Levenmouth Demonstration Turbine

EIA Update Report

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1 INTRODUCTION

This Environmental Impact Assessment Update Report (the EIA Update Report) has been prepared by Arcus Consultancy Services Ltd. (Arcus) on behalf of Offshore Renewable Energy (ORE) Catapult (the Applicant). This EIA Update Report is submitted in support of an application for a variation to Condition 1 of the Section 36 (S36) Consent for the Levenmouth Demonstration Turbine (the LDT) (Reference: 022/OW/SEM) and a revised Marine Licence application for the continued operation of the LDT (Reference: 04617/13). The variation is for an extension of the operational life of the LDT from five to 15 years; i.e. an extension for ten years (the Variation). There will be no change to any built or physical aspects of the operational Development, which consists of a single 7 megawatt (MW) testing turbine located off the East Fife Coast at the Fife Energy Park (FEP), Methil.

The purpose of this EIA Update Report is to present and assess the likely significant environmental effects resulting from the Variation. The EIA Update Report focuses on potential effects on seascape, landscape and visual interests; noise; ornithology; socio-economics; and carbon balance and climate change. The EIA Update Report will present details of the assessments undertaken, including cumulative effects, required mitigation and residual effects.

1.1 ORE Catapult

The Applicant is the UK's leading technology innovation and research centre for advancing wind, wave and tidal energy. The Applicant operates the largest concentration of open access renewable energy test and demonstration facilities in the world, with the LDT complementing the existing open access testing facilities in Blyth, Northumberland.

The Applicant completed acquisition of the LDT from Samsung Heavy Industries UK in November 2015. The LDT is the world's most advanced, open access offshore wind turbine dedicated to research. It offers opportunities for economic growth, training and development of skills essential for the future of offshore wind industry in Scotland and further afield. The Applicant is working closely with key academic and industry stakeholders to align the LDT research programme with industry priorities to continue driving down the costs of offshore wind, whilst maximising UK Supply Chain opportunities and growing the economic benefits arising from vibrant offshore wind sector.

1.2 Reasons for the Variation

The Applicant is seeking to extend the operational life of the LDT from five to 15 years to allow continued technology innovation through turbine testing and research.

1.3 EIA Update Report Outline

The assessment undertaken and presented in this EIA Update Report is derived through a systematic process of identification, prediction and evaluation of likely significant environmental effects of the Variation. The EIA Update Report should be read alongside, and regarded as an update of, the Environmental Statement submitted in July 2012 (the 2012 ES), including its figures and appendices.

As agreed with the Marine Scotland Licensing Operations Team (MS-LOT) in the Scoping Opinion (July 2017), the EIA Update Report focuses on potential effects on seascape, landscape and visual interests; noise; ornithology; socio-economics; and climate change and carbon balance. These topics have been included in the assessment due to their potential for significant effects or due to uncertainty at the scoping stage as to the level of potential effects.

The following topics have been scoped out of the EIA Update Report as no significant effects are expected on these receptors from the Variation: ecology; water resources and

coastal hydrology; cultural heritage; tourism, land use and commercial fisheries; navigation; telecommunications; shadow flicker; access and traffic; human health; and health and safety.

The EIA Update Report is structured as follows:

- Chapter 1 – Introduction;
- Chapter 3 – EIA Methodology;
- Chapter 2 – Project Description;
- Chapter 4 – Planning Policy and Legislative Context;
- Chapter 5 – Seascape, Landscape and Visual;
- Chapter 6 – Noise;
- Chapter 7 – Ornithology;
- Chapter 8 – Socio-Economics; and
- Chapter 9 – Climate Change and Carbon Balance.

The EIA Update Report is accompanied by the following documents:

- Non-Technical Summary;
- Planning Statement; and
- Pre Application Consultation Report.

2 PROJECT DESCRIPTION

2.1 Site and Surroundings

The LDT is located within the FEP, Methil, adjacent to the Methil Docks, off the East Fife Coast (the Site). The FEP is designated as engineering and research zone within the energy sector. The Site is surrounded by the former Methil Docks and the character of the area can be considered as industrial. The Methil Docks turbine is located to the north-east of the LDT and consent has been grated for two demonstrator turbines to the south of the LDT.

2.2 Project Description

The LDT consists of a single 7 MW operational turbine which measures 196 metres (m) from mean sea level (MSL) to blade tip, with a rotor diameter of 171 m. In addition to the turbine itself, the LDT also comprises of the following elements:

- A personnel bridge connection between the FEP and the turbine substructure;
- An onshore crane pad within the FEP; and
- An onshore control compound.

The LDT has been operational since 31 March 2014 and provides opportunities for training, technology innovation and research and development.

Whilst not its main purpose, the LDT also produces low carbon energy. The recorded energy generation in megawatt hours (MWh) by the LDT since 2015 is detailed in Table 2.1.

Table 2.1: LDT Energy Production

Year	Energy Production (MWh)	Capacity Factor (%)	Equivalent Number of Households Supplied*
2015**	4,827	7.9	1,258
2016	7,360	12.0	1,918
2017***	5,681	11.3	1,470

*Based on the 2015 mean domestic consumption for Scotland of 3,836 kWh per household[1].
**Operation was significantly constrained during 2015 by the consented noise limits.
***Data covers the period from 01 January 2017 to 26 October 2017.

It is acknowledged that the energy production and associated capacity factors for the LDT are lower than would generally be expected for a wind turbine; however this is due to greater periods of downtime associated with the LDT's primary purpose and to ensure the LDT is compliant with noise and shadow flicker limits.

2.3 Planning History

An application was submitted to the Scottish Ministers in July 2012 under Section 36 of the Electricity Act 1989 (as amended)[2] for the construction and operation of a single 7 MW demonstration wind turbine. The Application was supported by the 2012 ES. Subsequently, an addendum was submitted to the Scottish Ministers in March 2013 providing details of the increase in the size of borehole required for the turbine foundation. The application was granted consent by the Scottish Ministers on 03 May 2013. A further application was made to the Scottish Ministers on 03 October 2014 to vary the operational noise limits as

[1] Department for Business, Energy and Industrial Strategy, 2016. Sub-National Electricity and Gas Consumption Statistics. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579203/Sub-national_electricity_and_gas_consumption_summary_report_2016.pdf [Accessed on 13/09/2017]

[2] UK Government (1989) Electricity Act 1989 [Online] Available at: https://www.legislation.gov.uk/ukpga/1989/29/contents (Accessed 06/10/17)

detailed in Condition 13 and Annex 3 of the S36 Consent. This was approved on 23 March 2016.

A full planning statement setting out the full planning history is also submitted in support of the Variation.

2.4 Variation

The S36 Consent was originally granted for the LDT to Scottish Enterprise, with ownership of the S36 Consent being first assigned to Samsung Heavy Industries UK on 22 July 2013 and subsequently to the Applicant on 24 November 2015. In conjunction with the S36 Consent, two Marine Licenses were also obtained; one for a 'Marine Renewable Energy Project in the Territorial Sea and UK Controlled Waters adjacent to Scotland' and one for 'Dredging and Deposit of Solid Waste in the Territorial Sea and UK Controlled Waters adjacent to Scotland' as required by the Marine (Scotland) Act 2010.

A number of conditions have been imposed through the S36 Consent, of which Condition 1 specified the following:

*"The consent is for a period from the date the consent is granted until the date occurring **5 years** after the Final Commissioning of the turbine. Written confirmation of the date of the Final Commissioning of the turbine must be provided by the Company to the Scottish Ministers, the Planning Authority and Scottish Natural Heritage no later than one calendar month after the Final Commissioning of the Development."*

The Variation proposes the following amendment to Condition 1:

*"The consent is for a period from the date the consent is granted until the date occurring **15 years** after the Final Commissioning of the turbine. Written confirmation of the date of the Final Commissioning of the turbine must be provided by the Company to the Scottish Ministers, the Planning Authority and Scottish Natural Heritage no later than one calendar month after the Final Commissioning of the Development."*

Written confirmation of the final date of commissioning (i.e. 31 March 2014) was provided to the Scottish Ministers, the Planning Authority and Scottish Natural Heritage (SNH) in April 2014. If consented, the Variation will allow the LDT to remain operational until 31 March 2029 rather than 31 March 2019, as allowed under the original S36 Consent.

In conjunction with the application to vary the S36 Consent, a revised application for the 'Marine Renewable Energy Project in the Territorial Sea and UK Controlled Waters adjacent to Scotland' will also be submitted to allow for the extended operational period.

3 EIA METHODOLOGY

3.1 Legislative Context of the EIA

The 2014 EIA Directive (2014/52/EU)[3] required substantive amendments to the 2011 EIA Directive (2011/92/EU)[4] be transposed into Scottish law by 16 May 2017. In relation to the LDT, the 2014 EIA Directive is applied through the following regulations:

- The Electricity Works (EIA) (Scotland) Regulations 2017[5]; and
- The Marine Works (EIA) (Scotland) Regulations 2017[6].

Collectively the above Regulations are hereby referred to as the 2017 EIA Regulations.

The 2017 EIA Regulations came into force on 16 May 2017 and revoke

- The Electricity Works (EIA) (Scotland) Regulations 2000 (the 2000 EIA Regulations) as amended by the Electricity Works (Environmental Impact Assessment) (Scotland) Amendment Regulations 2008; and
- The Marine Works (EIA) Regulations 2007, as amended by the Marine Works (EIA) (Amendment) Regulations 2011 and the Marine Works (EIA) (Amendment) Regulations 2015.

The 2017 EIA Regulations are now applicable for assessment of the Variation, however under transitional agreements in certain circumstances they apply in a modified form for cases pre-existing 16 May 2017. The transitional agreements are applicable where an application for a Section 36 consent or a marine licence for an EIA project has, before the 16 May 2017, either:

- Submitted an ES in connection with an application to the Scottish Ministers;
- Made a request to the Scottish Ministers for a scoping opinion in connection with the project; or
- Made a request to the Scottish Ministers for a screening opinion.

As requests were submitted to the Scottish Ministers for both screening and scoping, prior to 16 May 2017, the EIA will be undertaken under the transitional agreements in the 2017 EIA Regulations.

3.1.1 Screening

Given the LDT was considered to be a Schedule 2(i) EIA development in terms of the now revoked EIA Regulations, it was concluded that by association, the Variation required an EIA Update to be undertaken.

A Screening Request (Appendix 3.1) was made to MS-LOT in January 2017. Following which a Screening Opinion (Appendix 3.2) was issued by MS-LOT on 16 March 2017 formally confirming that an EIA is required and that it is appropriate for the Variation to be considered as a variation under the Electricity Generating Stations (Applications for Variation of Consent) (Scotland) Regulations 2013 (the 2013 Regulations)[7].

[3] European Parliament and the Council of the European Union (2014) Directive 2014/52/EU) [Online] Available at: http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0052 (Accessed 12/10/17)

[4] European Parliament and the Council of the European Union (2011) Directive 2011/92/EU [Online] Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011L0092&from=EN (Accessed 12/10/17)

[5] Scottish Government (2017) The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] Available at: http://www.legislation.gov.uk/ssi/2017/101/contents/made (Accessed 12/10/17)

[6] Scottish Government (2017) The Marine Works (Environmental Impact Assessment (Scotland) Regulations 2017 [Online] Available at: http://www.legislation.gov.uk/ssi/2017/115/pdfs/ssi_20170115_en.pdf (Accessed 12/10/17)

[7] Scottish Government (2013) The Electricity Generating Stations (Applications for Variation of Consent) (Scotland) Regulations 2013 [Online] Available at: http://www.legislation.gov.uk/ssi/2013/304/contents/made (Accessed 12/10/17)

3.1.2 Scoping

The aim of the Scoping process was to identify key environmental issues, to determine the likelihood of the Variation causing significant environmental effects and to identify topics which can be scoped out of the assessment due to their lack of significant effects. A Scoping Report was issued to MS-LOT in April 2017 (Appendix 3.3)

Following consultation with both statutory and non-statutory consultees to obtain advice and guidance from each in respect of the information which should be scoped in or out of the EIA, MS-LOT issued their Scoping Opinion on 05 July 2017 (Appendix 3.4).

MS-LOT were satisfied that the requirements of the 2017 EIA Regulations had been met. They also confirmed that following the 2017 EIA Regulations coming into force, the terminology 'EIA Report' should be used in place of 'ES'. MS-LOT confirmed that whilst updated information regarding the environmental effects must be provided, documents submitted in support of the original application (i.e. the 2012 ES) can be resubmitted.

3.1.2.1 Topics Scoped Out

The following topics are to be scoped out of the EIA Update Report as no significant effects are expected:

- Ecology;
- Water Resources and Coastal Hydrology;
- Cultural Heritage;
- Tourism, Land Use and Commercial Fisheries;
- Navigation;
- Telecommunications and Existing Infrastructure;
- Shadow Flicker;
- Access and Traffic;
- Human Health; and
- Health and Safety.

3.1.2.2 Topics Scoped In

The following topics have been scoped in to the EIA Update Report given their potential for significant effects:

- Seascape, landscape and visual;
- Noise;
- Ornithology;
- Socio-economics; and
- Climate change and carbon balance.

3.2 Consultation

The purpose of the consultation process is to engage key stakeholders and identify headline environmental issues at an early stage, in order to determine which elements of the Variation are likely to cause any significant effects on the environment and to establish the extent of survey and assessment required for the EIA.

Where consultation has been undertaken with stakeholders to refine the assessment process this has been detailed in each technical chapter.

3.2.1 Public Consultation

Whilst not a formal requirement, the Applicant held a public consultation event on 05 October 2017 at the Fife Renewables Innovation Centre (the FRIC) in Methil.

Ten members of the public attended the consultation event to hear about the details of the Variation and provide their comments on this. Overall there was a sense of 'community

ownership' of the turbine with local residents having grown accustomed to the sight of the LDT. A small number of negative comments were made in regards to effects in terms of noise and shadow flicker. These issues are being investigated in line with the ongoing management processes already in place and it is expected that these can be fully resolved.

3.3 Assessment

3.3.1 Baseline Studies

A range of studies including desk based assessments, baseline surveys and site visits were undertaken to determine the baseline condition of the environment and the area that is likely to be effected by the Variation.

The baseline has been used to assess the changes that may take place during the extended operational phase proposed by the Variation.

Within each technical chapter, the methods of data collection are set out. The timing of the work and the defined study area, specifically relating to the subject matter in question, are also outlined within each chapter.

3.3.2 Predicting and Assessing Effects

Potential effects of the Variation on the baseline conditions were considered. In order to assess the potential effects arising from the Variation, the significance of such effects was determined. The determination of significance of the effect relates to the sensitivity of the resource or receptor being affected and the magnitude of change as a result of the impact. The assessment of effects will combine professional judgement together with consideration of the following:

- The sensitivity of the resource or receptor under consideration;
- The magnitude of the potential impact in relation to the degree of change which occurs as a result of the Variation;
- The type of effect, i.e. adverse, beneficial, neutral or uncertain;
- The probability of the effect occurring, i.e. certain, likely or unlikely; and
- Whether the effect is temporary, permanent and/or reversible; and
- Cumulative effects resulting from the Variation in conjunction with other developments.

Each technical assessment follows best practice guidance relevant to the discipline for the assessment of effects. Following identification of potential environmental impacts, baseline information was used to predict changes to existing site conditions and permit an assessment of the significance of these changes.

3.3.3 Assessment of Effects and Evaluating Significance

3.3.3.1 Sensitivity of Receptors

Receptor sensitivity may be categorised by a multitude of factors. The initial assessment, consultation and scoping stages identified these factors along with the implications of the predicted changes.

Table 3.1 details a general framework for determining the sensitivity of receptors. Each technical assessment will specify their own appropriate sensitivity criteria that will be applied during the EIA Update Report and details will be provided in the relevant chapters, where required.

Table 3.1: Framework for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance.
High	The receptor has a low ability to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance.
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value, or is of regional importance.
Low	The receptor is tolerant of change without detriment to its character, is low environmental value, or local importance.
Negligible	The receptor is resistant to change and is of little environmental value.

3.3.3.2 Magnitude of Impact

The magnitude of potential impacts will be identified through consideration of the Variation, the degree of change to baseline conditions predicted as a result of the Variation, the duration and reversibility of an impact and professional judgement, best practice guidance and legislation.

For the purposes of the EIA Update Report, the magnitude of an impact is considered to fall under one of the following categories of significance:

- Negligible – no detectable or material change to a location, environment, species or sensitive receptor;
- Low – a detectable but non-material change to a location, environment, species or sensitive receptor;
- Medium– a material, but non-fundamental change to a location, environment, species or sensitive receptor; or
- High – a fundamental change to location, environment, species or sensitive receptor.

Each technical assessment will apply their own appropriate magnitude of impacts criteria during the EIA Update Report, with the details provided in the relevant chapter. If impacts of zero magnitude (i.e. none/ no change) are identified, this will be made clear in the assessment.

3.3.3.3 Significance of Effect

The sensitivity of the asset and the magnitude of the predicted impacts will be used as a guide, in addition to professional judgement, to predict the significance of the likely effects. Table 3.2 summarises guideline criteria for assessing the significance of effects.

Table 3.2: Framework for Assessment of the Significance of Effects

	Sensitivity of Receptor				
Magnitude of Impact	**Very High**	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

Following assessment of the effects, those which are considered as either negligible or minor are generally deemed to be not significant according to both the now revoked EIA Regulations and the 2017 EIA Regulations (given the transitional period). Effects assessed as moderate or major are generally considered to be significant; however, professional judgement is used to inform the final conclusion relating to whether an effect is significant as per the now revoked EIA Regulations or 2017 EIA Regulations. Zero magnitude impacts upon a receptor result in no effect, regardless of sensitivity.

The EIA Update Report generally follows the aforementioned theoretical approach. Where specific technical assessment areas adopt differing criteria, this is identified within the methodology set out in the assessment section of that chapter.

3.3.4 Mitigation and Assessment of Residual Effects

Should the baseline studies and the assessment identify significant adverse effects, mitigation measures are proposed, to avoid, reduce or offset any adverse effects on the environment. Any residual effects were assessed accordingly, to identify any effects predicted to remain after the implementation of the mitigation measures.

This mitigation strategy is a hierarchical one which seeks:

- First to avoid or prevent significant adverse effects;
- Then to reduce those which remain; and
- Lastly, where no other remediation measures are possible, to propose appropriate mitigation to offset the impact.

3.3.5 Cumulative Effects

In accordance with the 2017 EIA Regulations, the EIA Update Report should take into consideration cumulative effects, which result from incremental changes caused by, newly operational or reasonably foreseeable development together with the LDT.

The cumulative assessment addresses the combined effects from the Variation to a baseline of identified wind farms on seascape, landscape and visual, noise, ornithology, socio-economics, climate change and carbon balance. The extent of any cumulative assessment is defined in each technical chapter. Consideration of cumulative effects has been undertaken for all technical assessments. Where no cumulative effects are likely, this is stated.

4 PLANNING POLICY AND LEGISLATIVE CONTEXT

This chapter of the EIA Update Report updates and supplements the information presented in the 2012 ES, providing a planning and legislative context whilst identifying key policy documents and material considerations relevant to the LDT. The 2012 ES assessed the planning and legislative framework relevant to the LDT at that time, and assessed compliance of the LDT against relevant policy and legislation.

Since the 2012 ES was submitted and determined, several changes have occurred to the legislative framework, including adoption of a new Local Development Plan, adoption of a new Strategic Development Plan and updates to a range of material planning considerations. As a result, the Variation has been fully assessed against the updated Development Plan (consisting of the Strategic Development Plan and Local Development Plan, including supplementary guidance), and the results of this assessment are presented in the Planning Statement that accompanies the Variation.

A brief overview of the Development Plan and relevant material considerations assessed within the Planning Statement is provided in the sub-sections below.

4.1 The Development Plan

Any proposal to construct, operate or vary the consent of an offshore power generation scheme with a capacity in excess of one megawatt (MW) requires Scottish Ministers consent under Section 36 of the Electricity Act 1989. The LDT will therefore be determined by Scottish Ministers, i.e. the determining authority. As the LDT is located under the jurisdiction of Fife Council (the Council), therefore the Council are a Statutory Consultee within the determination process and appropriate consideration to the policy and guidance set out within the Development Plan and relevant supplementary guidance is required.

The Development Plan comprises:

- SESplan Strategic Development Plan (adopted 27 June 2013) (the SDP); and
- FIFEplan (adopted 21 September 2017) (the LDP).

Compliance with the Development Plan is fully assessed in Section 3 of the Planning Statement, however an overview of the key provisions of the Development Plan is provided in Table 4.1 below.

Table 4.1: Development Plan Policies

Policy Reference	Policy Summary
SDP Policy 10: Sustainable Energy Technologies	The SDP seeks to promote sustainable energy sources, including the FEP at Methil. The SDP requires LDP to establish a framework for the encouragement of renewable energy developments that make a contribution to national targets for electricity generation, whilst taking into account relevant economic, social, environmental and transport considerations.
LDP Policy 1: Development Principles	Development proposals that conform to LDP policies and proposals whilst addressing individual and cumulative impacts will be supported. LDP Policy 1 is subdivided into three subsections: Part A advises that the principle of a development will be supported if it is within a defined settlement boundary and compliant with the policies for the location, or is located in an area where the use is supported by the LDP. Part B requires development proposals to *"address their development impact"* by complying with a range of criteria and supporting policies, including mitigation against any loss in infrastructure capacity, avoidance of any loss of valuable tourism, cultural and community resources, protecting existing and allocated employment land, protect recreation and community facilities, safeguard landscape character and qualities, avoidance of flood impacts, safeguard natural resources, and the historic environment, and avoid any negative impacts on important infrastructure.

Policy Reference	Policy Summary
	Part C sets out the range of supporting information or assessments the Council would expect to see support a development proposal, alongside compliance with the appropriate supporting LDP polices. Development proposals are expected to contribute to achieving the full potential for electricity from renewable sources, in accordance with national climate change targets, with due regard to relevant environmental, community and cumulative impact considerations.
LDP Policy 10: Amenity	Development will not be supported if it has a significant detrimental impact on the amenity of existing or proposed land uses. Development proposals must demonstrate that they will not cause any significant detrimental impact on a range of amenity receptors, including air quality, contaminated and unstable land, noise, light and other nuisances, including shadow flicker from wind turbines, traffic movements; loss of privacy, sunlight and daylight; construction impacts; visual impacts; loss of open space, green networks, and protected trees; and impacts on operations of existing or proposed businesses and commercial operations. Where impacts on amenity as a result of a development are identified, appropriate mitigation measures will need to be implemented.
LDP Policy 11: Low Carbon	Development of low carbon energy schemes within Fife is supported, on the basis that development proposals will not result in unacceptable significant adverse effects or impacts which cannot be satisfactorily mitigated. Cumulative impacts are expected to be considered, alongside relevant environmental and community considerations. Assessment of planning applications related to renewable energy developments will be based on the principles set out within Scottish Planning Policy ('SPP') and will include a range of considerations.
LDP Policy 13: Natural Environment and Access	Development proposals will only be supported where they protect or enhance natural heritage and access assets. Should adverse impacts on existing assets be unavoidable, the Council will only support development proposals where such impacts can be satisfactorily mitigated. Assets considered include designated sites of international, national and local importance, woodlands, trees and hedgerows that have a landscape, amenity or nature conservation value, biodiversity in the wider environment, protected and priority habitats and species, landscape character and views, carbon rich soils (including peat), green networks and greenspaces, and core paths, cycleways, bridleways, existing rights of way, established footpaths and access to water-based recreation. Development proposals are also required to assess any potential impacts on natural heritage, biodiversity, trees and landscape, whilst including proposals for the enhancement of natural heritage and access assets.

4.2 Material Considerations

The Planning Act states that when determining a planning application, the determining authority shall have regard to the relevant provisions of the Development Plan and to all other material considerations. The weight to be given to each material consideration is a matter for consideration by the determining authority.

An overview of material considerations considered applicable to the Variation are presented in Section 4 of the Planning Statement, alongside an assessment of the Variation against the provisions of these material considerations. The following documents are considered material in the determination of the Variation and include climate change legislation, national and regional planning and energy guidance. The list is not considered to be exhaustive, however it does contain the most relevant documents to the nature of the Variation:

- National Planning Framework 3 (June 2014);
- Scottish Planning Policy (June 2014);

- A Low Carbon Economic Strategy for Scotland;
- 2020 Routemap for Renewable Energy in Scotland June 2011 (updated October 2012, December 2013 and September 2015);
- Scotland's Economic Strategy (March 2015);
- Scotland's National Marine Plan (March 2015);
- Scotland's Offshore Wind Route Map – Developing Scotland's Offshore Wind Industry to 2020 and Beyond (January 2013);
- Wind Energy Planning Supplementary Guidance (June 2013);
- Low Carbon Scotland: Meeting the Emissions Reduction Targets 2013 – 2027: The Second Report on Proposals and Policies (June 2013);
- Blue Seas - Green Energy Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters (March 2011); and
- The Clean Growth Strategy – Leading the Way to a Low Carbon Future (October 2017).

4.3 Summary

Whilst there have been several changes to the legislative and policy context since the 2012 ES was determined, a review of the relevant policy documents has confirmed that the Variation sought is supported by the Development Plan and relevant material considerations. A full assessment of the Variation is provided within the Planning Statement that is submitted as part of the Application, and the Development is considered to comply with the overarching planning and legislative context applicable to it.

5 SEASCAPE, LANDSCAPE AND VISUAL

5.1 Introduction

This chapter of the EIA Update Report evaluates the effects of the proposed extension to the operational life of the LDT on the seascape, landscape and visual resources. This chapter updates and supplements the information presented in Chapter 5: Landscape and Visual (assessment) of the 2012 ES and it is intended that this chapter is read in conjunction with the 2012 ES.

The LDT comprises an offshore demonstration wind turbine that is 196 m to blade tip from MSL, associated with the FEP by Methil Docks and has been in operation since 2014. The Variation which this EIA Update Report supports is for the extension of the operational life of the turbine from five to 15 years. There will be no physical change to the existing development; therefore, in terms of sea/landscape and visual effects, any further potential effects will be limited to, and arise from, a change in the baseline conditions of the surrounding area and/or any changes in guidance. With this in mind, a viewpoint-led approach is adopted in order to understand further potential effects.

This approach has been informed by the Scoping Opinion (Appendix 3.4) dated 05 July 2017, which details the response from relevant consultees, namely: SNH; City of Edinburgh Council (CEC); Fife Council (FC); Historic Environment Scotland (HES); and East Lothian Council (ELC). The responses relative to landscape and visual matters are detailed in Table 5.1 below.

Table 5.1: Scoping Opinion Responses

Consultee	Response
SNH	No requirement for a Seascape, Landscape and Visual Impact Assessment (SLVIA) since there is no physical change to the LDT. In respect of cumulative assessment, SNH noted that after the LDT was consented (in 2012), any further wind development proposal will have been required to take account of this turbine in their respective assessments. Therefore there is no requirement for an update.
CEC	No comments.
FC	No comments relating to landscape and visual matters.
HES	Since their predecessor Historic Scotland did not raise any significant concerns, HES saw no need for further information. (In terms of landscape and visual matters this is taken to be the setting of scheduled sites.) However, at the request of ELC, a further viewpoint at East Lomond Hill (in the Lomond Hills) has been added.
ELC	Supported the inclusion of an SLVIA on the grounds that the guidelines have changed and the original LVIA requires to be checked against new guidance, and that visualisations should be produced in line with the current guidance. ELC also require the cumulative assessment to be updated. In addition, ELC identified three further viewpoints required to be assessed in the SLVIA to cover visual receptors and the setting of cultural heritage monuments. In addition, the existing viewpoint from Gullane has been moved to Gullane Beach at the high water mark (approx. grid ref: 34760, 683310). The three additional viewpoints are requested from the summits of North Berwick Law, Traprain Law and from the Hopetoun Monument on Byres Hill (in the Garleton Hills).

The Scoping Opinion concluded that a SLVIA is required in order to:

- Update the baseline conditions;

- Update the methodology to Guidelines for Landscape and Visual Impact Assessment (GLVIA) version 3 and identify any changes to the resulting assessment;
- Update the visualisations and assess existing viewpoints and those highlighted by ELC;
- Include a further four viewpoints, of which three are new to the assessment and one, from the Lomond Hills, was previously used; and
- Update the cumulative situation.

The Scoping Opinion concluded that since the LDT has been operational since 2014, it is accepted that the effects of the operational turbine are well understood and the geographical extent of the significant effects can be qualified.

SNH and ELC were approached to agree a method for revising visualisations. Both confirmed that in line with the SNH guidance, *Visual Representation of Wind Farms* (2017), where the LDT appears clearly in viewpoint photography there is no requirement for it to be painted out and re-montaged back in.

The consultation process also provided input to establish the list of viewpoints to be included in this assessment. These are listed in Table 5.2 below.

Table 5.2: Viewpoints

VP Ref.	Location	Grid Ref.	Distance to the LDT
1	B931/Fife Coastal Path, Buckhaven	E336546 N698829	500 m
5	Fife Coastal Path, Leven	E338521 N700655	3.0 km
6	Kennoway	E335618 N701941	4.0 km
7	Fife Coastal Path, Wemyss Castle	E332945 N695079	5.0 km
9	Fife Coastal Path, Lower Largo	E340759 N702543	6.0 km
12	Largo Law	E342674 N704970	9.0 km
13	Fife Coastal Path, Kincraig Point	E346176 N699827	9.5 km
16	A921/Fife Coastal Path, Kirkcaldy	E327955 N690297	12.0 km
18	Fife Coastal Path, Kinghorn	E327614 N687573	14.0 km
19	East Lomond Hill (Lomond Hills)	E324446 N706174	14.5 km
21a	Gullane	E347899 N683064	19.0 km

VP Ref.	Location	Grid Ref.	Distance to the LDT
Additional Viewpoints (i.e. not in the 2012 ES)			
21b	Alternative Gullane VP as suggested by ELC	E347660 N683310	19.0 km
25	Garleton Hills – Hopetoun Monument, Byres Hill	E350073 N676434	25.6 km
26	North Berwick Law	E355634 N684227	23.6 km
27	Traprian Law	E358154 N674657	31.9 km

5.1.1 Study Area

The study area for this assessment remains 15 kilometres (km) radius. As fully explained in the 2012 ES, a 30 km study area was considered in the first instance. This was reduced to 15 km following a preliminary appraisal using Zone of Theoretical Visibility (ZTV) information and site verification which demonstrated that significant effects were highly improbable beyond 15 km mainly due to the restricted theoretical visibility indicated beyond this distance.

As with the original LVIA (2012 ES), the 15 km distance does not provide a definitive distance beyond which the study is prohibited. Rather that this smaller study area relates to where the potential significant effects arising as a result of the LDT may be experienced. This was verified by selecting viewpoints which are further than 15 km, which address the concerns of consultees. As the LDT is now operational, the fieldwork and subsequent assessment, as documented in this report, illustrates that significant effects are limited to visual effects from within approximately 5 km of the LDT.

Specific viewpoints beyond 15 km that have been included in this assessment are:

- VP21a from Gullane (original viewpoint);
- VP21b from Gullane high water mark;
- VP25 from Garleton Hills – Hoptoun Monument on Byres Hill;
- VP26 from North Berwick Law, and
- VP27 from Traprain law.

The study areas and viewpoint locations, in addition to the ZTV are shown on Figure 5.1.

5.2 Landscape Policy, Assessment Methodology and Significance Criteria

Since the 2012 ES, planning policy has been updated, with the approval of the current *SES Plan* in June 2013 and the *FIFEPlan* being adopted in September 2017 which replaces the Mid Fife Local Plan (2012). In addition, Fife Council reviewed their wind energy Supplementary Planning Guidance (*Planning Supplementary Guidance, Wind Energy,* June 2013[8]) and commissioned a report to *"explore strategic landscape and visual cumulative impacts for onshore wind turbines and to identify remaining landscape capacity for further development*". This report is the *Review of Onshore Wind Energy in Fife – Strategic Cumulative Landscape and Visual Impact Assessment,* prepared by Ironside Farrar, 2013.

[8] https://www.fifedirect.org.uk/topics/index.cfm?fuseaction=page.display&p2sid=8044AA26-1CC4-E06A-52A4F2F250955548&themeid=2B482E89-1CC4-E06A-52FBA69F838F4D24

In respect of guidance, this assessment updates the methodology in line with the revised LVIA guidance (version 3 of the *GVLIA*, produced by Landscape Institute and Institute of Environmental Management & Assessment, 2013).

In terms of seascape assessment, SNH is in the process of undertaking select Coastal Character Assessments. The assessment that would cover the Site would be a Regional Character Assessment that has not yet commenced. Therefore, current best practice is based on the following documents:

- An assessment of the sensitivity and capacity of the Scottish seascape in relation to windfarms (Report 103, SNH, 2005); and
- An Approach to Seascape Character Assessment (Report NECR105, Natural England, 2012).

5.2.1 Landscape related Planning Policy

5.2.1.1 Strategic Development Plan 2013 (SES Plan)

The SES Plan seeks to promote sustainable development sources (Policy 10).

5.2.1.2 FIFEplan (2017)

In terms Renewable Energy, Policy 11, notes that "the assessment of proposals for renewable energy developments will be based on the principles set out in the current Scottish Planning Policy". Assessments will be considered in accordance with the topics normally covered in environmental impact assessment, and in relation to SLVIA these are:

- Landscape and visual impacts, including landscape character;
- All cumulative impacts, including cumulative landscape and visual impact, and
- Impacts on communities and individual dwellings.

5.2.1.3 Supplementary Guidance

The Fife Council *Wind Energy SPG* (2013) promotes the use of the *GLVIA* (see Section 5.2.2 below) to underpin assessment, and it recommends the Ironside Farrar Assessment, *Fife Onshore Wind Energy Review – Strategic Cumulative Landscape and Visual Impact Assessment* as an important tool to understanding the landscape capacity of the region.

The *Review of Onshore Wind Energy in Fife: Strategic Cumulative Landscape and Visual Impact Assessment* (by Ironside Farrar on behalf of Fife Council, 2013) qualifies the use of the document by drawing attention to the limitations of the Study. The most relevant of these limitations is that being a strategic Study, no site-specific conclusions should be drawn in relation to currently proposed or potential future wind turbines/wind farms.

5.2.2 Current Guidance – Landscape & Visual

The GLVIA varies from the previous version insofar as it aims to:

- *"reflect the expanded range of good practice that now exists"*;
- *"give greater recognition to sustainable development as a concept*", and
- *"seeks to avoid reflecting a specific point in time, recognising that legislative, statutory and policy contexts change so that guidance is tied to contexts will quickly become dated and potentially out of step".* (4th para, Preface)

In practical terms, the third version *"attempts to be clearer on the use of terminology"*, and encourages the landscape architect to place the emphasis of the assessment on identifying likely significant environmental effects.

The methodology used in this assessment has been adjusted accordingly and is set out in Section 5.2.4 below.

5.2.3 Current Guidance – Seascape assessment

There is no definitive guidance for assessing impacts on seascape in Scotland. However, Natural England published guidance entitled *An Approach to Seascape Character Assessment* (NECR105, 2012). The guiding principles set out in this document underpin this assessment (see Section 5.2.5 below).

In addition, the SNH commissioned report no.103 published in 2005, *An assessment of the sensitivity and capacity of the Scottish seascape in relation to windfarms*, and the Fife Council Wind Energy SPG (2013) have been consulted.

5.2.4 Landscape and Visual Impact Assessment Methodology

5.2.4.1 Landscape Effects

The distinctive quality of the landscape results from the combination of various characteristics and influences including: geology; topography; flora and fauna; land-use; settlement and cultural associations. Since people attach their particular experiences and values to the landscape, changes introduced into the landscape can alter the manner in which people experience their landscape, and the degree to which they enjoy their surroundings or visual amenity. Consequently there is a degree of professional judgement required in making the landscape assessment, and this is encouraged in the latest guidelines (GLVIA 3rd Edition).

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

- Landscape elements and combinations of these into patterns (e.g. hedgerows, trees and woodlands, and topography);
- Landscape character, in terms of national, regional and local distinctiveness; and
- Special interests, for example designations, conservation site and recognised cultural associations.

5.2.4.2 Visual Effects

Visual effects arise from changes to the baseline situation which intrude upon or obstruct the existing views. They relate to the change in composition of the landscape/seascape available in key views, and the degree to which the enjoyment of these views is improved or reduced.

The visual effects result from:

- The changes to views of the seascape/landscape as a result of Development; and
- The reaction of viewers who may be affected e.g. residents, walkers, road users etc.

5.2.4.3 Cumulative Effects

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

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

Landscape, visual and cumulative effects are assessed for receptors within the landscape. Landscape receptors include designated landscapes and landscape character areas, whilst visual receptors are people using facilities such as routes or outdoor amenities, or from specific locations which lend themselves to viewing the scenery such as bridges or the summits of hills. Cumulative effects are for both landscape and visual receptors.

5.2.4.4 Baseline Survey Methodology

The survey methods have not changed as a result of GLVIA version 3. Therefore, the baseline has been updated by:

- Updating the Geographical Information System (GIS) data sets for mapped information;
- Checking changes to landscape policy that may be relevant; and
- Visiting the study area and both original and requested viewpoints.

Any changes to methodology are noted.

5.2.4.5 Methodology for the Assessment of Effects

The changes to technical terminology stem from the overarching aim of basing the assessment on professional judgement that is clear and transparent as opposed to a formulaic approach of sensitivity x magnitude = effect. To this end the revised GLVIA advises in Box 3.1 that:

1. "nature of receptor (to replace shorthand 'sensitivity');
2. nature of effect (to replace shorthand 'magnitude')."

Therefore, in this assessment the nature of the receptor will be clearly described in terms of 'susceptibility' and 'value', and the nature of the effect will be fully described and summarised as 'level of change'.

The manner in which the nature of receptor and the nature of the effect are classified is dependent on the type of effect. Table 5.3 and Table 5.4 illustrate the manner in which the two types of effects (landscape and visual) are classified:

Table 5.3: Classification criteria for nature of receptor and nature of Landscape Effects

Nature of receptor (previously sensitivity) Criteria designed to probe the susceptibility of the type of change arising from the LDT in question and the value attached to the receptor.		**Nature of effect (previously magnitude)** Criteria designed to probe the level of the change and is judged on e.g. size and scale of the change / geographical extent of the change / duration of the effect and its reversibility.	
Class	**Typical Criteria**	**Class**	**Typical**
Very High	Little or no capacity to accept the LDT: Landscape elements of exceptional value and quality with no potential for restoration, substitution of enhancement.	Very large	Total loss or alteration of key landscape elements of the LDT site.
High	Low capacity to accept the LDT: Landscape elements of high value and quality with limited potential for restoration, substitution or enhancement.	Large	Significant loss or alteration of key landscape elements of the LDT site.

Nature of receptor (previously sensitivity) Criteria designed to probe the susceptibility of the type of change arising from the LDT in question and the value attached to the receptor.		**Nature of effect (previously magnitude)** Criteria designed to probe the level of the change and is judged on e.g. size and scale of the change / geographical extent of the change / duration of the effect and its reversibility.	
Medium	Moderate capacity to accept the LDT: Landscape elements of recognised value and quality with some potential for restoration, substitution or enhancement.	Medium	Conspicuous loss or alteration of key landscape elements of the LDT site.
Low	Moderately high capacity to accept the LDT: Landscape elements of some value and quality with scope for restoration, substitution or enhancement.	Small	Apparent loss or alteration of key landscape elements of the LDT site.
Very Low	High capacity to accept the LDT: Landscape elements of limited value and quality with considerable scope for restoration, substitution or enhancement.	Very Small	Minor loss or alteration of key landscape elements of the LDT site.
		Negligible	No loss or alteration of key landscape elements of the LDT site, amounting to no change.

The susceptibility and value of landscape receptors is also informed by the following factors:

- The scale of the landscape where a more intimate, smaller scale landscape is generally less able to accommodate the introduction of incongruous objects.
- The nature of views e.g. where panoramic, open views are generally more able to absorb change.
- Cultural heritage interest: these contribute to the value of the landscape. Where cultural heritage features are designated e.g. scheduled monument or listed building, the value is correspondingly higher.
- The presence of settlement and infrastructure has a bearing on the susceptibility and value of the landscape in question. Where there is obvious signs of modern settlement, buildings or infrastructure the landscape is generally considered to be of a higher value.
- Movement (other than clouds) and Wind: little or no movement within the landscape engenders a strong sense of stillness and calmness which is more susceptible to change, whereas fast moving traffic on main roads and/or clearly windswept locations would have a lower susceptibility to wind turbine development.

In terms of visual receptors, the Table 5.4 outlines the classification criteria.

Table 5.4: Classification criteria for nature of receptor and nature of Visual Effects

Nature of receptor (previously sensitivity) Criteria designed to probe the susceptibility of the type of change arising from the LDT in question and the value attached to the receptor.		**Nature of effect (previously magnitude)** Criteria designed to probe the level of the change and is judged on e.g. size and scale of the change / geographical extent of the change / duration of the effect and its reversibility.	
Class	**Typical Criteria**	**Class**	**Typical Criteria**
Very High	Informed by the landscape value of the receptor e.g. a viewpoint/visual amenity within a National Park.	Very large	Very Prominent Introduction of incongruous development that generates a highly noticeable level of change that affects all key characteristics and alters the entire view.
High	Informed by the landscape value of the receptor e.g. a viewpoint/visual amenity within a National Scenic Area.	Large	Prominent Introduction of incongruous development that generates a highly noticeable level of change that affects most key characteristics and alters a high proportion of the view.
Medium	Informed by the landscape value of the receptor e.g. a viewpoint/visual amenity within an undesignated landscape of medium susceptibility to the LDT.	Medium	Noticeable, partial change to a proportion of the landscape, affecting some key characteristics and the experience of the landscape. The introduction of some uncharacteristic elements. Some of the view is affected.
Low	Informed by the landscape value of the receptor e.g. a viewpoint/visual amenity within an undesignated landscape of low susceptibility to the LDT.	Small	Minor change, affecting some characteristics and the experience of the landscape to an extent. The introduction of elements that are not uncharacteristic. Little of the view is affected.
Very Low	Informed by the landscape value of the receptor e.g. a viewpoint/visual amenity within an undesignated landscape of low/no susceptibility to the LDT.	Very Small	Little perceptible change.
		Negligible	No discernible change.

The susceptibility and value of visual receptors also depends on the importance of the visual receptor and experienced based on the following considerations:

- Number of people likely to experience the view (in general, the higher the number of people likely to be affected by the experience the higher the value of the receptor).
- The Context of the view, e.g. whether people are likely to be moving or stationary, and how long they would be exposed to the effects of the view at any one time.
- Frequency, i.e. whether the receptor would be exposed to the change in the view daily, frequently, occasionally or rarely.
- Recognition of the importance of the view as reflected in planning designations, inclusion in guide books or on tourist maps.

Visual receptors are assessed against each of these criteria in turn in order to arrive at an overall conclusion on the overall susceptibility and value rating.

Two other factors influence the assessment of landscape and visual effects, namely the duration and the reversibility of the effects.

The overall landscape / visual effect is evaluated by combining the susceptibly and value of the receptor with the level of change that receptor is likely to experience if the Variation is consented. The greater the level of change, and the greater the susceptibility and value to the change, the larger the overall landscape / visual effect will be.

The landscape / visual effect is expressed as Major, Moderate/Major, Moderate, Minor/Moderate, Minor, Negligible/Minor and Negligible. This is based on the level of susceptibility and value of the receptor and the level of change likely to be experienced by that receptor, as illustrated in Table 5.5 below. However, the matrix in Table 5.5 **is not** used as a prescriptive tool, and professional judgement is used to evaluate the potential effects of any particular receptor and arrive at a balanced judgement. Therefore, in some situations the predicted effect may not correspond with the effect noted in the grid. Clearly, where there is a high level of change visited upon a receptor which has a high susceptibility to change, the overall effect will be Major. Conversely negligible effects will result where a receptor of lower susceptibility and unrecognisable value is affected by negligible level of change resulting from the LDT. Between these two extremes, the overall landscape / visual effect will vary continuously, and the judgement leading to the prediction of the overall effect is explained with reference to the criteria noted in the above paragraphs.

Table 5.5: Correlation of Susceptibility/Value and Level of Change to determine the Overall Effect

Susceptibility and Value (of the landscape or visual receptor to change)	**Level of Change** (positive or negative)					
	Very Large	Large	Medium	Small	Very Small	Negligible
Very High	Major	Major	Moderate - Major	Moderate	Minor - Moderate	Negligible
High	Major	Moderate - Major	Moderate	Minor - Moderate	Minor	Negligible
Medium	Moderate - Major	Moderate	Minor - Moderate	Minor	Negligible - Minor	Negligible
Low	Moderate	Minor - Moderate	Minor	Negligible - Minor	Negligible	Negligible
Very Low	Minor - Moderate	Minor	Negligible-Minor	Negligible	Negligible	Negligible

In terms of the EIA Regulations, the larger scale effects, and effects on receptors of higher susceptibility are more likely to be 'Significant'.

Cumulative landscape and visual effects are also assessed in accordance with the above method.

5.2.5 Seascape Assessment Methodology

Seascape is defined as the area of open water within view of the mainland extending from the low water mark.

The seascape baseline is informed by the SNH Commissioned Report 103, *An assessment of the sensitivity and capacity of the Scottish seascape in relation to windfarms"* (2005), and the assessment is made by applying a value/susceptibility to the seascape and correlating this to the level of change likely to be encountered (in accordance with the methodology in Section 5.2.4.5 above).

5.2.6 Assessment Limitations

This assessment focusses on exploring and identifying the potential for significant effects as directed by the current guidance (GLVIA, version 3) and endorsed in the EIA Regulations which call for the ES to be 'proportionate' to the effects. In order to do so, it is led by the viewpoint assessment since the selected viewpoints represent all key receptors with potential for significant effects including landscape, visual, cumulative and seascape.

Changes to baseline conditions are noted within this SLVIA, therefore it requires to be read in conjunction with the original LVIA submitted within the 2012 ES which provides full descriptions. However, the assessment of all receptors has been updated to accord with the revised methodology.

5.3 Baseline Conditions

The original LVIA recorded the baseline conditions in 2012. This section seeks to address any changes to the baseline over the last five years. This process has involved the following:

- Checking all visual receptors, designations and listed monuments to ensure these are up to date;
- Visiting the area and viewpoints to verify any tangible changes that may alter the assessment of 2012; and
- Apply a susceptibility / value to each receptor in accordance with the methodology noted in Section 5.2.4.

5.3.1 Landscape/Seascape Baseline

5.3.1.1 The Development Site

The LDT has been in situ at the FEP since 2014. It is located at approximately 45m offshore, due east of the FEP which extends to approximately 54 hectares (ha). The FEP is some 30 m Above Ordinance Datum (AOD) and the LDT turbine is at MSL. The FEP is home to businesses related to renewable, gas and oil energy sectors. As such it is industrial in nature. There is little to no change to the Site and surrounding area since 2012. Large swathes of the area surrounding the site remain semi-derelict since the land is largely made up of colliery spoil from the coal mine that was originally located there. The development of the area around the Site is ongoing with road infrastructure continuing.

The Site continues to be bound by a large steel fabrication plant to the north, and the western boundary of the Site is still defined by residential development along Wellesley Road B931. The North Sea wraps around the eastern and southern side of the Site, where it is known as the Firth of Forth.

The original LVIA (2012 ES) details the extent to which the landform rises to the north and west of the Site noting the isolated hill, Largo Law, north east of the Site and the Lomond Hills further west. It also confirms that the southern shoreline of East Lothian and the silhouette of the Lammermuir Hills beyond can be seen on a clear day.

The landuse of the study area remains largely unchanged since 2012, being predominantly arable farmland of medium to large fields, geometric in nature and defined by hedgerows and some dry stone walls. Pasture farmland predominates on the Lomond Hills with rough grazing and open moorland on the higher ground. There is no change to the settlement pattern of larger towns along coastline as described in the original LVIA, and the pylons and overhead power lines across the western parts of the study area remain unchanged. Also unchanged are the telecommunications masts on many hilltops.

5.3.1.2 Landscape Character

As for the original LVIA, the baseline landscape character for this assessment is based on the SNH landscape character assessment, the *Fife Landscape Character Assessment* (SNH Review No 113, prepared by David Tyldesley Associates, 1999). The baseline landscape character, as defined in this assessment, has not changed to such an extent as to alter the baseline. The landscape character types are shown on Figure 5.2. Please refer to paragraph 5.3.4 of the original LVIA (2012 ES) for a full description of the landscape character within the study area.

5.3.1.3 Landscape Planning Designations

There are no new areas of the Site that have been designated since 2012, therefore the baseline situation remains the same. There are no National Parks or National Scenic Areas within the wider study area. The Local Landscape Areas (LLAs) within the 15 km study area are illustrated on Figure 5.3 and listed below:

- Cullaloe Hills and Coast LLA, which covers a sizeable area west of Kirkcaldy and continues beyond the study area;
- East Neuk LLA, which encompasses a narrow coastal strip on the eastern end of Largo Bay and continues east beyond the study area;
- Largo Law LLA, which covers a small area north of Lower Largo encompassing Largo Law and Flagstaff Hill;
- Lomond Hills LLA, which covers a sizeable area north west of Glenrothes encompassing the Lomond Hills and extends into neighbouring Perth & Kinross;
- Tarvit and Ceres LLA, which covers a small area directly south of Cupar extending as far as the minor road linking the A916 with the B941; and
- Wemyss Coast LLA, which covers the coastal edge between Dysart and East Wemyss and is the smallest of the local designations.

Listed Gardens and Designed Landscapes

As noted in the 2012 ES, there were ten sites listed in the *Inventory of Gardens and Designed Landscapes* (GDLs) within the study area. Since then, Lentham Glen has been removed from the inventory; the remaining nine are illustrated on Figure 5.3 and listed below:

- Balbirnie House (adjoins the eastern built-up edge of Glenrothes);
- Balcarres House (lies approximately 5 km north of Earlsferry);
- Charleton House (lies approximately 4.5 km east of Lower Largo);
- Dysart House and Ravenscraig Park (on the coast between Kirkcaldy and Dysart);
- Hill of Tarvit (lies approximately 2.5 km south of Cupar);
- Lahill House (lies approximately 5 km east of Lower Largo);
- Leslie House (within the built-up confines of Glenrothes);
- Raith Park & Beveridge Park (adjoins the western built-up edge of Kirkcaldy); and
- Wemyss Castle (on the coast at West Wemyss).

Three of these GDLs, namely: Balcaskie House; Falkland Palace and Melville House, are excluded from this assessment. Falkland Palace and Melville House would experience little or no visibility as illustrated on the ZTV (Figure 5.3). Whilst the ZTV indicated visibility from Balcaskie house, in reality is would experience little or no visibility given that the designated landscape includes mature policy woodland. In addition all three are 15 km or more from the LDT.

5.3.1.4 Seascape

The baseline seascape character is informed by *An assessment of the sensitivity and capacity of the Scottish seascape in relation to windfarms* (SNH Commissioned Report No

103, 2005). The Site is situated within seascape character Area 2: Firth of Forth, the key characteristics of which are noted as including:

- *"long sandy beaches with low rocky headlands;*
- *backed by arable farmed carse of varying width contained by Lammermuirs in East Lothian; coastal wooded braes contain a narrower coastal edge within Fife;*
- *well settled coastal fringe with Edinburgh and other large urban areas present;*
- *industry, bridges and infrastructure are a feature, some rigs and ports in Firth;*
- *views focus on distinctive islands within Firth and on land either side;*
- *firth well used for recreation, including sailing, golf and holiday resorts."* (page 49)

The 'sensitivity' to wind development is rated as Medium, since it is considered that "turbines could relate to the broader scale of the Outer Firth and would have only minor impacts on flatter land profiles….. Scope exists to locate turbines at the transition between inner and Outer Firths with the aim or relating to existing industrial structures on the fringes of large settlements e.g. Cockenzie/Kirkcaldy, yet avoid conflicts with the narrow scale and focus of the Inner Firth and more naturalistic character of the Outer Firth." (page 50).

5.3.2 Visual Baseline

5.3.2.1 Settlements, Routes, Features and Attractions

Overall the baseline conditions of these receptors has not changed to an extent that would change the assessment. The receptors are listed and outlined in Table 5.6:

Table 5.6: Principal Visual Receptors

Visual Receptor	Description
Main Settlements (Figure 5.4)	
Buckhaven	Buckhaven is the closest settlement to the LDT, with residential properties facing directly towards it from around 500 m with an unobstructed outlook.
Methil	Methil is an industrial settlement adjoining Buckhaven. Its history is routed in coal mining. More recently the steel fabrication has become a leading industry located immediately north of the Fife Energy Park.
East Wemyss	East Wemyss lies on the coast around 2.5 km south-west of the LDT. This coastal village has a generally linear form associated with its coal-mining past and the caves along the coast.
Leven	Leven lies around 2.5 km north-east of the LDT at its closest point. This coastal town has coalesced with Methil. It is relatively low-lying and buildings are generally orientated to have views to the coast and sea beyond.
Windygates	Windygates lies around 3 km north-west of the LDT. It is separated from Methil by the River Leven and the A915 corridor.
Kennoway	Kennoway lies around 4 km north of the LDT at its closest point. The village has developed eastwards from Kennoway Burn and the houses on the outer edges of the village are outward looking.
Coaltown of Wemyss	Coaltown of Wemyss lies around 4.5 km south-west of the LDT. The small settlement is set within low-lying landform and houses are generally orientated to face north/south.
Lower Largo	Lower Largo lies around 5.5 km north-east of the LDT. This is picturesque coastal village relates to the beach which Main Street runs parallel to.

Visual Receptor	Description
Coaltown of Balgonie	Coaltown of Balgonie lies around 7 km west of the LDT. This is a relatively linear settlement on either side of the Main Street / B9130. It is also generally inward with outward looking dwellings on the west edge of the settlement.
Glenrothes	Glenrothes lies around 7.5 km due west of the LDT at its closest point. This planned new town is the administrative centre of Fife.
Kirkcaldy	Kirkcaldy lies around 7.5 km south-west of the LDT at its closest point. It is a large coastal town, second largest population centre in Fife.
Markinch	Markinch lies around 7.5 km north-west of the LDT, is a relatively low-lying settlement on the eastern edge of Glenrothes. Generally inward looking, there are some dwellings on the outer edges of the settlement that have an outward looking aspect over surrounding landscape.
Upper Largo	Upper Largo lies around 7.5 km north-east of the LDT. The housing within this small settlement is generally orientated north/south having views to Largo Bay along the southern side of the village.
Thornton	Thornton lies around 8 km west of the LDT. The settlement lies to the west of the A92 and the Thornton Golf Course.
Colinsburgh	Colinsburgh lies around 11.5 km to the east of the LDT. This small settlement is generally inward looking and set within low-lying landform. Occasional groups of housing on the outer edges of the settlement are orientated to look outwards to the wider countryside.
Freuchie	Freuchie lies around 11.5 km north-west of the LDT. The ZTV shows no visibility from here.
Earlsferry/ Elie	Earlsferry and Elie adjoin each other on the coast some 11-13 km due east of the LDT. The Earlsferry Links Golf Course defines the southern edge of the settlements and the focus for Elie is Elie Harbour and beach.
Kilconquhar	Kilconquhar lies around 12 km north-east of the LDT. This small village is linear and inward looking centring on Main Street.
Ceres	Ceres lies around 13 km north of the LDT. The settlement is set within a well-treed landscape and is generally inward looking.
Ladybank	Ladybank lies around 13 km north-west of the LDT. This village grew out of the industrial revolution being a centre for linen weaving, coal mining and malting.
Kinglassie	Kinglassie lies around 13.5 km due west of the LDT. The settlement is set in relatively low-lying landform and buildings are generally orientated north/south.
Falkland	Falkland lies around 14 km north-west of the LDT towards the limit of the study area. This historic town grew around the castle (now Falkland Palace), and is reputed to be the first conservation town in Scotland.
Kinghorn	Kinghorn lies around 14.5 km south-west of the LDT. This town was best known as a seaside resort and fishing port. Kinghorn Golf Course defines the south-western boundary of the settlement.
Routes: Major Roads (Figure 5.4)	
A955	As with the A921, the A955 closely follows a coastal route from Kirkcaldy to Leven, where it then joins the A915.

Visual Receptor	Description
A915	The A915 runs parallel with the coast between Kirkcaldy and Lower Largo, passing to within 2.5 km of the LDT as the route skirts around the northern built-up edges of Buckhaven and Methil. At Lower Largo the route deviates from the coast and heads in a north-easterly direction over higher ground towards the edge of the study area.
A911	The A911 connects Windygates to Glenrothes, traversing the study area in an east/west orientation. The road comes to within approximately 3 km of the LDT.
A916	The A916 runs in a north-south direction from its junction with the A911 at Kennoway to beyond the study area.
A92	The A92 runs north-south across the western part of the study area, passing through Glenrothes.
A912	The A912 just encroaches in to the north west of the study area where it passes through Falkland.
A917	The A917 runs in a broadly east-west direction from its junction with the A915 at Lower Largo, passing through Elie and beyond the study area.
A914	The A914 crosses the northern part of the study area between Glenrothes and Cupar.
A921	The A921 closely follows the coast from Kinghorn, at the southern limit of the study area, to Kirkcaldy where it joins the A92.
Routes: Walking Routes (Figure 5.4)	
Fife Coastal Path	Fife Coastal Path closely follows the coast between Kinghorn and Elie and passes within 500 m of the LDT.
Routes: Cycle Routes (Figure 5.4)	
National Cycle Route 1	National Cycle Route 1 follows a series of minor roads between Ceres and Falkland in the northern part of the study area and passes within 8 km of the LDT at its closest point.
National Cycle Route 76	National Cycle Route 76 just encroaches into the far south-west of the study area and passes within 12 km of the LDT where it follows the A921 through Kirkcaldy.
Regional Cycle Route 63	Regional Cycle Route 63 crosses the western part of the study area, passing through Glenrothes and linking National Cycle Routes 1 and 76 together.
Visitor Attractions	
Lomond Hills Regional Park (Country Park)	The Lomond Hills Regional Park is centred on the two peaks of the Lomond Hills Regional Park which extends to over 2,500 ha. The land use is predominantly sheep grazing with coniferous plantations on northern slopes. There are six reservoirs within the Park and numerous recreational activities take place including; walking; paragliding; mountain biking, and the annual Falkland Hill Race event.
Beaches: Largo Bay	The sand beaches at Largo Bay are popular holiday locations with the longest and broadest of these beaches being accessed from Leven Beach Holiday Park (just north-east of Leven). This beach faces south-east. A smaller and narrower sand beach is accessible from Lower Largo. This beach faces due south and looks out over the Bay. There is another section of beach on the east of the Bay. This beach is less easily accessible and is part of the Dumbarnie Links Nature Reserve.

Visual Receptor	Description
Beaches: Elie to Earlsferry	Elie to Earlsferry beaches are popular sand beaches that attract visitors through summer months. Elie beach is the easily accessible and the longer of the two beaches. It faces due south favouring the best of the sunshine. Earlsferry beach is marginally shorter and is accessed by a short walk along the southern boundary of the Earlsferry Links Golf Course. It faces south-west.
Beaches: Kirkcaldy	There are four beaches associated with Kirkcaldy which fall within the study area. 1. Linktown This is the main beach at Kirkcaldy, accessible from the Kirkcaldy Esplanade. It is a well-used beach facing east over the Firth of Forth and towards the North Sea. 2. Seafield This is a quiet beach, south of the Tiel Burn outlet. It is used for bird watching and to 'get away from it all'. This predominantly sand beach faces east. 3. Pathhead Sands This sand and shingle beach lies to the east of Kirkcaldy harbour. It is popular with locals during the summer months and dog walkers all year round. 4. Kinghorn Harbour This picturesque and more intimate stretch of beach is overlooked by Kinghorn. It faces south-east across the Firth of Forth towards Inchkeith Island.

5.3.2.2 Selected Viewpoints

The viewpoints illustrated and assessed in this report reflect the consultation undertaken with statutory consultees as noted in the introduction (Section 5.1). These viewpoints are listed in Table 5.7 below which also notes the type of viewpoint and the receptors represented.

Table 5.7: Selected Viewpoints

VP Ref	Location and distance	Receptors Represented	Type of Viewpoint
Viewpoints within the original LVIA (2012 ES – numbering retained for ease of reference)			
1	B931/Fife Coastal Path, Buckhaven 500m	Residents (Buckhaven) / Great Trail (Fife Coastal Path) / B Road Lowland River Basin Landscape Character Type (LCT)	Representative
5	Fife Coastal Path, Leven 3.0 km	Residents (Leven) / Great Trail (Fife Coastal Path) Firth of Forth Seascape	Representative
6	Kennoway 4.0 km	Residents Lowland River Basin LCT	Representative
7	Fife Coastal Path, Wemyss Castle 5.0 km	Scheduled Monument setting / Great Trail (Fife Coastal Path) Coastal Hills LCT	Representative

VP Ref	Location and distance	Receptors Represented	Type of Viewpoint
9	Fife Coastal Path, Lower Largo 6.0 km	Great Trail (Fife Coastal Path) / Residents Lowland Dens LCT	Representative
12	Largo Law 9.0 km	Hill walkers Lowland Dens LCT Firth of Forth Seascape	Static
13	Fife Coastal Path, Kincraig Point 9.5 km	Great Trail (Fife Coastal Path) Firth of Forth Seascape	Representative
16	A921/Fife Coastal Path, Kirkcaldy 12.0 km	Residents / Great Trail (Fife Coastal Path) Firth of Forth Seascape	Representative
18	Fife Coastal Path, Kinghorn 14.0 km	Kinghorn Beach / Great Trail (Fife Coastal Path) Firth of Forth Seascape	Representative
21a	Gullane 19.0 km	Residents Firth of Forth Seascape	Representative
21b	Alternative Gullane VP as suggested by ELC 19.0 km	Firth of Forth Seascape	Representative
Additional Viewpoints			
19 (previously used VP)	East Lomond Hill (Lomond Hills) 14.5 km	Lomond Hills Regional Park The Uplands LCC	Static
25	Garleton Hills – Hopetoun Monument, Byres Hill 25.6 km	Scheduled Monument Lowland Hills & Ridges LCT (Garleton Hills LCA)	Static
26	North Berwick Law 23.6 m	Coastal Margins LCT (North Berwich Plain LCA)	Static
27	Traprain Law 31.9 km	Lowland Plans LCT (Haddington Plan LCA)	Static

5.4 Assessment of Potential Effects

Section 5.3 has demonstrated that there are no changes to the baseline that may engender a change in assessment. However, there is a change to the selected viewpoints, which include four additional viewpoints and omits several of the viewpoints used in the 2012 ES (as listed above in Table 5.7)

As noted in Section 5.2.4, the revised guidance advises that the emphasis of landscape/seascape and visual impact assessment should be on identifying likely significant environmental effects. In order to test for significant effects, this assessment uses the selected viewpoints and assesses each receptor represented by each of the viewpoints. This approach allows for an informed judgement to be made as to the receptors/parts of the baseline that is likely to be affected significantly, and only those receptors are fully assessed.

5.4.1 Viewpoint Assessment

This assessment is set out in table format in order to demonstrate the consistency of the approach. The table does not serve to summarise or list the receptors and the context of the view; susceptibility and value, the level of change and the final effect are fully described for each receptor represented by the viewpoint.

Table 5.8: Viewpoint Assessment

Viewpoint	**1. B931/Fife Coastal Path/Buckhaven** **(Figure 5.5a-d)**		
Distance	0.5 km		
Context	The view towards the LDT is of the cranes in the steel fabrication facility which are tall vertical elements of a similar scale in this view to the LDT. The industrial character is echoed across the water by the rigs in the outer firth. The landscape to the right of the LDT (south) is simple in nature and horizontal lines in the overall landscape create the sense of a large-scale landscape.		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Lowland River Basin LCT Key characteristics: • Relatively low lying landform • Wide valley/basin contained by distance hills • Medium-scale, diverse, confined, flat, active, planned, organised, tended and regular.	Medium (in line with scale and simplicity of landscape in the viewpoint)	Small The LDT is conspicuous and noticeable, yet in keeping with the industrial land use of the site and the vertical scale of other industrial elements close by. Since the introduction of the LDT is not uncharacteristic in the busy industrial setting of the Site and little of the view is affected, the level of change is Small.	Minor (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Residents	Very High Since residents experience the change every day.	Small The LDT adds a further vertical industrial element into a part of the landscape already influenced heavily by tall industrial elements.	**Moderate Significant**
Road users	Medium Given the speed of travel and status of road.	Small The level of change affects a small part of the experience of the landscape at this location since the LDT is in keeping with the industrial character of the site.	Minor (Not Significant)

Viewpoint	**1. B931/Fife Coastal Path/Buckhaven (Figure 5.5a-d)**		
Walkers on the Fife Coastal Path	High Since walkers use this path for recreation to enjoy the scenery.	Small Whilst noticeable, the LDT fits well with the industrial elements in the view.	Minor/Moderate (Not Significant)

Viewpoint	**5. Fife Coastal Path, Leven (Figure 5.6a-d)**		
Distance	3.0 km		
Context	The LDT in this view relates to the Methil Dock wind turbine and the cranes in the steel fabrication plant. The flat foreground and the flat sea of the Firth provide a large scale seascape/landscape context.		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Industry, bridges and infrastructure are a feature, some rigs and ports in Firth.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Small The LDT is apparent and alters the overall composition of the seascape; however it is not uncharacteristic and does not change the character of the seascape in this view.	Negligible/Minor (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Residents	Very High Since residents experience the change every day.	Small The LDT adds a further vertical industrial element into a part of the landscape already influenced heavily by tall industrial elements.	**Moderate Significant**
Walkers on the Fife Coastal Path	High Since walkers use this path for recreation to enjoy the scenery.	Small The LDT fits well with the industrial elements in the view although it is noticeable in the view.	Minor/Moderate (Not Significant)

Viewpoint	**6. Kennoway** **(Figure 5.7a-f)**		
Distance	4.0 km		
Context	The LDT in the middle ground of this view with the neighbouring cranes of the steel fabrication plant. One of the oil rigs is visible in the far distance, and the single Methil Dock turbine is visible in the left of the view. The arable fields in the foreground provide the landscape context, and the majority of the built form of Methil is hidden from view behind the mature planting associated with the burn.		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Lowland River Basin LCT Key characteristics: • Relatively low lying landform. • Wide valley/basin contained by distant hills. • Medium-scale, diverse, confined, flat, active, planned, organised, tended and regular.	Medium (relating directly to the medium scale / moderate capacity to accept the LDT)	Small The LDT relates strongly to the industrial elements in the middle ground so there is an apparent alteration to the key landscape elements but this is in accord with the prevailing receiving character.	Minor (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Residents	Very High Since residents experience the change every day.	Small The LDT adds a further vertical industrial element into a part of the landscape already influenced heavily by tall industrial elements. Although the level of change is diminished by distance, the dwellings face the LDT squarely so it would remain in focus albeit in the middle ground.	**Moderate Significant**

Viewpoint	**7. Fife Coastal Path, Wemyss Castle** **(Figure 5.8a-d)**
Distance	5.0 km
Context	The LDT, in the middle to far ground of the view, relates to the water of the Firth as well as the steel fabrication cranes on the shore. The oil rigs in the right of the view compound the sense of industry and activity. The foreground is influenced by the mixed sand/pebble beach and the oil rigs on the horizon in the right of the view heavily influence the character of the seascape.

Viewpoint	**7. Fife Coastal Path, Wemyss Castle (Figure 5.8a-d)**		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Industry, bridges and infrastructure are a feature, some rigs and ports in Firth.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Small The LDT is apparent and alters the overall composition of the seascape; however it is not uncharacteristic and does not change the character of the seascape in this view.	Negligible/Minor (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Walkers on the Fife Coastal Path	High Since walkers use this path for recreation to enjoy the scenery.	Small The LDT fits well with the industrial elements in the view although it is noticeable in the view.	Minor/Moderate (Not Significant)

Viewpoint	**9. Fife Coastal Path, Lower Largo (Figure 5.9a-f)**
Distance	3.0 km
Context	The LDT in this view relates to the Methil Dock wind turbine and the cranes in the steel fabrication plant. The flat foreground and the flat sea of the Firth provide a large scale seascape/landscape context.

Viewpoint	**9. Fife Coastal Path, Lower Largo** **(Figure 5.9a-f)**		
LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Lowland Dens LCT Key characteristics: • Narrow, deep, gorge-like valleys cut deep into the Coastal Hills and Terraces and E. Fife slopes by fast moving burns; • Generally quiet and calm landscapes with a variety of irregular patterns, colours and textures.	High (small scale, and calm landscapes of low capacity to accept the LDT)	Very Small The LDT is in the distance, on the horizon where it relates strongly to the other industrial elements (cranes and Methil Dock turbine). The LDT causes a minor alteration to the landscape composition and the landscape character of the Lowland Dens prevails.	Minor (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Residents	Very High Since residents experience the change every day.	Very Small The dwellings represented by this viewpoint are orientated to look away from the LDT which is in the far distance. If visible from the dwellings it would be at an oblique angle and create little perceptible change in the environment of the residences.	Minor/Moderate (Not Significant)
Walkers on the Fife Coastal Path	High Since walkers use this path for recreation to enjoy the scenery.	Small The LDT is visible in the distance and relates well in terms of size and scale to the other industrial elements its location. The middle and foreground is dominated by rolling landform and planting associated with the golf course and there is little perceptible change to the view.	Minor/Moderate (Not Significant)

Viewpoint	**12. Largo Law Summit** **(Figure 5.10a-f)**		
Distance	9.0 km		
Context	This is a static, panoramic view from the summit of Largo Hill. It looks out over open countryside and the built form of Lower Largo towards Methil, the LDT and rigs in the Firth of Forth. In the distance, the coast of East Lothian is visible and the outline of the very distant Lammermuir Hills is just distinguishable. NB the LCT of Largo Law (Pronounced Volcanic Hills) is not assessed since the view looks out over the top of this to countryside between Largo Law and Methil (which is the Lowland Dens LCT).		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Lowland Dens LCT Key characteristics: • Narrow, deep, gorge-like valleys cut deep into the Coastal Hills and Terraces and E. Fife slopes by fast moving burns; • Generally quiet and calm landscapes with a variety of irregular patterns, colours and textures.	High (small scale, and calm landscapes of low capacity to accept the LDT)	Very Small The LDT relates strongly to the other industrial elements (cranes and Methil Dock turbine) on the coastline and to the rigs further out in the Firth. The LDT causes a minor alteration to the landscape composition but does not affect the overall character of the landscape.	Minor (Not Significant)
Firth of Forth Seascape The key characteristic prevalent in this view is: • Industry, bridges and infrastructure are a feature, some rigs and ports in Firth.	Low (This seascape in this view has a moderately high capacity to accommodate the LDT)	Small The LDT is apparent and alters the overall composition of the seascape; however it is not uncharacteristic and does not change the overall character of the seascape in this view.	Negligible/Minor (Not Significant)

Viewpoint	**12. Largo Law Summit** **(Figure 5.10a-f)**		
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Hill walkers	High (since walkers generally climb the hill to appreciate the scenery and the panoramic views)	Very Small The LDT is not 'out of place' and fits comfortably with the industrial setting of the steel fabrication works and the rigs in the distance.	Minor (Not Significant)

Viewpoint	**13. Fife Coastal Path, King Craig Point** **(Figure 5.11a-f)**		
Distance	9.5 km		
Context	This is a static viewpoint at Kincraig Point which is located along the Fife Coastal Path (Great Trail) at Kincraig Point. It is a static viewpoint and also representative of the path and the seascape as it illustrates the relationship of the LDT to the coastline and the Firth of Forth, and the Lomond Hills are visible in the right side of the view.		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Industry, bridges and infrastructure are a feature, some rigs and ports in Firth.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Very Small The LDT results in a minor alteration to the elements of the seascape at this distance.	Negligible (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Walkers on the Fife Coastal Path	High Since walkers use this path for recreation to enjoy the scenery.	Small The LDT is apparent but not uncharacteristic. Little of the view is altered.	Minor/Moderate (Not Significant)

Viewpoint	**16. Fife Coastal Path, Kirkcaldy** **(Figure 5.12a-d)**		
Distance	12.0 km		
Context	This viewpoint represents the Fife Coastal Path (Great Trail) at Kirkcaldy Esplanade and beach. The view looks north-east along the coast and out to the Firth of Forth and the rigs.		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Industry, bridges and infrastructure are a feature, some rigs and ports in Firth.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Small The LDT is apparent and results in a minor alteration to the elements of the coastline at this distance. It relates to the industrial nature of the Rigs also visible in the view.	Negligible/Minor (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Walkers on the Fife Coastal Path	High Since walkers use this path for recreation to enjoy the scenery.	Small The LDT is apparent yet alters only a small part of the view. It does not look incongruous or out of place.	Minor/Moderate (Not Significant)

Viewpoint	**18. Fife Coastal Path, Kinghorn** **(Figure 5.13a-d)**
Distance	14.0 km
Context	This viewpoint represents the Fife Coastal Path (Great Trail) at Kinghorn Beach, which is overlooked by the settlement. It looks northwards along the coastline. In this view the LDT turbine appears to stand away from the coast and relates to the busy-ness of the Firth of Forth with large industrial ships moving towards the harbour and the rigs in the left of the view.

Viewpoint	**18. Fife Coastal Path, Kinghorn** **(Figure 5.13a-d)**		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Long sandy beaches interspersed with low rocky headlands.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Small The LDT alters the elements of the coastline slightly at this distance. It relates to the industrial nature of the rigs also visible in the view so does not seem out of place.	Negligible/Minor (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Walkers on the Fife Coastal Path	High Since walkers use this path for recreation to enjoy the scenery.	Small The LDT is apparent yet alters only a small part of the view. It does not look incongruous.	Minor/Moderate (Not Significant)

Viewpoint	**19. East Lomond Hill (Lomond Hills)** **(Figure 5.14a-f)**		
Distance	14.5 km		
Context	This static viewpoint illustrates the panoramic view from East Lomond Hill towards the LDT, looking out over the Lomond Hills Regional Park and much of eastern Fife towards the Firth of Forth.		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Views focus on distinctive islands within the Firth and land on either side.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Very Small At this distance and within a panoramic view, the LDT results in a minor alteration to the landscape elements. It is well located within the context of industrial elements and also relates to the rigs in the Firth.	Negligible (Not Significant)

Viewpoint	**19. East Lomond Hill (Lomond Hills)** **(Figure 5.14a-f)**		
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Hill walkers	High Since walkers use this path for recreation to enjoy the scenery.	Very Low The LDT results in little perceptible change at this distance and within such a wide panoramic view.	Minor (Not Significant)

Viewpoint	**21a. Gullane** **(Figure 5.15a-f)**		
Distance	19.0 km		
Context	This viewpoint is from the northern extents of Gullane and looks out over the Firth of Forth towards Fife. The silhouette of the Lomond Hills is visible left of centre and Largo Law is visible in the right of the view. Within these two landforms, and relating to the coast and water is the LDT turbine.		
LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Views focus on distinctive islands within the Firth and land on either side.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Very Small The LDT is apparent and results in a minor alteration to the seascape relating to the rigs and the seascape around them.	Negligible/Minor (Not Significant)
SEA/VISUAL EFFECTS			
Residents	Very High Since residents experience the change every day.	Very Low The LDT results in little perceptible change to this view due to the distance and the industrial context Site.	Minor/Moderate (Not Significant)

Viewpoint	**21b. Gullane – Alternative view** **(Figure 5.16a-f)**		
Distance	19.0 km		
Context	This viewpoint represents the seascape from the high water mark at Gullane beach. The view is of open water with the coast of Fife in the distance. The LDT is visible in the vicinity of the rigs. At this distance the LDT is small and fits well within the large scale expanse of water and the industrial flavour of the seascape relating to the rigs.		
LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Industry, bridges and infrastructure are a feature, some rigs and ports in Firth.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Very Small The LDT is visible in the context of rigs and in relation to the large expanse of the Firth of Forth. At this distance it generates a minor alteration to key elements whilst also fitting into the existing industrial context.	Negligible (Not Significant)

Viewpoint	**25. Garleton Hills – Hopetoun Monument, Byres Hill** **(Figure 5.17a-f)**
Distance	25.6 km
Context	This static viewpoint illustrates the panoramic view from the summit of Byres Hill in the Garleton range of hills in East Lothian. The view towards the LDT is over the farmland of East Lothian to the Firth of Forth with the mainland of Fife visible in the distance on a clear day. The LDT is visible in good conditions set behind the rigs on the firth.

Viewpoint	**25. Garleton Hills – Hopetoun Monument, Byres Hill** **(Figure 5.17a-f)**		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Lowland Hills & Ridges (Garleton Hills LCA). Key characteristics: • Distinctive topography culminating in prominent landmark; • Diverse land cover; • Marked contrast in landform and land cover with surrounding coastal plain; • Archaeological remains.	High (due to high visibility and visual prominence)	Negligible At this distance (over 20 km), the LDT, though visible on a clear day, is in the far distance on the far side of the Firth. It is a very small element in the view that results in no loss or alteration to the key characteristics of this landscape.	Negligible (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Hill walkers	High Since walkers use this path for recreation to enjoy the scenery.	Negligible The LDT results in no discernible change to the experience of this panoramic view.	Negligible (Not Significant)

Viewpoint	**26. North Berwick Law** **(Figure 5.18a-f)**
Distance	23.5 km
Context	This static viewpoint illustrates the panoramic view from East Lomond Hill towards the LDT, looking out over the Lomond Hills Regional Park and much of eastern Fife towards the Firth of Forth.

Viewpoint	**26. North Berwick Law** **(Figure 5.18a-f)**		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Firth of Forth Seascape The key characteristic prevalent in this view is: • Views focus on distinctive islands within the Firth and land on either side.	Low (This seascape has a moderately high capacity to accommodate the LDT)	Very Small Though visible on a clear day, the LDT results in little perceptible change to the character of the seascape.	Negligible (Not Significant)
Coastal Margins (North Berwick Plain LCA). Key characteristics: • Dominant arable land cover; • Diversity of coastal scenery and habitats; • Rich historical heritage; • Extensive views.	High (due to high visibility and visual prominence)	Negligible Although visible from over 20 km, the LDT affects a very small part of the panorama resulting in no loss or alteration to the key characteristics of this landscape.	Negligible (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Hill walkers	High Since walkers use this path for recreation to enjoy the scenery.	Negligible The LDT results in no discernible change to the experience of this panoramic view.	Negligible (Not Significant)

Viewpoint	**27. Traprain Law** **(Figure 5.19a-f)**
Distance	31.9 km
Context	This static viewpoint illustrates the panoramic view from Traprain Law towards the LDT, looking out over the East Lothian coastal landscape towards the Firth of Forth.

Viewpoint	**27. Traprain Law** **(Figure 5.19a-f)**		
SEA/LANDSCAPE EFFECTS			
LCT/Seascape	**Susceptibility & Value**	**Level of Change**	**Local effects**
Coastal Margins (Haddington Plain LCA). Key characteristics: • Core of productive arable landscape; • Strong field pattern reinforced by abundant shelterbelts; • Extensive outward views from higher ground; • Rich historical legacy.	High (due to high visibility and visual prominence)	Negligible The LDT results in no discernible loss or alteration to the key characteristics of this landscape.	Negligible (Not Significant)
VISUAL EFFECTS			
Receptor	**Susceptibility & Value**	**Level of Change**	**Effect**
Hill walkers	High Since walkers use this path for recreation to enjoy the scenery.	Negligible The LDT results in no discernible change to the experience of this panoramic view.	Negligible (Not Significant)

The Viewpoint Assessment (Table 5.8 above) demonstrates that significant effects resulting from the LDT are limited to residential receptors that directly face the LDT within a distance of approximately 3 km. The potential for significant effects on the settlements has been explored further by assessing the potential effect on settlements within 5 km of the LDT.

5.4.2 Effects on Settlements within 5 km

The Viewpoint Assessment demonstrates that where there are dwellings orientated to face the LDT within up to approximately 5 km, with clear views to the LDT, the residents are likely to experience significant visual effects. This situation occurs in the following instances:

- Wellesley Road, South Street, Station Road, Lady Wynd and Shore Street in Buckhaven and Methil - select properties with views to the LDT, since the structures associated with the Docks, FEP and the steel fabrication works can intervene to limit visibility;
- Dwellings on Castle Terrace, Kennoway which have direct views of the LDT; and
- A limited few dwellings on Golf Road in Lower Largo with direct views of the LDT.

5.5 Cumulative Effects

The LDT was constructed in 2014 and since then there have been no changes to the form of the LDT. This EIA Update Report is to support an extension in time, from 5 years to 15 years, and no changes or additions to the LDT are proposed. Therefore, according to current cumulative assessment guidelines, and as verified by SNH in consultation, a cumulative assessment is not technically required.

Whilst the GLVIA guidance has been revised, this does not affect the cumulative guidance, as provided by SNH (*Assessing the Cumulative Impact of Onshore Wind Energy Development* published in 2012). Therefore, the comments on cumulative effects in this assessment are made based on the wirelines and visualisations which demonstrate the cumulative situation.

Refer to Figure 5.20 which illustrate the LDT in relation to other developments that are constructed, consented, or within the planning system. These illustrate the relationship of the LDT with other wind developments.

It is notable that the LDT combines with only two other developments; Forthwind and Methil Docks, to create the sense of a larger wind development. All other onshore wind developments are either sufficiently inland and/or distant enough to ensure that there is a sense of separation and that the cumulative effects arising are not significant.

Viewpoints 1, 5, 6, 7 and 9 (Figures 5.5, 5.6, 5.7, 5.8 and 5.9 respectively), demonstrate how the LDT turbine will appear in simultaneous views with the 2-B Energy turbines to give the impression of a three turbine offshore wind farm. Since the turbines are of similar scale and size and offshore, and given that the receiving part of the Firth of Forth is industrial in character (with the proximity of the rigs), the cumulative effect is not considered to be significant.

There are also combined views of the LDT with the Methil Dock turbine. In views towards the LDT from the northern coastal areas where visibility is possible, these two turbines read as one development with distance creating an illusion equalising the scale and size of the turbines (Viewpoint 5, Figure 5.6). From western and southern views the difference in scale is more apparent, yet the turbines are also more recognisable as two different developments (Viewpoints 6, 7 and 9). Since both relate strongly with the industrial elements of the steel fabrication works, it is considered that the cumulative effect is not significant.

5.6 Summary of Effects

This Seascape/Landscape and Visual Impact Assessment has assessed the effects of the LDT which is already constructed. For this reason it has been possible to appreciate the full extent of effects without having to rely heavily on visualisations. This has rendered a slightly different result of significant effects resulting in an overall reduction in significant effects.

No significant effects have been identified on the local landscape units, and the Fife Coastal Path is not impacted significantly by the LDT. The main reason for this change to the original assessment is that the LDT sits within an area that has a strongly industrial character which is influenced by tall vertical machinery and a strong sense of movement with cranes moving; rigs on the firth moving and the general sense of industrial activity. The LDT sits seaward from the shoreline and this ensures that the industrial activity along the coast intervenes in close views. Since the baseline conditions are industrial in character, it is considered that the local landscape character areas are already influenced by that character and the LDT does not 'tip the balance' sufficiently to generate a significant effect. Likewise the visual effects experienced by walkers of the Fife Coastal Path would be already be significantly affected by the industrial setting of the Site. Whilst

the LDT adds to this sense of industrialisation, it does not exacerbate the existing character to such an extent as to be considered significant.

In respect of dwellings facing the LDT within approximately 5 km, it is considered that the movement of the turbine would generate an ongoing and continuous visual effect to the extent that this would be considered significant. Therefore significant effects have been identified on the following receptors which correspond with the original LVIA (2012 ES):

- Houses on the coastal edge of Buckhaven and Methil (30-40 no) and from some houses within these settlements that gain an open view;
- Houses on the southern edge of Kennoway (20-30 no); and
- Local views from a small number of houses on the western edge of Lower Largo (3-5 no).

As noted in the original LVIA, these visual effects result from the turbine itself and not the other elements of the LDT. It is also notable that the severity and adversity of the LDT will be experienced differently by people depending on their opinions. Where people associate wind turbines with clean energy, this is likely to be experienced less significantly and perhaps even positively. Where the feeling generated is one of dislike, the LDT will be experienced adversely to a greater degree.

5.7 Statement of Significance

This update to the SLVIA has verified the baseline conditions and note that these have not changed sufficiently to alter the assessment. Following this, the LDT has been assessed against current revised guidance criteria. The assessment has found that significant effects are limited to visual receptors within 3 km to 5 km of the LDT.

The points of note for this Development in respect of the EIA regulations and significance are:

- The LDT is a single turbine a short distance off the shore from an industrial part of Fife coastline.
- The LDT turbine is 196 m to blade tip, yet it appears to be smaller in the majority of views because the turbine is at MSL and the landmass is always at a higher elevation, with the FEP being 30 m higher than the level of the LDT.
- The turbine is particularly well-located, relating directly to the industrial elements on the coast, i.e. the FEP and the steel fabrication works, as well as the industrial elements off shore i.e. the rigs.
- The LDT does not generate significant effects on nationally or locally important designated sites, scheduled monuments or listed gardens and designed landscapes.
- Significant visual effects are limited to within approximately 3 km to 5 km of the LDT.
- There are no significant cumulative effects identified.

6 NOISE

6.1 Introduction

This Chapter of the EIA Update Report evaluates the effects of the proposed extension to the operational life of the Levenmouth Demonstration Turbine (the LDT) in terms of noise on nearby sensitive receptors. This Chapter updates and supplements the information presented in Chapter 6: Noise of the 2012 ES and it is intended that this Chapter be read in conjunction with the 2012 ES.

Since the turbine is now built and operational, construction effects are not relevant. The present chapter focuses on operational impacts, both for the scheme in isolation and cumulatively with other developments in the area. Specifically, the consented Forthwind Demonstration Project will be considered. The proposed Forthwind Offshore Wind Demonstration Array is currently at scoping stage with limited information available to allow a detailed impact assessment. The assessment for the proposed Forthwind Offshore Wind Demonstration Array will need to consider the impact of the proposed extension of the operational life of the LDT. Other, more distant wind farms were not considered because their potential noise contribution was considered negligible.

6.2 Assessment Methodology and Significance Criteria

6.2.1 Legislation, Policy and Guidance

The relevant planning guidance remains similar to that described in the 2012 ES, with Scottish Planning Policy (SPP[9]) and Planning Advice Note PAN1/2011 providing general advice[10] on evaluating noise in the context of the planning system.

6.2.1.1 Scottish Government Planning Information on Onshore Wind

The Scottish Government's Online Renewables Planning Advice was updated[11] in May 2014 but continues to make reference to the recommendations of 'The Assessment and Rating of Noise from Wind Farms'[12] (ETSU-R-97). It advises that ETSU-R-97 "should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments".

6.2.1.2 ETSU-R-97 and current good practice

Following the study on behalf of the then Department for Energy and Climate Change (DECC) on the application of ETSU-R-97, referenced in the 2012 ES, the Institute of Acoustics (IOA) set out to produce further guidance on good practice on the application of ETSU-R-97. The resulting Good Practice Guide (or IOA GPG[13]) provides detailed technical guidance on a wide number of points, including noise prediction methodology and cumulative effects, effectively replacing the previous recommendations referenced in the 2012 ES (Bowdler et. al., 2009). The IOA GPG was subsequently endorsed by the Scottish Government which advised in its Online Renewables Planning Advice that the GPG 'should be used by all IOA members and those undertaking assessments to ETSU-R-97'.

[9] Scottish Planning Policy (SPP), Scottish Government, 2014.

[10] PAN1/2011 Technical Advice Note – Assessment of Noise, Scottish Government, March 2011.

[11] Scottish Government, Online Renewables Planning Advice, Onshore Wind Turbines (http://www.gov.scot/Resource/0045/00451413.pdf). Updated May 28, 2014.

[12] ETSU R 97, the Assessment and Rating of Noise from Wind Farms, Final ETSU-R-97 Report for the Department of Trade & Industry. The Working Group on Noise from Wind Turbines, 1997.

[13] A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, M. Cand, R. Davis, C. Jordan, M. Hayes, R. Perkins, Institute of Acoustics, May 2013.

6.2.1.3 Infrasound and Amplitude Modulation

With regard to infrasound and low frequency noise, the above-referenced Online Renewables Planning Advice refers to a report[14] for the UK Government which concluded that 'there is no evidence of health effects arising from infrasound or low frequency noise generated by the wind turbines that were tested'. The current recommendation is therefore that ETSU-R-97 should continue to be used for the assessment and rating of operational noise from wind farms.

Since the 2012 ES, additional research has been published on the subject of wind turbine blade swish or Amplitude Modulation (AM). An extensive programme entitled 'Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect' was published by RenewableUK[15]. The IOA has also published[16] an objective technique developed for quantifying AM noise. The UK Government commissioned a review on subjective response to AM noise which outlines considerations for the control of this feature, based on the IOA methodology, which was published[17] in late 2016. The Scottish Government is currently reviewing these recommendations in the context of the Scottish planning system[18]. As noted above, current Scottish Planning Policy endorses ETSU-R-97 and the IOA GPG, neither of which propose a specific control for AM.

6.2.2 Study Area

The study area comprises the residential receptors nearest to the LDT. These are represented by the same three locations considered in the 2012 ES. Additional receptors were considered in the ES for the Forthwind Demonstration Project (Forthwind ES), and these become relevant when considering cumulative impacts. These noise-sensitive receptors are listed in Table 6.1 below and shown on Figure 6.1. This list of receptor locations is not intended to be exhaustive but sufficient to be representative of the receptors closest to the LDT and other schemes considered.

Table 6.1: Assessment Locations

Property	Easting	Northing	Source
Location 1 - 20 Wellesley Road	336441	698727	2012 ES
Location 2 - 94 Wellesley Road	336229	698480	2012 ES
Location 3 - 12 Erskine St	336092	698226	2012 ES
13 Shore Street	336120	698042	Forthwind ES
26 Back Dykes	333834	696495	Forthwind ES
3 Cave Cottages	334211	696883	Forthwind ES
51-57 West High Street	335791	697727	Forthwind ES

[14] 'The measurement of low frequency noise at three UK wind farms', M. Hayes, DTI Report W/45/00656/00, 2006.

[15] Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect, Renewable UK, December 2013.

[16] Institute of Acoustics (IOA) Amplitude Modulation Working Group, Final Report, A Method for Rating Amplitude Modulation in Wind Turbine Noise, June 2016.

[17] Review of the evidence on the response to amplitude modulation from wind turbines, WSP for Department for Business, Energy & Industrial Strategy. October 2016

[18] Scottish Government, Onshore Wind Policy Statement (January 2017), http://www.gov.scot/Publications/2017/01/7344/6

Property	Easting	Northing	Source
9 Shore Street	335955	697932	Forthwind ES

6.2.3 Baseline Survey Methodology

6.2.3.1 Consent conditions

Following consultation with Marine Scotland and Fife Council, in March 2016 the Scottish Ministers granted an application to vary the initial consent for the LDT. The variation comprised a change of wording for condition 13 and a replacement of the numerical noise limits stated in Annex 3 of the original consent, which were based on the survey results referenced in the 2012 ES. These specific limits were replaced with a more generic statement:

"At standardised 10 m wind speeds not exceeding 12 ms-1, the rating level of noise emissions (measured as LA90,10 min) from the wind turbine, when measured at any dwelling in existence prior to the installation of the Development or at any dwelling which has been given planning permission prior to such installation, shall not exceed:

• The greater of 35 dB(A) or 5 dB above the prevailing background noise (LA90,10 min) between the hours of 07:00-23:00; and

• The greater of 43 dB(A) or 5 dB above the prevailing background noise (LA90,10 min) between the hours of 23:00-07:00.

The wording of Condition 13 was changed to correctly reference these limits as set out in Annex 3. It is therefore possible to determine noise limits based on background noise measurements under different conditions, such as those which prevail at the site in different wind directions. As these limits are based on ETSU-R-97, they represent relevant criteria on which to base the assessment of the LDT.

6.2.3.2 Background monitoring at the site: 2010 and 2015

In 2010, Arcus undertook background monitoring at three representative locations neighbouring the Site. These measurements were used in the 2012 ES but no analysis of was made of how background noise levels vary with wind direction.

In 2014, Arcus undertook noise measurements following construction of the LDT, with the turbine both operating and not operating[19]. These measurements were undertaken during a period of relatively elevated industrial activity and are not referenced further in the present Chapter.

Supplementary measurements were collected by Hoare Lea, at the Fife Energy Park (FEP) over a period of approximately nine weeks from 13 August 2015 to 18 October 2015. These measurements were taken at three monitoring locations that were not identical to the previous three locations, due to practical constraints, but which were considered representative. During this measurement period, local industrial activity was relatively low. These measurements are described in Appendix 6.1.

The additional monitoring in 2015 was undertaken both in periods when the LDT was operating and not operating: the aim was to evaluate how both background noise and turbine noise levels varied at the Site with regard to wind speed and wind direction. For example, it was observed that background noise levels appeared to increase under broadly onshore winds likely due to the influence of coastal waves.

[19] Arcus, Fife Energy Park, offshore wind turbine operational noise assessment, May 2014.

Following additional consultation, and as a simplifying assumption, it was decided to consider two main wind direction sectors:

- Onshore: wind directions of 20 to 190 degrees from north.
- Offshore: wind directions of 190 to 20 degrees from north.

Furthermore, to maximise the amount of data obtained, and the effective range of wind directions and wind speeds in the dataset, the 2010 and 2015 datasets were combined at each location and a revised analysis undertaken for day-time and night-time periods in both of the above wind direction sectors. The day-time analysis was undertaken over the entire day-time period, 07:00 to 23:00, as stated in the 2016 varied condition, which was consented following consultation with Fife Council and Marine Scotland. Although the general procedure of ETSU-R-97 defines day-time limits based on backgrounds measured during quiet periods of the day (see 2012 ES), ETSU-R-97 does allow for consideration of other periods of the day in some cases. In the present case, the strong influence of industrial activities in the noise environment at the site makes this a relevant consideration.

In both cases, the measurements were referenced to wind speeds at the turbine's hub height (110 m) and expressed at a standard height of 10 m. The resulting "standardised wind speeds" are therefore derived in accordance with the preferred method set out in the IOA GPG. For the 2010 survey, wind speeds measured at 70 m and 51 m height were used to extrapolate the 110 m high wind speed, as allowed in the IOA GPG. For the 2015 survey, an anemometry mast located on the Site measured wind directly at 110 m height.

Furthermore, the data was analysed in line with good practice, with periods of rainfall and atypical noise excluded where relevant.

The detailed report of Appendix 6.1 presents the results of this survey and analysis in further detail.

6.2.4 Methodology for the Assessment of Effects

6.2.4.1 Operational noise assessment methodology

The general approach for the assessment of operational noise remains broadly as set out in the 2012 ES. Noise limits are determined in accordance with the above baseline assessment methodology (Section 6.2.3.2) and the revised consent conditions for the scheme (Section 6.2.3.1).

Whilst the 2012 ES was based on theoretical emissions levels, since then operational noise measurements have been undertaken of the LDT. Results were obtained in different wind directions representing changes in turbine noise levels attributed to propagation and directivity factors. It is mainly on the basis of these measurements that the operational noise effects of the LDT are assessed.

The measurements were supplemented by a predictive noise model to represent the variation in turbine noise levels from the LDT at all wind speeds, as well as allowing an assessment of the relative decrease of noise levels at more distant locations. A predictive model was also required to evaluate the noise from the consented Forthwind Demonstration Project as part of the cumulative noise assessment.

The predictive noise model used was similar to the one described in Section 14.4.2 of the 2012 ES and based on the ISO 9613-2 standard and which follows the recommendations of the IOA GPG. As the LDT is located close to the shoreline, propagation occurs effectively over land and a ground factor of G=0.5 can be used. For the more distant Forthwind turbines, propagation over water occurs and in that case a factor of G=0 was

used. In addition, several references[20],[21] also propose an additional factor of 10log(d/d0) to account for enhanced propagation over the sea in some conditions. The reference distance d0 would vary in reality based on a range of factors but a value of d0 of 1 km was assumed in line with the latest guidance13. In addition, a detailed study12 points out that when the offshore noise propagation reaches the shore, reflection effects of the shoreline lead to reductions of typically 3 decibels (dB). Therefore, for properties which are clearly located inland, such as Locations 1 to 3 in Table 6.1, a factor of 3 dB was deducted from the calculated levels for the Forthwind turbines. For the other assessment locations which are situated on the edge of the shore, this reduction was not applied as a precautionary measure.

6.2.4.2 Operational Significance criteria

Planning policy in Scotland states that ETSU-R-97 should be used to assess and rate operational noise from proposed wind farm developments, taking into account current good practice. The acceptable limits for wind turbine operational noise are clearly defined in the ETSU-R-97 document and these limits should not be breached. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise immission[22] levels at nearby noise sensitive properties are within the noise limits derived in accordance with ETSU-R-97.

Depending on the levels of background noise the satisfaction of the ETSU-R-97 derived limits can lead to a situation whereby, at some locations under some wind conditions and for a certain proportion of the time, wind turbine noise may be audible. Nonetheless, if predicted noise levels are within the ETSU-R-97 criteria, operational noise is considered acceptable and not a significant effect; if predicted noise levels are above the ETSU-R-97 criteria, operational noise is considered unacceptable and a significant effect.

6.2.4.3 Cumulative noise assessments

ETSU-R-97 is clear that the noise limits described apply to the total operational noise from all operating wind turbines. Therefore, the total calculated cumulative wind turbine noise immission levels will be compared to noise limits derived in accordance with the extant consent for the LDT.

The IOA GPG states that if the contribution of another wind farm is 10 dB or more below that of another wind farm, its relative contribution is considered negligible.

6.2.5 Assessment Limitations

The current assessment is based on measured rather than estimated operational noise emission data for the existing turbine of the LDT. In some cases, limited data was obtained in some wind conditions, which is considered reasonable, and extrapolation was done using a predictive model as described in this Chapter.

6.3 Baseline Conditions

6.3.1 Measured background noise levels

The results of the background noise surveys, based on the combination of the 2010 and 2015 data and analysed in accordance with the above methodology, are detailed in

[20] M. Boué (KTH/Vinforsk), Long-Range Sound Propagation Over the Sea with Application To Wind Turbine Noise, Final report for the Swedish Energy Agency project 21597-3.

[21] Swedish Environmental Protection Agency, Measuring and Calculating Sound From Wind Turbines, Guidance Document, June 2013.

[22] The term 'noise immission' relates to the sound pressure level (the perceived noise) at receptor locations as opposed to the term 'noise emission' which relates to the sound power level radiated by a source such as a wind turbine.

Appendix 6.1. The variation in measured levels with wind speed was determined with trend-line analysis, in accordance with current good practice.

At the surveyed locations, measured background noise levels were influenced by local industrial activities, particularly during the day-time. However, this industrial activity was relatively reduced during the 2015 survey, which means that the combination of the 2010 and 2015 datasets represents a relatively conservative dataset. Levels measured during onshore wind conditions tended to be higher, likely due to the influence of the sea.

6.3.2 Derived Noise limits

Section 6.2.3.1 explains that condition 13 of the consent defines noise limits based in part on background noise levels, which may vary at different times and in different wind conditions, or the level of industrial activity in the area for example. For the purpose of the present assessment, the robust background dataset described above was used to derive noise limits at the three main representative locations in accordance with the wording of Annex 3 of the consent and detailed in Table 6.1. The resulting noise limits are set out in Table 6.2 and

Table 6.3.

Table 6.2: Derived day-time noise limits (LA90, dB) from the noise survey

Property	Standardised Wind speed (m/s)									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Onshore winds: 20-190										
Location 1 - 20 Wellesley Road	43.2	45.0	47.1	49.6	52.1	54.4	56.6	58.3	59.6	60.4
Location 2 - 94 Wellesley Road	42.9	43.5	44.4	45.8	47.6	49.6	51.7	53.7	55.4	56.5
Location 3 - 12 Erskine St	42.7	45.0	47.6	50.4	53.1	55.6	57.8	59.6	61.2	62.5
Offshore winds: 190-20										
Location 1 - 20 Wellesley Road	43.5	44.3	45.0	45.6	46.1	46.4	46.7	46.8	46.8	46.8
Location 2 - 94 Wellesley Road	43.3	44.0	45.0	46.1	47.2	48.4	49.6	50.7	51.8	52.7
Location 3 - 12 Erskine St	41.9	42.2	43.1	44.8	47.2	50.1	53.2	56.0	56.0	56.0

Table 6.3: Derived night-time noise limits (LA90, dB) from the noise survey

Property	Standardised Wind speed (m/s)									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Onshore winds: 20-190										
Location 1 - 20 Wellesley Road	43.0	43.0	43.0	45.4	49.5	53.1	55.6	56.2	56.2	56.2
Location 2 - 94 Wellesley Road	43.0	43.0	43.0	43.0	43.8	46.6	49.5	51.9	52.8	52.8
Location 3 - 12 Erskine St	43.0	43.0	44.6	47.6	51.1	54.9	58.0	59.7	59.7	59.7
Offshore winds: 190-20										
Location 1 - 20 Wellesley Road	43.0	43.0	43.0	43.0	43.0	43.5	44.7	46.0	46.0	46.0
Location 2 - 94 Wellesley Road	43.0	43.0	43.0	43.0	43.0	43.0	44.8	47.0	49.3	51.4
Location 3 - 12 Erskine St	43.0	43.0	43.0	43.0	43.7	47.6	52.4	57.3	57.3	57.3

6.3.3 Operational noise levels

The survey undertaken at the site in 2015 also determined operational levels from the LDT. Appendix 6.1 details the analysis undertaken: in summary, measurements were taken at all three locations with the LDT operating, covering a range of wind speeds and wind directions. The measurements, in line with current good practice, were corrected for the influence of background noise using periods in which the LDT was switched off. The operational noise analysis was undertaken in two 90-degree wind direction sectors, representing both onshore and offshore wind conditions, to minimise the scatter in the data.

Despite the extensive measurement period, the range of wind speeds obtained was limited in some cases. Variations in emission levels at higher wind speeds was also considered unrepresentative as the LTD is thought to reach its maximum level of noise emission at a standardised wind speed of 7 metres per second (m/s). The analysis was therefore supplemented by a predictive model with notional emissions values which were adjusted to match the measured noise levels in conditions in which the turbine noise could most clearly be measured. When reductions or increases were measured in different wind directions, these predicted levels were adjusted to best match the measurements based on the relevant wind speeds in which clear measurements were available. As the 2015 survey could not be undertaken at Location 3 (Table 6.1) directly due to practical constraints, a measurement location closer to the LDT was chosen and corrected to Location 3 using the predictive model.

The resulting derived operational noise levels from the LDT are set out in Table 6.4.

Table 6.4: Derived operational noise levels (LA90, dB) – LDT

Property	Standardised Wind speed (m/s)									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Onshore winds : 20-190										
Location 1 - 20 Wellesley Road	37.8	38.8	42.0	45.0	47.0	47.0	47.0	47.0	47.0	47.0
Location 2 - 94 Wellesley Road	38.2	39.2	42.4	45.4	47.4	47.4	47.4	47.4	47.4	47.4
Location 3 - 12 Erskine St	36.1	37.1	40.3	43.3	45.3	45.3	45.3	45.3	45.3	45.3
Offshore winds : 190-20										
Location 1 - 20 Wellesley Road	33.8	34.8	38.0	41.0	43.0	43.0	43.0	43.0	43.0	43.0
Location 2 - 94 Wellesley Road	35.5	36.5	39.7	42.7	44.7	44.7	44.7	44.7	44.7	44.7
Location 3 - 12 Erskine St	33.3	34.3	37.5	40.5	42.5	42.5	42.5	42.5	42.5	42.5

6.4 Assessment of Potential Effects

The operational noise levels of Table 6.4 are then compared with the derived noise limits of Table 6.2 and

Table 6.3: see Table 6.5 (day-time) and Table 6.6 (night-time). For the avoidance of doubt, negative numbers in the following tables indicate that the predicted noise immission levels are below the limit.

Table 6.5: Difference between the Derived Day-time Noise Limits and the Predicted LA90 Wind Farm Noise Immission Levels of the LDT

Property	**Standardised Wind speed (m/s)**									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Onshore winds : 20-190										
Location 1 - 20 Wellesley Road	-5.4	-6.1	-5.1	-4.5	-5.0	-7.4	-9.5	-11.3	-12.6	-13.4
Location 2 - 94 Wellesley Road	-4.7	-4.3	-2.0	-0.4	-0.2	-2.2	-4.3	-6.3	-8.0	-9.1
Location 3 - 12 Erskine St	-6.6	-7.9	-7.3	-7.1	-7.8	-10.3	-12.5	-14.3	-15.9	-17.2
Offshore winds : 190-20										
Location 1 - 20 Wellesley Road	-9.7	-9.5	-7.0	-4.6	-3.1	-3.4	-3.7	-3.8	-3.8	-3.8
Location 2 - 94 Wellesley Road	-7.8	-7.5	-5.3	-3.4	-2.5	-3.7	-4.9	-6.0	-7.1	-8.0
Location 3 - 12 Erskine St	-8.6	-7.9	-5.6	-4.3	-4.7	-7.6	-10.7	-13.5	-13.5	-13.5

Table 6.6: Difference between the Derived Night-time Noise Limits and the Predicted LA90 Wind Farm Noise Immission Levels of the LDT

Property	**Standardised Wind speed (m/s)**									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Onshore winds : 20-190										
Location 1 - 20 Wellesley Road	-5.2	-4.2	-1.0	-0.4	-2.5	-6.1	-8.6	-9.2	-9.2	-9.2
Location 2 - 94 Wellesley Road	-4.8	-3.8	-0.6	2.4	3.6	0.8	-2.1	-4.5	-5.4	-5.4

Property	Standardised Wind speed (m/s)									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Location 3 - 12 Erskine St	-6.9	-5.9	-4.3	-4.3	-5.8	-9.6	-12.7	-14.4	-14.4	-14.4
Offshore winds : 190-20										
Location 1 - 20 Wellesley Road	-9.2	-8.2	-5.0	-2.0	0.0	-0.5	-1.7	-3.0	-3.0	-3.0
Location 2 - 94 Wellesley Road	-7.5	-6.5	-3.3	-0.3	1.7	1.7	-0.1	-2.3	-4.6	-6.7
Location 3 - 12 Erskine St	-9.7	-8.7	-5.5	-2.5	-1.2	-5.1	-9.9	-14.8	-14.8	-14.8

It is apparent from Table 6.6 that, at Location 2 (94 Wellesley Road), the operational levels determined from the LDT exceed the derived night-time limits for a range of wind speeds (as highlighted): 6 to 8 m/s (onshore winds) and 7 to 8 m/s (offshore winds). This would therefore represent a potentially significant operational noise effect, based on the conservative limits derived in the present assessment. If background noise levels consistently increased during night-time periods, for example due to industrial activity, increased noise limits may be derived under the extant consent conditions and a different assessment outcome could be determined as a result.

6.5 Mitigation Measures and Residual Effects

6.5.1 Operational noise mitigation

The operational noise levels from the LDT can be reduced in several ways in order to result in compliance with the derived noise limits.

First of all, in common with most turbine models, the LDT's control system can prevent the turbine operating, in accordance with a schedule of different wind conditions and/or different times of the day. Such a schedule is currently in place for the LDT to mitigate excesses above the limits identified in previous studies.

Alternatively, a reduction in the operational noise levels produced by the LDT could also potentially be achieved by use of noise control modes. Reduced noise operation is available for most modern variable speed, pitch-regulated wind turbine models and allows the sound power output of the turbine to be reduced across a range of operational wind speeds, albeit with some loss of electrical power generation. These systems are generally similar in that they rely on the turbine's computer based controller adjusting either the pitch of the blades or holding back the rotational speed of the blades to reduce emitted noise under selected wind conditions (direction, speed or some combination of the two). In this manner, noise management only comes into play (and therefore potential power generation capacity is only lost) for those conditions under which it is required. Noise control modes for the LDT are under development but likely to be available in the near future and could therefore be employed by the LDT in its future operational life.

The Applicant is committed to operating the LDT in a manner continue to comply with the noise limits presented in Condition 13 and Annex 3 of the extant consent using either of these measures or a combination of them.

6.5.2 Residual Effects

The proposed mitigation measures can reduce operational noise levels at noise-sensitive receptors such that they comply with the derived noise limits and the Applicant is committed to putting these in place. Therefore, residual noise levels following mitigation are acceptable and therefore not significant in the context of the EIA regulations.

6.5.3 Monitoring requirements

It is proposed that, should planning consent be granted for the Variation, a noise condition incorporating the extant condition 13 attached to the consented LDT (Section 6.2.3.1) is applied. Such a condition includes the requirement that, in the event of a noise complaint, noise levels resulting from the operation of the LDT are measured to demonstrate compliance with relevant noise limits. Such monitoring would be done in full accordance with ETSU-R-97.

6.6 Cumulative Effects

The assessment of cumulative effects is considered in detail in Appendix 6.1 and is summarised below.

6.6.1 Forthwind Demonstration Project

The operational noise levels for the LDT as outlined in Table 6.4, were compared with predictions for the consented Forthwind scheme under worst-case onshore wind conditions. The latter were determined based on the emission levels assumed in the Forthwind ES and using the prediction model described above in Section 6.2.4.1. This results in noise levels which differ from these shown in the Forthwind ES.

This comparison determined that, at Locations 1 and 2 of Table 6.1, the predicted noise levels for the consented Forthwind scheme were 10 dB or more below those of the LDT and therefore represent a negligible contribution to the operational levels. This was also the case for Location 3, except at some wind speeds where this difference was marginally less than 10 dB; however, at this location the cumulative noise levels at all wind speeds remained below the noise limits of Table 6.2 and

Table 6.3 at all wind speeds.

Cumulative noise levels were also considered at the additional assessment locations from the Forthwind ES and detailed in Table 6.1. These locations are further from the LDT and cumulative noise levels remained below the noise limits derived in the Forthwind ES at all wind speeds.

In offshore wind conditions, noise at the assessment locations from the consented offshore turbines would be reduced in most conditions, due to propagation effects, and the same conclusions reached.

The Applicant has been in discussion with the developer of the Forthwind Demonstration Project in order to agree procedures to suitably manage cumulative noise levels, in consultation with Fife Council in the event that the Forthwind Demonstration Project is constructed and operated. Condition 28(i) of the Forthwind Demonstration Project states:

"an agreed and operational protocol agreement between the Company and FEPOWDT regarding the apportionment and control of noise which ensures that noise impacts from the combined developments do not exceed the allowable environmental limits"

Until such time as the condition has been discharged, the Forthwind Demonstration Project turbines cannot be operated. Furthermore Condition 29 of the Forthwind Demonstration Project consent states:

"If the monitoring of noise levels undertaken in accordance with the Noise Measurement and Mitigation Scheme show that the noise of the Development, either alone or in combination with FEPODWT, exceeds the agreed noise limits the operation of the WTGs comprising this Development [Forthwind] must cease immediately. The operation of the WTGs must remain ceased until such time as the Company has satisfied the Scottish Ministers, in consultation with FC, that appropriate mitigation measures, as specified in the Noise Measurement and Mitigation Scheme or any other such measures as defined by Scottish Ministers, have been put in place".

These conditions as applied to the Forthwind Demonstration Project secures acceptable cumulative noise levels in practices should the LDT and the Forthwind Demonstration Project operate simultaneously.

6.7 Summary of Effects

Table 6.7: Summary of effects – noise

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Noise Sensitive Receptors	Operational noise levels exceed derived night-time noise limits under some conditions (wind speeds & directions).	Significant	Operational noise restrictions under specific conditions.	Acceptable and therefore not significant.

6.8 Statement of Significance

The assessment of the operational noise associated with the LDT has been shown to comply, following mitigation, with criteria derived in accordance with the extant consent for the LDT and therefore operational noise effects are considered acceptable and therefore not significant in the context of the EIA Regulations.

When considered the cumulative effect of the consented Forthwind scheme, based on the available information, it was concluded that these effects would either be negligible or such that cumulative operational noise would remain below the derived noise limits. Therefore, cumulative operational noise levels would remain acceptable and not significant.

7 ORNITHOLOGY

7.1 Introduction

This Chapter of the EIA Update Report evaluates the effects of the proposed extension to the operational life of the Levenmouth Demonstration Turbine (the LDT) on birds. This Chapter updates and supplements the information presented in Chapter 8: Ornithology of the 2012 Environmental Statement (2012 ES) and it is intended that this Chapter is read in conjunction with the 2012 ES.

A Project Environmental Monitoring Programme (PEMP) was produced to comply with the requirements set out in Planning Condition 11 of the S36 Consent for the LDT. The PEMP sets out specific monitoring and mitigation measures required to be undertaken, associated with various environmental and ecological aspects, one of which was birds. Construction and operational phase bird monitoring surveys were subsequently undertaken between July 2013 and March 2017 and were designed to provide information to understand the interaction of birds with the LDT turbine. The bird monitoring surveys have been continued since March 2017 and are planned to continue throughout the existing five-year operational consent of the LDT; however, those data have not yet been collated and analysed and are therefore not available for inclusion in this assessment.

Baseline data for this assessment are therefore available from two main sources:

- Baseline data collected between September 2006 and September 2007 for the 2012 ES; and
- Construction and operational phase monitoring data, collected between July 2013 and March 2017.

This Chapter is supported by the following figure and appendix:

- Figure 7.1: Special Protection Areas
- Appendix 7.1: Levenmouth Demonstration Wind Turbine Year 1–3 Operational Bird Monitoring: Comparative Analysis (October 2017)

Annual bird monitoring reports which were produced in 2015, 2016 and 2017 as part of the PEMP are also available in the public domain for review; however, the Comparative Analysis Report (Appendix 7.1) includes the relevant construction and operational phase monitoring data and analyses for this assessment.

7.1.1 Consultation

The approach has been informed by the Scoping Opinion dated 05 July 2017, which details the responses from relevant consultees.

Table 7.1 summarises the Scoping Opinion responses of relevance to the ornithological assessment.

Table 7.1: Summary of Scoping Opinion Responses

Consultee	Scoping Advice	Action
Scottish Natural Heritage (SNH)	Agreed with the Scoping report that birds should be scoped out of the EIA Update Report. Also provided advice relating to amendments to the draft Year 3 Annual Monitoring Report and Comparative Analysis Report for the LDT.	Assessment of effects on birds has been scoped in due to responses from other consultees. The suggested amendments have been made so that the Comparative Analysis Report (Appendix 7.1) provides sufficient information to inform this assessment.

Consultee	Scoping Advice	Action
Marine Scotland Science (MSS)	Advised that it does not seem appropriate to scope out assessment of impacts on birds and that it seems clear that likely significant effects exist to the Firth of Forth Special Protection Area (SPA) and Outer Firth of Forth and St Andrews Bay proposed SPA (pSPA). Recommended that detailed analysis of the monitoring data is undertaken and presented in the EIA Update Report.	Assessment of effects on birds has been scoped in. More detailed analysis of the monitoring data has been undertaken and is presented in Appendix 7.1.
Royal Society for the Protection of Birds (RSPB)	Did not agree with the decision to scope out ornithology. Advised that the LDT is now also located in the Outer Firth of Forth and St Andrews Bay pSPA and that Habitats Regulations Assessment (HRA) is required. The assessment should also include impacts on the Firth of Forth and Forth Islands SPA. An assessment of cumulative impacts with other developments in the Firth of Forth should also be conducted.	Assessment of effects on birds has been scoped in. The assessment presented in the EIA Update Report takes the form of HRA and includes a cumulative impact assessment.
SNH **Telephone consultation (13/09/17)**	Consultation to discuss the scope of amendments to the Comparative Analysis Report and approach to the ornithological assessment presented in the EIA Update Report. SNH recommended a 'light touch' and suggested that if the assessment is primarily concerned with effects on the pSPA, then it could be presented as a quick HRA report. Also advised that the HRA for the Forthwind Offshore Demonstration Project could be relied on for information. SNH recommended that the scope is also discussed with MSS.	The suggested amendments have been made so that the Comparative Analysis Report (Appendix 7.1) provides sufficient information to inform this assessment. The assessment in this EIA Update Report follows the process of HRA as the scope of the assessment is restricted to impacts on the European sites. MSS were contacted to arrange a consultation but were unable to engage within the timescales required for submission of this EIA Update Report.
Marine Scotland Licensing Operations Team (MS-LOT) **Email (10/10/17)**	Reiterated that ornithology should be scoped in to the EIA Update Report due to the location of the turbine in the pSPA and that MSS scoping advice should be followed.	Assessment of effects on birds has been scoped in and considers the potential for significant effects on the pSPA.

7.2 Assessment Methodology and Significance Criteria

7.2.1 Legislation, Policy and Guidance

The baseline and monitoring surveys were carried out with reference to the prevailing best practice guidance and through agreement in consultation with SNH at the time the surveys were designed and undertaken. Details of the consultations and guidance relevant at the time are provided in the 2012 ES and monitoring reports.

Through a process of scoping and consultation for this EIA Update Report, it was ascertained that the key consideration for the updated assessment of effects on birds was the potential for impacts on the qualifying interest features of European sites that may

have connectivity with the LDT. The process for doing this is a HRA. Potential effects on ornithological interests beyond those associated with European sites have been scoped out of this assessment. As such, the key legislative documents are:

- Council Directive 1992/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora ("Habitats Directive");
- Council Directive 2009/147/EC on the Conservation of Wild Birds ("Birds Directive"); and
- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) ("Habitat Regulations").

HRA fulfils the requirements of the Habitats and Birds Directives, as implemented in Scots Law via the Habitat Regulations for offshore projects within Scottish Territorial Waters i.e. within 12 nautical miles (nm) of the mainland. Under the terms of this legislation, a HRA is required before a project which may affect a European Site(s) can be lawfully undertaken or authorised.

A European site (also known as a Natura 2000 site) is either a Special Area of Conservation (SAC) or candidate SAC (cSAC) designated to fulfil the requirements of the Habitats Directive or a SPA designated to fulfil the requirements of the Birds Directive. It is also a matter of Government policy that these procedures apply to listed or proposed Ramsar sites identified through the Ramsar Convention 1976, potential SACs (pSAC) and pSPAs. Therefore, such sites are included under the European Site heading for the purposes of carrying out the HRA.

The HRA presented in this chapter follows the principles set out in the Habitats Regulations Assessment Handbook (DTA Publications), which complies with the requirements set out in EU (European Communities 2000, 2002)[23],[24] and national planning policy (Scottish Planning Policy (2014) paragraphs 207-210).

Having ascertained that the LDT is not connected with the management of the European Sites for nature conservation, the HRA comprises four stages:

Screening: assessing whether or not the project would have a 'likely significant effect' (LSE) on the European Sites, either alone, or in combination with other plans or projects. If the Screening procedure concludes that there is a LSE on a European Site, then an Appropriate Assessment (Step 2) would apply. If not, then the project may be authorised.

Appropriate Assessment (AA): the AA is undertaken by the competent authority responsible for determining the application. Its purpose is to assess the implications of the project in respect of the European Sites' Conservation Objectives, which should enable the competent authority to determine whether or not the project would adversely affect the integrity of the designated sites. If it can be ascertained beyond reasonable scientific doubt that the project would not adversely affect the integrity of the European Sites, then it can be authorised. If not, Steps 3 and 4 would apply.

Alternative Solutions: where the project may potentially damage a designated site, alternative solutions to the project need to be proposed. If there are no alternatives that do not affect the integrity of the European Sites, step 4 applies.

Imperative Reasons of Overriding Public Interest (IROPI): projects that damage the protected site may proceed for imperative reasons of overriding public interest if compensatory measures are secured.

[23] European Communities 2000. *MANAGING NATURA 2000 SITES: The provisions of Article 6 of the 'Habitats' Directive 92/43/CEE*. Office for Official Publications of the European Communities, Luxembourg.

[24] European Communities 2002. *Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*. Luxembourg: Office for Official Publications of the European Communities.

Many projects do not need to progress beyond Stage 1 where it can be identified that there is no causal link between a project and a European site or that the probability of a significant effect is negligible or de minimis.

The Variation will be determined by MS-LOT as the competent authority. It is also the responsibility of MS-LOT to undertake any AA that may be required under the terms of the Habitats Regulations, with statutory advice provided by SNH. Whilst the competent authority will ultimately undertake the AA, it is the responsibility of the developer and their consultant to provide the relevant information to enable them to do so. This chapter and associated appendix are intended to provide MS-LOT with the relevant information for them to discharge their duties under the Habitats Regulations.

7.2.2 Study Area

The Study Area for the assessment of impacts on birds encompasses a large area including the Firth of Forth SPA, the Forth Islands SPA and the Outer Firth of Forth and St Andrews Bay Complex pSPA (Figure 7.1).

The baseline surveys undertaken for the 2012 ES were focussed on a survey area of shoreline and inshore waters extending up to 110 m landward and seaward of the turbine location along the length of the Fife Energy Park (Appendix 7.1).

The construction and operational phase monitoring surveys included an area of up to 500 m around the turbine location (Appendix 7.1).

7.2.3 Baseline Survey Methodology

The baseline survey methodology is described in full in the 2012 ES and its accompanying Technical Appendix 8.1. The monitoring survey methodology is detailed in the annual monitoring reports and in the Comparative Analysis Report (Appendix 7.1). A summary is provided below.

7.2.3.1 Baseline Survey Method

Surveys were carried out over a 12 month period between September 2006 and September 2007. Vantage point surveys totalling 124 hours of observations were undertaken from a single location overlooking the survey area. Two methods were used to record data on target species activity: flight activity and distribution. Target species included all species found on the Firth of Forth SPA/Site of Special Scientific Interest (SSSI)/Ramsar citations, as well as all other waders, wildfowl, seabirds and raptors.

- Focal Animal Sampling (Flight Activity): birds in flight were recorded in various height bands and geographical grid cells. Data were applied to a collision risk model to estimate and assess the collision risk posed by the LDT turbine.
- Activity Summary (Distribution): a census of birds perched on the shoreline or on the sea surface within the survey area at the start of each survey and repeated every 30 minutes of the survey. Data were used to assess the potential impact of displacement from the area around the LDT turbine.

7.2.3.2 Monitoring Survey Method

The monitoring surveys have covered a construction phase, a pre-commissioning phase (i.e. the turbine was in place) before operation was officially commissioned and three years of operational phase.

A total of 36 hours of surveys were carried out during the construction phase between July and mid-October 2013. A further 66 hours of observations were undertaken during the pre-commissioning phase between late October 2013 and March 2014. A total of 144 hours of observations have been carried out during each of three years of operational phase monitoring between April 2014 and March 2017.

The methods employed were similar to those used during the baseline surveys in 2006/07, with some exceptions that are detailed in Appendix 7.1. A series of vantage point surveys were undertaken to record bird flight activity and distribution.

- Flight Activity: in addition to recording the location and height of flights into different distance and height bands, the birds' behaviour around the LDT turbine was also noted to identify flights appearing to exhibit avoidance behaviour.
- Activity Summary (Distribution): a census of all birds on the water (not including birds perched on the shoreline) within the survey area repeated at hourly intervals throughout the survey. The distance of foraging birds from the LDT turbine was also recorded.

7.2.4 Methodology for the Assessment of Effects

The assessment of effects in terms of HRA differs from that employed in EIA. The purpose of HRA is to identify whether or not there is a LSE on a European site and then if a LSE is identified, to determine whether or not there would be an adverse effect on the integrity of the European site.

In HRA, the 'significance' of an effect is not determined through consideration of the sensitivity of the receptor and the magnitude of the potential effect. In HRA, 'likely significant effect' is the step where potential effects of the Variation are initially considered and refers to any potential connectivity or interaction with the European site which has the potential to affect the qualifying interests of the site in terms of its conservation objectives. The LDT must be considered in isolation, as well as in combination with other plans or projects. Where there is a quantifiable effect on a qualifying interest of a European site that is not considered to be negligible or de minimis, then it therefore is considered to be a LSE and the next stage (AA) of the HRA process is required.

In undertaking the AA, the term 'adverse' is used to identify and describe negative impacts on the integrity of a European site in view of its conservation objectives. The conservation objectives are a set of criteria that need to be met to ensure that the qualifying features of the European site are maintained or restored. The conservation objectives are designed to ensure that the integrity of the site will be maintained, and deterioration or significant disturbance of the qualifying interests will be avoided.

The assessment method presented in this chapter aims to:

1. Identify the European sites that may have connectivity to the LDT;
2. Identify the relevant conservation objectives of those European sites that may be affected by the Variation;
3. Identify the LSEs in relation to each qualifying interest feature of the European sites; and
4. For those qualifying interests where LSE cannot be ruled out, assess whether or not the potential magnitude of change as a result of the Variation alone, and in combination with other projects, could have an adverse impact on the integrity of the European site in view of the conservation objectives.

Ecological integrity is defined (in relation to designated sites) in the Committee on the Office of the Deputy Prime Minister (ODPM) circular 06/2005[25] as a site's "coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified". Favourable conservation status is defined as follows:

[25] ODPM Circular 06/2005 / Defra Circular 01/2005. *Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system.* Office of the Deputy Prime Minister, London / Department for Environment, Food and Rural Affairs, London. Although this guidance is directed at the English planning, the definition of integrity is equally applicable in Scotland.

- Population dynamics indicate that the species is maintaining itself on a long-term basis as a viable component of its habitats;
- The natural range of the species is not being reduced, nor is likely to be reduced for the foreseeable future; and
- There is (and will probably continue to be) a sufficiently large habitat to maintain its populations on a long-term basis.

An effect can be judged as a threat to the integrity of a site where it would adversely affect the favourable conservation status of a qualifying species, or stop a recovering species from reaching favourable conservation status.

7.2.5 Assessment Limitations

There is a comprehensive set of data from the baseline and monitoring surveys and there are not considered to be any substantive gaps in baseline bird survey data that prevent a robust assessment. There are difficulties separating the potential effects that the operational Development turbine may have had on bird abundance and distribution from other effects in the wider environment (e.g. changes in water quality, recreation and other development or commercial pressures) that may be driving the changes seen at a local level.

7.3 Baseline Conditions

7.3.1 Designated Sites

Through scoping and consultation, three European sites have been identified that have connectivity with the LDT through their location and qualifying interests:

- Firth of Forth SPA;
- Forth Islands SPA; and
- Outer Firth of Forth and St Andrews Bay Complex pSPA.

7.3.1.1 Firth of Forth SPA

The Firth of Forth SPA comprises a complex of estuarine and coastal habitats stretching from Alloa to the coasts of Fife and East Lothian. The LDT is located partially within the boundary of the SPA.

Qualifying interests of the Firth of Forth SPA include:

- Wintering populations of European importance of Annex 1 species:
  - Red-throated diver;
  - Slavonian grebe;
  - Golden plover; and
  - Bar-tailed godwit.
- Wintering populations of European and international importance of migratory species:
  - Pink-footed goose;
  - Shelduck;
  - Knot;
  - Redshank; and
  - Turnstone.
- Post-breeding (passage) population of European importance of Annex 1 species:
  - Sandwich tern.
- Wintering waterfowl assemblage of European importance, including nationally important numbers of migratory species:

- Great crested grebe;
- Cormorant;
- Scaup;
- Eider;
- Long-tailed duck;
- Common scoter;
- Velvet scoter;
- Goldeneye;
- Red-breasted merganser;
- Oystercatcher;
- Ringed plover;
- Grey plover;
- Dunlin; and
- Curlew.

- The assemblage also includes large numbers of the following species:
  - Wigeon;
  - Mallard; and
  - Lapwing.

The Conservation Objectives of the SPA are:

To avoid deterioration of the habitats of the qualifying species [listed above] or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site*
- *Distribution of the species within site*
- *Distribution and extent of habitats supporting the species*
- *Structure, function and supporting processes of habitats supporting the species*
- *No significant disturbance of the species*

7.3.1.2 Forth Islands SPA

The Forth Islands SPA comprises a number of separate islands or island groups, principally Inchmickery (together with the nearby Cow and Calves) off Edinburgh, Long Craig, Fidra, Lamb and Craigleith together with the Bass Rock off North Berwick, and the much larger Isle of May in the outer part of the estuary. The site also includes additional other small islands. Qualifying interests include:

- Breeding populations of European importance of Annex 1 species:
  - Arctic tern;
  - Roseate tern;
  - Common tern; and
  - Sandwich tern.
- Breeding populations of European importance of migratory species:
  - Gannet;
  - Shag;
  - Lesser black-backed gull; and
  - Puffin.
- Breeding assemblage in excess of 20,000 individual seabirds, including nationally important numbers of the following species:

- Razorbill;
- Guillemot;
- Kittiwake;
- Herring gull;
- Cormorant;
- Fulmar;
- Gannet;
- Lesser black-backed gull;
- Shag;
- Puffin.
- Arctic tern;
- Common tern;
- Roseate tern; and
- Sandwich tern.

The Conservation Objectives of the SPA are:

To avoid deterioration of the habitats of the qualifying species [listed above] or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site*
- *Distribution of the species within site*
- *Distribution and extent of habitats supporting the species*
- *Structure, function and supporting processes of habitats supporting the species*
- *No significant disturbance of the species*

7.3.1.3 Outer Firth of Forth and St Andrews Bay Complex pSPA

The Outer Firth of Forth and St Andrews Bay Complex pSPA comprises an area of 2,720 square kilometres (km2) of estuarine and marine habitat, stretching from Arbroath to St. Abb's Head and encompasses the Firth of Forth, the outer Firth of Tay and St. Andrews Bay. It is adjacent to parts of the Firth of Forth SPA and overlaps with parts of the Forth Islands SPA. The LDT is located partially within the boundary of the pSPA.

Qualifying interests of the pSPA include:

- Populations of European importance of Annex 1 species:
  - Red-throated diver (non-breeding);
  - Little gull (non-breeding);
  - Common tern (foraging birds from nearby breeding colonies);
  - Arctic tern (foraging birds from nearby breeding colonies); and
  - Slavonian grebe (non-breeding).
- Migratory populations of European importance of the following species:
  - Eider (non-breeding);
  - Long-tailed duck (non-breeding assemblage);
  - Common scoter (non-breeding assemblage);
  - Velvet scoter (non-breeding assemblage);
  - Goldeneye (non-breeding assemblage);
  - Red-breasted merganser (non-breeding assemblage);
  - Gannet (foraging birds from nearby breeding colonies);
  - Manx shearwater (breeding assemblage);

- Shag (foraging birds from nearby breeding colonies and non-breeding assemblage);
- Kittiwake (breeding and non-breeding assemblages);
- Guillemot (breeding and non-breeding assemblages);
- Razorbill (non-breeding assemblage);
- Puffin (breeding assemblage);
- Black-headed gull (non-breeding assemblage);
- Common gull (non-breeding assemblage); and
- Herring gull (breeding and non-breeding assemblages).

The draft Conservation Objectives of the pSPA are:

To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, subject to natural change, thus ensuring that the integrity of the site is maintained in the long-term and it continues to make an appropriate contribution to achieving the aims of the Birds Directive for each of the qualifying species.

This contribution will be achieved through delivering the following objectives for each of the site's qualifying features:

a) Avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term;

b) To maintain the habitats and food resources of the qualifying features in favourable condition.

Further details about the draft conservation objectives for the pSPA are provided in the pSPA Advice to Support Management document (SNH & JNCC 2016)[26].

7.3.1.4 SPA reference populations

In 2016, a HRA was submitted in relation to the potential effects of the Forthwind Offshore Wind Demonstration Project comprising two offshore turbines in the Firth of Forth, approximately 1.5 kilometres (km) from the LDT. For that assessment, the reference population sizes for assessment for each species at each SPA were agreed with SNH and MSS. The same principles are applied for this assessment:

- For the Firth of Forth SPA, populations are presented as at citation but the assessment is based on data from the second cycle of SPA site condition monitoring provided by SNH (unpublished) in order to reflect recent population trends;
- Counts for the pSPA were taken from consultation documents (SNH & JNCC, 2016)26;
- Counts for the Forth Islands SPA were taken from the Appropriate Assessment of offshore wind projects in the outer Firth of Forth (MS, 2014)[27];
- Any species for which recent counts were unavailable were assessed against the SPA population at designation.

7.3.2 Baseline and Monitoring Survey Results

The 2012 ES (and its accompanying Technical Appendix 8.1) and the annual monitoring reports provided full details of the distribution and abundance of all bird species observed during the surveys.

Appendix 7.1 (Comparative Analysis report) provides a summary listing all of the qualifying interest species of the Firth of Forth SPA, the Forth Islands SPA and the Outer Firth of

[26] SNH & JNCC (2016) Outer Firth of Forth and St Andrews Bay Complex Proposed Special Protection Area (pSPA) No. UK9020316. SPA Site Selection Document: Summary of the scientific case for site selection. Final version (7) for submission to Marine Scotland, June 2016. Available at: www.snh.gov.uk/docs/A2020842.pdf, accessed 09/10/2017.

[27] MS (2014) Seagreen Appropriate Assessment. Marine Scotland. Retrieved 17/04/2015 from http://www.gov.scot/Topics/marine/Licensing/marine/scoping/Seagreen3/seagreenaa

Forth and St Andrews Bay Complex pSPA, along with a categorisation of their frequency of occurrence during flight activity and activity summary (presence on the shoreline or sea surface) surveys during the baseline and monitoring periods. The summary in Table 5 of Appendix 7.1 categorises frequency of occurrence into:

- None: there were no observations for that type of survey during the relevant seasons;
- ≤ 10 flights or ≤ 5 records: there were ten or less flight observations (flight activity) or five or less records on the shoreline or sea surface in the survey area (activity summary) during the specified baseline survey or monitoring season; and
- > 10 flights or >5 records: there were more than ten flight observations (flight activity) or more than five records on the shoreline or sea surface in the survey area (activity summary) during the specified baseline survey or monitoring season.

Table 7.2 shows the frequency of occurrence of SPA/pSPA qualifying interest species in three categories: those species that were observed in flight on more than ten occasions during each of the baseline or monitoring seasons; those species that were observed on the shoreline or sea-surface on more than five occasions during each of the baseline or monitoring seasons; and those species that were either not recorded at all, or were observed in flight on fewer than ten occasions and on the shoreline/sea-surface on fewer than five occasions during each season.

Table 7.2: Frequency of Occurrence of Qualifying Interest Species of the SPAs/pSPA during Baseline and Monitoring Flight Activity and Activity Summary Surveys

> 10 flights	**> 5 records on shoreline / sea surface**	**No records or ≤ 10 flights and ≤ 5 records on shoreline / sea surface**
Eider (non-breeding)	Eider (non-breeding)	Pink-footed goose
Long-tailed duck (non-breeding)	Long-tailed duck (non-breeding)	Shelduck
Red-breasted merganser (non-breeding)	Velvet scoter (non-breeding)	Wigeon
Fulmar (breeding)	Red-breasted merganser (non-breeding)	Mallard
Gannet (breeding)	Red-throated diver (non-breeding)	Scaup
Cormorant (breeding & non-breeding)	Cormorant (breeding & non-breeding)	Common scoter
Shag (breeding & non-breeding)	Shag (breeding & non-breeding)	Goldeneye
Oystercatcher (non-breeding)	Herring gull (breeding & non-breeding)	Great crested grebe
Lesser black-backed gull (breeding)	Guillemot (breeding & non-breeding)	Slavonian grebe
Herring gull (breeding & non-breeding)		Manx shearwater
Kittiwake (breeding & non-breeding)		Ringed plover
Sandwich tern (breeding)		Golden plover
Common tern (breeding)		Grey plover
		Lapwing
		Knot
		Dunlin
		Bar-tailed godwit
		Curlew
		Redshank
		Turnstone
		Little gull
		Black-headed gull
		Common gull
		Sandwich tern (passage)
		Roseate tern

> 10 flights	> 5 records on shoreline / sea surface	No records or ≤ 10 flights and ≤ 5 records on shoreline / sea surface
		Arctic tern Razorbill Puffin

7.4 Assessment of Potential Effects

7.4.1 Identification of Likely Significant Effects

The assessment of effects for a wind energy development usually considers the different phases of the construction, operation and decommissioning of the project. In this case, the application is for the extended operational period of the LDT from a maximum of five years to a maximum of 15 years, after which it would be decommissioned (the Variation).

The LDT has already been installed and commissioned, therefore the potential effects of construction of the LDT are scoped out of this assessment.

The potential effects of decommissioning the LDT have already been assessed in the 2012 ES. The potential effects of decommissioning were identified as:

- Temporary, reversible, small-scale displacement of small numbers of individuals from sub-optimal foraging and resting areas; and
- Temporary, reversible, small-scale disruption to flight movements of small numbers of birds along the coastline, resulting in reduced survival or breeding productivity due to adverse energetic consequences.

For all species and designated sites considered, the potential effects of decommissioning were assessed with near-certain confidence to be of negligible magnitude and extremely unlikely to occur. The potential effects of decommissioning of the LDT are therefore scoped out of this assessment.

The assessment is therefore limited to the operational phase of the Variation and considers the LDT operating for a further ten years. The LDT is considered likely to cause three types of direct and indirect effect: disturbance, barrier effect to movements and collision.

7.4.1.1 Operational Disturbance

Operational disturbance many arise from increased movements of personnel, vehicles, boats and machinery servicing the LDT, as well as from visual and noise disturbance created by the moving parts of the LDT turbine. Species with low tolerance for such disturbance may be displaced from the area. The assessment of operational disturbance was presented in the 2012 ES for the operational phase of five years; for all species, the assessment concluded with near-certain confidence that the potential effect would be of negligible magnitude and/or extremely unlikely to occur. As data on the abundance and distribution of birds around the operational Development turbine are available from the monitoring studies, the potential effect of operational disturbance is examined further in this assessment.

Table 7.2 identifies nine species that have more than five records of birds on the shoreline or sea surface within the survey area during each baseline or operational monitoring season: eider (non-breeding), long-tailed duck (non-breeding), velvet scoter (non-breeding), red-breasted merganser (non-breeding), red-throated diver (non-breeding), cormorant (breeding & non-breeding), shag (breeding & non-breeding), herring gull (breeding & non-breeding) and guillemot (breeding & non-breeding).

The Comparative Analysis report in Appendix 7.1 to this chapter of the EIA Update Report describes the trends in the numbers of those nine species of birds in the survey area between the baseline period, the pre-commissioning phase and the three years of operation of the LDT.

Table 7.3 identifies the species screened in and out of further assessment of operational disturbance effects and the reasons why there may or may not be LSEs of operational disturbance/displacement. As a high-level filter for LSEs at this screening stage, species (in their appropriate season) are screened out if:

- The monthly peak-mean number of birds in the survey area is less than 0.1% of the SPA or pSPA population; displacement effects acting on such small proportions of the European site populations would not be likely to be significant; or
- The Comparative Analysis in Appendix 7.1 demonstrates that there is no evidence of a decline in numbers using the survey area through the operational monitoring period; if birds do not appear to have been displaced by the presence of the LDT turbine in the first three years of operation, it is unlikely that a significant displacement effect would occur through the rest of the extended operational period.

Table 7.3: Identification of LSEs due to operational disturbance

Species (season)	LSE	Reason
Eider (non-breeding)	YES	The peak-mean numbers in the survey area each season were between 0.1% and 1% of the Firth of Forth SPA reference population and there is some evidence of a decrease in numbers in the survey area through the course of the operational monitoring.
Long-tailed duck (non-breeding)	NO	The peak-mean numbers in the survey area each season exceed 1% of the Firth of Forth SPA reference population (Cycle 2) and were between 0.15 and 1% of the pSPA cited population, but there is no evidence of a decline in numbers using the survey area through the operational monitoring period.
Velvet scoter (non-breeding)	NO	The peak-mean numbers in the survey area each season were usually less than 0.1% of the Firth of Forth SPA or the pSPA reference populations. Potential displacement of relatively very small numbers of birds in the context of the pSPA population would not be likely to have a significant effect on the sites.
Red-breasted merganser (non-breeding)	YES	The peak-mean numbers in the survey area each season were between 0.1% and 1% of the Firth of Forth SPA and the pSPA reference populations and there is some evidence of a decrease in numbers in the survey area through the course of the operational monitoring.
Red-throated diver (non-breeding)	YES	The peak-mean numbers in the survey area each season exceed 1% of the Firth of Forth SPA reference population (Cycle 2) and were between 0.15 and 1% of the pSPA cited population; and there is some evidence of a decrease in numbers in the survey area since the baseline.
Cormorant (non-breeding)	NO	The peak-mean numbers in the survey area each season were between 0.1% and 1% of the Firth of Forth SPA cited population but there is no evidence of a decline in numbers using the survey area through the operational monitoring period.
Cormorant (breeding)	NO	The peak-mean numbers in the survey area each season were between 0.1% and 1% of the Forth Islands SPA reference population but there is no evidence of a decline in numbers using the survey area through the operational monitoring period.

Species (season)	LSE	Reason
Shag (non-breeding)	NO	The peak-mean numbers in the survey area each season were between 0.1% and 1% of the pSPA cited population but there is no evidence of a decline in numbers using the survey area through the operational monitoring period.
Shag (breeding)	NO	The peak-mean numbers in the survey area each season were less than 0.1% of the Forth Islands SPA or the pSPA reference populations. Potential displacement of relatively very small numbers of birds in the context of the SPA population would not be likely to have a significant effect on the site.
Herring gull (breeding and non-breeding)	NO	In general, gulls show a lack of consistent displacement/macro-avoidance behaviour at constructed wind farms (e.g. Krijgsveld et al., 2011)[28]. There are no likely significant effects and lesser black-backed gull is therefore scoped out of further assessment for displacement.
Guillemot (breeding and non-breeding)	NO	The peak-mean numbers in the survey area each season were usually less than 0.1% of the Forth Islands SPA or the pSPA reference populations. Potential displacement of relatively very small numbers of birds in the context of the SPA and pSPA populations would not be likely to have a significant effect on the sites.

7.4.1.2 Barrier Effect

The presence of the LDT may cause an obstruction to bird flight, forcing birds to fly above or around the structure. This has a potential for population disturbance by increasing energy expenditure of individuals, particularly where regularly used flight paths between important sites for feeding or roosting are affected. On a small scale, barrier effects on bird populations have not been found to be significant. As this is a single turbine, sufficiently isolated from other proposed or existing turbines in the wider area, birds are extremely unlikely to need to take such active deviation from flight routes that there would be any material energetic consequences affecting their productivity or survival. There is no likely significant effect of operational barrier to movement, which is therefore scoped out of this assessment.

7.4.1.3 Collision

Collision would occur when a bird flying through the rotor swept area is struck by a moving rotor blade. Collision of a bird with operational turbine rotors is almost certain to result in the death of the bird and the loss of individuals from the population could affect the conservation status of that population. The 2012 ES assessed with near-certainty that the potential effect of collision over the five-year operational phase of the turbine would be of negligible magnitude and/or extremely unlikely to occur. Monitoring over the first three years of operation of the LDT shows that in 144 hours of observations each year, there have been very few birds observed flying through the window representing the rotor swept area. These were as follows:

- Year 1: lesser black-backed gull (2 birds); herring gull (4 birds);
- Year 2: lesser black-backed gull (1 bird); herring gull (3 birds); and
- Year 3: herring gull (8 birds); cormorant (2 birds); gannet (1 bird).

The collision risk based on this frequency of observed flight activity through the rotor swept area is negligible. Furthermore, these are the observations of birds flying through a

[28] Krijgsveld, K.L., Fijn, R.C., Japink, M., van Horssen, P.W., Heunks, C., Collier, M.P., Poot, M.J.M., Beukers, D. & Dirksen, S. (2011) *Effect studies Offshore Wind Farm Egmond aan Zee. Flux, flight altitude and behaviour of flying birds*. Bureau Waardenburg report 10-219. Bureau Waardenburg, Culemborg.

square window extending perpendicular to the coast that spans the maximum width and height of the rotor swept area. It therefore includes space in the corners of the window in which the rotors could not reach (because the rotors are represented by a circle with a centred in a square with the same dimensions as the diameter of the circle); birds flying through those areas would not be at risk of collision; this could account for quite a high proportion of flights, particularly in the lower or higher parts of the window. Birds that fly through the window at times when the rotor is not aligned perfectly across the window might also not be at any risk of collision if flying through parts of the window where the rotors would not extend to (because the rotors are represented by an ellipse within the square window). It appears from the monitoring survey results that the conclusions of the assessment presented in the 2012 ES are correct – the potential effect of collision risk to any species is negligible irrespective of the length of the operational phase of the turbine. For this reason, there is no likely significant effect of collision risk for any species, which is therefore scoped out of this assessment.

7.4.2 Scope of HRA

The final SPAs and species screened in to the further assessment in the HRA are listed in Table 7.4 together with the population size and season for assessment and the effect to be assessed.

Table 7.4: Sites and species for further assessment in the HRA

SPAs	Season	Assessment Period	SPA Population (Individuals)		Effect to be Assessed	Project Period of Assessment
Firth of Forth			**Citat-ion**	**Cycle 2**		
Eider	Non-breeding	Mid-Sep to mid-Apr	9,400	5,184	Displacement	Operation
Red-breasted merganser	Non-breeding	Sep to Mar	670	369	Displacement	Operation
Red-throated diver	Non-breeding	Mid-Sep to Mar	90	81	Displacement	Operation
pSPA			**Citation**			
Eider	Non-breeding	Sep to Mar	21,546		Displacement	Operation
Red-breasted merganser	Non-breeding	Sep to Mar	369		Displacement	Operation
Red-throated diver	Non-breeding	Mid-Sep to Mar	851		Displacement	Operation

There are predicted to be no LSEs associated with the breeding seabird populations of the Forth Islands SPA, or of any of the breeding qualifying interests of the pSPA.

In terms of the conservation objectives for the European sites, the most relevant in relation to the LDT and potential for displacement is to ensure the long term maintenance of the species as a viable component of the site and the distribution of the species within the site.

7.4.3 Potential Effects of Operational Disturbance

The magnitude of the effect of displacement on the Firth of Forth SPA and Outer Firth of Forth pSPA is assessed by using displacement/mortality matrices and considering the trend in the monthly peak-mean numbers occupying the survey area each season.

Birds within a zone of influence of the LDT may be displaced to varying degrees depending on the species' sensitivity to the presence of the LDT turbine. The fate of displaced birds will also vary depending on a number of factors, such as the quality of the surrounding habitat and its capacity to accommodate displaced birds. Displacement was therefore assessed using SNH's recommended matrix method (JNCC, 2015)[29] and based on the estimated population of birds (derived from the mean of the monthly peaks in the baseline) in the baseline survey area. Displacement (the number of birds as a proportion of the SPA/pSPA population) was calculated in 10% increments from 0 to 100%; mortality at 0, 5%, then in 10% increments to 100%. An example matrix is shown below (Plate 7.1). Any value exceeding 1% of the SPA population is shaded in orange. In this example, a displacement rate of 70% would have to be accompanied by mortality of 50% of displaced birds to affect more than 1% of the SPA population.

It is recognised here that the baseline survey area was a relatively small zone around the LDT. As a result, the displacement effect is also examined in terms of a potentially larger number of birds in a larger potential zone of influence.

Species XX	15.00	Mortality											
500		100	90	80	70	60	50	40	30	20	10	5	0
Displacement	100	3.0%	2.7%	2.4%	2.1%	1.8%	1.5%	1.2%	0.9%	0.6%	0.3%	0.2%	0.0%
	90	2.7%	2.4%	2.2%	1.9%	1.6%	1.4%	1.1%	0.8%	0.5%	0.3%	0.1%	0.0%
	80	2.4%	2.2%	1.9%	1.7%	1.4%	1.2%	1.0%	0.7%	0.5%	0.2%	0.1%	0.0%
	70	2.1%	1.9%	1.7%	1.5%	1.3%	1.1%	0.8%	0.6%	0.4%	0.2%	0.1%	0.0%
	60	1.8%	1.6%	1.4%	1.3%	1.1%	0.9%	0.7%	0.5%	0.4%	0.2%	0.1%	0.0%
	50	1.5%	1.4%	1.2%	1.1%	0.9%	0.8%	0.6%	0.5%	0.3%	0.2%	0.1%	0.0%
	40	1.2%	1.1%	1.0%	0.8%	0.7%	0.6%	0.5%	0.4%	0.2%	0.1%	0.1%	0.0%
	30	0.9%	0.8%	0.7%	0.6%	0.5%	0.5%	0.4%	0.3%	0.2%	0.1%	0.0%	0.0%
	20	0.6%	0.5%	0.5%	0.4%	0.4%	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%
	10	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Plate 7.1: Example Displacement Matrix

Blue cell = the SPA or pSPA reference population for assessment;

Green cell = the estimated population of the survey area (mean of baseline monthly peak counts);

Displacement from the area around the LDT is discussed in terms of the likelihood of a significant effect on the population and in the context of displacement based on the known distributions of key species within the Firth of Forth.

If it is assumed that all birds are displaced from the baseline survey area or a potentially larger area around the turbine of up to 500 m (which is effectively equivalent to the potential 'zone of influence'), this is an area of 1.6 hectares (ha) of the SPA and 54.86 ha of the pSPA compared to the total SPA or pSPA areas of 6,317 ha and 272,068 ha respectively, which would be equivalent to very small availabilities of 0.025% and 0.020% of the SPA and pSPA respectively. The increase in density of birds in the surrounding area due to displacement from a potential 500 m zone of influence would also be correspondingly small albeit birds are not distributed evenly through the SPA and pSPA. In general, significant effects from displacement are not anticipated for the regional wintering population represented by the pSPA or at the Biologically Defined Minimum Population

[29] JNCC (2015a) *Seabird Displacement Impacts from Offshore Wind Farms: report of the MROG Workshop, 6-7th May 2015*. JNCC Report 568. 69 pp. Available at http://jncc.defra.gov.uk/pdf/568_web.pdf.

Scale (BDMPS) for the wider region of the UK North Sea and Channel as defined by Furness (2015)[30].

7.4.3.1 Eider (non-breeding)

The previous assessment in the 2012 ES concluded that "the area close to the Development site is not critical for this species and there is a considerable amount of more suitable foraging area within the Firth of Forth. Any displacement from this area as a result of the presence of the operational turbine is near-certain to have a negligible effect on the population within the Firth of Forth."

There was a monthly peak-mean of 17.6 birds recorded in the baseline survey area during the baseline surveys. Approximately twice as many were recorded in the monitoring survey area during the winter during the pre-commissioning period following installation of the turbine and before the LDT was officially commissioned as operational. The monthly peak-mean numbers subsequently decreased over the course of the following three winters of operation of the LDT to a slightly lower value than during the baseline, as shown in Chart 7.1 (noting the difference in survey areas between baseline and monitoring phases), although there is relatively high variance in the samples (the chart shows one standard deviation above and below the mean of the monthly peak counts each season):

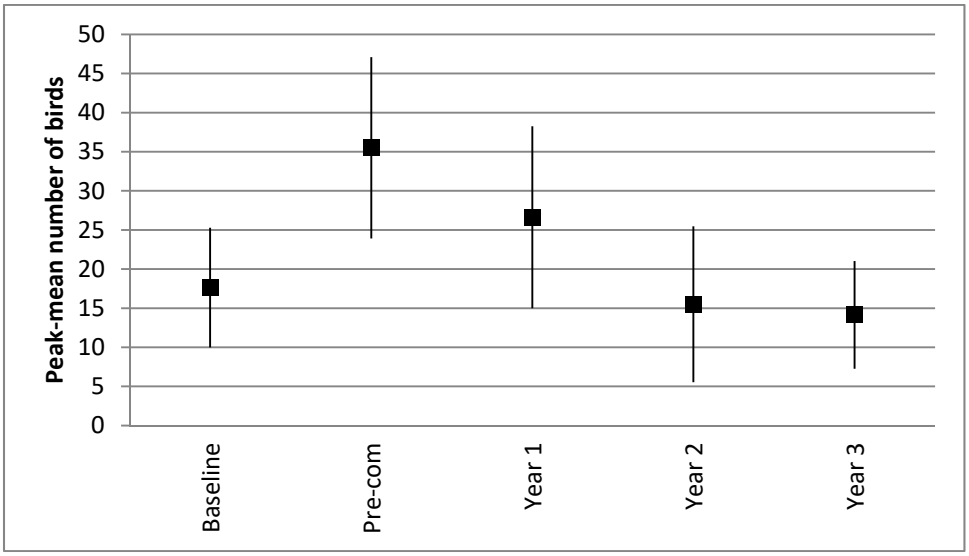

Chart 7.1: Trend in the monthly peak-mean number of eider recorded during each non-breeding survey season

[30] Furness, R.W (2015) *Non-breeding season populations of seabirds in UK waters: population sizes for Biologically Defined Minimum Population Scales (BDMPS) Appropriate, Species-Specific, Geographic Non-Breeding Season Population Estimates*. Natural England Commissioned Report 164.

Table 7.5: Firth of Forth displacement matrix (Cycle 2 reference population) for eider

E.	17.63	Mortality											
5184		100	90	80	70	60	50	40	30	20	10	5	0
Displacement	100	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	90	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	80	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	70	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
	60	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
	50	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
	40	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	30	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	20	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 7.6: Outer Firth of Forth and St Andrews Bay Complex pSPA displacement matrix for eider

E.	17.63	Mortality											
21546		100	90	80	70	60	50	40	30	20	10	5	0
Displacement	100	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	90	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	80	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	70	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	60	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	50	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	40	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

On the basis of a monthly peak-mean of 17.6 birds recorded by the baseline surveys, even at rates of 100% displacement and 100% mortality of displaced birds, there would be less than 1% reduction in the SPA and pSPA populations. The monitoring surveys have demonstrated that the LDT has not resulted in total displacement of eider from the area within 500 m of the turbine, but there may be a slight reduction in the number of birds occupying the area. At magnitudes of less than 30% displacement, there would be less than 0.1% reduction in the SPA and pSPA populations, irrespective of the level of mortality in displaced birds. Such levels of displacement appear to be extremely unlikely to occur over the extended lifetime of the LDT. The same conclusions would apply even if there were a larger population of, for example, 50 eider present within a larger zone of influence than the baseline survey area.

The effect of displacement as a result of the LDT alone will not therefore adversely affect the integrity of the Firth of Forth SPA or the Outer Firth of Forth and St Andrews Bay Complex pSPA.

7.4.3.2 Red-breasted merganser (non-breeding)

The previous assessment in the 2012 ES did not include red-breasted merganser as a valued ornithological receptor for assessment because "the [baseline] data collected have demonstrated that their presence at or near the site is very infrequent or they are species of low conservation value and it is considered that potential effects of the Development on their populations are highly likely to be negligible."

There was a monthly peak-mean of 1.7 birds recorded in the baseline survey area during the baseline surveys. Numbers were much lower and birds were observed less frequently

in the winter during the pre-commissioning period following installation of the turbine. The monthly peak-mean numbers subsequently fluctuated over the course of the following three winters of operation of the turbine to a slightly lower value than during the baseline (Chart 7.2, noting the difference between baseline and monitoring survey areas), although there is relatively high variance in the samples (the chart shows one standard deviation above and below the mean of the monthly peak counts each season):

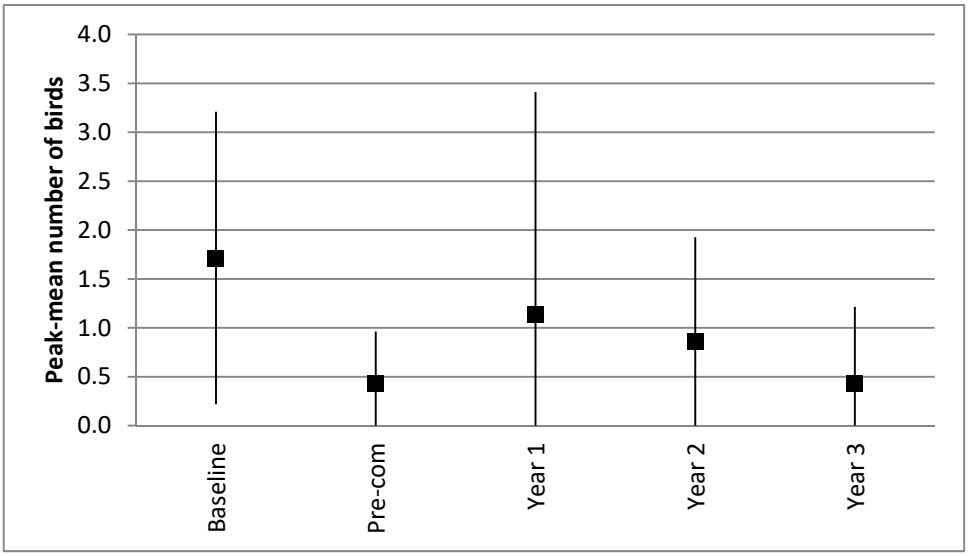

Chart 7.2: Trend in the monthly peak-mean number of red-breasted merganser recorded during each non-breeding survey season

Table 7.7: Firth of Forth displacement matrix (Cycle 2 reference population) for red-breasted merganser

RM	1.71	Mortality											
369		100	90	80	70	60	50	40	30	20	10	5	0
Displacement	100	0.5%	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
	90	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
	80	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	70	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	60	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	50	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
	40	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
	30	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	20	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 7.8: Outer Firth of Forth and St Andrews Bay Complex pSPA displacement matrix for red-breasted merganser

RM	1.71	Mortality											
369		100	90	80	70	60	50	40	30	20	10	5	0
Displacement	100	0.5%	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
	90	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
	80	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	70	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	60	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	50	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
	40	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
	30	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	20	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

On the basis of a monthly peak-mean of 1.7 birds recorded by the baseline surveys, even at rates of 100% displacement and 100% mortality of displaced birds, there would be less than 1% reduction in the SPA and pSPA populations. The monitoring surveys have demonstrated that the LDT has not resulted in total displacement of red-breasted merganser from the area within 500 m of the turbine, but there may be a reduction of up to 75% in the number of birds occupying the area or the frequency of use of the area. At magnitudes of less than 75% displacement, there would be less than 0.4% reduction in the SPA and pSPA populations, irrespective of the level of mortality in displaced birds. Such levels of displacement appear to be extremely unlikely to occur over the extended lifetime of the LDT.

The effect of displacement as a result of the LDT alone will not therefore adversely affect the integrity of the Firth of Forth SPA or the Outer Firth of Forth and St Andrews Bay Complex pSPA.

7.4.3.3 Red-throated diver (non-breeding)

The previous assessment in the 2012 ES concluded that "it is considered that the area close to the Development site is not important for this species [red-throated diver]. Any displacement from this area is near-certain to have a negligible effect on the population within the Firth of Forth."

There was a monthly peak-mean of 1.3 birds recorded in the survey area during the baseline surveys. Numbers were much lower and birds were observed less frequently in the winter during the pre-commissioning period following installation of the turbine. The monthly peak-mean numbers subsequently fluctuated over the course of the following three winters of operation but have remained lower than the baseline by over 50% (Chart 7.3):

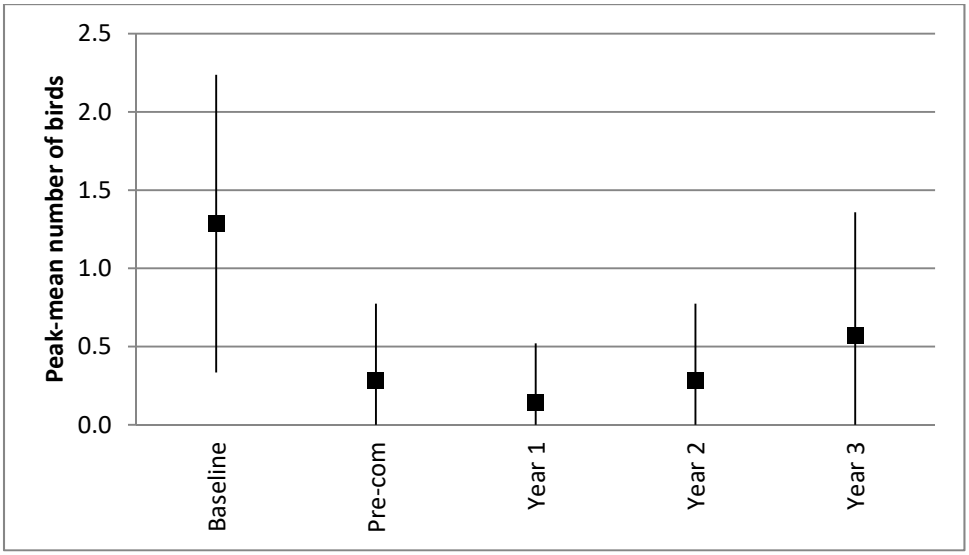

Chart 7.3: Trend in the monthly peak-mean number of red-throated diver recorded during each non-breeding survey season

Table 7.9: Firth of Forth displacement matrix (Cycle 2 reference population) for red-throated diver

RH	1.29	Mortality											
81		100	90	80	70	60	50	40	30	20	10	5	0
Displacement	100	1.6%	1.4%	1.3%	1.1%	1.0%	0.8%	0.6%	0.5%	0.3%	0.2%	0.1%	0.0%
	90	1.4%	1.3%	1.1%	1.0%	0.9%	0.7%	0.6%	0.4%	0.3%	0.1%	0.1%	0.0%
	80	1.3%	1.1%	1.0%	0.9%	0.8%	0.6%	0.5%	0.4%	0.3%	0.1%	0.1%	0.0%
	70	1.1%	1.0%	0.9%	0.8%	0.7%	0.6%	0.4%	0.3%	0.2%	0.1%	0.1%	0.0%
	60	1.0%	0.9%	0.8%	0.7%	0.6%	0.5%	0.4%	0.3%	0.2%	0.1%	0.0%	0.0%
	50	0.8%	0.7%	0.6%	0.6%	0.5%	0.4%	0.3%	0.2%	0.2%	0.1%	0.0%	0.0%
	40	0.6%	0.6%	0.5%	0.4%	0.4%	0.3%	0.3%	0.2%	0.1%	0.1%	0.0%	0.0%
	30	0.5%	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
	20	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	10	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 7.10: Outer Firth of Forth and St Andrews Bay Complex pSPA displacement matrix for red-throated diver

RH		Mortality											
851		100	90	80	70	60	50	40	30	20	10	5	0
Displacement	100	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	90	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	80	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	70	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	60	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	50	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	40	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

On the basis of a monthly peak-mean of 1.3 birds recorded by the baseline surveys, rates of at least 60% displacement and 60% mortality of displaced birds would be required to cause a 1% reduction in the Firth of Forth SPA population. However, even at rates of

100% displacement and 100% mortality of displaced birds, there would be less than 0.2% reduction in the pSPA population. The monitoring surveys have demonstrated that the LDT has not resulted in total displacement of red-throated diver from the area within 500 m of the turbine. Levels of displacement that would cause a substantive effect on the population of the SPA or pSPA appear to be extremely unlikely to occur over the extended lifetime of the LDT.

The effect of displacement as a result of the LDT alone will not therefore adversely affect the integrity of the Firth of Forth SPA or the Outer Firth of Forth and St Andrews Bay Complex pSPA.

7.5 Mitigation Measures and Residual Effects

There are no proposed mitigation measures necessary to avoid, reduce or compensate for any negative effects of the LDT.

In future it may be possible for collaborative work to be undertaken between the various demonstration projects in the Firth of Forth (Levenmouth Demonstration Project and Forthwind), to inform future consenting decisions and conditions. The data collected to date can be provided to the appropriate agency in order to facilitate any such future study should it be required.

7.6 Cumulative Effects

Projects included in the in-combination assessment depend on the species and effect assessed. All potential collision effects have been screened out of this assessment, therefore collision effects from other projects are not considered in the in-combination assessment. Displacement effects are given further consideration.

Methil Docks Wind Turbine is a single 0.75 Megawatts (MW) onshore turbine with a small rotor radius of 23.5 m and hub height of 55 m, which was commissioned in 2010. In combination effects are screened out of the in-combination assessment of impacts on marine species associated with the SPAs and pSPA, owing to its small size and onshore location and the likelihood that any of its effects are accounted for in the monitoring data collected between 2013 and 2017.

The Forth and Tay offshore developments include:

- Neart na Gaoithe Offshore Wind Farm (450 MW): located in the outer Firth of Forth, 15.5 km to the east of Fife Ness; consented in 2014.
- Inch Cape Offshore Wind Farm (784 MW): located in the outer Firth of Forth, approximately 15 km east of the Angus coast; consented in 2014.
- Seagreen Alpha Offshore Wind Farm (525 MW): located in the outer Firth of Forth, approximately 27 km east of the Angus coast; consented in 2014.
- Seagreen Bravo Offshore Wind Farm (525 MW): located in the outer Firth of Forth, approximately 38 km east of the Angus coast; consented in 2014.

The four offshore developments have been subject to HRA, during which process, it was concluded that there were no LSEs associated with the Firth of Forth SPA. The Outer Firth of Forth and St Andrews Bay Complex pSPA was not under consultation at the time and was not assessed. However, the three species screened in as important ornithological features where there may be LSEs in this assessment for the LDT are qualifying interests of both the SPA and pSPA. None of the three species: eider, red-breasted merganser and red-throated diver, were screened in to the HRA for any of the four offshore developments as there was very infrequent occurrence of any birds in their potential zones of influence. In-combination effects of the four Forth and Tay offshore developments are therefore screened out of this assessment. It is acknowledged that Scoping Reports have been submitted in 2017 in relation to revised applications for three of the four Forth and Tay

offshore developments; however, the LSEs would remain the same and do not affect the decision to scope them out of the in-combination assessment for the LDT.

The Forthwind Offshore Wind Demonstration Project comprises two large turbines with a maximum capacity of 18 MW, located approximately 2 km offshore from Methil in the Forth of Forth. The HRA for the Forthwind development included assessments of the Forthwind turbines in combination with the LDT (then the 'Samsung Heavy Industries Turbine'). The in-combination assessment concluded for each species:

- Eider: "As the area affected by these projects is small, matrix calculations indicate that any displacement would have to be accompanied by high levels of mortality to exert an effect and, displacement effects from the Samsung Heavy Industries turbine appear to be very low, therefore in-combination effects from the projects are assessed as not significant."
- Red-breasted merganser: "…there are very small numbers of red-breasted merganser in the [Forthwind] Development's ZoI, in-combination effects on the red-breasted merganser population of the Firth of Forth SPA and the wider regional population (dSPA) [now the pSPA] either from displacement or collision are assessed as not significant."
- Red-throated diver: "…the combined zone of influence of both projects is a small proportion of the total area available within the wider region and the numbers of birds potentially affected remains very low. For example, assuming that the combined effects of the project were double those of the Forthwind proposal at 100% displacement, effects on the SPA/dSPA population would still be less than 1% of the population assuming 100% mortality. Based on these data, the in-combination effects of the projects are assessed as not significant."

Based on the above assessment, it is concluded that the effects of the LDT both alone and in-combination with other projects within the region which are already licensed, are not significant for all species considered here.

Forthwind have also submitted a Scoping Report for a further array of seven turbines adjacent to their Offshore Demonstration Project of two turbines. However, an application for a marine licence has not yet been submitted and data relating to the effects on birds are not yet available.

7.7 Summary of Effects

Table 7.11: Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Eider associated with the Firth of Forth SPA	Operational displacement	Likely significant effect (HRA)	None required	No adverse effect on integrity
Red-breasted merganser associated with the Firth of Forth SPA	Operational displacement	Likely significant effect (HRA)	None required	No adverse effect on integrity
Red-throated diver associated with the Firth of Forth SPA	Operational displacement	Likely significant effect (HRA)	None required	No adverse effect on integrity

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Eider associated with the pSPA	Operational displacement	Likely significant effect (HRA)	None required	No adverse effect on integrity
Red-breasted merganser associated with the pSPA	Operational displacement	Likely significant effect (HRA)	None required	No adverse effect on integrity
Red-throated diver associated with the pSPA	Operational displacement	Likely significant effect (HRA)	None required	No adverse effect on integrity

The proposed Variation has not changed the assessment of effects caused by the LDT, as reported in the 2012 ES.

7.8 Statement of Significance

This chapter of the EIA Update Report has assessed the effects of the LDT alone and in-combination on the qualifying interests of the Forth Islands SPA, the Firth of Forth SPA and the Outer Firth of Forth and St Andrews Bay Complex pSPA.

Construction and decommissioning effects were screened out of the assessment.

The main potential effect assessed was associated with the potential for displacement of wintering seaducks during operation of the LDT. On the basis of evidence from operational monitoring surveys for the LDT, the potential effects of collision and barrier to movement were screened out of the assessment.

Whilst all SPA conservation objectives have been considered, the assessment has focussed on the objectives relating to the maintenance of the population of the species as a viable component of the SPA and the potential for displacement caused by the operation of the LDT.

Based on the above assessment, it is concluded that the effects of the LDT both alone and in-combination with other projects within the region which are already licensed, are not significant for all species considered here. This HRA therefore concludes that there are no adverse effects on the integrity of the:

- Forth Islands SPA;
- Firth of Forth SPA; and
- Outer Firth of Forth and St Andrews Bay Complex pSPA.

8 SOCIO ECONOMICS

8.1 Introduction

This Chapter of the Environmental Impact Assessment Update Report (EIA Update Report) evaluates the effects of the proposed extension to the operational life of the LDT on socio-economic resources. This Chapter updates and supplements the information presented in Chapter 11: Socio-economics, Tourism, Land-Use and Commercial Fishing of the 2012 Environmental Statement (2012 ES) and it is intended that this Chapter is read in conjunction with the 2012 ES. Note that no assessment of tourism, land use or commercial fishing is included within this chapter as no significant effects are expected.

Since the submission of the 2012 ES, the Applicant has commissioned BiGGAR Economics to undertake a socio-economic analysis of the construction, and operation and maintenance effects of the LDT. The Levenmouth Demonstration Turbine: Socio-economic Analysis is submitted in support of this Application as Appendix 8.1.

The effects are the same as those presented in the 2012 ES, except where specified in this chapter of the EIA Update Report. As the LDT is now operational, construction effects are not assessed as such, rather they have been confirmed following completion of the construction phase and are set out in Section 8.3.1.4 of the EIA Update Report.

8.2 Assessment Methodology and Significance Criteria

8.2.1 Legislation, Policy and Guidance

The national, regional and local planning policy context has changed since the 2012 ES and this is described in in Chapter 4: Planning Policy and Legislative Context.

Since the submission of the 2012 ES, the Offshore Wind Industry Group (OWIG) undertook a review of Scotland's Offshore Wind Route Map (2011) and produced an update document[31] which discussed progress made in the following key areas:

- Investment in infrastructure;
- Appropriate supply chain;
- Ongoing innovation of technologies and practices;
- Regulation of and access to the electricity grid;
- Managing the marine environment;
- Finance; and
- Securing support of local communities and existing users of the sea.

In addition to the reference material listed in Section 11.2.2 of the 2012 ES, the following additional documents have been used to inform the baseline description set out in this Chapter:

- BiGGAR Economics (2017) 'Levenmouth Demonstration Turbine: Socio-economic Analysis' (the BiGGAR Economics 2017 Report); and
- Department for International Trade (2015) 'UK Offshore Wind: Opportunities for trade and investment'[32].

The remainder of Section 11.2.1 and Section 11.2.2 of the 2012 ES remain unchanged.

[31] Scottish Government (2013) Scotland's Offshore Wind Route Map, Developing Scotland's Offshore Wind Industry to 2020 and Beyond [Online] Available at: http://www.gov.scot/Publications/2013/01/5856 (Accessed on 03/10/17)

[32] Department for International Trade (2015) UK Offshore Wind: Opportunities for trade and investment [Online] Available at: https://www.gov.uk/government/publications/uk-offshore-wind-opportunities-for-trade-and-investment/uk-offshore-wind-opportunities-for-trade-and-investment (Accessed 06/10/17)

8.2.2 Study Area

The Study Area used in this assessment of socio-economic receptors is based on the local and regional economic areas.

No changes to the Study Area have been made since the 2012 ES, and hence the Site Description and Study Area remain unchanged from Section 3.3 of the 2012 ES.

8.2.3 Baseline Survey Methodology

Baseline conditions have been established through reference to the 2012 ES and further desktop studies of the legislation, policy and guidance referenced in Section 8.2.1.

No additional consultation has been undertaken to inform this Chapter. The relevant organisations were contacted with regard to the LDT as detailed in Section 11.2.3 of the 2012 ES.

8.2.4 Methodology for the Assessment of Effects

The significance of the potential effects of the LDT has been classified by professional consideration of the sensitivity of the receptor and the magnitude of the potential impact.

The scale of significance described below has been used to assess the potential and residual effects of the LDT against baseline conditions. The assessment process aims to be objective and quantifies the effects as far as possible; however some effects can only be evaluated on a qualitative basis.

This EIA assesses the effects of the operational and decommissioning phase for the LDT. Construction effects are not assessed as the LDT is already operational; this EIA Update Report considers the effects of the Variation, i.e. the extension of the operational life of the LDT, from five years to 15 years. The LDT will test offshore turbines for a maximum of 15 years from the first commencement of operations (i.e. March 2014), following which the turbine will be removed and the site decommissioned.

The assessment considers the effects and defines them as:

- Negligible/no effect: either no change or no detectable change to a location, environment or sensitive receptor;
- Minor: a detectable but non-material change to a location, environment or sensitive receptor;
- Moderate: a material, but non-fundamental change to a location, environment or sensitive receptor; and
- Major: a fundamental change to a location, environment or sensitive receptor or in breach of recognised legislation, policy or standards.

For assessing significance, consideration is given to the national, regional and local baseline situation. The magnitude of the impact is determined in proportion to the area of impact relevant to each receptor. For the purpose of the assessment, a moderate or major effect is deemed to be 'significant' in terms of the EIA Regulations.

In terms of socio-economic factors, potential effects would be significant if the LDT resulted in any fundamental or material changes in population, structure of the community, and economic activity during the operational phase.

8.2.5 Assessment Limitations

The BiGGAR Economics 2017 Report states that data is not available to meaningfully quantify future economic impacts of the LDT. However, it is expected that as the research and technology innovation activity realises their commercial potential and the students translate their enhanced education into the workplace, the economic impact of the LDT will grow in the future.

There are no further limitations of the assessment, gaps in the baseline data or uncertainties.

8.3 Baseline Conditions

8.3.1 Socio-Economics

8.3.1.1 The Economic Value of UK Offshore Wind Industry

This Section updates Section 11.3.1.1 of the 2012 ES.

Since the submission of the 2012 ES, the Department for International Trade (formerly UK Trade and Investment) published the 'UK Offshore Wind: Opportunities for Trade and Investment' report in 2015[33]. This report highlights the fact that the UK is the global market leader in offshore wind, with, as of 2015, 5.5 gigawatts (GW) of offshore wind installed or under construction, and is on track to deliver a further 5 GW by 2020. The UK offshore wind market has also received significant investments from global investors and is consistently ranked as one of the best places in the world to invest in offshore wind technology[34].

Between 2014 and 2015, Scotland's total installed offshore wind capacity was 197 MW, with a further 2,284 MW consented during that same period[35]. One of the offshore wind farms consented during this period is the Beatrice Offshore Wind Farm, a 588 MW wind farm located in the Outer Moray Firth. Construction on this wind farm began in 2016 for onshore elements and 2017 for the offshore elements and is due to become fully operational by 2019. It is estimated that the total expenditure on the Beatrice Offshore Wind Farm will be approximately £2.6 billion, with around 45% of this investment expected to be within the UK[36] and will support up to 18,100 years of full-time employment in the UK (of which around 5,800 would be in Scotland). In addition, testing and training has been undertaken on the Siemens 7 MW turbine at the National Offshore Wind Turbine Test Facility at Hunterston, which has underpinned investor confidence in the turbine and allowed a final investment decision to be reached for the Beatrice Offshore Wind Farm to use this model[37].

In addition to offshore wind farms, the Scottish supply chain currently has strengths in maritime engineering and onshore wind energy that allow it to compete for contracts with offshore wind farms elsewhere in the UK and abroad.

Section 11.3.1.1 of the 2012 ES remains unchanged.

8.3.1.2 Local Authority Population and Economy

This Section updates Section 11.3.1.2 of the 2012 ES.

The LDT is located on the northern shore of the Firth of Forth at Fife Energy Park (the FEP), Methil. The coastal town of Methil is located 2.3 kilometres (km) south-west of Leven and approximately 12 km north-east of Kirkcaldy in the Levenmouth ward.

[33] Department for International Trade (2015) UK Offshore Wind: Opportunities for trade and Investment [online], Available at: https://www.gov.uk/government/publications/uk-offshore-wind-opportunities-for-trade-and-investment/uk-offshore-wind-opportunities-for-trade-and-investment (Accessed on 05/10/17)

[34] Ernst & Young Global Ltd (2016) Renewable Energy Country Attractiveness Index [Online] Available at: http://www.ey.com/gl/en/industries/power---utilities/renewable-energy-country-attractiveness-index (Accessed 05/10/17)

[35] RenewableUK (2015) Wind Energy in the UK, State of Industry Report 2015 [Online] Available at: www.renewableuk.com/resource/resmgr/publications/reports/StateIndustryReport2015Full.pdf (Accessed 05/10/17)

[36] Beatrice Offshore Windfarm Limited project (2017) Socio-economic impact report, July 2017 [Online] Available at: https://docs.wixstatic.com/ugd/22cf9a_4e2d2b9e5c854396bb7fc836ae1f8e3a.pdf (Accessed 11/10/17)

[37] BiGGAR Economics (2016) National Offshore Wind Turbine Testing Facility: Socio-economic Analysis. [Online] Available at: http://sse.com/media/448064/Hunterston-Economic-Impact-of-National-Offshore-Wind-Turbine-Testing-Facility-Executive-Summary-21Dec16.pdf (Accessed 11/10/17)

Based on the most recent figures from the Office of National Statistics (2016)[38], the population of Fife was 370,300 representing 7% of Scotland's total population. This represents a marginal increase in population presented in the 2012 ES from 365,000.

The latest statistics show Fife has a higher population of individuals who are economically active (77.4%) compared to Scotland (76.9%) as a whole; however it is lower than the UK average (78.0%). The Fife region has seen a continuous shift from traditional manufacturing economy to a service based economy, with the majority employed in the public service sector.

Based on the 2016 Office of National Statistics figures, the gross weekly pay for residents in Fife is £517.10. This is 3.4% lower than the Scottish average of £535.00 and 4.5% lower than the British average of £540.20.

The remainder of Section 11.3.1.2 of the 2012 ES remains unchanged.

8.3.1.3 Fife Energy Park

This Section updates Section 11.3.1.4 of the 2012 ES.

The FEP is a world leading engineering and research zone within the energy sector. A joint venture between Scottish Enterprise and Fife Council, FEP is capable of supporting the largest oil, gas and renewables projects and encompasses a 55 hectare (ha) engineering site, comprising of Methil Docks, Methil Docks Business Park and Low Carbon Investment Park.

It is ideally suited for a range of marine energy activities, in particular; manufacturing, fabrication and engineering, research and development, and operations and maintenance.

The LDT forms part of the 'Test and Demonstration Zone' which Invest in Fife market as the *"largest open access wind turbine"*[39]. Fife is located only 25 nautical miles from the closest of the proposed Scottish Territorial Waters and Round 3 offshore wind developments announced by the Crown Estate.

With approximately 1,400 wind turbines due to be developed off the east coast of Scotland – and three developments in close proximity to the coast of Fife – Fife's experienced supply chain companies are well placed to provide support to all phases of offshore wind development, from manufacturing and construction, through to operations and maintenance.

Fife is a leading region within the Scottish manufacturing sector and the largest contributor to the Scottish Manufacturing Gross Value Added (GVA). The manufacturing sector in Fife generated £1.3 billion GVA in 2015, up from £1.0 billion GVA in 2010. The number of manufacturing companies in Fife has increased 14%, from 590 companies in 2010 to 672 in 2015. Over a similar timeframe, manufacturing businesses in Scotland have increased by 10%. These figures suggest that Fife has performed better than Scotland as a whole in attracting new and existing manufacturing businesses.

The LDT is an attractive asset and 'pull' factor to support Fife's success as a manufacturing base. Invest in Fife presents the LDT as an attractive asset in the brochure 'Locating your Offshore Wind Business in Fife'[40]. In 2017, Limpet Technology Ltd relocated their main operations from Edinburgh to Fife in order to be closer to the LDT and the opportunities it offers. This move has resulted in an increase of eight, high value manufacturing jobs to Fife. Limpet Technology is a growing Small and Medium sized Enterprise (SME) and it is

[38] NOMIS (2016) Labour Market Profile – Fife [Online] Available at: https://www.nomisweb.co.uk/reports/lmp/la/1946157419/report.aspx?town=Fife#tabrespop (Accessed 06/10/17)
[39] Invest in Fife (2017) Energy Park Fife: An Ideal Location – Unique Facilities [Online] Available at: https://www.investinfife.co.uk/content/energy-park-fife/ (Accessed 05/10/17)
[40] Invest in Fife (2014) Locating your Offshore Wind Business in Fife [Online] Available at: https://issuu.com/investinfife/docs/locating_your_offshore_wind_busines (Accessed 06/10/17)

likely to expand as the company moves its offshore wind technology into the production and sales phase.

Figure 3.1 in Appendix 8.1 shows that the employment supported in Fife associated with the LDT has grown from 2015 to 2017. The majority of the growth is due to businesses being attracted to Fife due to the LDT.

The further education support provided by the Applicant, in particular the Fife College renewable energy technician course as stated in Section 8.4.2.2, is highlighted in the 'Locating your Offshore Wind Business in Fife' brochure to emphasise the existing offshore wind skills base in Fife.

As set out in Section 11.6.1.4 of the 2012 ES, the Applicant is committed to making a major contribution to enhancing the area's reputation and helping to make the aspiration of an Industry Centre of Technology in Fife a reality. The remainder of Section 11.3.1.4 of the 2012 ES remains unchanged.

8.3.1.4 Construction Baseline

As the Variation applies only to the extension of the operational life of the LDT, construction effects should not be considered as part of the Application. The construction of the LDT has changed the baseline economic conditions.

The LDT was part of a £100 million investment in the offshore renewable energy sector in Fife. Of this £23 million capital investment in the LDT, expenditure was split between:

- Development;
- Balance of plant;
- Turbine; and
- Grid connection.

The economic effects associated with these contracts is realised when companies are awarded these contracts and employ individuals to undertake the work. The civil engineering firm Graham undertook a large proportion of the balance of plant and turbine contracts, including:

- Marine works;
- Transport and offloading of components from quayside;
- Turbine installation;
- Mechanical and electrical installations; and
- All temporary works.

The total value of this contract to Graham was £12 million[41] and lasted for an eight month period. It was estimated that further contracts worth £4.5 million were secured in Fife, £14.4 million were secured in Scotland and £8.6 million were secured outside Scotland.

The number of jobs that were supported by construction contracts was estimated by considering the turnover to employment ratios in each of the key sectors where this expenditure occurs. The effects are reported in job years[42], and are equivalent to one full year employment for one individual. It was estimated that during the planning and construction phase the LDT supported 126 job years in Scotland and generated £15.2 million GVA. In Fife, the contribution was 38 job years and £4.7 million GVA.

The construction of the LDT has brought about an increased employment, business opportunities and generation of green energy onsite. As the LDT is operational, the Variation will not result in any socio-economic construction effects.

[41] Graham Construction, (2014), Samsung Prototype Offshore Wind Turbine [Online] Available at: https://www.graham.co.uk/samsung-prototype-offshore-wind-turbine (Accessed 03/10/17)

[42] Note that these figures are report in job years and because the contract period with Graham Construction was less than one year, there will have been more than this number of people employed during the 8 month time period.

8.3.2 Public Attitudes towards Windfarms

This Section supplements Section 11.4.1 of the 2012 ES.

An Ipsos MORI poll was commissioned by Renewable UK / Hill and Knowlton Strategies in 2012 to determine public attitudes towards wind farms. The survey, based on 1,009 respondents, found that over 65% of respondents were in favour of wind power in the UK. Furthermore, 57% of respondents believed wind farms were an acceptable addition to the landscape.

Individual attitudes towards windfarms are subjective in nature and subject to a value judgement that differs amongst members of the public. It is however, relevant to note that the LDT will comprise a single demonstration wind turbine installed at any one time and is located within an industrial area.

8.4 Assessment of Potential Effects

The socio-economic assessment aims to predict the likely effects (both positive and negative) arising from the LDT. This Chapter of the EIA Update Report will address any additional effects of extending the operational lifetime of the LDT rather than the principle of the LDT as this has already been established given the consent and that it is now operational.

Social and economic effects are divided into:

- Direct effects: opportunities that can be created as an immediate effect of the Variation, for example opportunities in the operation of the LDT and research and development associated with the LDT;
- Indirect effects: opportunities that will be created by the LDT further down the supply chain, for example companies providing services to the LDT during operation and decommissioning; and
- Induced effects: for example employment opportunities created by the additional spend of wages into the local economy and the purchasing of basic materials, equipment and office space for staff.

8.4.1 Direct Effects

8.4.1.1 Operations and Maintenance Effects

The LDT has had an effect on the economy during its current operational phase through expenditure on supplies and community programmes. To date the average annual budget for the operations and expenditure of the LDT has been £1.1 million. This is split between:

- Non-domestic rates (11%);
- An operations and maintenance contractor (33%);
- Rental and insurance (41%);
- Science, Technology, Engineer and Mathematics (STEM) Engagement Officer (3%); and
- Unplanned maintenance allowance (12%).

The employment supported by this expenditure was estimated by considering the turnover to employment ratios in each of the key sectors where this expenditure occurs. For example, the revenue per head in Fife Council is approximately £42,500[43]; therefore the Non-Domestic Rates paid supported the equivalent of three jobs within Fife Council.

[43] BiGGAR Economic calculations based on Fife Council Annual Accounts and Scottish Governments Local Authority Employment Statistics

The employment supported in each of the areas of operations and maintenance spend are summarised in Table 8.1. This shows that the total employment supported through this expenditure is equivalent to 13 jobs, eight of which are in Fife.

Table 8.1 Employment Supported through Operations and Maintenance Expenditure

	Turnover per Job	Employment Supported	Employment Supported in Fife
Non-Domestic Rates	£42,500	3	3
Operations and Maintenance Contractor	£132,300	3	1
Rental/Maintenance/Other	£84,600	5	3
Unplanned Maintenance	£132,300	1	0
Science, Technology, Engineering and Maths Engagement Officer	£35,000	1	1
Total	**£426,700**	**13**	**8**

In addition to the jobs supported directly by the operational and maintenance expenditure, there is induced employment supported by the salary expenditure of these positions. This was calculated using the data on average salaries in the renewable energy sector and Scottish Government data on the proportion of household spending that is retained in Scotland. It was estimated that this expenditure would support one additional job in Fife and two additional jobs across Scotland.

The combined economic effect impact of the core employees and those in the supply chain (direct and induced) for the operations and maintenance activities of the LDT generates £0.6 million GVA for Fife and £1.2 million GVA for the Scottish economy each year. It does this through supporting 15 jobs in Scotland, of which nine are in Fife. This exceeds the estimation of six full-time maintenance and administrative jobs expected to be generated by the LDT as stated in Section 11.6.1.2 of the 2012 ES.

The annual effects of the LDT are expected to grow, however if current activity levels are maintained, the Variation will generate an additional £11.5 million GVA for the Fife economy and contribute at least an additional £1.1 million to Fife Council through the payment of Non-Domestic Rates.

Therefore, the operations and maintenance expenditure is expected to continue to support nine jobs in Fife. The Variation to extend the operational life of the LDT will equate to nine jobs for a further ten years which will total 90 job years. This will represent a short term, minor positive effect at a local level, as it will enhance the socio-economic effects under operation and maintenance for a further ten years, which whilst positive is not significant in terms of the EIA Regulations.

Without the Variation and the continued operation of the LDT, these additional benefits would not be realised.

8.4.1.2 Decommissioning

Socio-economic effects during the decommissioning phase are anticipated to be of a similar nature and scale to those of the construction phase, thereby representing a short-term, minor positive effect acting at a local or regional level. Consequently, socio-economic effects arising from the decommissioning phase of the LDT are considered to be not significant.

The Variation will not exacerbate any socio-economic effects in terms of decommissioning of the LDT and as such, the acceptability of the decommissioning effects on socio-economic receptors has been established as acceptable.

8.4.2 Indirect Effects

The LDT has had indirect socio-economic effects on companies and prospective employees that cannot be quantified in terms of GVA and employment.

8.4.2.1 STEM Engagement Officer

Direct effects of this position are discussed in Section 8.4.1.1 and the effects of the work with the students are discussed qualitatively here.

The development of the local skills base is an important part of the remit of the Applicant. The Applicant has funded a post in Levenmouth Academy to encourage pupils to consider the possibilities of careers in Science, Technology, Engineering and Mathematics (STEM) and improve the number of pupils who progress on to positive destinations after leaving school. The STEM Engagement Officer is responsible for encouraging local businesses to become involved in opportunities available through STEM channels. The STEM Engagement Officer is a full time position and represents a £35,000 per annum commitment by the Applicant into local skills development.

There is limited data regarding the positive effects on performance (including in STEM) and career prospects of pupils from Levenmouth Academy, as only one academic year has been completed at the new facility. It is not possible to quantify any of the educational benefits associated with the LDT, however the STEM Engagement Officer initiative has been recognised as a leading initiative as it was awarded the 'Best Community Engagement Award' at the 2016 Green Energy Awards.

The Variation to extend the operational life of the LDT will have a minor beneficial effect in developing local skills base through the STEM Engagement Officer. Although the Variation would result in the continued employment of the STEM Engagement Officer and the benefits associated with this, it is not considered significant in terms of the EIA Regulations.

Conversely, without the Variation and the continued operation of the LDT, the STEM Engagement Officer would no longer be employed and the benefits of associated with this position would cease to be experienced.

8.4.2.2 Further Educational Support

The Applicant is running targeted education support through its collaboration with Fife College and the Energy Skills Partnership. This programme has, to date, allowed 16 renewable energy technicians, trained at Fife College, to visit the LDT, which is a unique experience, as access to offshore wind turbines usually requires a time-consuming journey and costly inactive periods for the turbine.

The Applicant is also working with Heriot Watt University (HWU) and the Energy Skills Partnership to deliver an Immersive Hybrid Reality Turbine (IHR). With this technology the students are able to wear Oculus Rift goggles to explore the inside of the turbine. The IHR won the UK Career Development award (2017) for Best Practice in the Use of Technology in Career Development[44] and has since been nominated and shortlisted for the Contribution to Skills award at the Scottish Green Energy Awards. The development of this technology will enable a larger number of students, in Scotland and further afield, to

[44] Heriot Watt University (2017) Heriot-Watt team win award for virtual reality construction industry careers app [Online] Available at: https://www.hw.ac.uk/about/news/heriot-watt-team-win-award-for-virtual.htm (Accessed 11/10/17)

experience the offshore turbine environment, without the cost and risk associated with physical access.

Although the IHR is primarily used in the college to contribute to the training of future wind energy professionals, there is also a mobile version of the IHR, which has toured at Science Events and in schools. This has allowed over 2,000 people to experience the turbine environment. This strengthens Scotland's ability to undertaken operation and maintenance work, without contracting it to companies elsewhere.

As set out in Section 11.6.1.4 of the 2012 ES, the Applicant is committed to working in partnership with national and local agencies, working to maximise the knowledge opportunity at all levels, from operational/installation training through to degree level and postgraduate research work.

The Variation to extend the operational life of the LDT will have a minor beneficial effect on further educational support and development in renewable energy. Although the Variation would result in further educational support and development of renewable energy, it is not considered significant in terms of the EIA Regulations.

In the absence of the Variation and continued operation of the LTD, the beneficial effects on further educational support and development in renewable energy will not be realised.

8.4.2.3 Promoting Research and Development in Renewable Energy

The Applicant is undertaking research that will support the wider knowledge and understanding of the offshore wind sector, including developing the Clone of Levenmouth Offshore Wind Turbine (CLOWT). This involves putting sensors on various parts of the turbine to allow real time measurements to be taken on how the turbine is operating under the various strains. This will increase sector understanding of how turbines react to the environment, as currently most stress data is taken from calculations. The data this technology will generate could have a significant effect on the long term cost of offshore wind energy.

The Variation to extend the operational life of the LDT will have a minor beneficial effect on promoting research and development in renewable energy and is therefore not significant in terms of the EIA Regulations.

In the absence of the Variation and the continued operation of the LDT, a valuable research and development resource will be lost to the industry.

8.4.2.4 Proving Technology

The LDT serves an important function as a testing facility, providing an opportunity for companies to experiment with new technologies and innovations. The LDT offers companies and small businesses the unique environment of an offshore wind turbine, within an easily accessible shoreline location. The Variation will allow further technology to be tested, advancing offshore wind technology.

As detailed in Appendix 8.1, the LDT has allowed Limpet Technology Ltd, an SME who specialise in height safety and industrial access solutions, to progress an evolutionary offshore personnel transfer system that will allow them to enter and influence the offshore wind energy sector operations and maintenance market. The product will improve the current methods by which turbine technicians transfer from the boat to the turbine, in order to undertake repair work while at sea. The new technology increases the potential access window for offshore wind turbines from 55% to 85% of the time, based on increasing the accessible wave height from 1.5 m to 3 m, which will result in the reduction of significant delays and cost implications. Limpet Technology Ltd have been able to test different iterations of the product at the LDT and invite potential clients to view the

technology in action. Alternative testing on offshore turbines would have been considerably more expensive.

The LDT is opening up further to other companies who are keen to test and commercialise technology and innovations on an easily accessible offshore wind energy turbine. This negates the expenses and problems typically associated with offshore wind such as adverse weather, safety risks and the costs of building substructures.

The principle effects will arise from the sustainability of the offshore wind energy sector. To capitalise on the economic opportunities that could be created by this sector are significant[45]; impact of the core employees and those in the supply chain improve performance and reliability of offshore wind energy. Therefore in addition to the benefits for companies that develop cost saving products, there will be wider implications for the renewable energy sector as it becomes more competitive, prolific and attractive to investors.

Recent contracts awarded to offshore wind projects as part of the Contracts for Difference (CfD) programme have shown a significant cost reduction over the past five years. This is in part due to innovations in operations and maintenance that have reduced the long term costs associated with this form of energy. As a result, the Levelised Cost of Electricity (LCoE) has reduced by 32% in the past five years and this trend is set to continue. The 2017 CFD awards, indicate a further reduction in LCoE of 33% to 47% could be achieved within approximately five years[46].

FEP is well suited to the offshore wind industry, as it is ideally located for companies who manufacture components for the offshore wind industry. Whilst not a direct effect of the LDT, this would present a significant benefit to the local, regional and national economy and support the LDT of the offshore wind industry in Scotland. The Variation to extend the operational life of the LDT will have a minor effect on emerging technology and therefore not significant in terms of the EIA Regulations.

Without the Variation and the continued operation of the LDT, means of reducing risk and cost through the development of new technologies will not be realised.

8.5 Mitigation Measures and Residual Effects

There are no significant effects predicted during the 15 year operational period of the LDT, therefore, no mitigation is proposed.

As no mitigation measures are proposed, the residual effects are as per the assessment of effects presented in Section 8.4 of the EIA Update Report.

8.6 Cumulative Effects

Since the 2012 ES was submitted, there has been little change to the cumulative baseline of the LDT, with the exception of ForthWind Offshore Wind Demonstration Project Phase 1. ForthWind have consent for two demonstration turbines (198.5 m to tip from Lowest Astronomical Tide (LAT)) located approximately 1.5 km seaward at Methil, approximately 1.3 km south-east of the LDT. Consent also is currently being sought by Forthwind from Marine Scotland for a Section 36 and Marine Licences to construct and operate an additional seven turbines adjacent to the two consented turbines (the ForthWind Array).

Local socio-economic effects have been defined as acting at a local level. Given the low magnitude of effects predicted on socio-economic receptors, even with additional wind farms, the cumulative effects are unlikely to lead to a fundamental change in local

[45] Green Investment Group (2015), UK Offshore Wind: Opportunities for Trade and Investment

[46] Catapult Offshore Renewable Energy (2017) ORE Catapult welcomes today's Contracts for Difference (CfD) auction results, recognising innovation opportunities ahead [Online] Available at: https://ore.catapult.org.uk/press-release/ore-catapult-welcomes-todays-contracts-difference-cfd-auction-results-recognising-innovation-opportunities-ahead/ (Accessed 11/10/17)

economic activity. The potential exists, should a large enough number of wind farms be consented in the area, for Fife's reputation as a leading area in the offshore wind sector may continue to develop and further job creation may occur to support the industry. However, this is likely to depend on a range of economic factors other than directly from the wind farm. The cumulative effects on socio-economic receptors are unlikely to be significantly increased as a result of the construction of the ForthWind Demonstration Turbines, and is considered to be not significant.

No further changes to the cumulative effects are required to be made since the submission of the 2012 ES, and hence Section 11.9 does not require updating.

8.7 Summary of Effects

The LDT will continue to have an effect on the Scottish economy from its operation as a testing and training facility and the associated indirect effects that it has with the community. There is a clear demand for the continued use of the LDT as a testing and training facility for the offshore wind industry in Fife, Scotland and further afield. There is an economic benefit to extending the operational life of the LDT in a location which is already determined as acceptable.

The quantifiable economic effects associated with the ongoing operations and maintenance will continue as long as the LDT remains operational. The Variation will continue to help to:

- Remove barriers in the UK industrialisation of offshore wind;
- Increase local industry and academic collaboration, thereby building knowledge capacity in the local area;
- Make significant progress in integrated system technology for offshore wind;
- Facilitate the growth and development of the industry, develop industry process, workforce skills and industry culture in the Fife area; and
- Raise the profile of Fife at an international level.

In estimating these effects, it was assumed that future operations and maintenance expenditure would be at a similar level to the annual expenditure to date. Therefore, the operations and maintenance expenditure is expected to continue to support nine jobs in Fife. The Variation to extend the operational life of the LDT will equate to nine jobs for a further ten years which will total 90 job years.

Without the Variation, the LDT will cease operation after five years of operation and the range of socio-economic benefits associated with this, as summarised above, will be lost. Research infrastructure, such as the LDT, will be vital in ensuring the offshore wind energy sector can become cost competitive and therefore sustainable.

8.8 Statement of Significance

A negligible effect is anticipated during the 15 year operational phase on local and national economy.

Operation and decommissioning of the LDT will not result in any fundamental or material changes in population, structure of the local community or long term employment.

The Variation will result in positive effects on the local economy during the operational phase. However, none of these effects are considered significant in terms of the EIA Regulations.

9 CLIMATE CHANGE AND CARBON BALANCE

9.1 Introduction

This chapter of the EIA Update Report evaluates the effects of the proposed 10 year extension to the operational life (the Variation) of the LDT on climate change and carbon balance. This chapter updates and supplements the information presented in Section 15.3 ('Climate and Carbon Balance') of Chapter 15: Miscellaneous Issues of the 2012 Environmental Statement (2012 ES) and it is intended that this chapter is read in conjunction with that.

9.1.1 Changes since the 2012 ES

Climate Change Impact Assessment (CCIA) is a new requirement of the European Commission (EC) EIA Directive 2014/52/EU[3], as transposed into Scottish legislation through the 2017 EIA Regulations. The Variation falls under the transitional arrangements in place between previous legislation and the implementation of the 2017 EIA Regulations, which means there is no formal requirement for the inclusion of a CCIA. As detailed in the Scoping Report, the Applicant has elected to include a CCIA within this EIA Update Report given the inherent relationship between the LDT and climate change.

For the 2012 ES, it was not possible to calculate the displacement of carbon dioxide (CO_2) due to the nature of the LDT as a test facility and unknown performance data for the turbine design at that time. As the LDT has now been operational since March 2014 and the generation data of the LDT for the operational phase is now available, an estimation of the future CO_2 savings has been determined using project-specific information.

9.2 Assessment Methodology and Significance Criteria

Currently only provisional guidelines exist to standardise the CCIA process in the UK. The Institute of Environmental Management (IEMA) published 'Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation'[47] in November 2015, with the intention of providing an updated and finalised version when the EC Directive was transposed into UK law. At time of writing, no update to these guidelines has been published.

The IEMA guidelines[47] have been used in order to develop an assessment methodology and significance criteria, detailed in Sections 9.2.1 and 9.2.2 respectively. The following assessment areas are considered in terms of the Variation:

- How vulnerable the LDT is to changes in the future baseline environment as a result of climate change;
- How the Variation could influence climate change; and
- A summary of effects of the future climate change scenario on environmental receptors sensitive to climate change.

9.2.1 Assessment Methodology

9.2.1.1 Vulnerability of the LDT to Climate Change

This section of the CCIA identifies aspects of the LDT which are potentially vulnerable to the effects of climate change throughout the project lifespan. Where identified, these vulnerabilities can then be mitigated through embedded mitigation or the application of other measures.

[47] Institute of Environmental Management (IEMA) (2015). Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation. Available at: https://www.iema.net/assets/templates/documents/iema_guidance_documents_eia_climate_change_resilience_and_adaptation%20(1).pdf [Accessed 11/10/2017]

Climatic changes are likely to occur during the operational phase of the Variation. Future climate projections are published by the Met Office through the UK Climate Projections (UKCP09) website[48].

For this assessment it is proposed that the UKCP09 medium emissions scenario (A1B) will be utilised as the future baseline. This scenario is based on a future world of rapid economic growth and the rapid introduction of new and more efficient technologies with a balance of non-fossil fuel and fossil fuel intensive energy technologies. Projected climatic changes at the 50% probability level (central estimate) are also utilised in this CCIA assessment, unless otherwise indicated.

As the LDT is situated in a coastal location, and with a tip height of 196 m from MSL, the following climate considerations are considered to have the potential to impact upon the LDT and its environment:

- Wind speeds;
- Sea levels; and
- Storm surges.

Assessment Limitations

It is important to note that climate change projections are based on global models for a range of greenhouse gas emissions scenarios and generally consider regional responses to climate change rather than local responses. For this assessment, local data (based on a 25 km grid square) has been obtained from the UKCP09 for assessing sea level changes, however regional (e.g. Scotland wide) and national (e.g. UK wide) data has been used to inform the assessments of all other climatic considerations.

The UK Climate Projections (UKCP09) website[49] provides future climate projections for land and marine regions as well as observed climate data for the UK. As this Variation is for a time extension of 10 years, the future climatic baseline is assessed until 2029 however future predictions, as detailed in Section 9.3, for regional and national climatic changes are only available for 2040-2099.

9.2.1.2 Influence of the Variation on Climate Change

This section of the CCIA seeks to quantify the effect of the Variation on climate change in order to undertake an assessment of significance of the effect. The predicted greenhouse gas emissions, and emissions savings of the LDT will be calculated and used to undertake this assessment.

As the LDT is not located on carbon rich soils, and the Variation is to extend the operational life of the LDT with no physical changes proposed, it is not deemed necessary to undertake a full carbon balance assessment. Instead, as the LDT has been operational for three years, an update on the future CO_2 savings has been be undertaken based on operational generation data.

9.2.1.3 Effects of Climate Change upon Environmental Receptors of the Variation

The future baseline scenario set out in Section 9.3 of this chapter has been taken into account in the assessments undertaken elsewhere in this EIA Update. Section 9.2.1.1 details the climate conditions relevant to the assessment of climate change effects on the LDT as a receptor, however a number of other climatic considerations are relevant to environmental receptors considered elsewhere in this EIA Update Report, including changes in:

[48] UKCP09 (2016). UK Climate Projections. Available at: http://ukclimateprojections.metoffice.gov.uk/ [Accessed on 27/09/2017]

[49] UK Climate Projections Website [online]. Available at: http://ukclimateprojections.metoffice.gov.uk/ [Accessed on 11/10/2017]

- Temperature; and
- Precipitation.

Section 9.4.3 of this chapter contains a summary of environmental receptors assessed elsewhere in the EIA Update Report which are potentially vulnerable to the aforementioned climatic changes.

9.2.2 Significance Criteria

The IEMA guidelines for CCIA state the following with regards to the assessment of significance:

"This guidance is not proposing changes to the significance criteria used in the EIA process. However, the susceptibility or resilience of the receptor to climate change must be considered as well as the value of the receptor.

Therefore, a high-value receptor that has very little resilience to changes in climatic conditions should be considered more likely to be significantly affected than a high-value receptor that is very resilient to changes in climatic conditions.

The uncertainty of the combined effect needs to be taken into account. If uncertainty about how a receptor will adapt to a changing climate is high, then it is recommended that a conservative threshold of significance is adopted within the evaluation".

The vulnerability of the LDT, influence of the Variation on climate change and effect on environmental receptors are fundamentally different assessments; the first considering effects on the LDT as a receptor and the other two considering effects on environmental receptors as a result of the Variation. To determine whether effects are significant under the EIA Regulations, it is appropriate to consider the sensitivity of the receptor and the magnitude of the impact, associated with the professional judgement of the assessor.

Section 3.3.2 of Chapter 3 of this EIA Update Report details the categories of significance which effects are assessed as:

- Negligible – no detectable or material change to a location, environment, species or sensitive receptor;
- Minor – a detectable but non-material change to a location, environment, species or sensitive receptor;
- Moderate – a material, but non-fundamental change to a location, environment, species or sensitive receptor; or
- Major – a fundamental change to location, environment, species or sensitive receptor.

Effects assessed can be both beneficial (positive) and adverse (negative) as a result of the LDT.

Sensitivity of climate change receptors is inherently linked to the magnitude of the impact. Whilst receptors may be considered "high-value", a non-material magnitude of the impact would result in any effect being considered not significant.

Section 9.4 of this chapter details the assessment for each receptor.

9.3 Baseline Conditions

9.3.1 Current Climatic Baseline

The UK Climate Projections Report: The Climate of the UK and Recent Trends[50] provides observed climate data for UK Regions. Table 9.1 below indicates the observed changes in

[50] Jenkins, G.J., Perry, M.C., & Prior, M.J. (2008). The Climate of the UK and Recent Trends. Met Office, Hadley Centre, Exeter, UK.

climatic variables between 1961 – 2006 (reported at the 95% confidence level) for the East of Scotland (where the LDT is located).

Table 9.1: Observed Changes in Climatic Variables for the East of Scotland (1961 – 2006)

Climate Variable	Annual Observed Change (1961– 2006)
Daily mean temperature	+1.2 degrees Celsius (°C)
Daily maximum temperature	+1.36°C
Daily minimum temperature	+1.13°C
Change in days of air frost	-27.6 days
Change in cooling degree days	2.5 days
Change in heating degree days	-13.0 days
Change (days) in days of rain ≥ 1mm	5.8 days
Percentage change in total precipitation	18.7%
Change in mean sea-level pressure (hectopascal (hPa))	-0.3 hPa
Change in relative humidity	-2.4%

Whilst no change was observed, the annual average 10 m wind speed between 1961 and 2006 was recorded as 10 – 14 knots in the east of Scotland.

9.3.2 Future Climate Projections Relevant to Climate Change Effects upon the LDT

9.3.2.1 Wind Speeds

This section is based on predictions presented in the UK Climate Projections Science Report: Probabilistic Projections of Wind Speed[51]. This report has predicted summer and winter wind speeds for the 2040-2069 and the 2070-2099. Whilst the LDT will not be operating between 2040-2069, this period provides the closest projection period to operating phase of the Variation. Therefore, for the purposes of this assessment, predicted values for the 2040-2069 have been used.

For Scotland, predicted summer wind speeds for 2040-2069, at the 50% probability level (under the medium emissions scenario), are slightly skewed towards a small reduction in wind speed, with changes predicted between -0.2 m/s and 0 m/s which equates to around a reduction of 0.4 knots. This is a minimal change compared with the typical magnitude of summer mean wind speeds for Scotland which is between 7-14 knots.

Predicted winter wind speeds for 2040-2069 in Scotland at the 50% probability level (under the medium emissions scenario) are between -0.2 m/s to 0.1 m/s which equates to roughly 0.4 knots and is a relatively small change compared to the mean observed winter wind speed value of between 10-24 knots over Scotland[51].

These predictions are in line with the findings by Pryor and Barthelmie (2010)[52] who conclude that in the near-term (i.e. until the 2050s) there will be no detectable significant change in the wind resource of northern Europe.

[51] Sexton and Murphy (2010). UKCP09: Probabilistic Projections of Wind Speed. Available online at: http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87876&filetype=pdf [Accessed on 13/09/2017]

[52] Pryor, S.C. and Barthelmie, R.J. (2010). Climate Change Impacts on Wind Energy: A Review. *Renewable and Sustainable Energy Review,* 14(1):430-437.

9.3.2.2 Sea Levels

This section is based on predictions presented in the UK Climate Projections Science Report: Marine and Coastal Projections Report[53].

Sea level for a particular region generally differs from the global mean. Local sea level is affected by ocean circulation and by geographical variations in the temperature and/or salinity of the water column. Sea level around the UK rose by approximately 1 millimetre/year (mm/year) in the 20th Century, corrected for land movement, with the rate for 1990s and 2000s higher than this, with evidence of increases up to 1.3 mm/year within areas of Scotland[54].

At the Site, by 2029 relative sea levels[55] are anticipated to increase by approximately 7.8 cm (based on the 50% probability level and medium emissions scenario)[53].

9.3.2.3 Storm Surges

This section is based on predictions presented in the UK Climate Projections Science Report: Marine and Coastal Projections Report.

Around the UK coastline, the size of surge expected to occur on average about once in every 50 years, is projected to increase by less than 0.9 mm/year during the 21st century. In most locations, this trend cannot be clearly distinguished from natural variability. In the UK, the largest storm surge trends are expected to be observed in the Bristol Channel and Severn Estuary, where the trend is for an increase in the 50 year skew surge return of around 0.8 mm/year.

9.3.3 Future Climate Projections Relevant to Climate Change Effects upon Environmental Receptors

In addition to the climate changes listed in Section 9.3.2, the following climate changes are applicable to environmental receptors considered elsewhere in this EIA Update Report, although are not directly considered to inform assessment within this chapter.

9.3.3.1 Temperature

This section is based on predictions presented in the UK Climate Projections Science Report: Climate Change Projections[56].

Predicted temperature changes are assessed for regional areas throughout the UK, including East Scotland. The mean temperature for the East Scotland during the 2040-2069 period is predicted to increase by 1.7^{O}C in winter, and up to 2.3^{O}C in summer (based on the 50% probability level and medium emissions scenario, considered to be the central estimate).

9.3.3.2 Precipitation

This section is based on predictions presented in the UK Climate Projections Science Report: Climate Change Projections[56].

Predicted precipitation changes are assessed for regional areas throughout the UK, including East Scotland. During the 2040-2069 period, the annual mean precipitation

[53] Lowe *et al.,* (2009). UK Climate Projections Science Report: Marine and Coastal Projections. Met Office Hadley Centre, Exeter, UK. Available online at: http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87906&filetype=pdf [Accessed 11/10/2017]

[54] Jenkins *et al.,* (2008). UK Climate Projects Science Report: The Climate of the UK and Recent Trends. Available online at: http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87933&filetype=pdf [Accessed 11/10/2017]

[55] Relative sea levels are calculated by combining the land movement rate with the absolute sea level rise.

[56] Murphy *et al.,* (2009). UK Climate Projects Science Report: Climate Change Projections. Available online at: http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87894&filetype=pdf [Accessed 12/10/2017]

percentage change is predicted at 0%, derived from a predicted winter increase of 10% precipitation and a summer decrease of 12% (based on the 50% probability level and medium emissions scenario, considered to be the central estimate).

9.3.4 Greenhouse Gas Emissions Targets

A substantial reduction in greenhouse gas emissions is imperative to avoid irreversible damage caused by the impacts of climate change. The Scottish Government has introduced a number of policies aimed at reducing greenhouse gas emissions and meeting renewable energy targets set at a UK, European and International level.

The Climate Change Act 2008 is legally binding legislation that includes a requirement for the UK secretary of state to ensure that the *"net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline*".

The Climate Change (Scotland) Act 2009 creates a statutory framework for reductions in greenhouse gas emissions. A target reduction of 80% had been set for 2050 with an interim target of a 42% reduction in emissions by 2020. This Act requires local authorities to act in a way that contributes and helps deliver these emission targets. This interim target of a 42% reduction in emissions was met in 2014 and the Scottish Government has now outlined a new interim target to reduce greenhouse gas emissions by 66% by 2032[57].

In 2015, energy generated from renewable technologies generated the equivalent of 59.4% of Scotland's electricity requirements, compared to just over 10% in 2001. The majority of this growth is attributed to a substantial increase in onshore wind developments[13]. With the development of multiple offshore wind farms, including Beatrice Offshore Wind Farm, Hywind and Aberdeen Offshore Wind Farm which are, as of November 2017, in the construction and pre-construction phases, it is anticipated that offshore wind farms will make a sizeable contribution to the energy generated from renewable energy technologies within Scotland. Further growth in offshore is anticipated and recognised within the Scottish Government's Draft Energy Strategy.

In June 2017, the Scottish Government introduced the "Climate Change Bill – Consultation Paper" which proposes to amend parts of The Climate Change (Scotland) Act 2009 in order to increase emission reduction targets[58].

Table 5.3 of the Digest of United Kingdom Energy Statistics (DUKES) 2017[59] provides details of the sources used in generation of electricity throughout 2016 by major power producers. Of a total of 54.61 million tonnes of oil equivalent (toe) generated in 2016 within the UK, 30.3 million toe were generated by natural gas, oil and coal, and 6.8 million toe were generated from renewable resources. These numbers demonstrate that fuels which emit high levels of carbon emissions are generating the majority of electricity within the UK.

9.4 Assessment of Potential Effects

9.4.1 Vulnerability of the LDT to Climate Change

Wind turbines are designed to capture wind energy, they are therefore built to withstand extreme climatic conditions, and are deliberately constructed in exposed locations. However, wind energy developments could potentially be sensitive to significant changes in climatic variables, including atmospheric circulation and land cover changes as well as

[57] The Scottish Government (2017) Draft Scottish Energy Strategy. Available online at: http://www.gov.scot/Resource/0051/00513466.pdf [Accessed on 13/09/2017]

[58] The Scottish Government (2017) Climate Change Bill – Consultation Paper. Available online at: http://www.gov.scot/Publications/2017/06/8208 [Accessed on 03/10/2017]

[59] Department of Business, Energy & Industrial Strategy (2017) Digest of United Kingdom Energy Statistics 2017. Available online at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2017-main-report [Accessed on 03/10/2017]

changes in the frequency of extreme events (e.g. storms), which could damage wind turbines or alter their efficiency[60]. The following sections provide an assessment of the vulnerability of the LDT to the climatic factors to which it is potentially sensitive, as identified in Section 9.3.

9.4.1.1 Wind Speeds

As set out in Section 9.3.2.1, in the near-term (i.e. 2040 - 2069 period) there will be no detectable significant change in the wind resource of northern Europe.

As a result, these minor predicted changes in summer and winter wind speeds between 2040 - 2069 are highly unlikely to affect the operation of the LDT, which will be decommissioned before 2040. Given the limited magnitude of the impact and the negligible sensitivity of the LDT as an environmental receptor, there is no significant effect in terms of the EIA Regulations predicted as a result of increased wind speeds during the operational phase of the LDT.

9.4.1.2 Sea Levels

As set out in Section 9.3.2.2, by 2029 relative sea levels[61] at the Site are anticipated to increase by approximately 7.8 cm (based on the 50% probability level and medium emissions scenario)[53].

Due to the time limited nature of the Variation and that the LDT is constructed on a substructure platform approximately 18 m above MSL, it is highly improbable that the LDT will be vulnerable as a result of the minimal predicted increase in sea levels at the Site.

As a result of the non-material magnitude of the impact and the negligible sensitivity of the LDT as an environmental receptor, no significant effect in terms of the EIA Regulations is predicted on the LDT in relation to a rise in sea levels.

9.4.1.3 Storm Surges

As set out in Section 9.3.2.3, around the UK coastline, the size of storm surge expected to occur, on average, approximately once in every 50 years, is projected to increase by less than 0.9 mm/year over the 21st Century. In most locations, this trend cannot be clearly distinguished from natural variability.

Due to the temporary nature of the Variation and the fact that the LDT is constructed on a substructure which is 18 m above MSL, it is highly improbable that increases in storm surges will affect the operation of the LDT. Given the non-material increase of the storm surges and the negligible sensitivity of the LDT as an environmental receptor, no significant effect in terms of the EIA Regulations is predicted on the LDT in relation to increased storm surges.

9.4.2 Influence of the Variation on Climate Change

The intertidal environment upon which the LDT is constructed is characterised by boulder and cobble dominated habitat interspersed with patches of sandy gravel. As the LDT is not located on carbon rich soils, and this Variation is to extend the operational life of the LDT, with no physical changes proposed, it is not deemed necessary to undertake a full carbon balance assessment. Instead, as the LDT has been operational for three years, an update on the amount of electricity generated and the number of equivalent homes powered is provided in Chapter 3: Project Background. Section 9.4.1.1 assesses the likely change in wind speeds as a result of climate change over the operational phase of the LDT, which is

[60] Pryor, S.C. and Barthelmie, R.J. (2010). Climate Change Impacts on Wind Energy: A Review. *Renewable and Sustainable Energy Review,* 14(1):430-437.

[61] Relative sea levels are calculated by combining the land movement rate with the absolute sea level rise.

considered to be non-material. It is therefore considered likely that the energy generated by the LDT will remain similar throughout the duration of the LDT. It is considered that given the substantial constraint to operation during 2015, due to the low levels of consented noise limits, this year was exceptional and is not included in averages, therefore, the average capacity factor of the LDT is calculated to be 11.65% when taking into operation throughout 2016 and 2017. Based on this average capacity factor, it is expected the Variation would result in the production of approximately 7,149 MWh annually, equating to 71,487 MWh over the 10 year extension. This is the equivalent of approximately 615 toe annually, equating to approximately 6,147 toe over the course of the 10 year extension[62], which is a positive environmental effect.

Whilst these numbers appear small in relation to the UK generation from carbon based fuels (30.3 million toe), the R&D and training being undertaken at the LDT will help improve the efficiency of offshore turbines, reducing downtime and increasing energy production from renewable resources.

This is considered to be a negligible, positive environmental effect that is not significant under the EIA Regulations.

9.4.3 Effects of Future Climate Change Scenario on Environmental Receptors Sensitive to Climate Change

Chapters 5 to 8 of this EIA Update Report assess a range of environmental effects, and include a consideration as to the likely change in baseline conditions as a result of climate change, as detailed in Section 9.3 of this chapter. The changes to baseline conditions as detailed in each chapter and associated effect of climate change on the receptors assessed within each chapter are summarised in Table 9.2 below.

Table 9.2: Climate Change Effects on Environmental Receptors

EIA Update Chapter	Environmental Receptor	Climate Change Effect	Effect on Receptors
Chapter 5: Seascape, Landscape & Visual Impact	North Sea / Population	Rise in sea levels	Negligible rise in sea levels results in no change to seascape baseline during the operational phase of the LDT.
Chapter 6: Noise	Population	N/A	None
Chapter 7: Ornithology	Ornithology population	Rise in sea levels	Negligible rise in sea levels results in no change to protected feeding areas within the ornithology study area during the operational phase of the LDT.
Chapter 8: Socio-economics	Population	N/A	None

As summarised in Table 9.2, this EIA Update Report has considered the effects of climate change on sensitive environmental receptors, based on the future climate change projections detailed in Section 9.3 of this chapter.

The future climate change projections all result in negligible changes to the environmental receptors during the Variation; given the relatively limited magnitude of change as a result of climate change over the period of the Variation, no additional significant effects to those already identified within this EIA Update Report will occur as a result of climate change during the operational phase of the LDT.

[62] One toe is the equivalent to 11.63 MWh. International Energy Agency (2017). Unit Converter. Available online at: https://www.iea.org/statistics/resources/unitconverter/ [Accessed on 03/10/2017]

9.5 Mitigation Measures and Residual Effects

Section 9.4 of this chapter identified that all effects are of such limited and negligible nature that they are not significant and therefore no mitigation is required under the EIA Regulations or recommended as best practice.

9.6 Cumulative Effects

As discussed in Section 9.3.4, the Scottish and UK Governments have set ambitious targets for reducing greenhouse gas emissions by 2050[57]. This Variation, in conjunction with other renewable energy developments, will contribute to Scotland and the UK's aims to reduce carbon emissions and achieve meet its ambitious greenhouse gas emissions targets. As a test facility, the Variation will allow further research and development to take place which will likely contribute towards the growth of the offshore wind sector in Scotland.

Table 5.3 of DUKES 2017 details the sources used in generation of electricity throughout 2016 by major power producers. Approximately 6.8 million toe were generated from renewable resources in 2016, and the LDT contributed to this renewable generation, which accounts for approximately 12.5% of all generation by major power producers in the UK.

Between 2012 and 2016, renewable energy generation by major power producers, as detailed within Table 5.3 of DUKES 2017[59], increased from 3.8 million toe to 6.8 million toe, indicating more renewable capacity has been constructed since 2012. It is considered a conservative, worst-case assumption that the UK renewable energy generation will not increase on the 2016 generation of 6.8 million toe per annum over the extended operational phase of the LDT. UK renewables generation contributing to approximately 12.5% of all UK generation is considered to be a significant, positive, cumulative environmental effect under the EIA Regulations and will contribute to the UK's legally binding emission reduction targets.

9.7 Summary of Effects

The predicted future climatic baseline conditions are highly unlikely to affect the operation of the LDT.

Extending the operation of the LDT by a further ten years will have a positive effect on carbon savings, and a significant positive effect when considered cumulatively with UK-wide renewable energy deployment.

No additional significant effects to those already identified within this EIA Update Report will occur as a result of climate change during the operational phase of the LDT.

9.8 Statement of Significance

No negative significant effects will occur on the LDT as a result of the future baseline climate change environment.

The LDT will not significantly influence climate change. The LDT will have a significant, positive cumulative effect with regards to reduction in carbon emissions when considering the UK-wide electricity generation mix.

No additional significant effects to those already identified within this EIA Update Report will occur as a result of climate change during the operational phase of the LDT.

10 SUMMARY

This EIA Update Report for the Variation has been carried out in accordance with the Screening and Scoping Opinion provided by the MS-LOT and the requirements of relevant good practice guidance. This involves the compilation, evaluation and presentation of any potentially significant environmental effects resulting from the LDT.

The extension of the operational life of the LDT presents an important environmental and economic benefit to the wider renewables industry by allowing for further testing and development of products and services for the Scottish offshore wind industry. In-turn this supports the wider enhancement of skills and expertise relevant to the industry. In addition, the Variation will support the continued operation and proposed long-term expansion and development of FEP.

The limited environmental effects arising from the LDT with regards to seascape, landscape and visual; noise; ornithology; and climate change and carbon balance are already in existence. The Variation will simply extend the duration of these effects rather than introduce any new effects. The principle of the LDT has already been established as acceptable by MS-LOT and Fife Council, the considerable socio and economic benefits arising from the LDT should be balanced against the extended duration of the existing environmental effects.