines.</p> <p>The turbines appear on the distant horizon, over 8km from the viewer in this view. The turbines would be viewed predominantly against the sky in this open vista, with the lower tower sections backdropped by the band of shelterbelt behind the development. It is unlikely that they will be overly significant features in this heavily man modified view, which already contains a large number of vertical features. The turbines would occupy a negligible extent of both the horizontal and vertical views from this location.</p> <p>The overall magnitude of change for the development is considered to be low, as the view already features some strong vertical elements with the nearby pylons, leading to a moderate level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>The North mains of Cononsyth turbine appears against the landscape to the right of the Crofts Farm turbines from this location. The single turbine is not an overly prominent feature within this open vista.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>The single turbine at Pickerton is visible to the far right of the view, the single turbine would be screened from view by the intervening woodland from this location. The single turbine appearing against that landscape located over 10km from the viewer it is unlikely to be an overly significant feature in this view. There are also theoretical views of the Govals and Frawney windfarms, although they are barely visible features from this location.</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>There are a number of planning developments theoretically visible in the view, alongside the Crofts Farm turbines from this location. The most prominent of these is the single turbine at Cuthlie, the single turbine sits on the horizon to the left of the Crofts Farm development. The single turbine appears slightly more prominent than the proposed turbines at Crofts Farm. The Dubton Farm turbine appears in the view with Pickerton, neither turbine is expected to be visible from here.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	<p>On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a low magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.</p>	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Low</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Moderate

Figure 7.17	Viewpoint 6: Friockheim	
Description	<p>Viewpoint 6 is taken from E359814 N749591, at the minor road which leads to the cemetery on the southern edge of the settlement of Friockheim. The view faces southwards towards the turbines which are located ~5.7km from the viewer. This view was chosen to represent a worst case scenario for local residents as there are no predicted views from other areas within the settlement.</p> <p>The view is very enclosed from this location. The mature shelterbelt woodland which runs along the field boundaries to the south of the settlement provides significant screening, forcing views inwards rather than over the surrounding countryside to the south. The minor road can be seen running from the centre of the view to the left, before it bends to the right, disappearing behind the stone wall which marks the nearby field boundary. The middle ground is dominated by a small number of large arable fields, with the landscape rolling up slightly towards the horizon, further enclosing the view. To the left the cemetery is located beyond the significant mature hedgerow which runs along the roadside.</p>	
Sensitivity	<p>The viewpoint represents a worst case scenario for the residents of Friockheim and as such is considered to be of high sensitivity.</p>	
Magnitude of Change	<p>Receptors of this view would be 5.7km from the proposed turbines.</p> <p>The turbines appear theoretically visible on the horizon from this location. Sited between two bands of shelterbelt the view is framed on each side by this woodland. In reality the turbines are heavily screened in this view by further woodland present in the wider view, with only the upper sections of the turbines theoretically visible. They appear smaller in scale than some of the more prominent features in the view and as such would neither dominate nor control this view. The turbines would occupy a negligible to low extent of both the horizontal and vertical view.</p> <p>The overall magnitude of change for the development is considered to be low, as the view already features some strong vertical elements predominantly the significant bands of shelterbelt, leading to a moderate level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are no operational turbines visible from this location.</p> <p>The cumulative magnitude of change for operational projects would be none.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location</p> <p>The cumulative magnitude of change for consented projects would remain none.</p> <p><u>Operational, Consented, In Planning</u></p> <p>There are no planned projects visible from this location.</p> <p>The cumulative magnitude of change for planning projects would remain none.</p>	
Type of Effect	<p>On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a low magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.</p>	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Low</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Moderate

Figure 7.18	Viewpoint 7: Dodd Hill	
Description	<p>Viewpoint 7 is taken from E345256 N739618, by the cairn at the summit of Dodd Hill. The view faces east towards the turbines which is located ~12.9km from the viewer.</p> <p>The view is very open from this prominent elevated location. Facing eastwards, the view overlooks the large agricultural plain that makes up much of the intervening landscape, between the Sidlaws and the eastern coast. The landscape slopes gently towards the coast, allowing for views of the sea beyond the landscape, when looking north-east, east and south-east towards Dundee. Inland the view offers a more rural and natural landscape with the foreground consisting of heather moorland and gorse. In the middle ground arable fields and coniferous plantations are the predominant landcover and this continues until the topography begins to rise again in the distance. For much of the view the northern end of the Sidlaw Hills make up the horizon and towards the right of the view further in the distance the landscape opens up over the Strathmore Valley. The landscape is fairly expansive and of a large scale with a few man-made features such as electricity pylons, communication masts and farm infrastructure. The view will be valued as part of the Sidlaw hills and by walkers in the area.</p>	
Sensitivity	<p>The viewpoint is located at the summit of Dodd Hill and is representative of views experienced by walkers in the area, and is therefore considered to be of High sensitivity.</p>	
Magnitude of Change	<p>Receptors of this view would be 12.9km from the proposed turbines. The turbines would be viewed on the distant horizon from this location, sitting over 12km from the viewer. They would appear on the horizon backdropped by the sky. At this distance it is unlikely that the turbines would have any significant impacts on this open and grand vista, featuring in a similar view to the nearby communication mast which provides a scaling feature, reducing the vertical extent of the proposed development significantly. The proposed turbines would occupy a negligible extent of both the horizontal and vertical view from this location.</p> <p>The overall magnitude of change for the development is considered to be negligible, as the view already features some strong vertical elements with the nearby communications masts, leading to a moderate/minor level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are no operational turbines visible in the same direction as the Crofts Farm turbines from this location. The North mains of Cononsyth turbine is heavily screened and is unlikely to be visible from this location. The Michelin Tyre Factory turbines appear below the viewer, viewed solely against the landscape, appearing successively in this view with the Crofts Farm turbines. The operational Tealing turbine appears to the rear of the view, the single turbine appearing against the landscape would not feature prominently, viewed against the flat arable landscape to the west.</p> <p>There are theoretical distant views of the Tullo developments, however, from this location they are barely discernible features on the distant horizon.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>Successive views occur with the nearby Govals and Frawney developments which appear to the rear of the view. The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>There are a number of planned developments visible from this location, the single turbine at Stotfaulds appears in the same view as the Crofts Farm turbines, the single turbine is a much more prominent feature in this landscape, viewed breaking the horizon from this location. As well as the Stotfaulds turbines there are also views of the Cuthlie, Upper Balmachie and New Downie turbines, although these developments are less prominent features in the view, similar to the Crofts Farm development.</p> <p>The single turbine at Tealing 2 sits within the landscape, viewed as an extension to the operating Tealing turbine.</p> <p>To the north-west the Nathro Hill windfarm spreads across the horizon, occupying a significant proportion of the distant horizon in this direction, viewed against the sky</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	<p>On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a negligible magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.</p>	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Negligible</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	<i>Moderate/Minor</i>

Figure 7.19	Viewpoint 8: Tentsmuir	
Description	<p>Viewpoint 8 is taken from E347170 N727786, on the northern coast of Fife, within the Tentsmuir Recreational Area, a large coastal area of Fife popular for various outdoor recreation purposes such as cycling, walking and bird watching. Much of the area is covered with tree plantation, but the view looks north-east from the recreational path which circumnavigates the area, just to the east of Tayport, across the Firth of Tay estuary towards Carnoustie and Broughty Ferry.</p> <p>From this sea level view, the key foreground features of the scene include the rough grasses which grow on the sandy soils at the water's edge and the Firth of Tay itself. The Tay itself dominates much of the view, covering the middle ground, opening up further to the right as it enters the North Sea. On the opposite banks the built features of the coast including the settlements of Broughty Ferry, Monifieth and Carnoustie are all visible. Beyond this low coastal horizon, a secondary but also minor horizon of fields can be discerned, marking a distinction between the urban environment and the agricultural area beyond. This horizon is often topped with trees and other dark vegetation which provides a visual contrast to the patchwork of fields immediately below.</p>	
Sensitivity	This viewpoint was selected to represent recreational users visiting the area and forms part of the Tentsmuir SLA as such is considered to be of High sensitivity.	
Magnitude of Change	<p>Receptors of this view would be 19.5km from the proposed development.</p> <p>From this location the proposed turbines would be barely distinguishable features on the distant horizon, located almost 20km from the viewer. The intervening landscape also provides a great deal of screening, with only the upper sections of the turbines theoretically visible. The proposed development would occupy a negligible extent of both the horizontal and vertical views from this location.</p> <p>The overall magnitude of change for the development is considered to be negligible, as the turbines would not feature prominently in this open view, leading to a moderate/minor level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>The Michelin Tyre Factory turbine are visible successively on the opposite side of the Tay estuary from this location, being viewed predominantly against the landscape, with the upper sections breaking the horizon. The relative lack of visibility of the Crofts turbines from this location means there is little in the way of cumulative interaction between these developments.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>The Govals and Frawney developments appear successively on the horizon beyond the Michelin Tyre Turbines from this location, being viewed predominantly against the sky.</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>As well as these more prominent developments which appear successively to the left of the view, there are views of the Stotfaulds, New Downie, Cuthlie and Upper Balmachie turbines alongside Crofts Farm, none of these turbines are predicted to be easily discernible features in this view.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a negligible magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Negligible</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	<i>Moderate/Minor</i>

Figure 7.20	Viewpoint 9: Kirriemuir Hill	
Description	<p>Viewpoint 9 is taken from E339173 N754591, at the summit of Kirriemuir Hill, which is located on the eastern edge of the settlement of Kirriemuir. The view faces south-east towards the turbines which are located ~20.6km from the viewer.</p> <p>The view from this location is very open. The landscape rolls away from the viewer, remaining predominantly flat over the middle ground, before rising in the distance with the hills to the east of Forfar forming a gently rolling horizon. The landcover is dominated by arable farmland, with large rectilinear fields the main feature of the view. The fields are broken up by areas of shelterbelt woodland which mark the field boundaries and provide some localised screening features. Other field boundary features include post-and-wire fencing and hedgerows. As well as these features there are some poly-tunnels used for growing fruit and other crops which contrast with the more natural colours of the surrounding fields. Woodland becomes a more dominant landscape feature towards the middle ground where the landscape rises. There are several areas of significant plantation woodland, the dark green areas draped over the rolling hills. The landscape is peppered with individual properties predominantly farmsteads with associated outbuildings and other pieces of infrastructure, while the settlement of Forfar is also visible, nestled below the hills which rise to the east of the settlement. As well as these man made features there are a number of local roads and electricity pylons which cross the area.</p>	
Sensitivity	The viewpoint represents visitors to Kirriemuir Hill, primarily ramblers and other recreational users and as such is considered to be of high sensitivity.	
Magnitude of Change	<p>Receptors of this view would be 20.6km from the proposed turbines.</p> <p>The wireline suggests that there may be some theoretical visibility of the blade tips of the Crofts Farm turbines from this location. In reality there would be no discernible change to this view with the addition of the proposed turbines, due to this minimal visibility combined with woodland on the horizon.</p> <p>The overall magnitude of change for the development is considered to be negligible, as the turbine would have no impact on this view, leading to a moderate/minor level of effect.</p>	
Cumulative Impact	<u>The Crofts Farm turbines are not visible from this location, as such there will be no cumulative effects between the proposed development and the other developments theoretically visible in this view.</u>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a negligible magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Negligible</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Low

Figure 7.21	Viewpoint 10: White Caterthun	
Description	<p>Viewpoint 10 is taken from E354782 N766029, at the summit of the ancient fort of White Caterthun. The view faces southwards towards the turbines which are located ~21.6km from the viewer.</p> <p>The panoramic view offered from the top of the fort is very open, particularly to the east where views are not constrained by the more upland landscapes to the west. The view overlooks a predominantly flat agricultural plain, dominated by large arable fields. The openness of the view allows for visibility of the coast which is located ~25km from the viewer at this location. The landscape is interspersed with woodland features ranging from tree clusters and shelterbelts to large scale plantations. To the rear of the view the landscape takes on a more moorland upland feel, with rough grasses and heather dominating the landcover, while the large scale hills to the west limit long distance views. The view is open and vast, with views over distant settlements such as Brechin, Forfar and Stonehaven all possible from this elevated location. Roads and other key infrastructure features such as pylons and communications masts nestle within the landscape below without being prominent in the grand scale of the vista.</p>	
Sensitivity	The viewpoint represents visitors to the ancient forts and as such is considered to be of high sensitivity.	
Magnitude of Change	<p>Receptors of this view would be 21.6km from the proposed turbine.</p> <p>The proposed turbines appear theoretically visible on the distant horizon within this view. The turbines appearing completely back dropped by the sky. The proposed development would occupy a negligible extent of both the horizontal and vertical view from this viewpoint. In reality it is unlikely that the turbines will be an easily discernible feature in this view, at this distance it is not predicted that there will be any significant impacts on the scale or setting of the surrounding open landscape.</p> <p>The overall magnitude of change for the development is considered to be negligible, due to the openness and scale of the surrounding landscape, as well as the distance to the proposed development, leading to a moderate/minor level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are successive views from this location between the Tullo developments and the Crofts Farm turbines, the Tullo windfarm appearing on the distant horizon. Viewed solely against the sky it is not an overly prominent feature in the view. To the far right of the view the Ark Hill windfarm is also theoretically visible, similarly this is not a prominent feature in this view, visible backdropped by the surrounding upland landscape.</p> <p>The single turbine at North Mains of Cononsyth appears in the view alongside the proposed development, neither development is overly visible from this elevated and distant vantage point.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>The Hill of Strathcathro, Pickerton and Dunswood turbines all share a similar view to the Crofts Farm development from this location. The most prominent of these is the Dunswood turbine, which is located in the farmland below the viewer, the single turbine appears completely back dropped by the surrounding landscape.</p> <p>The larger developments of Frawney and Govals are located on the horizon to the right of the view. These projects are located over 25km away and are not expected to feature prominently in the view.</p> <p>Successive views occur to the north with the Steelstrath turbine as well as the Shiels and Easter Tulloch which form part of an extension to the operating Tullo turbines.</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>There are a number of single turbine and small clusters theoretically visible from this location, these include Arbikie, Renmure, Bolshan, Dubton Farm, Cuthlie, Cotton of Pitkennedy, Hillhead of Ascurry, Newmill of Balgavies and New Downie. These turbines appear predominantly against the surrounding landscape which would allow much of the development to be absorbed by the landscape.</p> <p>To the rear of the view the Nathro Hill windfarm would be more prominent located on a neighbouring hill ridge the windfarm would appear against the sky.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a negligible magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Negligible</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	<i>Moderate/Minor</i>

Figure 7.22	Viewpoint 11: Crombie Park	
Description	<p>Viewpoint 11 is taken from E353759 N740750, at the side of the B961 to the north-east of Crombie Park. The view faces north-east towards the turbines which are located ~5.1km from the viewer. The Park itself is heavily wooded and this location was chosen to represent a worst case scenario for the area.</p> <p>The view is fairly open from this location. The landscape across the fore and middle ground is made up of gently rolling arable fields. The horizon rises gently forming a lip which limits long distance views particularly over the left and central areas of the vista. The landscape slopes gently from left to right, with longer distance views occurring to the right of the view. The scene is dominated by a series of large predominantly rectilinear agricultural fields, reinforcing the arable nature of the local landscape. The fields are bound by a mixture of post-and-wire fencing, drystone walls and intermittent shelterbelts which also help to break up the view. Around the horizon there are larger areas of plantation woodland, running predominantly along the central horizon of the view. There are a number of man-made features within the view, with the B961 visible running between the fields in the left hand side of the view, rising with the topography before it disappears as the road curves to the right. A number of wooden pole electricity pylons run through the nearby fields, associated with the scattered farmsteads which sit within the landscape.</p>	
Sensitivity	The viewpoint represents visitors to Crombie Park and road users of the B961 and as such is considered to be of medium sensitivity.	
Magnitude of Change	<p>Receptors of this view would be 5.1km from the proposed turbine.</p> <p>From this location the proposed turbines would be viewed on the distant horizon. The turbines would appear balanced and in keeping with the scale of the view. They are viewed solely against the sky. The turbines would occupy a negligible extent of the horizontal and vertical view within this open vista. The turbines would appear in a view that has been heavily human influenced, with the proposed development would add two vertical features to the view but would neither dominate nor control the setting or scale of the vista.</p> <p>The overall magnitude of change for the development is considered to be low, as the view already features some strong vertical elements with the nearby pylons and the general man modified nature of the farming landscape, leading to a moderate/minor level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are no operational turbines visible from this location.</p> <p>The cumulative magnitude of change for operational projects would be none.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location</p> <p>The cumulative magnitude of change for consented projects would remain none.</p> <p><u>Operational, Consented, In Planning</u></p> <p>The single turbine proposed at Cuthlie would appear in the view to the right of the proposed Crofts Farm turbines. The single turbine would be viewed breaking the horizon, although it would appear in amongst an area of shelterbelt woodland which would offer some screening from this location.</p> <p>The cumulative magnitude of change for planning projects would become negligible.</p>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a low magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>Medium</i>
	Magnitude:	<i>Low</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	<i>Moderate/Minor</i>

Figure 7.23	Viewpoint 12: Pitmuies House	
Description	<p>Viewpoint 12 is taken from E356920 N749908, at the side of the A932 near Pitmuies House and Guthrie Castle. The view faces south towards the turbines which are located ~5.3km from the viewer.</p> <p>This view feels fairly enclosed from this location. The landscape in the foreground rises sharply in front of the viewer, particularly to the left of the view, while the landscape in the middle ground rises again enclosing the view further. The land cover across the foreground of the view is dominated by a large arable field, bound to the left by a row of mature trees, which further adds to the sense of enclosure. This pattern is repeated on the horizon over the middle ground where dense bands of mature woodland line the horizon limiting any further views. A series of electricity pylons run through the view from right to left, the pylons breaking the horizon, while the single turbine at North Mains of Cononsyth is partially visible over the tree line on the horizon. These vertical features add further man made features to the arable landscape.</p>	
Sensitivity	The viewpoint represents visitors to Pitmuies House and road users travelling on the A932 and as such is considered to be of high sensitivity.	
Magnitude of Change	<p>Receptors of this view would be 5.3km from the proposed turbine.</p> <p>The proposed turbines are heavily screened from view from this location. The intervening landscape limiting the visible portion of the turbines to the upper tower sections, hubs and blades. These views are further screened by the introduction of the mature band of woodland which sits on the horizon, this would limit views to the very tips of the proposed turbine blades. The proposed development would occupy a negligible extent of both the horizontal and vertical view from this location.</p> <p>The overall magnitude of change for the development is considered to be negligible, as the proposed turbines will add a barely discernible feature to the view, leading to a moderate/minor level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>The North Mains of Cononsyth turbine sits directly in front of the Crofts Farm development from this location, the turbine can be seen above the intervening tree line, with views limited to the upper sections of the turbine only.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location.</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>There are no planned projects visible from this location.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a negligible magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Negligible</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	<i>Moderate/Minor</i>

Figure 7.24	Viewpoint 13: A92 Inverkeilor	
Description	<p>Viewpoint 13 is taken from E366151 N748331, at the side of the A92 to the south of the settlement of Inverkeilor. The view faces south-west towards the proposed development which is located ~9.6km from the viewer.</p> <p>The view is fairly enclosed from this location. The A92 takes up much of the view running through the foreground from left to right, bound from the neighbouring fields by a crash barrier and a post-and-wire fence. Beyond the road the landscape quickly returns to agricultural use with the fields running right up to the roads edge. The rolling nature of the surrounding fields, limit views quickly from this location. Views are further restricted by bands of shelterbelt woodland scattered along the horizon, primarily across the left and centre of the view. The view is heavily modified with the A road a prominent feature from this location.</p>	
Sensitivity	The viewpoint represents road users travelling south-west on the A92 from Inverkeilor and as such is considered to be of medium sensitivity.	
Magnitude of Change	<p>Receptors of this view would be 9.6km from the proposed turbine.</p> <p>The proposed turbines would be completely screened in this view, the wireline suggests that the very tips of the blades may be theoretically visible over the horizon; however, in reality these would not appear in this view. A combination of distance and other features present in the view restricting any potential views.</p> <p>The overall magnitude of change for the development is considered to be none, there would be no change to the baseline features of this vista.</p>	
Cumulative Impact	<u>The Crofts Farm turbines are not visible from this location, as such there will be no cumulative effects between the proposed development and the other developments theoretically visible in this view.</u>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The lack of visibility of the development from this location would lead to no discernible change in this view.	
Assessment of Visual Effects	Sensitivity:	<i>Medium</i>
	Magnitude:	-
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	-

Figure 7.25	Viewpoint 14: Balmashanner Hill	
Description	<p>Viewpoint 14 is taken from E345769 N749307, at the summit of Balmashanner Hill to the south-east of Forfar. The view faces south-east towards the turbines which are located ~12.4km from the viewer.</p> <p>The view is very open in places from the summit of the hill. To the left of the view, the beginnings of a band of mature woodland can be observed, which limits views significantly. To the rear, the monument at the hill summit restricts views in this direction. Around the centre of the vista the view is very open with long distance views occurring over the surrounding arable landscape. This rural landscape undulates gently towards the coast, while views of the coast are not possible exist due to the rolling up of the distant horizon. The landcover of large arable fields create a patchwork effect, spread across the surrounding landscape, with intermittent areas of shelterbelt and larger policy woodland breaking up the field pattern. There are a number of man-made features within the view. These tend to be individual dwellings, predominantly farm steadings and associated infrastructure in the form of large modern outbuildings.</p>	
Sensitivity	<p>The viewpoint represents visitors to Balmashanner Hill, primarily walkers and other recreational visitors and as such is considered to be of high sensitivity.</p>	
Magnitude of Change	<p>Receptors of this view would be 12.4km from the proposed turbine.</p> <p>The proposed development sits on the distant horizon from this location. The two turbines would be viewed solely against the sky. At this distance, given the scale of the landscape below it is not expected that the proposed turbines would be easily discernible features. The development would occupy a negligible extent of both the horizontal and vertical view.</p> <p>The overall magnitude of change for the development is considered to be negligible, due to the distance to the development, leading to a moderate/minor level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are theoretical views of the North Mains of Cononsyth turbine from this location, it is barely visible on the horizon and would be unlikely to feature prominently in this view. To the rear of the View the Drumderg turbines are visible on the distant horizon, among the more upland landscape. The development would be viewed backdropped by the sky.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>The Pickerton turbine is located to the left of the view, the single turbine would be screened by intervening vegetation from this location. To the right of the view the Govals and Frawney wind turbines would be viewed on the horizon, the turbines appearing solely against the sky in a successive view with the Crofts Farm turbines.</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>The turbines at Hillhead of Ascurry and Cuthlie appear in the view either side of the Crofts Farm turbines; neither development is an overly prominent feature in the view, with the landscape features limiting views. To the rear of the viewer the Nathro Hill windfarm spreads across the horizon the linear development occupying a significant portion of the horizon, the turbines appearing solely against the sky. The windfarm would be a fairly obvious feature from this elevated location.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	<p>On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a negligible magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.</p>	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Negligible</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	<i>Moderate/Minor</i>

Figure 7.26	Viewpoint 15: Turin Hill	
Description	<p>Viewpoint 15 is taken from E351395 N753524, at the summit of Turin Hill. The view faces south-east towards the turbines which is located ~10.6km from the viewer.</p> <p>This is a grand and open vista from the hill summit, with long distance views to the south and east. The landscape rolls gently allowing for views towards the coast, with the sea visible to the left of the view. The land cover is again dominated by large scale rectilinear fields, in keeping with the predominant landscape character in the area. The fields create a distinct patchwork effect on the surrounding landscape. While bands of shelterbelt and larger scale plantation woodland help to break up the dominant pattern of agriculture a little. To the right of the view the eastern banks of Roscobie Loch can be seen feeding the Balgavies Loch which sits in the middle of the view. The lochs and connecting waterways are lined by dense mature woodland, picking them out of the surrounding landscape. There are a number of man-made features within the wider landscape, these are predominantly farm properties, associated with the surrounding landscape, these farms tend to sit adjacent to other infrastructure such as large outbuildings and sheds, as well as occasional grain silos. The settlement of Letham is also visible to the right of the view beyond the Lochs.</p>	
Sensitivity	The viewpoint represents walkers and other visitors to the summit of Turin Hill and as such is considered to be of high sensitivity.	
Magnitude of Change	<p>Receptors of this view would be 10.6km from the proposed turbine.</p> <p>The proposed development would be viewed on the distant horizon from this elevated position. The turbines would be completely backdropped by the sky. The woodland which runs along the distant horizon would provide some further screening, reducing the vertical extents of the development further. The turbines would occupy a negligible extent of both the horizontal and vertical view, at this distance it is not predicted that the development will be an easily discernible feature within this grand vista.</p> <p>The overall magnitude of change for the development is considered to be low, as the distance between the viewer and the development and the openness of the view would limit the potential impacts of the proposed development on the view, leading to a moderate level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>The North Mains of Cononsyth turbine appears in the view to the left of the proposed turbines, the single turbine is barely discernible in this open vista.</p> <p>Successive views occur with the Ark Hill turbines to the right of the view, although these turbines are partially screened by the intervening landscape and the visible portions of the development appear completely against the distant landscape, limiting their potential prominence.</p> <p>To the rear of the view the Drumderg turbines are also visible, located over 30km from the viewer and not appearing as an overly prominent feature in this view. The turbines sit on the horizon and are backdropped by the sky in this view.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>The Pickerton turbine is visible to the left of the view, the single turbine would be viewed solely against the landscape below the viewer, although slightly more prominent due to the proximity of the turbine to the viewer.</p> <p>Successive views occur with the larger windfarms of Frawney and Govals. These developments appear much more prominently in the view that the Crofts Farm turbines from this location.</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>The Cuthlie turbine appears to the left of the Crofts Farm turbines, the single turbine would not be visible from this location at this distance. The Newmill of Balgavies and Hillhead of Ascurry turbines are slightly more prominent located to the right of the proposed development. In this open landscape neither turbine is expected to be an overly prominent feature.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a low magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Low</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	<i>Moderate</i>

Figure 7.27	Viewpoint 16: North of Drummyellow	
Description	<p>Viewpoint 16 is taken from E358465 N743889, at the side of a local minor road to the south-east of the proposed development site. The view faces north-west towards the turbines which are located ~1.2km from the viewer.</p> <p>The view feels fairly enclosed from this location, particularly over the left and central areas. The landscape slopes gently from left to right, opening up slightly to the right of the view, where there are slightly longer distance views, although these are still limited to the immediate localised area. The left and centre of the view is dominated by a single large arable field, while the local road runs through the right of the view, disappearing swiftly behind the local property and surrounding vegetation. To the right the pattern is continued, overlooking several more large arable fields. Woodland cover is sparse with the nearby properties at Grange of Conon, screened by a band of shelterbelt. Another intermittent line of trees runs across the horizon to the left of the view. The surrounding fields tend to be bound by post-and-wire fencing, with rough grassy boundaries at the road side. A handful of wooden electricity poles run along the roadside, associated with the nearby properties.</p>	
Sensitivity	<p>The viewpoint represents some of the closest visual receptors to the proposed development and as such is considered to be of high sensitivity.</p>	
Magnitude of Change	<p>Receptors of this view would be 1.2km from the proposed turbines.</p> <p>The proposed turbines would be viewed on the horizon, completely back dropped by the sky from this location. The development would be partially screened by the vegetation which surround the nearby properties, however, they would still add two significant vertical features to the local landscape and occupy a medium extent of the horizontal and vertical view. The turbines would appear within the working farmland landscape, alongside other man made features including farm buildings and other vertical features such as electricity pylon, whilst easily discernible they would not serve to dominate or control the vista.</p> <p>The overall magnitude of change for the development is considered to be medium, as the view already features some man made features including the local properties and other farm infrastructure, leading to a major/moderate level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>Successive views may occur with the North Mains of Cononsyth turbine, which sits to the right of the view. The single turbine is heavily screened by the intervening landscape and woodland and the Crofts Farm turbines feature much more prominently in this view.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>Distant views occur with the Pickerton turbine, sitting in the landscape to the north, it is not expected that the development will be an easily discernible feature in this view.</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>Nathro Hill occupies a significant portion of the horizon to the right hand side of the view, appearing in a successive view with the Crofts Farm turbines from this location. It is unlikely to feature prominently from this location given it is located almost 30km from the viewer.</p> <p>The single turbine at Dubton Farm sits in the landscape alongside the Pickerton turbine, the two developments appearing as one balanced cluster from this location.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	<p>On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a medium magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.</p>	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Medium</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Major Moderate

Figure 7.28	Viewpoint 17: South of Parkconon	
Description	<p>Viewpoint 17 is taken from E358631 N745376, at the side of a local minor road to the south of Parkconon. The view faces south-west towards the turbines which are located ~1.6km from the viewer.</p> <p>The view feels fairly open from this location. The foreground is dominated by a series of predominantly flat arable fields, bound by post-and-wire fences and hedgerows. The landscape pattern is repeated across the middle ground of the view, with farm buildings and Grange of Conon visible to the left of the view, surrounded by a band of shelterbelt woodland. The landscape rises towards the horizon, with the formation of a gently rolling horizon, limiting further views from this area. To the right of the view there are three distinct area of woodland which covers the rolling hillside around Cairnconon Hill. The view is pleasant and typical of the agricultural pattern across the wider area.</p>	
Sensitivity	<p>The viewpoint represents some of the closest visual receptors to the proposed development and as such is considered to be of high sensitivity.</p>	
Magnitude of Change	<p>Receptors of this view would be 1.6km from the proposed turbine.</p> <p>The turbines would add two strong vertical features to the view from this location. Viewed on the horizon, the turbines would appear solely against the sky. From this location the proposed turbines would occupy a medium extent of the horizontal view and a high extent of the vertical view.</p> <p>The overall magnitude of change for the development is considered to be high, as the most prominent vertical features within the view, leading to a major level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are no operational turbines in the same view as Crofts Farm. The North Mains of Cononsyth turbine is theoretically visible to the right of the view. The single turbine would be viewed against the sky on the horizon.</p> <p>The cumulative magnitude of change for operational projects would be negligible.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location</p> <p>The cumulative magnitude of change for consented projects would remain negligible.</p> <p><u>Operational, Consented, In Planning</u></p> <p>There are theoretical successive views to the left with the Cuthlie turbine partially visible above the horizon. Views are restricted to the hub and blades, while intervening vegetation and other landscape feature would limit potential views.</p> <p>The cumulative magnitude of change for planning projects would remain negligible.</p>	
Type of Effect	<p>On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a high magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.</p>	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>High</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	<i>Major</i>

Figure 7.29	Viewpoint 18: Redford	
Description	<p>Viewpoint 18 is taken from E356133 N744163, at the side of Burnhead Terrace within the settlement of Redford. The view faces north-east towards the turbines which is located ~1.1km from the viewer. The view was chosen to represent a worst case scenario for the local residents from the most open location within the settlement.</p> <p>The view is fairly enclosed from this location. The local landscape remains uniformly flat across the foreground, rising quickly beyond the buildings in the middle of the view. The rise in topography forms a gentle lip which encloses the view, while woodland associated with the nearby properties limits views to the right. The heavily man modified features associated with the settlement help to create a distinct barrier between the settlement and the surround arable landscape. Over the horizon there is a distinct band of shelterbelt woodland which runs down the hillside towards the settlement, while other woodland features present in the view enclose the nearby properties located on the northern side of the settlement.</p>	
Sensitivity	<p>The viewpoint represents some of the closest visual receptors to the proposed development and as such is considered to be of high sensitivity.</p>	
Magnitude of Change	<p>Receptors of this view would be 1.1km from the proposed turbines.</p> <p>The turbines would be viewed on the horizon from this vantage point. The development back dropped by the sky, adding two fairly prominent vertical features to the view. The intervening woodland provides a significant amount of screening for one turbine, limiting views to the hub and blades, while the other appears to the right of the woodland edge. The turbines appear in keeping with the scale of the surrounding landscape and features and would not dominate or control the views from this area, despite their obvious visibility in the view. The turbines would occupy a low to medium extent of the horizontal and vertical view from this location.</p> <p>The overall magnitude of change for the development is considered to be medium, as the development would not dominate or control the horizon, leading to a major/moderate level of effect.</p>	
Cumulative Impact	<p><u>Operational</u></p> <p>There are no operational turbines visible from this location.</p> <p>The cumulative magnitude of change for operational projects would be none.</p> <p><u>Operational, Consented</u></p> <p>There are no consented turbines visible from this location</p> <p>The cumulative magnitude of change for consented projects would remain none.</p> <p><u>Operational, Consented, In Planning</u></p> <p>The single turbine at Cuthlie is theoretically visible to the right hand side of the view. The single turbine would be viewed breaking the horizon from this location. Views would be limited by the built features of the settlement from this location.</p> <p>The cumulative magnitude of change for planning projects would become negligible.</p>	
Type of Effect	<p>On completion of the development the visual effect from this viewpoint would be permanent (reversible) and direct. The development would lead to a medium magnitude of change and despite the careful design of the project a man-made vertical structure in this area would always lead to a negative effect.</p>	
Assessment of Visual Effects	Sensitivity:	<i>High</i>
	Magnitude:	<i>Medium</i>
	Type of Effect:	<i>Permanent, direct and negative</i>
	Level of Effect:	Major/Moderate

Appendix 3 – LVIA Residential Assessment

(Included as a separate document)

Appendix 4 – Cultural Heritage Assessment

(Included as a separate document)

Appendix 5 – Hydrological drawing