

A large offshore wind turbine stands in the middle of a blue ocean under a clear sky. The turbine has three white blades and a yellow base. In the distance, another smaller wind turbine is visible on the horizon.

## **Review of Hawkins Report - Cable Related Concerns**

Aberdeen Offshore Wind Farm Limited

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## 1. Introduction

Natural Power have been asked on behalf of Aberdeen Offshore Wind Farm Limited (AOWFL) and Vattenfall to provide an independent assessment of the report *An Independent Evaluation of the Potential Impact of the Aberdeen Offshore Wind Farm upon Salmon and Sea Trout* by Anthony D. Hawkins (from hereon referred to as the Hawkins' report), commissioned by [REDACTED].

We have been asked in particular to review the Hawkins' report claims regarding the impact of electromagnetic fields (EMF) on migratory fish species of the Aberdeen Offshore Wind Farm (AOWF or the Project), as AOWFL has been asked to assess this by the Marine Scotland Licensing Operations Team (MS-LOT).

In addition, information provided within the Hawkins' report that is pertinent to the recently submitted Cable Laying Strategy (CLS) document, submitted on 27<sup>th</sup> January 2017 to fulfil conditions of the Section 36 Consent (S.36) and Marine Licence, has also been reviewed by Natural Power.

### 1.1. Summary of the Hawkins' report

The Hawkins report is lengthy document of 137 pages. The report states its purpose as being to '*evaluate the potential impact upon salmon and sea trout of the Aberdeen Offshore Wind Farm*' and sets out how this will be achieved in the summary. These steps are summarised below:

- Consider and determine the possible effects and identify potential impacts of the development upon salmonid fishes and salmon fisheries;
- A review of the Environmental Statement (ES) submitted in support of the application for AOWF and evaluate its relevance and adequacy; and
- Identify knowledge gaps and understanding of the impacts of wind farm developments upon salmon and sea trout.

The report also presents information provided in the ES (including the Habitats Regulation Assessment (HRA)) and provides information, within the main body of the text and within Annexes, on the following topics:

- The life cycle of Atlantic salmon;
- The life cycle of sea trout;
- EMF effects on fish and marine life;
- Effects of underwater noise (on fish); and
- Problems in the assessment of underwater noise.

The main objections to the AOWF Project relate to the author's opinion that Scottish Minister's decision to grant consent to the Project was based on a flawed ES and that certain conditions attached to the consent have not been met.

The reason for the belief that the ES is flawed is based on a number of criticisms, however the two main concerns relate (but are not limited) to:

- The impact of underwater noise on salmon and sea trout is flawed, since:
  - The Project will use suction buckets and underwater noise (constructional and operational) from turbines on foundations with suction buckets was not assessed in the ES; and
  - Noise modelling of underwater noise did not adequately consider particle motion;
- The impact of EMF on salmon and sea trout could not be carried out adequately as there is not enough known on:
  - Levels of EMF omitted from cables; and
  - How salmon and sea trout react to EMF.

As such the author believes that the Project should be delayed until more scientific research to address data gaps on the potential impacts of OWFs on salmon and sea trout has been undertaken.

Regarding the consent conditions, the report details that two compliance documents, the CLS and Project Environmental Monitoring Programme (PEMP), must be submitted to Marine Scotland six months prior to the commencement of cable laying and three months prior to the commencement of construction of the development respectively. The report raises questions as why to consultation has not yet been undertaken on these documents, particularly with salmon fishermen. It is worth noting here that Hawkins' report states that construction of the AOWF commenced in 2016, however offshore construction is not due to start until July 2017. Hence there may have been some discrepancy between expected and actual submission deadlines and consultation periods.

## 1.2. Purpose of this report

The Hawkins' report is lengthy (137 pages) with no conclusion section, hence, given the time constraints of this review requested by AOWFL, it is not possible to review the entire document at this stage. A summary of the topics covered in the report is provided in Appendix A.

This report, therefore concentrates on reviewing the information provided in relation to;

- The impacts of EMF arising from the AOWF on salmon and sea trout species; and
- Any other points raised in the Hawkins' report relating to the CLS.

## 2. Responses to issues raised within the Hawkins report

### 2.1. Main issues identified in relation to EMF

Issues and questions related to EMF are presented in multiple sections throughout the Hawkins' report. As the Hawkins' report does not employ the use of numbered section heading or numbered paragraphs, it is not possible to reference specific points made. Therefore, the main issues relating to EMF are summarised below:

1. *'The problems for salmon and sea trout created by noise and the generation of EMFs were not assessed fully by the original Environmental Statement. A more complete and accurate Environmental Statement is required.'*
2. *'In the absence of clear evidence on the impact of EMFs, and the efficiency of mitigation measures, there is a case for applying the precautionary principle and delaying the development until such evidence is available.'*
3. *'There is little actual evidence actually available to be able to assess the overall effect of EMFs from subsea cables on migration and movement behaviour of salmon and sea trout at the present time. There is insufficient evidence on the use of magnetic cues for orientation and migration by salmon and sea trout and no data available to be able to assess the effects of local changes in magnetic fields upon the migrations of these fishes. There may be a particular problem in shallow water, where migrating adult salmon are often found, and where they may come particularly close to electrical cables. On a precautionary basis, it is for the developers to demonstrate that there are no significant effects upon salmon and sea trout from the EMFs generated by cables. That has not yet been done.'*

### 2.2. Response to issues identified relating to EMF

As stated above, many of the issues raised relating to EMF are interrelated and overlap considerably. Therefore, rather than comment on each issue separately, responses have been provided which cover the overarching questions raised.

The ES (and associated technical appendices) presented a thorough review of the information available on EMF at the time of submission, and assessed the effects on salmon and sea trout against this available information (Appendix 22.2 section 3.3). This assessment was deemed sufficient to allow the Scottish Ministers to grant consent to the Project.

It should be noted that the literature review in Annex C (EMF) of the Hawkins' report, while very thorough, does not present any new information that would affect the conclusions of the ES. In addition, the literature review omits reference to a particularly useful study carried out by Marine Scotland Science as part of the National Research and Monitoring Strategy for Diadromous Fish (NRMSD). Since the submission of the AOWF ES in 2011, the NRMSD has been coordinating research to identify knowledge gaps and information requirements in relation to the potential effects of offshore and marine renewable energy generation on salmon and other freshwater fish that migrate to and from the sea (see <http://www.gov.scot/Topics/marine/marineenergy/Research/NatStrat>). The results of many of the studies coordinated through the NRMSDF add more certainty to the consenting decisions surrounding offshore wind farms in relation to salmon in particular. As part of this programme, research was carried to examine the response of salmon to mains frequency magnetic fields. Armstrong *et al.*, (2015<sup>1</sup>) exposed Atlantic salmon (both large adult salmon and post-smolts) to magnetic (B) fields of up to 95  $\mu$ T. The results observed showed exposed salmon elicited no significant changes in swimming behaviour in comparison to control groups. Overall, the study concluded that salmon are unlikely to be seriously adversely affected by magnetic fields. This research supports the conclusions of the AOWF ES, and fills many of the data gaps which were previously present in the knowledge base related to effects of EMF on salmonids.

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<sup>1</sup> J D Armstrong, D-C Hunter, R J Fryer, P Rycroft & J E Orpwood (2015) *Behavioural Responses of Atlantic Salmon to Mains Frequency Magnetic Fields*, Scottish Marine and Freshwater Science; Volume 6; Number 9. <http://www.gov.scot/Resource/0048/00484957.pdf> .



The conclusions of the AOWF ES are also supported by modelling work undertaken for the CLS in order to predict the strength of the B fields which will be emitted by the export and inter-array cables at the AOWF (CLS - Section 8). The study calculated the magnetic field magnitudes at a given distance from the 66 kV cables at indicative burial depths of 0.6, 1 and 2 m. The insulation and sheathing of the cable power cores, and the burial of the cables, encourage shielding of EMF. The predicted magnetic field of any of the cables buried to 0.6 m is expected to be below the earth's magnetic field (assumed to vary between 25  $\mu\text{T}$  and 65  $\mu\text{T}$ ). As such, at the indicative target burial depths of the Inter-array cables of up to 1.0 m, and offshore export cables of up to 1.5 m, EMF emissions at the seabed are expected to be significantly lower than the earth's magnetic field (at between 2.067 and 8.468  $\mu\text{T}$ ).

These field strengths will reduce to 0.218 – 0.31  $\mu\text{T}$  or 0.104 – 0.12  $\mu\text{T}$  at 5 and 10 m from the seabed respectively. These predicted field strengths are below the background level of the earth's magnetic field, and are also far below the level of 95  $\mu\text{T}$  used experimentally by Armstrong *et al.* (2015), therefore the prediction that salmon (and sea trout) behaviour will not be affected by EMF in the ES remains valid.

It is noted that the Environmental Impact Assessment (EIA) was undertaken on the assumption that 33kV cables would be used (as opposed to 66kV cables as proposed within the Cable Laying Strategy). However, it should be noted that while the voltage of a cable dictates the strength of an Electric (E) field (which is shielded by cable insulation), it is primarily the current, measured in Amperes, which dictates the strength of the magnetic (B) field, and in turn the resultant induced Electric (iE) field that can be present in the water column. As it is only the B and iE fields that can be detected outside of the cable shielding, the voltage carrying capacity is only relevant in that as it increases, the current (and therefore the respective B and iE field) decreases at the transmission of a given amount of power. It is therefore considered that the potential impacts on the environment from EMF will be no greater than (or less than) those described in the original Application for which consent was granted. As stated by the CLS report, consultation was also undertaken with MS-LOT and it has been confirmed that the 66 kV cables can be considered to be within the consented envelope due to the reasons set out above (MS-LOT email dated 10/12/15).

### 2.3. Main issues identified in relation to Cable Laying Strategy

A number of issues are raised in the Hawkins' report relating to the CLS and these are summarised below:

1. *'No later than six months prior to the commencement of cable laying, a Cable Laying Strategy had to be submitted by the Company to the Scottish Ministers for approval following consultation with SNH and any such other advisors as may be required at the discretion of the Scottish Ministers. The Strategy had to include the details of the location, the construction methods, and the monitoring methods for the grid export cables and cable landfall site. The Strategy had also to include the survey results of an inter-tidal habitat and relevant species survey which will help inform the cable routing location. The Strategy was intended to safeguard coastal processes in the wider Aberdeen Bay and ensure all environmental issues were considered in the location and construction of the export and inter array cables. This had to include coastal processes and benthic and intertidal habitats. It is not clear whether this Strategy has been completed and is available to stakeholders and other interested parties.'*
2. *'Cable laying was supposed to avoid any coastal netting stations, but it would now appear (from information provided by the owners of the Blackdog Fishing Station) that the cables are close to the station, and will affect fishing operations there adversely. It is important that the owners of salmon fishing rights that may be affected by such developments should be consulted by the developers and the Crown Estate on any proposals regarding the location and laying of cables.'*
3. *'It is questionable, however, whether there has been sufficient consultation with coastal salmon fishers to provide an assurance that the impact on their fisheries will be negligible. Severe problems may be expected at the Blackdog fishing station as a result of the current plans for laying cables, contrary to the assurance that cable laying would avoid such areas. Although the cables on the foreshore are to be buried, the owners of the Blackdog Fishing Station contend that conditions on the beach at Blackdog are very dynamic and sand levels can drop by as much as 4 to 5 meters at any time of the year. Exposure of the cables would make access to the fishings impossible. The cables need to be buried at sufficient depth to avoid being crushed by the tractor, trailer, boat etc., as when loaded, there would be a combined weight of approximately 8 tons. Deployment of fishing nets on the foreshore will also be restricted because of the need to place anchors in position and drive head poles into the ground. There is a real danger that the fishing vessel's anchors will snag the cables and*

*there may also be dangers when fishers dismount from boats into the water. Also, the positioning of the wind turbines relative to the fishing station and the nearby Blackdog firing range, may result in longer journeys by fishers to reach some of their nets, which has implications for their safety'.*

## 2.4. Responses to issues identified relating to the CLS

The issues raised relating to CLS are interrelated and overlap, therefore, rather than comment on each issue separately, a commentary has been provided on each question raised.

The CLS was submitted to Marine Scotland on 27<sup>th</sup> January 2017, and offshore construction is not due to commence until later in 2017, hence this document was submitted within licence compliance timelines. The CLS includes all details required as specified in the condition. According to the licence condition, it is at the discretion of Scottish Ministers to decide who is consulted regarding the CLS. Therefore, it is outwith the responsibility of the Developer to ensure all interested parties are consulted.

Regarding the Hawkins' report comment on how cable laying was '*supposed to avoid any coastal netting stations*', it is important to remember the cable corridor is already consented. Therefore, any comments can only relevantly be made on micro-siting within the consented corridor. Consultation has also been undertaken on the revised cable landfall through the application of detailed planning permission (for a route which is within the consented cable corridor). Consultation on the cable corridor was undertaken as part of the EIA and no objections from fishermen were received. The Section 36 and Marine Licence contain numerous conditions detailing mitigation measures to keep fishermen and other sea users informed of all marine works undertaken as part of construction, and these will be adhered to by the developer.

Regarding the question of beach erosion resulting in cable exposure and safety issues for fishing, AOWFL were advised by SNH to use the reviews the outputs from Scotland's Coastal Change Assessment (<http://www.dynamiccoast.com/>) to inform understanding of any potential changes in beach level in this area, and thus inform the target depth for cable burial. According to the Dynamic Coast project online tool, the coastline at Blackdog is undergoing accretion rather than erosion. It is considered that the cables are less likely to become exposed because of this. However, AOWFL is also concerned about changing coastal processes that could put the cable at risk of exposure through erosion, and therefore will design the landfall with an aim to minimise the risk of cables becoming exposed through the life of the Project. In addition, ABPMer have been undertaking a programme of beach topographic surveys works in order to investigate seasonal trends in beach topography. This work, carried out between 2010 and 2016, revealed seasonal movements of sand mainly arose due migration of the Blackdog burn, rather than erosion. In the unlikely event that the cable did become exposed, AOWFL have committed to re-bury any cable re-exposed by erosion (as described in Section 9 of the CLS).

It is also worthy of note with regards to the potential for cables to become exposed due to erosion at the landfall, a potential installation methodology for landfall is one of Horizontal Directional Drilling (HDD). With the HDD option, cables are estimated to be 12-14 m below ground level.



### 3. Conclusion

In conclusion, the main objections relating to the potential issues arising from EMF in the Hawkins' report is that the AOWF ES did not assess the impacts of EMF sufficiently, and that the knowledge on the potential impacts arising from EMF is too poor to make appropriate decisions. The concerns leading to these objections can be shown to be unfounded, due to two principal reasons:

- Recent studies by Marine Scotland Science (Armstrong *et al.*, 2015) observed no significant changes in swimming behaviour of salmon exposed to EMF in excess of those predicted to result in the cables from the AOWF, and concluded that salmon are unlikely to be 'seriously' adversely affected by B fields.
- Modelling presented within Armstrong *et al.*, 2015 shows the predicted field strength of the buried cable at 1m depth are within the background level of the earth's magnetic field. These fields would therefore not be likely to be detected by salmon or sea trout.

The main issues presented within the Hawkins' report with respect to the CLS appear to have arisen due to a misunderstanding in the commencement of offshore construction, thus when this CLS report should be submitted and who should be consulted upon with regards to its content.

- The CLS was submitted in January 2017 and contained the information specified with the licence condition, and sent out for consultation by Marine Scotland to relevant consultees as deemed appropriate by Scottish Ministers.
- The location of the cable corridor is already consented and consultation on this took place as the EIA stage. Fishermen will be informed of construction works through the mitigation measures prescribed in the Licence conditions.
- According to the Dynamic Coast project online tool, the coastline at Blackdog is undergoing accretion rather than erosion, and the cable landfall has been designed to minimise risk of re-exposure. A programme of beach topographic surveys works has been undertaken over six years in order to investigate seasonal trends in beach topography. With the preferred option for HDD cables are estimated to be 12-14 m below ground level. In the unlikely event that the cable did become exposed, AOWFL have committed to re-bury any cable re-exposed by erosion (as described in Section 9 of the CLS).

## Appendix A

Table A.1: Summary of topics covers in the Hawkins Report

Section title	Section content	Section Summary	Page number
Summary	Purpose of the review	Sets out document objectives as being: <i>to evaluate the potential impact upon salmon and sea trout of the proposed Aberdeen Offshore Wind Farm</i>	3
	The EOEDC	Provides background of the Project and an overview on consenting, with comments on licence conditions.	3-5
	Risks to salmon and sea trout	Points out the potential risks to migrating salmon and sea trout through the development of the Project.	5-6
	The environmental Impact Assessment	Briefly discusses the validity of the EIA, and consultation that took place.	6-7
	Evaluation of the Environmental Impact Assessment	Points out where the author has identified perceived flaws in the EIA. This includes comments of where consultation may or may not have taken place.	7-9
	Information Gaps	Lists information that the author considers requires further study before the Project is developed.	9-11
	The Overall Approach	Briefly discusses how the Project has been consented and again raises the points that the author considers there are a lot of gaps in knowledge.	11
The European Offshore Wind Deployment Centre (EOWDC)	The Proposal	This summaries proposal for the EOWDC development (the Project). It also includes Project time lines and states, 'Construction of the facility, which also includes 66 kV cabling, began in October 2016'.	15
	Planning Consent	Gives an overview of how the Project was consented and objections that were raised by the fishing community at the time.	16-17
	Conditions Imposed	Gives a brief overview of some of the licence conditions that were imposed through the consenting process, in particular the requirements to submit a PEMP and CLS. This section also raises questions as to why consultation has not yet occurred on these documents. It also discusses the funding of environmental research projects, and how the funding will be allocated through a Scientific Research and Monitoring Panel.	17-18

Section title	Section content	Section Summary	Page number
	Subsequent Progress with the Development	Looks at developments within the Project Description since the consent was issued, including new planning applications and challenges to the project from ██████████, as well as contracts placed with contractors. Again there is discussion on the lack of consultation over the PEMP.	18-19
	Scientific Programme	Discusses the how research funding that will be coordinated through the Scientific Research & Monitoring Panel Scientific studies will work and what it may include.	20
Description of the Wind Farm & Associated Activities	Location & Design of the Aberdeen Wind Farm	Provides an more detailed description of the Project, location and technologies to be used	21-22
	Work already undertaken or currently underway	Summarises the surveys that have taken place or going to take place.	22
	Seabird and cetacean survey	Gives an overview of the seabird and cetacean survey that took place at the site.	22-23
	Geophysical survey	This looks at the geophysical survey that took place at the site and its potential effects on salmon and sea trout and how these should have been assessed before deployment was permitted.	23-24
	Geotechnical investigations	Looks at the geotechnical investigation that took place at the site, potential effects of these on salmonid fish and how these should have been assessed before deployment was permitted.	24-25
	Libar Observations	Looks at wave buoy deployment, and discusses the potential effects of these on salmonid fish and how these should have been assessed before deployment was permitted.	25-26
Possible Effects of the Development upon Fishes	Fishes that might be affected by the wind farm development	Identifies any fish that may be potentially affected by the development.	27-29
	Salmon and Sea Trout along the Aberdeenshire Coast	Identifies the fact that salmon and sea trout are present in the area.	29
	Atlantic salmon	This section provides an overview of salmon, with no citations (these are found in a more detailed review in the Annex)	29
	The Life cycle of salmon	An overview on the life cycle of salmon	29-31
	Salmon migrations	An overview on migration in the life cycle of salmon, with some risks to salmon identified	31-33
	Brown Trout and Sea Trout	Brief overview of trout, with no citations (these are found in a more detailed review in the Annex)	33

Section title	Section content	Section Summary	Page number
	The life cycle of the sea trout	Brief overview on the life cycle of sea trout	33
	Sea trout migrations	Brief overview on what is known about migration routes of sea trout	33
The Wind Farm Development and Migratory Fishes	The importance of fish migrations	Briefly outlines the importance of fish migrations	34
	The requirements of migratory fishes	Discusses the requirements of migratory fish and points out key risks from the Project and where the author perceives that information gaps exist.	34-35
Factors potentially affecting coastal movements of migratory	The generation of electro-magnetic fields	Identifies the fact that EMF will be produced from the cables, and salmonids may be sensitive to EMF as they may use the earth's magnetic field for navigation.	36
	The generation of underwater noise	Identifies that underwater noise will be produced due to the Project and how that there is uncertainty on the impacts to salmonid migration from underwater noise.	36-37
The EIA	The Precautionary Principle	Discusses the Precautionary Principle and how this should be applied given the uncertainties relating to the impacts of the Project.	38-39
Material from the Summary of the EIA		Presents information directly the ES document, with commentary its appropriateness	39
	Marine Ecology	Looks at the Marine Ecology chapter of the ES and provides commentary on impacts on noise on other fish and how noise from suction bucket foundations was not assessed.	
	Commercial Fisheries	Looks at the Commercial Fisheries chapter of the ES, and how further consultation has been limited since the EIA.	39-40
	Salmon and Sea Trout	Presents potential impacts to salmon and sea trout identified in this chapter of the ES	40
Environmental Research and		Brief statement on how the ES states that the Project presents research opportunities for the benefit of stakeholders	

Section title	Section content	Section Summary	Page number
Development Opportunities			
	Chapter 13: Electromagnetic Fields	Discusses the EMF chapter of the ES and concludes that the author believes there is not enough information on this topic.	41-42
	Chapter 14 Statutory Designations and Conservation	Presents information from the Statutory Designation and Conservation chapter of the ES	42
	Chapter 21: Commercial Fisheries	Presents the information from the Commercial Fish chapter of the ES and concludes that there is not enough information on this topic to inform the ES and that the author believes further consultation since submission has not been adequate.	43
	Chapter 22: Salmon and Sea Trout	Presents the information from the Salmon and Sea trout chapter of the EIA and identifies that where the author believes consultation was inadequate.	43-44
	The Impact Assessment – Construction & Decommissioning	Presents the matrix tables from the ES for noise and increased sediment assessment.	44
	The Impact Assessment – Operational	Presents the matrix tables from the ES for EMF and presence of wind turbines	45
	The Impact Assessment – Fisheries	Presents the matrix tables from the ES for salmon and sea trout.	45
	Summary	Summarises key points made with in the EIA and concludes ' <i>that there were serious flaws within the EIA in relation to the assessment of noise impacts, and in relation to the lack of information on the effects of EMFs from electrical cables. Moreover, the anticipated liaison with stakeholders and fishing interest does not seem to have taken place.</i>	45-46
The Appropriate Assessment	The Appropriate Assessment performed for the River Dee SAC	Presents the AA undertaken and its conclusion and conditions arising from this.	47-50
Other Assessments of the Impact of	The MarVEN Study: Environmental Impacts of Noise, Vibrations and	Presents information from another study which identifies impacts associated with offshore wind farms.	51

Section title	Section content	Section Summary	Page number
Wind Farms upon Fishes	Electromagnetic Emissions from Marine Renewables		
	The effects of underwater sound	Looks at underwater noise impacts researched in the MaRVEN study.	51-52
	The effects of EMFs	Looks at EMFs impacts researched in the MaRVEN study	52
	Other Studies	Identifies other studies that look at effects of offshore wind farms, e.g. Bergström <i>et al.</i> (2014) and Wahlberg and Westerberg (2005).	52-55
An Independent Evaluation of the EIA	Salmon and Sea Trout Assessments	This section evaluates the salmon and sea trout assessments within the ES and identifies issues that the author perceives exist with the chapter.	55-56
	Evaluation of the Effects of Noise during Construction	Identifies issues with how the effect of noise during construction within the ES was assessed and raises two issues. The author considers that: noise from suction buckets was not included in the assessment; and the dBht (Species) metric (Nedwell <i>et al.</i> 2011) used to assessing underwater noise on fish is not appropriate for salmon as it does not include particle motion.	56-57
	Effects of Construction upon Juvenile Salmonids	Identifies issues with how the effect of construction upon juvenile salmonids was assessed within the EIA and concludes that the precautionary principal should be applied	57
	Effects of Construction upon Adult Salmonids	Identifies issues with how the effect of construction upon adult salmonids was assessed within the EIA and concludes that the precautionary principal should be applied, as suction buckets will be used.	57-58
	Evaluation of the Effects of Noise during Operation of the Wind Farm	Identifies issues with how the effect of operational noise upon salmonids was assessed within the EIA and points out this was not based on turbines with suction bucket foundations.	59
	Flaws in the overall assessment of noise effects	Looks at flaws in the assessment of operational noise effects, which were that particle motion was not considered and suction buckets will now be used which weren't assessed.	59-60
	Suction Bucket Foundations	Looks at details on suction buckets and concludes that the noise monitoring should be carried out.	60
	The effects of Increased Sediment Concentrations	Identifies issues with how the effects of increased sediment were assessed and points out that suction buckets were not assessed.	60-61
	Effects of Electromagnetic Fields (EMFs)	Identifies issues with how the effects of EMF were assessed and concludes that further studies need to be carried out on this as there insufficient evidence to conclude no significant effect.	61-62

Section title	Section content	Section Summary	Page number
	Interference with Fishing Activities	Looks at interference to fishing activities in the area of the development and concludes that consultation with fishermen must occur (and this may have been insufficient) and that fishing rights cannot be overridden by the Crown Estate.	62-63
Information Gaps	Information gaps inhibiting the EIA	Identifies information gaps inhibiting robust EIA for OWFs.	64-65
	Particular issues that needed to be addressed more fully by Wind Farm EIAs	Identifies issues that need further investigation before the construction of the wind farm.	65
	Examining the effects of electromagnetic fields (EMFs)	Identifies that further studies are needed examining EMF effects	65
	Examining the effects of underwater noise	Identifies that further studies are needed examining underwater noise effects.	65-66
	Evaluation of mitigation measures	Briefly looks at ways of assessing mitigating measures efficacy.	66
Annexe A:	The salmon life cycle	A detailed literature review of the life cycle of salmon	67-69
	Salmon fisheries	Describes salmon fisheries in Scotland.	69-70
	Salmon populations	Describes salmon populations in Scotland.	70-71
	Smolt migrations downstream	Discusses smolt migration downstream.	71-72
	Immediate marine migrations	Discusses how smolt migrate into the marine environment.	72-76
	Feeding of salmon at sea	Discusses the diets of salmon at sea.	76-77
	Survival rates in the sea	Discusses the survival rate of salmon in the sea.	77-79
	Changes in salmon abundance	Provides statistics on salmon abundances.	79-81
	Mortality in the high seas fisheries	Discusses salmon being caught as by catch by other fisheries once in the sea.	81-82
	Migration cues in the sea	Describes migration cues for salmon in the sea.	82-85
	Orientation to magnetic fields	Discusses the idea that magnetic fields are used by salmon as a guide in the sea.	85-86
	Other orientation mechanisms	Discusses other theories of how salmon orientate themselves when at sea.	86-87



Section title	Section content	Section Summary	Page number
	Modelling the migrations of salmon at sea	Discusses ways of modelling migrations of salmon at sea.	87-89
	Movements of returning salmon close to the coast	Describes salmon returning to the coastal area.	89-93
	Orientation mechanisms close to the home river	Discusses ways that salmon return to their home rivers.	93-94
	River identification and entry	Discusses the ways in which salmon identify their home rivers.	94-95
	The movements of kelts (post-spawning adult fish)	Describes the movements of kelts.	95-97
Annexe B:	Brown Trout and Sea Trout	A more detailed literature review of the life histories of brown trout and sea trout.	98-101
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# What we do

Natural Power is a leading independent renewable energy consultancy and products provider. The company offers proactive and integrated consultancy, management and due diligence services, backed by an innovative product range, across the onshore wind, offshore wind, wave, tidal, renewable heat, solar pv and hydro sectors, whilst maintaining a strong outlook on other new and emerging renewable energy sectors.

Established in the mid 1990s, Natural Power has been at the heart of many groundbreaking projects, products and portfolios for more than two decades, assisting project developers, investors, manufacturers, research houses and other consulting companies. With its iconic Scottish headquarters, The Green House, Natural Power has expanded internationally and now employs more than 330 renewable energy experts.

## Creating a better environment

# Our global expertise

Natural Power delivers services and operates assets globally for our clients, with eleven offices across Europe and North America and agencies active in South America and AsiaPac.

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