East Anglia ONE North and East Anglia TWO Offshore Windfarms

Applicants' Responses to Natural England's Deadline 1 Submissions

Applicant: East Anglia TWO and East Anglia ONE North Limited
Document Reference: ExA.AS-10.D2.V1
SPR Reference: EA1N_EA2-DWF-ENV-REP-IBR-001133

Date: 17th November 2020
Revision: Version 1
Author: Royal HaskoningDHV

Applicable to East Anglia ONE North and East Anglia TWO

Revision Summary				
Rev	**Date**	**Prepared by**	**Checked by**	**Approved by**
01	17/11/2020	Paolo Pizzolla	Lesley Jamieson / Ian MacKay	Richard Morris

Description of Revisions			
Rev	**Page**	**Section**	**Description**
01	n/a	n/a	n/a

Table of Contents

1	**Introduction**	**1**
1.1	Purpose	1
1.2	Offshore Ornithology	4
1.2.1	Summary of NE's Offshore Ornithology Issues	4
1.2.2	Specific Comments on Offshore Ornithology	6
1.3	Marine Mammals	40
1.4	Terrestrial Ecology	45
1.4.1	Outline SPA Crossing Method Statement	64
1.4.2	Outline Landfall Construction Method Statement	69
1.5	Landscape and Visual Impact Assessment	70
1.6	Seascape Landscape and Visual Impact Assessment (SLVIA)	74
1.6.1	Summary of NE Comments Submitted at Deadline 1	74
1.6.2	Detailed SLVIA Comments Submitted at Deadline 1	75
1.7	All Other Matters	96
1.7.1	Site Selection and Assessment of Alternatives	96
1.7.2	Project Description	98
1.7.3	Marine Geology Oceanography and Physical Processes	99
1.7.4	Benthic Ecology	108
1.7.5	Fish and Shellfish Ecology	113
1.8	Appendix 5 Outer Thames Estuary Cabling Note	116
1.9	East Anglia TWO Disposal Site Locations	117
1.10	DCO / DML	117
1.10.1	Outline Offshore Operations and Maintenance Plan	127
1.10.2	In-Principle Monitoring Plan	129

Appendix 1 Offshore Wind Turbine Visibility and Visual Impact Threshold Distances (Sullivan et al., 2013)

Appendix 2 London Array Offshore Windfarm Offshore Ornithology Monitoring Report

Appendix 3 Tranquillity Map

Appendix 4 Intrusion Map

Glossary of Acronyms

AEoI	Adverse Effect on Integrity
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
APP	Application Document
AR	Avoidance Rate
AS	Additional Submission
BBPP	Breeding Bird Protection Plan
BDMPS	Biologically Defined Minimum Population Sizes
BEIS	Department for Business, Energy & Industrial Strategy
CfD	Contract for Difference
CIA	Cumulative Impact Assessment
CMS	Construction Method Statement
CoCP	Code of Construction Practice
CRM	Collision Risk Model
DCO	Development Consent Order
DEFRA	Department for Food Agriculture and Rural Development
DEPONS	Disturbance Effects of Noise on the Harbour Porpoise Population in the North Sea
DML	Deemed Marine Licence
EC	European Commission
EDR	Effective Deterrent Range
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
EMP	Ecological Management Plan
EPP	Evidence Plan Process
EPS	European Protected Species
ES	Environmental Statement
ETG	Expert Topic Group
ExA	Examining Authority
FFC	Flamborough & Filey Coast
HDD	Horizontal Directional Drill
HRA	Habitats Regulation Assessment
IP	Interested Party
LCA	Landscape Character Area
LCT	Landscape Character Type
LMP	Landscape Management Plan
LVIA	Landscape and Visual Impact Assessment
MHWS	Mean High Water Springs
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MPA	Marine Protected Area
MSS	Marine Scotland Science
NE	Natrual England
NFFO	National Federation of Fishermen's Organisation
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Signficant Infrastructure Project
OLEMS	Outline Landscape and Ecological Management Strategy
ORJIP	Offshore Renewables Joint Industry Programme
OSSEA	Review and Update of Seascape and Visual Buffer study for Offshore Wind Farms
OWF	Offshore Windfarm
OWSMF	Offshore Wind Strategic Monitoring Forum
PEIR	Preliminary Environmental Information Report

PEIR	Preliminary Environmental Information Report
RAG	Red Amber Green
RR	Relevant Representation
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SCH	Suffolk Coasts and Heaths
SCHAONB	Suffolk Coasts and Heaths Area of Outstanding Natural Beauty
SEA	Strategic Environmental Assessment
SEL	Sound Exposure Level
SIP	Site Integrity Plan
SLVIA	Seascape, Landscape and Visual Amenity
SNH	Scottish Natural Heritage
SNS	Southern North Sea
SoCG	Statement of Common Ground
SoS	Secretary of State
SPA	Special Protected Area
SPL	Sound Pressure Level
SPR	ScottishPower Renewables
SSC	Suspended Sediment Concentrations
SSSI	Site of Special Scientific Interest
SZC	Sizewell C
UK	United Kingdom
UXO	Unexploded Ordnance
WR	Written Representation
WTG	Wind Turbine Generator
ZTV	Zone of Theoretical Visibility

Glossary of Terminology

Applicant	East Anglia TWO Limited / East Anglia ONE North Limited
Cable sealing end compound	A compound which allows the safe transition of cables between the overhead lines and underground cables which connect to the National Grid substation.
Cable sealing end (with circuit breaker) compound	A compound (which includes a circuit breaker) which allows the safe transition of cables between the overhead lines and underground cables which connect to the National Grid substation.
Construction consolidation sites	Compounds associated with the onshore works which may include elements such as hard standings, lay down and storage areas for construction materials and equipment, areas for vehicular parking, welfare facilities, wheel washing facilities, workshop facilities and temporary fencing or other means of enclosure.
Construction operation and maintenance platform	A fixed offshore structure required for construction, operation, and maintenance personnel and activities.
Development area	The area comprising the onshore development area and the offshore development area (described as the 'order limits' within the Development Consent Order).
East Anglia ONE North project	The proposed project consisting of up to 67 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia ONE North windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
East Anglia TWO project	The proposed project consisting of up to 75 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia TWO windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive, as defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017 and regulation 18 of the Conservation of Offshore Marine Habitats and Species Regulations 2017. These include candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas.
Generation Deemed Marine Licence (DML)	The deemed marine licence in respect of the generation assets set out within Schedule 13 of the draft DCO.
Horizontal directional drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
HDD temporary working area	Temporary compounds which will contain laydown, storage and work areas for HDD drilling works.

Inter-array cables	Offshore cables which link the wind turbines to each other and the offshore electrical platforms, these cables will include fibre optic cables.
Jointing bay	Underground structures constructed at intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land, and connect to the onshore cables.
Link boxes	Underground chambers within the onshore cable route housing electrical earthing links.
Meteorological mast	An offshore structure which contains metrological instruments used for wind data acquisition.
Mitigation areas	Areas captured within the onshore development area specifically for mitigating expected or anticipated impacts.
Marking buoys	Buoys to delineate spatial features / restrictions within the offshore development area.
Monitoring buoys	Buoys to monitor *in situ* condition within the windfarm, for example wave and metocean conditions.
National electricity grid	The high voltage electricity transmission network in England and Wales owned and maintained by National Grid Electricity Transmission
National Grid infrastructure	A National Grid substation, cable sealing end compounds, cable sealing end (with circuit breaker) compound, underground cabling and National Grid overhead line realignment works to facilitate connection to the national electricity grid, all of which will be consented as part of the proposed East Anglia TWO project Development Consent Order but will be National Grid owned assets.
National Grid overhead line realignment works	Works required to upgrade the existing electricity pylons and overhead lines (including cable sealing end compounds and cable sealing end (with circuit breaker) compound) to transport electricity from the National Grid substation to the national electricity grid.
National Grid overhead line realignment works area	The proposed area for National Grid overhead line realignment works.
National Grid substation	The substation (including all of the electrical equipment within it) necessary to connect the electricity generated by the proposed East Anglia TWO project to the national electricity grid which will be owned by National Grid but is being consented as part of the proposed East Anglia TWO project Development Consent Order.
National Grid substation location	The proposed location of the National Grid substation.
Natura 2000 site	A site forming part of the network of sites made up of Special Areas of Conservation and Special Protection Areas designated respectively under the Habitats Directive and Birds Directive.
Offshore cable corridor	This is the area which will contain the offshore export cables between offshore electrical platforms and landfall.
Offshore development area	The East Anglia TWO windfarm site and offshore cable corridor (up to Mean High Water Springs).
Offshore electrical infrastructure	The transmission assets required to export generated electricity to shore. This includes inter-array cables from the wind turbines to the offshore electrical platforms, offshore electrical platforms, platform link cables and export cables from the offshore electrical platforms to the landfall.

Offshore electrical platform	A fixed structure located within the windfarm area, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.
Offshore export cables	The cables which would bring electricity from the offshore electrical platforms to the landfall. These cables will include fibre optic cables.
Offshore infrastructure	All of the offshore infrastructure including wind turbines, platforms, and cables.
Offshore platform	A collective term for the construction, operation and maintenance platform and the offshore electrical platforms.
Onshore cable corridor	The corridor within which the onshore cable route will be located.
Onshore cable route	This is the construction swathe within the onshore cable corridor which would contain onshore cables as well as temporary ground required for construction which includes cable trenches, haul road and spoil storage areas.
Onshore cables	The cables which would bring electricity from landfall to the onshore substation. The onshore cable is comprised of up to six power cables (which may be laid directly within a trench, or laid in cable ducts or protective covers), up to two fibre optic cables and up to two distributed temperature sensing cables.
Onshore development area	The area in which the landfall, onshore cable corridor, onshore substation, landscaping and ecological mitigation areas, temporary construction facilities (such as access roads and construction consolidation sites), and the National Grid Infrastructure will be located.
Onshore infrastructure	The combined name for all of the onshore infrastructure associated with the proposed East Anglia TWO project from landfall to the connection to the national electricity grid.
Onshore preparation works	Activities to be undertaken prior to formal commencement of onshore construction such as pre–planting of landscaping works, archaeological investigations, environmental and engineering surveys, diversion and laying of services, and highway alterations.
Onshore substation	The East Anglia TWO substation and all of the electrical equipment within the onshore substation and connecting to the National Grid infrastructure.
Onshore substation location	The proposed location of the onshore substation for the proposed East Anglia TWO project.
Platform link cable	Electrical cable which links one or more offshore platforms. These cables will include fibre optic cables.
Safety zones	A marine area declared for the purposes of safety around a renewable energy installation or works / construction area under the Energy Act 2004.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water.
Transition bay	Underground structures at the landfall that house the joints between the offshore export cables and the onshore cables.
Transmission DML	The deemed marine licence in respect of the transmission assets set out within Schedule 14 of the draft DCO.

1 Introduction

1.1 Purpose

1. This document presents the Applicants' comments on Natural England's (NE) Deadline 1 submissions (REP1-153-158; REP1-160-161 and REP1-163-173). This includes the Applicants' responses to NE's comments on the Applicants' Comments on Relevant Representations (AS-036) for each receptor topic except for Seascape Landscape and Visual Impact Assessment (SLVIA) where relevant representation responses can be found in AS-036.

2. ***Table 1*** details the Deadline 1 documents submitted by NE alongside the Applicants' overarching responses which, where appropriate, include a cross-reference to where more detailed information has been provided.

3. This document is applicable to both the East Anglia TWO and East Anglia ONE North DCO applications, and therefore is endorsed with the yellow and blue icon used to identify materially identical documentation in accordance with the Examining Authority's procedural decisions on document management of 23rd December 2019 (PD-004). Whilst this document has been submitted to both Examinations, if it is read for one project submission there is no need to read it for the other project submission.

4. It should be noted regarding SLVIA, in ***section 1.6,*** some of comments from Natural England apply to the East Anglia ONE North project or the East Anglia TWO project only. Where comments relate to East Anglia ONE North only, these are highlighted in yellow. Similarly comments which relate to East Anglia TWO only are highlighted in blue. Additionally, ***Appendix 3*** and ***4*** of this document have been provided in response to a comment from Natural England regarding the East Anglia TWO project only, however, these appendices have been submitted into both Examinations for completeness.

Table 1 Documents Submitted by NE at Deadline 1 with Applicants' Overarching Responses

Document Name	Applicants' Response
EN010078 330917 EA2 Appendix A1b – NE Comments to Applicant Comments on NE RR [AS-036] Offshore Ornithology	See ***section 1.2***
EN010078 330917 EA2 Appendix A2 – NE Advice on LBBG Apportioning Alde Ore	Revised LBBG apportioning was provided in the updated cumulative and in-combination collision risk assessment submitted at Deadline 1 (REP1-147)

Document Name	Applicants' Response
EN010078 330917 EA2 Appendix A3 – NE Comments to Appendix 4 Ornithology Precaution Note [AS-041]	The Applicants note NE's response to Appendix 4 (AS-041), however the Applicants' position is unchanged. Given the decision agreed by the Applicants and NE at a workshop on the 28th of July to adopt the in-combination estimates agreed in the Norfolk Boreas examination, the Applicants do not intend to make further comment on this matter.
EN010078 330917 EA2 Appendix A4 – NE's Recommended Approach to Assessing Effects on Red-Throated Diver (RTD)	The Applicants have undertaken a new analysis of RTD displacement since the receipt of the NE Relevant Representation, reflecting the fact that NE's position on this issue has become more conservative than it was pre-application. The preliminary findings of this work were presented to NE and the RSPB at a workshop held on the 22nd October. The draft report will be provided to NE and the RSPB in mid-November, ahead of a further workshop in early December to present the results of the analyses and implications for HRA prior to submission of the document at Deadline 3.
EN010078 330917 EA2 Appendix A5 – NE Advice to BEIS On SPA Review of Consents	No response required
EN010078 330917 EA2 Appendix A6 – Norfolk Boreas Submission [REP-064]	No response required
EN010078 330917 EA2 Appendix A7 - Norfolk Boreas Submission [REP-065]	No response required
EN010078 330917 EA2 Appendix A8 - Norfolk Boreas Submission [REP-066]	No response required
EN010078 330917 EA2 Appendix B1b – NE Comments to Applicant Comments on NE RR [AS-036] Marine Mammals	See ***section 1.2.1***
EN010078 330917 EA2 Appendix C1b – NE Comments to Applicant Comments on NE RR [AS-036] Terrestrial Ecology	See ***section 1.4***
EN010078 330917 EA2 Appendix C2 – Comments to Outline SPA Crossing Method Statement	See ***section 1.4.1***
EN010078 330917 EA2 Appendix C3 – NE Comments on Draft Outline Landfall Construction Method Statement	See ***section 1.4.2***

Document Name	Applicants' Response
EN010078 330917 EA2 Appendix D1b – NE Comments to Applicant Comments on NE RR [AS-036] LVIA	See ***section 1.5***
EN010078 330917 EA2 Appendix E1b – NE Comments to Applicant Comments on NE RR [AS-036] SLVIA	See ***section 1.6***
EN010078 330917 EA2 Appendix E2 – NE Comments on Appendix 7: Offshore Windfarm Visibility and Visual Impact Threshold Distances (2012) Journal Article	The Applicants uploaded the wrong document and apologise to NE for this mistake. The correct document is now provided in Appendix 1 of this document. Therefore, no response to NE's Appendix E2 is provided however the Applicants would welcome a dialogue on Appendix 1 once NE have considered it.
EN010078 330917 EA2 Appendix F1b – NE Comments to Applicant Comments on NE RR [AS-036] All Other Matters	See ***section 1.7***
EN010078 330917 EA2 Appendix F2b – NE Comments to Appendix 5 Outer Thames Estuary Cabling Note [AS-042]	See ***section 1.8***
EN010078 330917 EA2 Appendix F4– NE Comments to Appendix 6: East Anglia TWO Disposal Site Locations (Windfarm Site) [AS-043]	See ***section 1.9***
EN010078 330917 EA2 Appendix G1b – NE Comments to Applicant Comments on NE RR [AS-036] DCO DML	See ***section 1.10***
EN010078 330917 EA2 Appendix I1b Natural England Risks and Issues Log	This appendix summarises NE's key concerns, specific details of which are captured for each receptor topic in the below sections. Therefore, no response is required.
EN010078 330917 EA2 Appendix J1 – NE Review of RR from Other Parties	No further comment.
EN010078 330917 EA2 Appendix K1 – NE Response to ExA Written Questions	The Applicants have provided a response at Deadline 2, where appropriate, to NE's response to ExA Written Questions in ExA.WQRs.D2.V1.

1.2 Offshore Ornithology

1.2.1 Summary of NE's Offshore Ornithology Issues

NE Summary point	Applicants' Comments
Collision Risk and Cumulative Impact Assessments	
We note that the Applicant has deferred responses to cumulative impact assessment (CIA) comments until after the Secretary of State decision on the Hornsea Project 3 and Norfolk Vanguard projects were made. Natural England has provided comments on the outcome of those decisions within our response to the proceeding Offshore windfarm NSIP examination - Norfolk Boreas [REP14 – 066].	The Applicants have submitted an updated cumulative and in-combination collision risk assessment at Deadline 1 (REP1-047). The assessment uses the cumulative and in-combination collision mortality estimates as agreed with NE for the Norfolk Boreas Deadline 8 position[1] (with amendments made for Hornsea 3's final submission regarding kittiwake collisions and removal of the Thanet Extension from all relevant parts of the assessment). The Applicants highlight their response to Procedural Decision 18 submitted to the Examining Authority (ExA) on the 13th of August which acknowledges that the basis of the SoS decisions on Norfolk Vanguard and Hornsea Three decisions remain unclear (in terms of which projects were included in the in-combination totals) and that NE have requested clarification on this. It is understood that there is not yet clarity on this issue. Understanding of the basis of the SoS decision will allow all parties to move forward with common understanding of the in-combination position.
We understand that the rationale for the Applicant's approach is to prevent the cumulative and in- combination assessments being revised, interpreted by the Applicant and then reviewed by stakeholders, more times than is necessary. We agree with this approach. However, we have previously provided regulators with our advice regarding our concerns about predicted level of cumulative/in-combination impacts on North Sea seabirds, e.g. EIA great black-backed gull at East Anglia 3 and Norfolk Vanguard, and Flamborough & Filey Coast (FFC) SPA kittiwakes at Hornsea 2 and Norfolk Vanguard. These concerns have intensified given the three further offshore wind farm NSIPs now submitted to PINS (Norfolk Boreas, East Anglia One North, East Anglia Two) and with a further project planned to submit in the next 12 months (Hornsea 4).	As per above, it is necessary to understand the basis of the SoS decision on Norfolk Vanguard as it is not clear if the Projects and Norfolk Boreas were taken into account in the in-combination totals. It is critical to understand this in order to know whether the Projects are 'additional' or already accounted for within the Norfolk Vanguard decision.
Therefore, we consider that without major project-level mitigation being applied to all relevant projects coming forward, there is a significant risk of large-scale impacts on seabird populations. Hence, as per our advice at Norfolk Vanguard and Norfolk Boreas, we recommend that for all relevant future projects located in the North Sea, raising turbine draught height as much as technically possible, should be considered as standard mitigation practice, and that where appropriate relevant proposals should include this measure in order to minimise their contributions to the cumulative/in-combination collision totals. We therefore advise that further raising the hub height of turbines is considered now, and not left until the later stages of the examination process. 'Front-loading' such mitigation measures now will also mean a further reduction in the number of revised collision assessments.	Regarding NE's concerns around the extent of cumulative impacts on seabirds and the requirement for mitigation in the form of a raising of wind turbine draught heights, the Applicants discussed this at a workshop on the 28th of July 2020 with representatives from NE, RSPB and the Marine Management Organisation (MMO). At this workshop the Applicants noted that due to more certainty with the procurement process for the East Anglia Hub (which incorporates East Anglia THREE, East Anglia ONE North and East Anglia TWO) the Applicants are able to provide further refinement of the turbine parameters. The Applicants are therefore able to commit to an increased air draught height (from 22 to 24m above Mean High Water Springs (MHWS)) which will reduce each Projects' individual collision risk mortalities for all relevant species. Additionally, the Applicants (which are a subsidiary of ScottishPower Renewables (UK) Limited (SPR)) also highlighted that a non-material change (NMC) application for SPR's East Anglia THREE project was submitted on 20th July 2020 (SPR 2020) and that a NMC application for SPR's East Anglia ONE project is anticipated to be submitted in early 2021[2]. If granted, these NMC applications will reduce the overall EIA cumulative collision mortality and the in-combination collision mortalities at both the Flamborough and Filey Coast SPA and the Alde-Ore Estuary SPA from the numbers that were submitted with the Projects' applications. The implications to the cumulative and in-combination collision mortalities of the draught height increase and NMC applications at East Anglia ONE and East Anglia THREE are presented in REP1-047.

[1] Norfolk Boreas, 2020. Deadline 8 submission. Offshore Ornithology Assessment Update Cumulative and In-combination Collision Risk Modelling [REP8-025]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-002005-Offshore%20Ornithology%20Assessment%20Update%20Cumulative%20and%20In-combination%20Collision%20Risk%20Modelling%20(Version%202)%20(Clean).pdf
[2] The East Anglia ONE NMC is simply to bring the consented position in line with the as-built position as that project is now operational. The East Anglia THREE NMC reduces that project's maximum turbine number and increases the air draught of all turbines to 24m above MHWS.

NE Summary point	Applicants' Comments
Natural England acknowledge that at the workshop on 28th July 2020 the Applicant has undertook a commitment to increase air- draft to 24m over MHWS. However, we are not clear why this cannot be increased to the same air- draft increases as the Norfolk OWF projects. Therefore, Natural England queries if there is a reluctance to further raise the draft height due to potential increases in the scale of other significant issues e.g. impacts on the special qualities of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty. As highlighted in NEs Deadline 1 Appendix E1b we recognise that there is likely to be conflict between potential mitigation to reduce SLVIA concerns with those of offshore ornithology with opposing requirements in relation turbine heights in reducing the scale of particular thematic impacts. Therefore, the Examining Authority may need to weigh up the overall merits of potential mitigation proposals and how the project design could be further adapted to meet all of the varying mitigation requirements. For example, turbines with higher draft height could be located further away from shore to avoid an increase in visual impact while still providing a reduction to collision mortality.	The southern North Sea is not physically uniform across its extent and therefore the design for one project may not be appropriate for another. The project design of each offshore windfarm is unique and based upon, amongst other factors, site specific parameters such as ground conditions and water depth. In considering appropriate mitigation measures, the Applicants have recognised impacts across different receptor topics (e.g. SLVIA and ornithology) and aim to ensure that the Projects can be delivered with minimum impacts. Given that site-specific conditions are not confirmed until post-consent and that turbine technology is evolving quickly there is a need to retain flexibility within the Rochdale Envelope in order to maintain a viable project.
Outer Thames Estuary SPA	
We advise that the other most critical area of oustanding concern for offshore ornithology, however, is the adverse effect on the Outer Thames Estuary (OTE) SPA, red throated diver (RTD) distribution due to displacement effects from the proposed windfarms. Natural England considers that there is a clear case for mitigation through redesign of the East Anglia ONE North array area so the turbines fall at least 10-12.5km from the SPA. We are concerned that no substantive response to Natural England's advice regarding this issue has been provided to date, but we note that the Applicant intends to submit a document at Deadline 3 and we will continue to advise them on the drafting of said document, where appropriate, through our Discretionary Advice Service. For more specific advice in relation to Outer Thames Estuary SPA red throated diver displacement impacts please see NEs Deadline 1 Appendix A4 and Appendix A5.	The Applicants have provided substantive responses to NE outside of the examination process which is documented within the SoCG submitted at Deadline 1. The Applicants have been undertaking new analysis of RTD information since the receipt of the Relevant Representation, reflecting the fact that NE's position on this issue has become more conservative than it was pre-application. The preliminary findings of this work were presented to NE and the RSPB at a workshop held on the 22nd of October. The draft report will be provided to NE and the RSPB in mid-November, ahead of a further workshop in early December to present the results of the analyses and implications for HRA prior to submission of the document at Deadline 3.

1.2.2 Specific Comments on Offshore Ornithology

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
1. Red-throated diver displacement impacts on Outer Thames Estuary SPA (OTE SPA) **Document used: 5.3 EA1N Information to Support the Appropriate Assessment Report**						
1	EA1N offshore windfarm (OWF) array area is immediately adjacent to the OTE SPA and, based on studies conducted at other windfarms, is likely to result in displacement of red-throated divers, leading to a long-term reduction in the abundance of divers within part of the SPA and a re-distribution of the interest feature, and result in an adverse effect on integrity (AEOI) from the project alone. **Natural England's advice is that to avoid an AEOI the boundary of the development should be amended so no part of the array is within 10 km of the boundary of the SPA.** The high level conservation objectives and supplementary advice for the OTE SPA can be found in the conservation advice package for the site, which is here. The conservation objectives for the OTE SPA are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring: the extent and distribution of the habitats of the qualifying features the structure and function of the habitats of the qualifying features the supporting processes on which the habitats of the qualifying features rely the populations of each of the qualifying features the distribution of qualifying features within the site The supplementary advice on the site's conservation objectives describes the range of ecological attributes that are most likely to contribute to a site's overall integrity. Natural England advises that the following attributes within the supplementary advice should be considered as key when determining whether the proposed development will impact upon the site's ecological integrity:		The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	Whilst we welcome the Applicant's commitment to continued engagement with Natural England, we do note that the Applicant's consultant MacArthur Green has carried out a recent review of RTD displacement to inform The Crown Estate's Round 4 ornithology constraints for Offshore Wind leasing process (Furness, 2019). We also note the subsequent BioConsult report (Vilela et al. 2020) estimating diver displacement in the German North Sea calculated a displacement distance in spring of 10.2km. It is increasingly clear that there is a large and growing body of evidence that diver displacement from wind turbines can extend out to 10km and beyond, and we are not clear what is to be achieved by another review. Natural England considers that relocating both arrays beyond 10km of the OTE SPA has the potential to avoid an adverse effect on integrity (AEoI), subject to this being tested through a sufficiently detailed assessment of impacts. However, the methodology used to assess the magnitude of the displacement effect in the Environmental Statement (ES) does not allow such an assessment to be made. Currently, the report to inform the Appropriate Assessment (AA) does not assess the full extent of potential displacement. The assessment only considers displacement out to 4km and only considers one attribute (abundance) out of several that are relevant. The in-combination assessment also does not take account of the displacement from existing windfarms within the SPA.		The Applicants note that NE's response is the same as that provided in their previous advice on impacts to the Outer Thames Estuary SPA provided in June 2020. This response formed the basis of a discussion on the SPA at a workshop on the 28th of July 2020 when the Applicants sought clarity on a number of the issues raised in the advice. As agreed during the workshop, the Applicants updated the red-throated diver note (prepared for and circulated to NE, RSPB and the MMO prior to the 28th July workshop) in line with the DAS advice and the clarifications received at the workshop. The preliminary findings of this work were presented to NE and the RSPB at a workshop held on the 22nd of October. The draft report will be provided to NE and the RSPB in mid-November, with a further workshop planned following this to discuss the results of the updated analysis and updated implications for HRA prior to submission of the document at Deadline 3. . The analysis indicates that the maximum extent of potential displacement within the Outer Thames Estuary SPA is 7km, not 10km as reported elsewhere, and that the peak mean magnitude of displacement from the windfarms themselves is around 33%. Thus, the mean displacement effect decreases from 33% at 0km to 0% at 7km and clearly indicates that 1) a 10km buffer is not appropriate and 2) that the exclusion is not absolute since birds remain present in the windfarms, albeit at reduced densities. A similar finding has recently been reported from monitoring of the London Array windfarm (Appendix 2). Thus, presenting estimates of how much area lies within the various buffer distances of the windfarms as an indication of the extent of displacement, considerably overestimates the effective magnitude of displacement by a considerable margin.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
	Maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) Reduce the frequency, duration and / or intensity of disturbance affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed Natural England recommends that the Applicant reviews the targets and supporting notes for the above attributes in the supplementary advice. The target sets out the desired state of the attribute and the supporting notes provide detailed evidence of displacement impacts on red-throated diver, through changes in habitat distribution and disturbance caused by offshore wind farms. The most significant ornithological issue for Natural England is that the proposed array is in close proximity to the OTE SPA. We note that the 4km buffer around the array area overlaps with 33.2km2 of the OTE SPA, which represents 0.88% of the SPA area. For baseline characterisation surveys, Natural England advises that the whole of the area within which a planned array may be built plus at least a 4km buffer around those areas is covered by surveys. Buffers serve a number of purposes including assessing areas contiguous to the proposed development that may also be within its zone of influence. There is now evidence suggesting that 4km is likely be an underestimate of the true extent of the displacement, though assuming a magnitude of 100% out to 4km is likely to be an over-estimate. Therefore, when considering impacts on regional or biogeographic populations at the EIA scale, the use of the two components of our current advice (a conservative estimate of extent and a precautionary estimate of magnitude within that extent) in combination, is considered to provide an appropriate estimate for EIA assessment, based on our current understanding of the evidence base.			Therefore a full and robust assessment needs to be undertaken, using a series of 1km buffers out to at least 10km (at a workshop with the Applicant on 28th July this was agreed to extend out to 12.5km) for both EA1N and EA2 and other plans and projects causing displacement effects on the SPA, including all operational windfarms within 10km of the SPA. This needs to consider both the absolute area of habitat within likely zones of influence around each development over which usage levels by divers will be reduced due to the displacement effect, and the number of divers estimated to be displaced by EA1N/EA2. Also, for existing OWFs within the SPA the relative abundance of divers within the OWF and buffers before and after construction should be estimated. This will help to inform consideration of the impact of the recommended mitigation of moving the arrays away from the SPA, and to properly assess the existing extent of displacement and these projects' contribution to them. <u>General points on the Appropriate Assessments</u> As stated in our relevant representations/written representations [RR-059] the revised assessments need to be made in the context of the Conservation Objectives for the OTE SPA. The conservation objectives for the OTE SPA are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:		Analysis of data collected in the German Bight (Vilela et al, 2020)[3] has found reduced densities up to 10km from windfarms, however this observation cannot be categorically ascribed to the presence of the windfarms. Furthermore, the authors of the study make it clear that they do not consider their finding is automatically applicable to other locations. Regarding the inclusion of the Greater Gabbard and Five Estuaries extension projects in the cumulative displacement assessment, this issue was discussed at the workshop on the 28th of July and it was agreed that it was not appropriate to consider these projects in line with agreed cumulative Impact assessment methodology and PINS Advice Note 17: Cumulative Effects Assessment.

[3] Vilela, R., Burger, C.,Diederichs, A.,Nehls, G., Bachl, F., Szostek, L., Freund,A.,Braasch, A., Bellebaum, J., Beckers, B., Piper, W. (2020). Final Report: Divers (*Gavia spp*.) in the German North Sea: Changes in Abundance and Effects of Offshore Wind Farms. A study into diver abundance and distribution based on aerial survey data in the German North Sea. BioConsult Report prepared for Bundesverband der Windparkbetreiber Offshore e.V.

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	There is a strong and growing body of evidence that red-throated divers are displaced from areas of sea within OWFs and from the waters in their vicinity. There is no evidence to date of habituation. Although the distance around OWFs within which changes in the abundance of divers have been detected appears to vary between developments, in many studies the displacement effect can be detected well beyond the 4km distance which is typically used to inform baseline characterisation, including 8km (Webb and others 2017), 10km (Heinanan and others 2016), 13km (Petersen and others 2014). Mendel and others (2019) reports displacement up to 20 km from OWFs, with significant changes in densities at a distance of 16.5 km and the greatest changes in abundance within 10 km. Whilst we acknowledge that the level of displacement will not be 100% outside of the array itself and will likely show a gradient of diminishing effect with increasing distance from it, this body of evidence clearly demonstrates that displacement does occur beyond 4km (the extent of the buffer assumed in the SNCB displacement advice published in 2017). Therefore, in the context of SPA impact assessment (as opposed to EIA scale assessment), Natural England's current advice is that displacement effects are likely to occur up to 10km from the development and consequently the location of the array will result in a permanent or long term change in distribution of divers within the SPA as a result of the proposal. The Applicant acknowledges that, without modification, the project is likely to change the local distribution of red - throated divers in the part of the SPA in the vicinity of the proposed development. A change in distribution of divers on a continuing basis would not be consistent with fulfilling the conservation objectives for the OTE SPA. As the extent of available supporting habitat within the SPA will not be maintained as a result of the project alone, an AEOI cannot be ruled out. As a result, Natural England's advice is that in order to avoid an AEOI on the OTE SPA, the boundary of EA1N should be amended to ensure an adequate distance between the array and			the extent and distribution of the habitats of the qualifying features the structure and function of the habitats of the qualifying features the supporting processes on which the habitats of the qualifying features rely the populations of each of the qualifying features the distribution of qualifying features within the site The supplementary advice on the site's conservation objectives describes the range of ecological attributes that are most likely to contribute to a site's overall integrity. The outputs of these assessments should therefore be considered with respect to the following attributes: Attribute / Target Disturbance caused by human activity / Reduce the frequency, duration and / or intensity of disturbance affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed. Non-breeding population: abundance / Maintain the size of the non-breeding population at a level which is at or above 18,079 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent (our emphasis). Supporting habitat: extent and / Maintain the extent, distribution and availability of suitable		

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	the SPA, so as to minimise or avoid the re-distribution of divers within the SPA due to displacement. Of relevance to this advice, we note that the approach adopted by The Crown Estate when refining the boundary of the Round 4 Wash leasing region was to ensure no new proposed windfarms were within 10km of the Greater Wash SPA, based on a report from MacArthur Green (Furness and others 2019). The Report states "Since offshore wind farms can displace red-throated divers up to distances that in the extreme cases exceed 10km from the turbine, it may be prudent to trim the inshore boundary of Regions 3 and 4 so that these are a minimum of 10km from the outer edge of Greater Wash SPA." The 10km distance from the SPA is set as a minimum value by MacArthur Green on the basis that several studies that it cites show values that exceed 10km. This conclusion is in line with a recent study by Diershcke and others (2016) which highlights strong evidence for displacement beyond 10km. Natural England advises that a similar approach to the one taken by The Crown Estate in respect of the Wash Strategic Area for Round 4 be applied to EA1N and EA2. In other words, to rule out the risk of displacement impacts on red - throated diver in the OTE SPA, the boundary of the array should be set an appropriate distance from the SPA (i.e. a minimum of 10km).			distribution of supporting habitat for the non-breeding season	habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) at the following levels: Subtidal sand (220,295.55); Subtidal coarse sediment (73,606.64); Subtidal mixed sediments (62,100.63 ha); Subtidal mud (12,549.14 ha); Circalittoral rock (335.2 ha); and Water column. The assessment should also fully consider the impacts of the construction phase (including cable installation) and Operation & Maintenance (O&M) works, in additional to effects from the array itself. This should consider vessel movements (including cabling vessels) and helicopter traffic. This will involve considering O&M works for the existing offshore windfarms where relevant. <u>Assessing impacts from EA1N/EA2</u> <u>Alone</u> The first step is to determine what the full impact of displacement from EA1N/EA2 alone may be. This will require considering displacement effects beyond the 4km buffer currently considered in the Environmental Statement. Assuming that displacement effects extend only to 4km from the proposed array predicts impacts affecting 33.2km^2 of the OTE SPA, which represents 0.88% of the SPA area. However, when using a 10km buffer around the array the overlap with the SPA is 121.40 km^2, which represents 3.09% of the SPA that will be subject to some degree of displacement.		

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				We acknowledge that displacement will not be 100% throughout the distance over which displacement effects occur, and there will be a gradation of displacement which will decrease with distance from the windfarm. Nevertheless there is a growing body of evidence that displacement of RTD occurs at distances much greater than in earlier studies, which were limited by the size of the study area and/or use of inappropriate survey platform (boat- based surveys). As noted above, the recent BioConsult report (Vilela et al. 2020) estimating diver displacement in the German North Sea calculated a displacement distance in spring of 10.2km. The German Bight study was based on the entire study area and for all available data over an 18 year period. This, in tandem with other studies with a suitably extensive survey area, provides a robust evidence base for displacement occurring up to and beyond 10km from operational windfarms. Vilela et al. (2020) does caution that the available results can only be transferred to other areas outside the study area to a very limited extent, and therefore need to be tested on a case by case basis, but does provide evidence that divers are displaced up to 10km. This is consistent with the MacArthur Green report to The Crown Estate (Furness 2019) which advised that new offshore windfarm leasing areas should be a minimum of 10km from the outer edge of Greater Wash SPA, and the latest evidence from the OTE SPA. Natural England has recently provided comments on the draft final year post- construction ornithological monitoring report for London Array OWF, during which displacement effects have been detected out to 11.5km from the Array. Therefore we advise that an assessment is undertaken, based on the assumption of displacement occurring up to at least 10km		

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				(12.5km would be appropriate on the basis of the Heinanen at al 2020, which found displacement effects out to 10-15km, and 12.5km is the midpoint). We acknowledge that the range of displacement within each 1km band from the proposed windfarm will decrease the further the distance from the windfarm, and a range of displacement within each 1km. As agreed at the workshop on 28th July 2020 the Applicant will undertake the assessment out to 12.5km. Assessing impacts against current levels of displacement from constructed offshore windfarm projects It is important to consider what the additional displacement from this project will add to the current level of in-combination displacement from operational projects within the SPA, particularly in the absence of a Review of Consent for the OTE SPA covering all these projects. Natural England are already of the view that an AEoI on the OTE SPA cannot be ruled out (Natural England's response to BEIS dated 24th May 2013). Therefore in addition to an AEoI alone from EA1N, additional displacement from EA1N/EA2 will only increase the likelihood of an in-combination AEoI arising due to the conservation objectives relating to the distribution of divers not being fulfilled. The survey data that informed the current boundary of the SPA was based on surveys undertaken before most of the relevant OWFs were constructed. This fact, together with Natural England's advice that an AEoI cannot be excluded from existing windfarms, means it is crucial that the Examining Authority has a clear understanding of the existing level of impacts from the operational windfarms, in order to then consider in-combination effects. We advise that an assessment of the level of displacement		

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				from the projects that are now operational are considered including: London Array Gunfleet Sands I,II and III Kentish Flats and Kentish Flats Extension Greater Gabbard Thanet. The outputs should be considered in-combination with those from the EA1N/EA2 assessment and with reference to the relevant Conservation Advice attributes. Evidence from existing windfarms indicates that an AEoI in-combination from existing OWFs cannot be ruled out. For the OWFs within the SPA the total windfarm footprint area alone equates to 4.2% of the SPA being affected by displacement, with a 2km buffer it is 9.9%, with a 4km buffer it is 17.7% and with a 10km then 47.43% of the SPA is subject to some degree of displacement. Therefore it is our view that based on the scale of the existing impacts an AEoI cannot be excluded from the additional loss of supporting habitat as proposed by the EA1N and EA2 projects. Therefore, we consider there being limited benefit in undertaking an assessment of the change in distribution of actual numbers of divers. As discussed at the meeting on 28th July 2020, as the Applicant wants to consider numbers of divers displaced, Natural England is content to see the assessment based on both area affected and numbers of birds displaced. As the analysis of numbers of divers is planned in addition to determining the area affecting RTD distribution and the quantification of reduced availability of supporting habitat, Natural England advises that the gradation is based on the figures on an average of distances from published studies (Webb et		

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				al.2017; Vilela et al. 2020), assuming a gradient out to zero displacement at 12.5km. In-combination assessment with other plans and projects We note that the only project 'in planning' which is considered by the Applicant is the Sizewell C power station. It should also be noted that some projects are planned but not yet in the planning system, e.g. Greater Gabbard Extension. The location of the proposed 'extensions' are known, therefore it is possible to include such projects in the assessment of total area of SPA affected and numbers of RTDs displaced, based on the datasets held by JNCC and Natural England that have been provided to SPR.		
2	Natural England notes that the level of vessel traffic associated with site maintenance has been quantified but consideration of the impact of this element has not been further considered. The operation of the site will necessitate an increase in the number of vessel journeys through the SPA, involving both boats and helicopters. As both have the potential to be disturbing to red-throated diver the impacts of these need to be considered and where appropriate mitigated.		The operation and maintenance port has not been confirmed at this stage. However, it is clear from consideration of the existing volume of shipping traffic through the region (***Chapter 14 Shipping and Navigation***, ***Appendix 14.2*** (APP-475) and ***Figures 14.3*** (APP-237) and ***14.4*** (APP-237)) which includes the Outer Thames Estuary SPA, that the addition of vessels transiting to and from the port and the windfarm (less than two vessel round trips per day) will have a negligible effect on the levels of shipping disturbance over and above the average of 71 vessel movements per day recorded within the shipping and navigation study area. NE have indicated for this Project and previous projects that, notwithstanding the low additional volumes of vessel traffic, they consider there is still the potential for an adverse effect due to operation and maintenance vessel movements. However, NE have also advised that implementation of best practice guidance (as proposed by NE) on vessel operation whilst transiting the Outer Thames Estuary SPA during sensitive periods of the year (i.e. the red-throated	As the location of the O&M port is not known at this stage, Natural England recommends that the Applicant commits to mitigating impacts from vessels in future by commitment to best practice vessel movements through the SPA with regard to birds such as RTD, including for example(as was done by Norfolk Vanguard and Norfolk Boreas): Avoid and minimise maintenance vessel traffic, where possible, during the most sensitive time period for RTD i.e. between November and March inclusive. Restrict vessel movements where possible to existing navigation routes. Avoid over-revving of engines (to minimise noise disturbance). Avoid rafting birds either in-route to array from operational port and/or within the array (dependent on location) and where possible avoid disturbance to areas with consistently high diver density.		The Applicants will include the measures suggested by NE and the measures outlined by the Applicants in the original response in a best-practice protocol for minimising disturbance to red-throated divers during construction and operation. This will be adopted and will be provided as part of the project environmental management plan to be approved by the MMO in consultation with NE and secured under condition 17 of the generation DML and condition 13 of the transmission DML.

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			diver nonbreeding season, or key parts thereof) will remove the likelihood of an adverse effect on the integrity of the Outer Thames Estuary SPA red-throated diver population. A best-practice protocol for minimising disturbance to red-throated divers during construction and operation will be adopted and will be provided as part of the project environmental management plan to be approved by the MMO and secured under condition 17 of the generation DML and condition 13 of the transmission DML. Once further information is available about the port(s) that will be used for construction, operations and maintenance, then appropriate vessel traffic management measures including, where relevant, some or all of the below best practice examples can be formulated in agreement with the MMO and NE: Restricting vessel movements to existing navigation routes (where the densities of divers are typically relatively low); Where it is necessary to go outside of established navigational routes, selecting routes that avoid known aggregations of birds; Maintaining direct transit routes (to minimise transit distances through areas used by divers); Avoidance of over-revving of engines (to minimise noise disturbance); and, Briefing of vessel crew on the purpose and implications of these vessel management practices (through, for example, tool-box talks). Whilst the operational impact was not assessed, it can be considered in relation to the assessment undertaken for cable laying. ***Section 4.3.1.2.2*** of the ***Information to Support Appropriate Assessment Report*** (APP-043)) assesses the displacement			

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			during construction from two cable laying vessels operating simultaneously. For the purposes of the assessment it is assumed that these vessels are effectively stationary and therefore cause a constant displacement effect which (using NE's precautionary 100% displacement and 10% mortality rates) leads to annual mortality of up to 9.5 individuals. This results in an increase in background mortality by a maximum of 0.21 to 0.72% which would not result in an AEoI (see ***section 4.3.1.2.2*** of the ***Information to Support Appropriate Assessment Report*** (APP-043)). Also, note the Applicant's response to Point 5 of Offshore Ornithology below detailing additional precaution regarding the duration of cable laying activity. NE is in agreement that the assessed cable laying effects do not represent an AEoI. Given that displacement impacts from cable laying vessel activity within the SPA would be of a higher magnitude than maintenance vessel impacts (as they are assessed as effectively stationary vessels) the Applicant considers that maintenance vessel trips would not result in an AEoI. If used, helicopters are a potential source of disturbance to red throated diver in the Outer Thames Estuary SPA. The minimum safe altitude for helicopters operating offshore is 1,000 feet above the highest known obstacle (i.e. wind turbine blade tips) within 5nm. It is considered that at these altitudes that any disturbance caused by the visual presence or noise of helicopters will be minimal and will not result in significant disturbance of red-throated diver.			
3	Natural England agrees that assuming a 100% displacement in a 2km buffer around the cable laying vessel is a reasonable approach. Whilst the level of displacement affecting up to 3.5% of the OTE SPA area would be significant, we do acknowledge that the		***Section 4.3.1.2.2*** of the ***Information to Support Appropriate Assessment Report*** (APP-043) assesses the displacement during construction from two cable laying vessels operating simultaneously. For the	Natural England's view is that an AEoI on OTE SPA from in-combination effects from operational windfarms cannot be ruled out. Therefore any further additional impacts should be avoided wherever possible.		The Applicants will continue to engage with NE on this.

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	displacement is short-term. We also note however that given the time this will take (identified in paragraph 213 as being 110 days) there is the potential to carry out this activity during the part of the year when red-throated divers are not present and so would not be exposed to displacement risks associated with this activity.		purposes of the assessment it is assumed that these vessels are effectively stationary and therefore cause a constant displacement effect which (using NE's precautionary 100% displacement and 10% mortality rates) leads to annual mortality of up to 9.5 individuals. This results in an increase in background mortality by a maximum of 0.21 to 0.72% which would not result in an AEoI (see ***section 4.3.1.2.2*** of the ***Information to Support Appropriate Assessment Report*** (APP-043)). Also, note the Applicant's response to Point 5 of Offshore Ornithology below detailing additional precaution regarding the duration of cable laying activity. NE is in agreement that cable laying effects do not represent an AEoI for the project alone and therefore the Applicant considers that a seasonal restriction on cable laying is not required. Additionally, whilst the duration of export cable installation programme is relatively short, it does comprise a number of independent activities including; any requirements for sand wave levelling; pre-lay grapnel run, near-shore works associated with the HDD punch out location and placement of mattresses / cable protection over existing cables at crossing locations. Delays to any of the activities, for example, due to inclement weather, could result in cable installation not being completed within the summer period and works having to be stood down until the following summer. This would present a significant risk to completing the construction programme on time and meeting Contract for Difference (CfD) contractual milestones for delivery of first power.	Although Natural England agree that it is unlikely that there will be an AEoI from offshore export cable laying from the project alone, it does not follow that no seasonal restriction is required, particularly given the existing pressures the SPA is subject to. We therefore maintain that cable laying should be restricted to avoid the key period when the largest numbers of RTD will be present, i.e. November to March.		

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4	Natural England notes that the Applicant states that the 4km buffer has an overlap with the SPA of 33.2km^2 which represents 0.88% of the SPA. As the Applicant acknowledges, without modification the project would potentially change the local distribution and abundance of red-throated diver in this section of the SPA. As outlined in Point 1 above, this would not be consistent with fulfilling the Conservation Objectives for the OTE SPA, and recent studies have revealed that displacement extends to at least 10km. When using a 10km buffer around the array the overlap with the SPA is 121.40 km^2, which represents 3.09% of the SPA.		The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 1 above.		See the Applicants' response to Point 1 of offshore ornithology above. The Applicants have undertaken analysis of survey data collected in the Outer Thames area between 2002 and 2018 and the results will be submitted at Deadline 3, following consultation with NE and the RSPB. This analysis indicates that the maximum extent of potential displacement within the Outer Thames Estuary SPA is 7km, not 10km as reported elsewhere, and that the peak mean magnitude of displacement from the windfarms themselves is around 33%. Thus, the mean displacement effect decreases from 33% at 0km to 0% at 7km and clearly indicates that a 10km buffer is not appropriate and also that the exclusion is not absolute since birds remain present in the windfarms, albeit at reduced densities. A similar finding has recently been reported from monitoring of the London Array windfarm (Appendix 2). Thus, presenting estimates of how much area lies within the various buffer distances of the windfarms as an indication of the extent of displacement, considerably overestimates the effective magnitude of displacement by a considerable margin.
5	Natural England agrees with the conclusion that there is likely to be no adverse effect alone as a result of red-throated diver displacement due to cable laying. Our conclusion is based on the fact that the cable laying operations are of a temporary nature. However, given Natural England's view that we are already unable to rule out AEOI in-combination from displacement as a result of disturbance within the SPA, we maintain that a seasonal restriction in cable laying activity should put be in place to minimise the effects on red-throated diver.		Notwithstanding NE's concerns on wider in-combination displacement, the Applicant considers that the statement in **section 12.6.1.1.1 of *Chapter 12 Offshore Ornithology*** (APP-060) remains valid - on the basis that *"a maximum of 10 [rounded from 9.5] birds would die as a result of displacement over this period, a seasonal restriction is not considered to be justified (or proportionate)…in addition to the measures set out in the best practice protocol for red-throated divers"* Where applicable, best practice vessel management as described in the best practice protocol for red-throated divers will apply for cable laying vessels.	As stated under Point 3 above, given Natural England's view that we are already unable to rule out AEoI in- combination from displacement as a result of disturbance within the OTE SPA, we maintain that a seasonal restriction in cable laying activity should put be in place to minimise the effects on RTD.		See the Applicants' response to Point 3 of offshore ornithology above.

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			Furthermore, the worst case assessment of 10 (rounded from 9.5) mortalities would occur in a single winter season, and the mortality would only reach this level if all of the worst case parameters advised by NE are applied, i.e. 100% displacement, 10% mortality and cable laying within the SPA extending for the entire winter. Since the cable laying vessels will move at between 80-300m/hr, with an assumed 12 hour working day, the vessel will traverse the 25km of SPA in the cable route in 7 to 20 days. The winter period defined for red-throated divers is defined as approximately 240 days. Therefore, on the basis of the realistic duration of works, the precautionary assumption that this impact would last for the whole non-breeding season over-estimates the impact magnitude by 9 to 35 times. Thus, just on the basis of the time the vessels are expected to be present in the SPA, the worst case mortality of 10 is more likely to be no more than 0.3 to 1.1 individuals.			
6	Natural England does not agree with the Applicant's estimate that up to 33 individuals will be displaced within the SPA by the proposed EA1N project. Firstly, the extent of displacement effects is known to extend to beyond 10km, and therefore assuming that displacement effects only go out to 4km (even if assuming 100% displacement within that area) means the impacts are potentially underestimated. In addition, the permanent loss of the availability of SPA supporting habitat, due to the presence of the windfarm means the conservation objectives to maintain the extent of supporting habitat will not be met. If a 10km buffer is used, based on the recent OTE survey data Natural England calculates that 70 individuals would be displaced		The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 1 above.		See the Applicants' response to Point 1 of offshore ornithology above. It should be stressed that NE's statement: '*the extent of displacement effects is known to extend to beyond 10km*' overstates the evidence. Analysis of data collected in the German Bight (Vilela et al, 2020)[4] has found reduced densities up to 10km from windfarms, however this observation cannot be categorically ascribed to the presence of the windfarms. Furthermore, the authors of the study make it clear that they do not consider their finding is automatically applicable to other locations. It is also important to note that the analysis conducted by the Applicants has not found 100% displacement even within the windfarms in the SPA itself. Thus,

[4] Vilela, R., Burger, C.,Diederichs, A.,Nehls, G., Bachl, F., Szostek, L., Freund,A.,Braasch, A., Bellebaum, J., Beckers, B., Piper, W. (2020). Final Report: Divers (Gavia spp.) in the German North Sea: Changes in Abundance and Effects of Offshore Wind Farms. A study into diver abundance and distribution based on aerial survey data in the German North Sea. BioConsult Report prepared for Bundesverband der Windparkbetreiber Offshore e.V.

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						since displacement is predicted to be, at worst, only partial this will not represent '*permanent loss of the availability of SPA supporting habitat'.* Further information on this topic will be submitted at Deadline 3.
7	The focus on predicted mortality and the effect this would have on the abundance of red-throated divers within the SPA is not the only issue for assessing impacts on the SPA. As stated previously, the change in distribution of divers due to the close proximity of the proposed array to the OTE SPA also needs to be considered. Moreover, it is worth noting that the mortality rates are a relatively crude method of capturing a range of potentially deleterious effects that could arise from displacement, including reduced fitness for migration and reduced productivity during the breeding season. Therefore, we advise that further consideration is given to this matter.		The Applicant agrees that the application of mortality rates (as advised by NE) is a crude approach for considering the potential impacts of displacement. Furthermore, it is also the most precautionary, since impacts on adult survival for relatively long-lived, slow breeding species such as this will always have the greatest effect on the population. The other effects noted by NE (e.g. reduced reserves for migration or reproduction) will all have much lower overall impacts on the population. The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 1 above.		See the Applicants' responses to Points 1, 4 and 6 of offshore ornithology above.
8	As stated by the Applicant, there is a requirement to maintain the extent and distribution of supporting habitats for the designated species. Natural England does not agree with the statement that "this requirement is not strictly at risk". Although the turbines themselves are not proposed to be constructed within the SPA, the supporting habitat will be directly affected because red-throated diver avoid areas in the vicinity of wind turbines, even when they are many kilometres away. There will be a change in the distribution of qualifying features (i.e. red-throated diver) within the site local on a continuing basis, and consequently a change in availability, extent and distribution of the habitats of the qualifying features. Therefore, Natural England advises that an AEOI cannot be ruled out beyond reasonable scientific doubt for the project alone.		The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 1 above.		See the Applicants' responses to Points 1, 4 and 6 of offshore ornithology above.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
9	There are in-combination effects from operational windfarms within the SPA. As noted by the Applicant, low densities within existing operational windfarms reported in Irwin and others (2019) provides evidence of the impact of operational windfarms on the distribution of red-throated divers within the SPA.Natural England is already of the opinion that an AEOI of the red-throated diver population of the OTE SPA cannot be ruled out beyond all reasonable scientific doubt, as a result of the scale of in-combination displacement due to consented and operational projects within the SPA (Natural England, 2019). Our advice remains that AEOI in-combination cannot be ruled out. Any additional effects in terms of reduced habitat availability and changing the distribution of red-throated diver within the SPA as a result of EA1N will only add to in-combination impacts.		The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 1 above.		See the Applicants' responses to Points 1, 4 and 6 of offshore ornithology above.
10	Natural England acknowledges that the estimates of the red-throated diver population in the OTE SPA have recently increased significantly. Although there is a possibility that this reflects a real increase in abundance over time, this increase is most likely to be due primarily to the change in survey platform, moving from visual aerial to digital aerial surveys which have much higher detection rates, and fly at a higher altitude and are therefore less disturbing. In any event, in addition to considering the objective of maintaining abundance, it is important that the extent of available habitat within the SPA is maintained.		The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 1 above.		See the Applicants' responses to Points 1, 4 and 6 of offshore ornithology above. The Applicants dispute NE's interpretation of the increasing abundance of divers reported for the SPA. While it is agreed that there has likely been some improvement in detection rates, it seems very unlikely that this has resulted in the three-fold increase in the abundance estimate. Therefore the Applicants disagree with NE's position that '*there is a possibility that this reflects a real increase in abundance over time*' and consider that rather than this being a 'possibility' it is the much more likely source of the majority of the observed increase.
11	Based on the predicted reduction in the availability of supporting habitat within the SPA, Natural England concludes that AEOI of the OTE SPA due to loss of habitat as a consequence of displacement of red-throated divers from the EA1N windfarm alone cannot be ruled out beyond reasonable scientific doubt. As stated in point 8, Natural England is already of the opinion that an AEOI of the OTE SPA cannot be ruled out beyond all reasonable scientific doubt due to the scale of in-combination displacement of red-throated diver due to consented and operational projects within the SPA.		The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 1 above.		See the Applicants' responses to Points 1, 4 and 6 of offshore ornithology above.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
2 Collision Risk Modelling (CRM) parameters. **Document used: 6.1.12 EA1N Environmental Statement Chapter 12 Offshore Ornithology, 6.3.12.2 EA1N Environmental Statement Appendix 12.2 Ornithology Technical Appendix, 5.3 EA1N Information to Support the Appropriate Assessment Report**						
12	Natural England welcomes that the Applicant has incorporated uncertainty in seabird density, collision avoidance rates, flight heights and nocturnal activity in their collision assessments. This has been undertaken using the Band (2012) model and presenting multiple tables of the outputs using the variations in the various parameters, as presented in Annex 4 of Appendix 12.2 of the submission documents. Whilst we welcome that the Applicant has considered the uncertainty/variability in this way, we note that this does not allow the uncertainty/variability in the various input parameters to be fully integrated. Therefore, we recommend that if the Applicant undertakes any further collision risk modelling that this is undertaken using the Marine Scotland Science (MSS) stochastic collision risk model (sCRM), and that the log file produced by the sCRM is also included. We note that there are ongoing issues with the sCRM tool which need to be addressed, so we accept that the use of the sCRM tool is dependent on any coding errors in the tool being rectified.		Noted. The Applicant will continue to monitor the status of the MSS sCRM model throughout the examination period.	It is noted that the Applicant will continue to monitor the status of the MSS sCRM model throughout the examination period, which is prudent. Natural England anticipates in future to recommend use of the MSS sCRM, but until we have established the appropriate values for key parameters including avoidance rate we currently recommend the use of deterministic models. However, due to the considerable uncertainty/variability in the input parameter values used in the CRM, and in the model itself, to allow a robust assessment of potential collision impacts on populations it is important to take account of this uncertainty where possible and to indicate the range of confidence around the collision estimate. Therefore Natural England advises that for the key input parameters of monthly bird density, flight height, avoidance rate, and nocturnal activity factor, uncertainty around the parameter estimates should be considered on an individual parameter basis. This gives an indication of which parameters might have the most influence on the prediction of collision risk, recognising that individually these will not reflect the effect of uncertainty across all parameters.		The Applicants are not aware of any further updates to the MSS sCRM. The Applicants also notes the parameters upon which NE has advised upper and lower estimates should be used in the collision modelling (and which were provided in the Projects' CRM results; APP-470). The Applicants also note that for other recent windfarm assessments NE has only considered the outputs using the upper and lower seabird densities on the basis that these have the widest range and therefore generate the highest and lowest upper and lower estimates. This was also the case for the Projects and hence, to simplify the assessment it is proposed that when updated modelling is provided it will present mean estimates (derived using the mean value for all parameters) and upper and lower values derived using the upper and lower densities and the mean value for all other parameters. This is the same approach that has been used for the Norfolk Vanguard and Norfolk Boreas windfarms and which NE has agreed is appropriate. There have been no further updates by the Applicants.
13	Natural England notes that the Band model (2012) and CRM Option 2 has been used. Use of Option 2 was accepted by Natural England during the Evidence Plan process in preference to Option 1 of the model, after it was communicated that APEM had no confidence in the site specific flight heights derived from digital aerial methods. The main assessment		The Applicant has undertaken assessment of collision risks using option 2 of the Band (2012)[5] collision risk model. Use of this model option was agreed in consultation with NE and the RSPB through the Evidence Plan Process (see ***Appendix 12.1*** of ***Chapter 12 Offshore Ornithology*** (APP-060) and followed advice from the digital	We acknowledge that the use of option 2 of the Band (2012) collision risk model, which uses generic Potential Collision Height data, was agreed in consultation with NE and RSPB.		Noted.

[5] Band, W. (2012) Using a collision risk model to assess bird collision risks for offshore wind farms. The Crown Estate Strategic Ornithological Support Services (SOSS) report SOSS-02. SOSS Website. Original published Sept 2011, extended to deal with flight height distribution data March 2012

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
	does not consider the CRM predictions from the Band Option 1 outputs, only those for Option 2. We note that in Annex 4 of Appendix 12.2 that the results using Option 1 are presented in Tables 21 and 22. The % Potential Collision Heights (PCHs) for these species from the site-specific data are significantly higher than those from the generic data, and the resulting CRM predictions are considerably higher than those from Option 2 (e.g. 57.99 kittiwake collisions from Option 2 compared to 261.79 from Option 1 for the central input values). Natural England acknowledges the concerns of the aerial survey contractors over the aerial survey data flight height figures, noting this was also the case at Thanet Extension, where aerial survey data flight height figures were also significantly higher than the generic flight heights. However, this dataset emphasises the critical importance of considering potential variability in flight heights when assessing collision risk impacts, rather than assuming the central input value necessarily represents the 'most likely' impact. Accordingly, we recommend that the Applicant takes a more narrative approach to the assessment, and considers the Option 1 outputs for the above species in the context of the relevant Option 2 95% CIs, as part of a more range-based approach to consideration of CRM impacts. This should not just consider the mean/central predicted collision figures, but also those based on the range of predicted figures resulting from the Applicant's consideration of the uncertainty/variability in the input parameters.		aerial surveyor that their method to estimate seabird flight height was insufficiently robust to be relied upon for use in the site specific (i.e. option 1) version of the Band model. Consequently, the Applicant does not consider that the option 1 collision estimates should be used in the assessment and this had been agreed with stakeholders. The collision assessments presented confidence intervals around the mean predictions derived from upper and lower 95% confidence intervals on the seabird density estimates, avoidance rates and generic flight heights (APP-470) and of these the estimates around density, which are the widest and therefore most precautionary, have been considered in the assessment (e.g. through assessment of the change in background mortality expected for the mean, lower and upper estimates). Therefore, the Applicant considers that the collision assessment has given full consideration to the uncertainties in the input parameters and these have been presented in an appropriate manner.			
14	It is of concern that the predicted mortalities using CRM Option 1, based on site specific estimates of PCH are significantly higher than the outputs using Option 2, which is based on generic boat based estimates of flight height.		The Applicant provided the option 1 collision estimates at the request of NE but, as noted in response to the previous comment, they are not considered reliable and have not been considered in the assessment, as agreed with NE during the Evidence Plan Process (EPP).	We accept the use of Option 2 in the assessment, but advise that the Applicant's assessment still needs to consider that this approach may be underestimating potential collision. There is clearly an issue with the collection of accurate evidence on site- specific flight heights of seabirds, which highlights the need to collect real evidence on actual collisions. This lack of evidence also highlights the need for consideration of		The Applicants would support opportunities for strategic research into methods to more accurately understand the localised flight heights of seabirds. Regarding mitigation, the Applicants have committed to an increase in air draught height of 2m from 22 to 24m above mean high water springs (MHWS). As demonstrated in the Updated Cumulative and In-combination Collision Risk Assessment (REP1-047), the 2m increase in air draught reduces the mortalities for kittiwake and lesser black-backed gull by 11% (East Anglia TWO)-16% (East Anglia ONE North) and 10% (East Anglia

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
				mitigation through raising turbine draught heights by as much as is possible.		TWO) 12% (East Anglia ONE North) below those assessed in the ES respectively. Moreover, when these reductions are combined with the reductions achieved from SPR's NMC applications at its sister projects EA1 and EA3, the cumulative mortalities associated with EA2, EA1N, EA3 and EA1 reduce by 24% and 26% below those assessed in the ES for kittiwake and lesser black-backed gull respectively (see ***Table 2*** in REP-047).
15	Natural England welcomes that the SNCB recommended Avoidance Rates have been used.		Noted.	No response required.		No response required.
16	Natural England acknowledges that evidence from the ORJIP collision avoidance study indicates that Avoidance Rates for gannet may be higher than the Avoidance Rates currently recommended by the SNCBs. Natural England are content for the inclusion of Avoidance Rates from Bowgen & Cook (2018) within impact assessments, provided that they are presented alongside outputs based on the SNCB recommended Avoidance Rates.		Noted. The avoidance rates on which the conclusions of the assessment are based are those recommended by NE. However, where appropriate, collision estimates using the Bowgen & Cook (2018)[6] gannet avoidance rate are presented alongside these.	No response required.		No response required.
17	Natural England recognises from recent evidence presented by the Applicant that nocturnal activity levels for some species may be lower than the levels that equate to the nocturnal activity factors currently used in CRM. However, we also note that there is uncertainty about the empirical activity levels and uncertainty about how these might translate into nocturnal factors applicable to the Band model. Nevertheless, we do note and welcome that the Applicant has considered the range of Natural England advised nocturnal activity factors to be used with the Band (2012) and therefore we will consider the predicted impacts on the basis of the Natural England recommended rates for all species.		Noted.	No response required.		No response required.

[6] Bowgen, K. and Cook, A. (2018). Bird Collision Avoidance: Empirical evidence and impact assessments. JNCC Report No. 614, JNCC, Peterborough.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
18	Natural England welcomes the use of our recommended Avoidance rates and nocturnal activity factors, and accept that there is an argument to present the Applicant's preferred options alongside. However, given the significant difference in predicted mortality when Option 1 is used, we advise suggest that this demonstrates that overall assessments of collision risk may not be precautionary enough. The fact that predictions would be significantly higher using Option 1 adds strength to the argument that hub height should be increased to reduce the collision risk as much as possible.		The Applicant again notes the responses made to the previous comments (on the unreliability of the flight height estimates on which the option 1 estimates are based) and stresses that these figures should not be considered in the assessment. As a consequence, the Applicant disagrees that the value of the option 1 estimates indicates a need for increased precaution, since the estimates are known to be unreliable to an unknown extent.	Ongoing disagreement		The Applicants have nothing to add. It was understood that this matter was closed on the basis that the use of Option 2 was agreed through the EPP.
3. Cumulative and In-combination Assessments **Documents used: 6.1.12 EA1N Environmental Statement Chapter 12 Offshore Ornithology (Paragraph numbers given refer to this document),6.3.12.3 EA1N ES Appendix 12.3 Supplementary Information for the Cumulative Impact Assessment.**						
19	Natural England advises that the cumulative operational displacement assessment totals for red-throated diver are based on an incomplete data set. Table 12.37 excludes a number of projects including Gunfleet Sands, Kentish Flats, Kentish Flats Extension, London Array and Scroby Sands. These missing projects will reduce the confidence in the assessments and result in a significant under-estimation of the cumulative/in-combination assessments.		As shown in ***Table 12.3.7*** of ***Appendix 12.3 of Chapter 12 Offshore Ornithology*** (APP-471), the cumulative assessment presented no displacement mortality estimates for these projects either because red-throated diver was a) not assessed in these windfarm assessments or b) only a qualitative assessment was presented. Therefore, it was not possible to include these projects in the Applicant's red-throated diver cumulative assessment. It should be noted however, that the SeaMast dataset which has informed the assessment takes into account these projects given that the surveys were conducted while these projects were operational.	We advise that it is still possible to undertake a cumulative RTD displacement assessment that includes all relevant projects even when figures are not presented in the individual Environmental Statements. An assessment similar to the EIA assessment presented at Thanet Extension could be undertaken, where a relative comparison using a single density surface, like SeaMaST is used, and shapefiles of individual windfarms and buffers are overlaid. The dataset in SeaMaST does not pre-date the projects listed (with the exception of Scroby Sands). We therefore advise that a thorough EIA cumulative assessment is undertaken, including all relevant projects.		See the Applicants' response to Point 1 of offshore ornithology above. The Applicants also highlight that the requested assessment ('*An assessment similar to the EIA assessment presented at Thanet Extension*') was provided in ***Table A12.3.10*** of ***Appendix 12.3*** (APP-471). Therefore, the Applicants consider that the assessment requested by Natural England, including all relevant projects, has already been provided.
20	Natural England advises that the comparative approach to red-throated diver displacement assessment is welcomed. In Appendix 12.3,Table A12.3.9 it is noted that only five of the 38 projects listed have a higher relative contribution than EA2, and these (London Array, Gunfleet Sands, Kentish Flats and Scroby Sands) four are constructed within the OTE SPA.		The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 1 above.		See the Applicants' responses to Points 1, 4 and 6 above.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
21	The disproportionate contribution that EA1N makes is clear in Table A12.3.9. EA1N alone contributes 9.1% of the cumulative total, whereas all other Tier 4 projects combined (i.e. excluding EA1N) contribute 5.6% of the relative contribution to potential displacement. Although the approach considering the relative contribution to the cumulative total is helpful, and identifies that EA1N does not make a significant, it does not adequately consider the overall level of cumulative displacement. This is due to displacement from a number of projects not being included. See Point 18 Above		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a Secretary of State (SoS) decision on Norfolk Vanguard and Hornsea Project 3 has been made. With regards to the point regarding projects missing from the red-throated diver cumulative displacement assessment, refer to the Applicant's response to Point 19 of Offshore Ornithology.	Natural England advises that with reference to cumulative/in-combination consideration for RTD, particularly in relation to HRA issues relating to the OTE SPA, there is no benefit in waiting for decisions on Norfolk Vanguard and Hornsea Project 3 to progress matters.		The inclusion of the holding statement regarding Hornsea Three and Norfolk Vanguard was included in error and should be disregarded. As described in Point 1 of offshore ornithology, the Applicants will continue engagement with NE on RTD matters as described in Point 1 of offshore ornithology.
22	As mentioned in Point 18, Table 12.37 does not include a number of windfarms, which results in a significant underestimate of impact. Therefore the total annual mortality figure of 37 -409 individuals is a possible under-estimation. However, even as a potential underestimate, the predicted mortality of 37 – 409 birds as a result of displacement is significant, resulting as it does in an increase of 16.2% in the mortality rate of the total reference population of red -throated divers in this area in the non-breeding season (Appendix 12.3). When using the biogeographic estimate of individuals, the increase in mortality by between 0.6% and 6.6%, which is of concern.		With regards to the point regarding projects missing from the red-throated diver cumulative displacement assessment, refer to the Applicant's response to Point 19 of Offshore Ornithology. Regarding the predicted mortality of red-throated diver, the Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	See response under Point 19 above.		See the Applicants' response to Point 1 and Point 19 of offshore ornithology.
23	Whilst it is stated by the Applicant that the assessment includes several sources of precaution, it includes assumptions that may not reflect the full extent of diver displacement. Although Natural England welcomes that assumptions around 100% displacement out to 4km are used, we know that in some cases this may underestimate the degree of displacement if the extent of displacement is 10km or more in some cases. In addition, there are a number of OWF excluded from the analysis and it is therefore not considering the full extent of cumulative displacement.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made. With regards to the point regarding projects missing from the red-throated diver cumulative displacement assessment, refer to the Applicant's response to Point 19 of Offshore Ornithology. Regarding the cumulative displacement impact on red-throated diver, the Applicant is undertaking a review of available evidence	As stated under Point 21 we do not see any benefit in waiting for the decisions on Norfolk Vanguard and Hornsea 3 before progressing assessments for RTD. Given the close proximity of EA1N to the OTE SPA and Natural England's view that an AEoI alone cannot be ruled out we advise that this matter is progressed. We understand that the Applicant will be submitting a document at Deadline 3 when we will provide further comment.		The inclusion of the holding statement regarding Hornsea Three and Norfolk Vanguard was included in error and should be disregarded. As described in Points 1, 4 and 6 of offshore ornithology, the Applicants have been progressing matters regarding red-throated divers from shortly after receiving NE's relevant representation response. There will continue to be engagement with NE on RTD matters during the examination period as described in Point 1 of offshore ornithology.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
			on this matter and will continue engagement with NE in order to agree a way forward.			
24	Due to the Applicant's worst case scenario assessment of minor adverse, and considering that some projects are not included in the assessment, Natural England is unable to rule out a significant adverse effect for cumulative operational displacement on red-throated diver at the EIA scale.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made. With regards to the point regarding projects missing from the red-throated diver cumulative displacement assessment, refer to the Applicant's response to Point 19 of Offshore Ornithology.	See responses to Point 1, 19 and 21 above.		As described in Point 1 of offshore ornithology, the Applicants will continue engagement with NE on RTD matters as described in Point 1 of offshore ornithology. Also, see Point 19 of offshore ornithology.
25	Natural England welcomes that a quantitative cumulative estimate of gannet displacement has been included. We agree that effect of cumulative displacement for gannet is likely to be negligible at the EIA scale.		The Applicant notes that NE agrees that the effects of cumulative displacement on gannet is likely to be negligible at the EIA scale.	No response required.		No response required.
26	Natural England advises that the cumulative auk (razorbill and guillemot) operational displacement assessment totals are based on an incomplete data set. The following wind farm projects are missing from the assessments: Beatrice Demonstrator, Gunfleet Sands, Kentish Flats, Kentish Flats Extension, Methil, Rampion and Scroby Sands. Whilst these missing projects are likely to involve low numbers of auks, the missing data would reduce confidence in the assessments and due to the potential under-estimation of the cumulative assessments.		As described in ***section 12.7.3*** of ***Chapter 12 Offshore Ornithology*** (APP-060) a review of the BDMPS regions for guillemot and razorbill indicated that all the windfarms identified for inclusion in the CIA in ***Table 12.37*** of the chapter have the potential to contribute a cumulative effect. This table includes all of the projects highlighted by NE except Methil. However, for Kentish Flats, Scroby Sands, Gunfleet Sands and Beatrice Demonstrator there are no data on displacement mortalities available for these species from their assessments. It is acknowledged that Kentish Flats Extension, Rampion and Methil were not included in the EIA and no explanation was provided. The Applicant can clarify that displacement mortality estimates for these projects were not included because: Kentish Flats Extension – Razorbill were not included in the Kentish Flats Extension displacement assessment and no quantitative assessment of displacement mortality for guillemot was undertaken. It is noted that low numbers of guillemot (14)	NE notes that the addition of those projects may not add much to the overall totals. However, we advise that they should be included. Even if the numbers from these projects are zero or not available, they should be listed in the cumulative/in-combination tables so that future projects know what has been included and it is also clear that all relevant OWFs have been considered.		The Applicants have submitted updated cumulative and in-combination displacement tables for guillemot and razorbill at Deadline 2 (see REP1-047) which includes estimates for the mentioned projects where data are available. The updates presented do not alter the conclusions of negligible significance for the EIA and no AEoI for the HRA within the assessments submitted (Chapter 12 Offshore Ornithology (APP-060) and the Information to Support Appropriate Assessment Report (APP-043)).

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
			were recorded in the Kentish Flats Extension windfarm site and 2km buffer; Rampion – a quantitative assessment of displacement mortality on razorbill and guillemot was not undertaken for this project; and Methil – An assessment of operational displacement was not carried out for razorbill and guillemot in this project's EIA.			
27	It should be noted that at Vanguard, Natural England was unable to rule out a significant adverse effect for cumulative operational displacement on razorbill or guillemot at the EIA scale. Furthermore, during the Vanguard examination, due to Natural England's concerns regarding the incomplete baseline surveys for the Hornsea 3 project, and the associated level of uncertainty as regards the potential impacts of that project, Natural England was not in a position to advise that an AEOI could be ruled out for the razorbill and guillemot features of the Flamborough and Filey Coast SPA (FFC SPA) for impacts in-combination with other plans and projects when Hornsea 3 was included in the in-combination total. Please see our comments on the Applicant's Deadline 8 updated auk displacement assessment submitted at Deadline 9, available from: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-003190- DL9%20-%20Natural%20England%20-%20Deadline%20Submission.pdf. The East Anglia OWFs are adding further birds to these totals, as would Hornsea 4, and therefore our assessment is that it is not possible to rule out a significant effect at cumulative EIA scale for guillemot and razorbill displacement, or an adverse effect on integrity of the guillemot and razorbill features of the FFC SPA.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made.	It is noted that the Applicant will submit a revised document at Deadline 1.		The Applicants have submitted updated cumulative and in-combination displacement tables for guillemot and razorbill at Deadline 2 (see ExA.AS-3.D2.V1) which includes estimates for the mentioned projects where data are available. The updates presented do not alter the conclusions of negligible significance for the EIA and no AEoI for the HRA within the assessments submitted (Chapter 12 Offshore Ornithology (APP-060) and the Information to Support Appropriate Assessment Report (APP-043)).

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
28	The cumulative annual gannet collision risk prediction of 2,607 as set out in Table 12.42 differs to the totals agreed at the end of the Norfolk Vanguard examination, which was 2,735. It is not clear why these two totals differ. We seek clarification regarding this matter. We also note that the totals do not include figures from Hornsea 4. A PEIR for this project is available. Even without the additional figure from Hornsea 4, the total predicted annual mortality exceeds 1% of baseline mortality. Therefore these impacts require further consideration. Furthermore, during the Vanguard examination, due to Natural England's concerns regarding the incomplete baseline surveys for the Hornsea 3 project, and the associated level of uncertainty as regards the potential impacts of that project, Natural England was not in a position to advise that an AEOI could be ruled out for the gannet features of the Flamborough and Filey Coast SPA (FFC SPA) for impacts in-combination with other plans and projects when Hornsea 3 was included in the in-combination total.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made.	It is noted that the Applicant will submit a revised document at Deadline 1.		Following the SoS decisions on Norfolk Vanguard, Hornsea Project Three and Thanet Extension, the Applicants have updated the cumulative and in-combination collision assessments and submitted these at Deadline 1 (REP1-047). The revised totals (***Table 3*** of REP1-047) are based on a common position using those submitted at Norfolk Boreas Deadline 8 (which have been agreed with NE and which include Hornsea Four). These revised totals also incorporate the design changes for the Projects (a 2m increase in draught height) and non-material amendments for the East Anglia ONE and East Anglia THREE windfarms. Taken together the project revisions have reduced the cumulative impacts on gannet by 96.4 and the in-combination impacts apportioned to the Flamborough and Filey Coast SPA by 10.1 compared with the final estimates agreed at Norfolk Boreas.
29	Natural England acknowledges that as built scenarios are an important issue with regard to cumulative/in-combination CRM predictions and assessments. However, without a legally secured reduction in the consented Rochdale envelope, and an agreed strategic approach and re-run CRM with the final design parameters, cumulative/in-combination assessments should be based on the CRM predictions that were consented. We note that EA1 is currently the only project to date to meet these tests.		See the Applicant's response to Point 34 of Offshore Ornithology below which reflects the Applicant's position on this matter.	We note the comments the Applicant has made in Appendix 4 (***AS-041)*** on 'precaution within offshore ornithology impact assessments', and that this includes consideration of the mechanisms which would prevent 'build out' as envisaged by Natural England. Please see Natural England Deadline 1 response Appendix A3		We note NE's response to Appendix 4 (***AS-041***) contained within Natural England Deadline 1 response Appendix A3, however the Applicants' position is unchanged. Given the decision agreed by the Applicants and NE at a workshop on the 28th of July to adopt the in-combination estimates agreed in the Norfolk Boreas examination, the Applicants do not intend to make further comment on this matter.
30	Natural England acknowledges that a higher avoidance rate of 99.5% for gannet has been recommended by Bowgen & Cook (2018) and that this would significantly reduce the cumulative total. Natural England and the other SNCBs are currently considering our response to the recommendations in Bowgen & Cook (2018). Our current advised avoidance rates are those set out in SNCBs (2014).		The Applicant welcomes the consideration by NE and the other SNCBs of the higher, evidence-based gannet avoidance rates described in Bowgen and Cook (2018). As agreed at an ETG meeting on the 20th June 2019, the Applicant has presented project-alone collision mortality estimates for gannet and kittiwake based on the 98.9% rate recommended by NE (see ***Table 12.34***	No further response		No response required.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
			of ***Chapter 12 Offshore Ornithology*** (APP-060)) alongside the 99.5% Bowgen and Cook (2018) rate (see ***Table 12.35*** of ***Chapter 12 Offshore Ornithology*** (APP-060), the latter being presented for information only.			
31	Natural England acknowledges that assuming 25% nocturnal activity with gannet is precautionary, and that is why we have moved to a position of presenting a range of nocturnal activity between 0% and 25%. We note that the nocturnal activity factor from the review of nocturnal activity in gannets (Furness and others 2018) has not been used in the assessment.		Refer to the response at Point 36 of Offshore Ornithology.	This point remains under discussion		No response required.
32	It is acknowledged that if the higher avoidance rates in Bowgen & Cook (2018) are used, the overall impact significance will be reduced. However, Natural England advised that a significant (moderate adverse) impact on gannet at the EIA scale could not be ruled out due to cumulative collision totals at the end of the Vanguard hearing, and therefore adding more collisions from Boreas, the East Anglia projects and Hornsea 4 will not change this position.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made.	We note that revised Collision Risk Modelling with be provided by the Applicant at Deadline 1		The Applicants have updated the collision assessments as requested (REP1-047), taking into account design revisions for the Projects as well as at other windfarms. The Applicants acknowledge NE's position on the assessments but disagree with their conclusion on significance, which is considered to be over precautionary, due to an accumulation of precautionary assumptions.
33	The kittiwake cumulative collision risk assessment in Table 12.43 differs to the totals agreed by Natural England at the end of the Vanguard hearing. This agreed total was 4,114. There will also be a need to include the figures from Hornsea 4's PEIR. Before these figures are added there is already a 2.5% increase above baseline mortality.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made.	We note that revised Collision Risk Modelling with be provided by the Applicant at Deadline 1		See response to point 28. The revised totals (REP1-047) incorporate design changes for the Projects (a 2m increase in draught height) and non-material amendments for the East Anglia ONE and East Anglia THREE windfarms, as well as the refusal of Thanet Extension. Taken together these project revisions have reduced the cumulative impacts on kittiwake by 124 and the in-combination impacts apportioned to the Flamborough and Filey Coast SPA by 6. Regarding the revised totals for kittiwake (see the cumulative and in-combination collision risk update submitted at Deadline 1 (REP1-047) updates from Orsted 2020[7] of 73 annual apportioned kittiwake FFC SPA collisions have also been incorporated.

[7] Orsted (2020). Response to the Secretary of State's Consultation Appendix 4: Post Examination Mitigation and Project Envelope Modifications. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-003194-HOW03_CON02_Appendix4%20Annexes_Mitigation.EnvelopeModifications.pdf

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
34	Whilst Natural England notes that some projects have built out to less than their consented capacity, we do not accept that it is appropriate to revisit the cumulative collision risk whilst consents for unused capacity remain in place and in the absence of re-run collision risk assessments using the built turbine parameters.		The Applicant acknowledges NE's position and has therefore based the cumulative assessments on project designs from original worst case ES assessments or updated ornithological assessments that have been undertaken as part of a non-material change (relevant for windfarms in England) or a varied Section 36 consent (relevant for windfarms in Scotland) application. ***Table A12.3.1*** in ***Appendix 12.3 - Information for the Cumulative Assessment*** (APP-471) clearly sets out the origin of each of the mortality figures used in the cumulative assessment (and indicates if a 'theoretical' or non-consented as-built figure is also presented). The only projects included in the CIA used in the ES which fit NE's description of "*consents for unused capacity* [which] *remain in place*" are for Inch Cape and Neart na Gaoithe – however in both these cases the projects did re-run the collision risk assessments for the new worst case. In the case of these two projects, whilst NE may state that there is potential to build out under the old consents (as these have yet to be rescinded) the fact remains that the worst cases on which the original consents were based represent uneconomic or obsolete technology. For Neart na Gaoithe the turbines have already been procured as construction is underway[8]. The Applicant has produced a note on precaution within offshore ornithology impact assessments which discusses the use of 'as-built' mortality figures. This includes consideration of the mechanisms which would prevent 'build out' as envisaged by NE (see ***section 2.3*** of ***Appendix 4 (AS-041)***).	See NE's Deadline 1 Appendix A3		See Response to Point 29 of offshore ornithology.

[8] https://www.edfenergy.com/media-centre/news-releases/construction-neart-na-gaoithe-offshore-wind-farm-project-go-ahead

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
			The Applicant also welcomes NE's recent submissions for the Norfolk Boreas project in which NE have agreed that '*there is likely to be some headroom; however the exact extent of any potential headroom is not agreed*'.[9]			
35	Natural England acknowledges that a higher avoidance rate of 99% for kittiwake has been recommended by Bowgen & Cook (2018) and that this would reduce the cumulative total. Natural England and the other SNCBs are currently considering our response to the recommendations in Bowgen & Cook (2018).		Noted. The Applicant would like to understand if there is potential for NE to reach a decision on this during the examination period.	Before the SNCBs are able to reach a decision on whether or not to accept the recommendations in Bowgen & Cook (2018) there is a requirement for more work to be undertaken. Accordingly Natural England's advice remains as set out in the 2014 SNCB advice note, although we will keep the Examining Authority updated should this evolve during the Examination. However, as agreed in the ETG process we are content with the outputs using Bowgen & Cook (2018) to be presented alongside those predicted using the SNCB currently recommended avoidance rates.		Noted.
36	Natural England notes the comments on nocturnal activity, and notes that reducing the nocturnal activity would result in a reduction in predicted mortality.		***Annex 4*** of ***Appendix 12.2*** (APP-470) presents various collision mortality estimates based upon a range of nocturnal activity factors relevant to each particular species. For kittiwake, lesser black-backed gull, greater black-backed gull and herring gull, the nocturnal activity rate on which the conclusion of significance of project-alone collision impact is based is 50%. However, the collision mortality estimate based on a nocturnal activity rate of 25% is also provided. For gannet, the nocturnal activity rate on which the conclusion of significance of project-alone collision impact is based is 25% however collision mortality estimates based on nocturnal activity rates of 8% during the breeding season and 4% during	This remains under discussion		The Applicants have accepted the use of the common cumulative and in-combination mortality estimates for the basis of the assessment going forward. The Applicants' position regarding precaution as stated within AS-041 is unchanged. The Applicants do not propose to comment further on the matter of precaution and therefore do not consider this matter to still be under discussion.

[9] Natural England, 2020. Deadline 9 Natural England's Updated Offshore Ornithology Advice Norfolk Boreas. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-002099-EN010087_Boreas_D9_13_Updated%20Ornithology%20advice.pdf

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
			the non-breeding season (as described in Furness, et al, 2018[10]) are also presented. Additionally, ***section 2.2.2.2*** and ***Table 2.2*** of ***Appendix 4 (AS-041)*** of this document, describes the reductions in collision mortality estimates that could be achieved if lower, more realistic nocturnal activity rates are used. ***Table 2.2*** highlights potential project alone collision mortality reductions of 15.4% for kittiwake, 12.2% for lesser black-backed gull and 20% for gannet. It is not straightforward to accurately apply these updates to nocturnal activity rates cumulatively and so this has not been shown in ***Appendix 4 (AS-041)***. However, it is clear that if similar reductions in overall mortality estimates were realised from an amendment to nocturnal activity rates at other projects, then the current cumulative mortality estimate for all species against which all offshore windfarm ornithology assessments are assessed is a significant overestimate.			
37	Natural England notes that taking into account some elements of potential precaution e.g. nocturnal activity rates will lead to a reduction in mortality estimates. However, there are elements of the assessment, such as the use of generic potential collision heights (PCHs) rather than site specific PCHs, which could result in an underestimate of collision risk. There is also the critical issue of variability in all of the input data, not least in bird density. In that context, Natural England advised that a significant (moderate adverse) impact on kittiwake cannot be ruled out due to cumulative collision totals at the end of Vanguard, and therefore adding more collisions from Boreas, the East Anglia projects and Hornsea 4 will not change this position.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made. The Applicant also considers that NE's approach to the assessment, which is based on combinations of highly precautionary assumptions, results in conclusions that are over precautionary. For example, while it is reasonable to consider uncertainty about individual parameters within the collision model by modelling a range of values and giving due consideration to the higher mortalities obtained, if this is applied to multiple parameters simultaneously (e.g. nocturnal activity, avoidance rate and flight	The focus of the Applicant's response is based on the incorrect assertion that Natural England's approach to the assessment is based on combinations of highly precautionary assumptions, resulting in conclusions that are over precautionary. However, it needs to be acknowledged that there is a significant degree of both uncertainty and variability in all the input parameters to Collision Risk Modelling (CRM). As a result it is important to take account of this uncertainty where possible and to indicate the range of confidence around the collision estimate, in order to provide a robust assessment of potential collision impacts on populations. Therefore Natural England advises that for the key input parameters of monthly bird density,		The Applicants note NE's comments on this matter and refer to the Applicants' response to Point 29 of offshore ornithology.

[10] Furness, R.W., Garthe, S., Trinder, M., Matthiopoulos, J., Wanless, S. & Jeglinski, J. (2018). Nocturnal flight activity of northern gannets *Morus bassanus* and implications for modelling collision risk at offshore wind farms. Environmental Impact Assessment Review, 73, https://doi.org/10.1016/j.eiar.2018.06.006

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
			height) then there is a high risk of presenting extremely unlikely combined outcomes as realistic. Furthermore, when these are then combined with precautionary assumptions about foraging ranges, extended breeding seasons and density independence in population modelling, the final outcome may potentially be an extremely large over-estimate of realistic impacts magnitudes. The increase in over precaution in impact assessment has come about gradually in offshore wind impact assessment as the process has become increasingly technical. The Applicant considers there to be an urgent need for NE to give detailed consideration to the level of combined precaution currently applied in ornithology impact assessment with the aim that this should be treated in a more proportionate manner. The Applicant has produced a note on precaution within offshore ornithology impact assessments (***Appendix 4 (AS-041)***.	flight height, avoidance rate, and nocturnal activity factor, uncertainty around the parameter estimates should be considered on an individual parameter basis, and that a range-based approach to considering impacts is taken to acknowledge the level of confidence in CRM predictions.		
38	As stated for gannet and kittiwake, whilst Natural England notes that some projects have built out to less than their consented capacity, we do not accept that it is appropriate to revisit the cumulative collision risk for lesser black-backed gull when consents for unused capacity (including phased builds) remain in place and in the absence of re-run collision risk assessments using the built turbine parameters. Please see comment 28 above.		See the response to Point 34 of Offshore Ornithology which reflects the Applicant's position on this matter.	See response to Point 34 above.		See the Applicants' response to Point 34 of offshore ornithology above.
39	As stated for gannet and kittiwake, Natural England notes that it is suggested that using a nocturnal activity factor of 3 (50%) in collision risk modelling is likely to be an overestimate nocturnal activity. For that reason we advise that a range between 25% and 50% are presented with the assessment.		The Applicant welcomes NE's agreement that a 50% nocturnal activity rate for gulls is probably too high. Refer to the Applicant's response to Point 36 of Offshore Ornithology for more detail on the nocturnal activity rates presented within the assessment.	As set out above at point 37		No response required.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
40	Whilst Natural England acknowledges that there are elements of the cumulative assessment that result in a higher mortality total, we have concerns about use of Option 2 and the fact that much higher predicted collisions are predicted when using Option 1. However, we agree that the cumulative impact on lesser black- backed gull at the EIA scale is minor adverse (not significant).		The Applicant has undertaken assessment of collision risks using option 2 of the Band (2012) collision risk model. Use of this model option was agreed in consultation with NE and the RSPB through the Evidence Plan Process (see ***Appendix 12.1*** of ***Chapter 12 Offshore Ornithology*** (APP-060) and followed advice from the digital aerial surveyor that their method to estimate seabird flight height was insufficiently robust to be relied upon for use in the site specific (i.e. option 1) version of the Band model. Consequently, the Applicant does not consider that the option 1 collision estimates should be used in the assessment and this had been agreed with stakeholders. The Applicant welcomes that NE is in agreement with the conclusion of the cumulative assessment (for EIA) on lesser black-backed gull.	This remain ongoing.		The Applicants have nothing to add. It was understood that this matter was closed on the basis that the use of Option 2 was agreed through the EPP.
41	An increase of 6% above baseline mortality for great black-backed gull based on the largest Biologically Defined Minimum Population Scale (BDMPS) is significant.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made.	We acknowledge that the cumulative figure will need updating in light of the decisions on Vanguard and Hornsea 3. However, this will be unlikely to make a difference to Natural England's conclusions, as we have already advised that a significant adverse effect couldn't be ruled out for cumulative CRM for great black- backed gull at EA3 and further collisions have now been added from further windfarms (e.g. EA1N and EA2) irrespective of Vanguard and Hornsea 3.		See response to point 28. The Applicants note that the non-material change for the East Anglia ONE windfarm alone reduces the collisions of great black-backed gull by 15, while the revised collisions summed for both the Projects is 12. Therefore, the addition of the Projects is more than offset by the reduction at East Anglia ONE.
42	As stated above, whilst Natural England notes that some projects have built out to less than their consented capacity, we do not accept that it is appropriate to re-calculate the cumulative collision risk when consents for unused capacity (including phased builds) remain in place and in the absence of an agreed strategically re-run collision risk assessments using the built turbine parameters. Please see comment 28 above.		See the response to Point 34 of Offshore Ornithology above which reflects the Applicant's position on this matter.	See response to Point 34 above.		See the Applicants' response to Point 34 of offshore ornithology above.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
43	Natural England notes that it is suggested that using a nocturnal activity factor of 3 (50%) in collision risk modelling is likely to be an overestimate of nocturnal activity. For that reason we advise that a range between 25% and 50% are presented with the assessment.		The Applicant welcomes NE's agreement that a 50% nocturnal activity rate for gulls is probably too high. Refer to the Applicant's response to Point 36 of Offshore Ornithology for more detail on the nocturnal activity rates presented within the assessment.	Please see NE response to point 37.		No response required.
44	The Population Viability Analysis (PVA) model outputs predicted populations being up to 7.7% smaller using the density dependent model, and up to 21.5% smaller than the un-impacted scenario using density independent outputs based on an annual mortality of 900. At the end of the Norfolk Vanguard examination Natural England's position was that we were unable to rule out a significant (moderate adverse) effect on great black-backed gull from cumulative collision mortality at an EIA scale, and that position has not changed.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made.	See response to 41 above.		No response required.
45	Natural England disagrees with the summary that concludes no greater than minor adverse significance for all species. At the end of Norfolk Vanguard we advised significant adverse effect at EIA for cumulative collision for gannet, kittiwake and great black-backed gull. Since then more birds have been added to these totals from Boreas, EA1N, EA2 and also Hornsea 4, and as a result our position on these species remains unchanged.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made.	We note that the Applicant intends to submit revised CRM at Deadline 1		The Applicants submitted an updated cumulative and in-combination collision risk assessment at Deadline 1 (REP1-047).
4. Scale of predicted cumulative and in-combination impacts and requirement for mitigation. **Documents used: 5.3 EA1N Information to Support the Appropriate Assessment Report, 6.1.12 EA1N Environmental Statement Chapter 12 Offshore Ornithology, 6.3.12.3 EA1N ES Appendix 12.3 Supplementary Information for the Cumulative Impact Assessment.**						

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
46	Natural England has previously provided regulators with our advice regarding our concerns about predicted level of cumulative and in-combination impacts on North Sea seabirds. For EIA we have been unable to rule out a significant adverse effect for cumulative operational impacts on: kittiwake, gannet and great black-backed gull for cumulative collision impacts; guillemot, razorbill and red-throated diver for cumulative displacement impacts For HRA we have been unable to rule out adverse effect on integrity on: kittiwake from FFC SPA due to in-combination collision impacts not including Hornsea 3, and gannet from FFC SPA due to in-combination collision impacts when Hornsea 3 is included. guillemot and razorbill at FFC SPA due to in-combination displacement effects when Hornsea 3 is included. lesser black-backed gull from Alde-Ore Estuary SPA due to in-combination collision impacts. red-throated diver from Outer Thames Estuary SPA due to in-combination displacement effects. These concerns as expressed during the Vanguard examination are likely to only intensify given that additional birds from Boreas, the East Anglia projects and Hornsea 4 are being added to these totals. Natural England therefore considers that without major project-level mitigation being applied to all relevant projects coming forward, there is a significant risk of large-scale impacts on seabird populations. Natural England therefore recommends that EA1N and EA2 commit to raising turbine draught height, as has been done by other projects (e.g. Hornsea 2, East Anglia 3 and Vanguard), in order to minimise their contribution to the cumulative/in-combination collision totals by as much as is possible. We also strongly recommend that the boundary of EA1N and EA2 arrays are re-designed to ensure that arrays are at least 10km from the boundary of the OTE SPA to avoid displacement of red-throated diver within the SPA.		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made. Regarding the impacts on red-throated diver in the OTE SPA, The Applicant is undertaking a review of available evidence on this matter and will continue engagement with NE in order to agree a way forward.	Regarding in-combination impacts on RTD, we would appreciate clarification regarding the anticipated completion of the review of evidence. We again note that the conclusions of such a review are unlikely to have changed since the MacArthur Green report for The Crown Estate (Furness 2019), which recommended that potential leasing areas for OWFs should be located at least 10km from SPAs that support non-breeding RTD as a qualifying feature.		The Applicants have been undertaking new analysis of RTD information since the receipt of NE's Relevant Representation, reflecting the fact that NE's position on this issue has become more conservative than it was pre-application. The preliminary findings of this work were presented to NE and the RSPB at a workshop held on the 22nd of October. The draft report will be provided to NE and the RSPB in mid-November, ahead of a further workshop in early December to present the results of the analyses and implications for HRA prior to submission of the document at Deadline 3. Additionally, the Applicants have submitted an updated cumulative and in-combination collision risk assessment (REP1-047) at Deadline1. This incorporates the Applicants' commitment to an increase in air draught height of 2m from 22 to 24m above mean high water springs (MHWS) and the NMC applications at the Applicants' sister projects EA1 and EA3 which have further reduced the total cumulative collision mortalities.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
5. Post consent monitoring. **Documents used: 8.13 EA1N Offshore In Principle Monitoring Plan**						
47	Natural England welcomes the statement in the In Principle Monitoring Plan that the Applicant will engage with stakeholders and that the methodology would be developed through the Ornithological Monitoring Plan (required under Condition 14(1) (l) of Schedule 9 and 10 of the DCO). We agree with the Applicant that the aims of monitoring should be to reduce uncertainty for future impact assessment and address knowledge gaps. However, we disagree with the Applicant's assertion that displacement effects on red-throated diver would not create impacts of more than minor adverse significance during any biological season during construction and operation phases. Validating the extent of red-throated diver displacement will be the main priority for any post-consent monitoring. Natural England also disagrees that the risk to birds from cumulative collisions with wind turbines across all windfarms considered is assessed as no greater than minor adverse significance for all species. For kittiwake, gannet and great black-backed gull we are unable to rule out significant impact cumulatively. Given Natural England's previous advice at recent projects regarding our concerns about predicted levels of cumulative and in-combination impacts on seabirds and this project's likely contribution to those impacts should it be consented, we consider the aspects that are likely to be relevant for consideration for post-consent monitoring are as follows: Validating levels of red-throated diver displacement; Improving our understanding of collision risk (which could potentially include monitoring of collisions at the site via cameras on turbines, improvements to modelling, options for mitigation and reduction); Collection of reliable data on seabird flight heights. Once the final impact figures are agreed, the key issues should be identified so that discussion can be held with relevant stakeholders and the Applicant to		As agreed at SoCG meeting 1 with NE, in order to avoid duplication of work, the Applicant will address cumulative/in-combination matters once a SoS decision on Norfolk Vanguard and Hornsea Project 3 has been made. Following this, the Applicant will consider this matter further. Additionally, the Applicant is currently preparing a clarification note with regard to red throated diver which will be discussed with NE and will be submitted during the Examination. As a result, NE's comments regarding ornithological monitoring are currently under consideration by the Applicant.	See response to points 1 and 46.		See the Applicants' response to Point 1 and 46 of offshore ornithology.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
	identify what it the most appropriate focus of post consent ornithological monitoring.					
48	Natural England notes that reference is made to supporting "joint industry projects or alternative site based monitoring of existing seabird activity inside the area(s) within the Order Limits in which it is proposed to carry out construction works with its potential wider benefits." It is not clear what is being proposed or what the mechanism may be to ensure that appropriate monitoring is undertaken. We therefore recommend that the most significant area or areas of ornithological uncertainty is identified, and an in-principle monitoring plan is agreed.		With regard to project-level ornithological monitoring, please see the Applicant's response to Point 23 of DCO, DMLs and Related Certified Documentation below. As noted above, the Applicant is a subsidiary of SPR and with regard to ornithological strategic monitoring, SPR has been at the centre of driving progress in the offshore wind industry, from advancing the deployment of innovative aerial survey techniques early on East Anglia ONE that saw their widespread uptake elsewhere in favour of boat based surveys, to providing technical and financial input into the Offshore Renewables Joint Industry Programme (ORJIP) Bird collision avoidance study at Thanet Offshore Wind Farm, and to hosting an annual Strategic Ornithology Conference comprising academics, regulators and offshore wind developers from across the UK to share updates on new science and understand knowledge gaps. SPR has also been a leading contributor to the recently completed Offshore Wind Strategic Monitoring Forum (OWSMRF) pilot project which formed as an outcome of the 2018 Strategic Ornithology conference. OWSMRF brought scientific, regulatory and developer representatives together to discuss and document the strategic knowledge gaps facing the industry which were beyond the scope of individual offshore wind projects to address, with the aim of drafting scopes of work which could be taken forward by industry groups to close	We note and welcome SPR's input into the Offshore Renewables Joint Industry Programme (ORJIP), the hosting of an annual Strategic Ornithology Conference, and the involvement in OWSMRF. However, if there is no mitigation and EA1N and EA2 are consented in their current layout, our view is that there will be an AEoI on the RTD feature of the OTE SPA. Given the significance of the predicted impacts on OTE SPA, Natural England believes that the monitoring should focus of validating the predicted impacts, if no mitigation is undertaken, and this needs to be secured through licence conditions.		The Applicants will update the in-principle monitoring plan to include a requirement for RTD monitoring which will be re-submitted to the Examination at Deadline 3. The Applicants intend to update conditions 20 and 22 of the generation DML and conditions 16 and 18 of the transmission DML to make provision for pre-construction and post-construction ornithological monitoring which will be included in the updated Draft DCO submitted into the Examination at Deadline 3.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix A - Offshore Ornithology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix A1b)	RAG Status Assigned by NE (Appendix A1b)	Applicants' Response
			those gaps. Following completion of OWSMRF, SPR is co-ordinating engagement across the developer group to seek funding for taking forward the scopes of work through ORJIP, TCE Enabling Actions, developer partnerships and academia. However, this strategic support is not considered to be relevant to the application as strategic monitoring is not appropriate at a project level in the context of a DCO.			

1.3 Marine Mammals

	Point Taken from NE's Relevant and Written Representations EA2 Appendix B - Marine Mammals	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix B1b – REP1-166)	RAG Status Assigned by NE	Applicants' Response
Document Used: 6.1.11 EA2 Environmental Statement Chapter 11 Marine Mammals						
1	The phrases 'same day' and '24 hour period' seem to be used interchangeably throughout the marine mammal chapter and associated documentation when they are not quite the same thing. If this follows through to the assessment stage Natural England considers a clarification note may be required as to the intended wording and any consequences for either the EIA or HRA.		In the assessment same day and 24hrs have both been used and assume a 24hr period from midnight - midnight For implications, see the Applicant's response to Point 3 of Marine Mammals below.	Natural England notes the Applicant's response to this point is captured in the response to point 4.		No response required.
Document Used: 5.3 EA2 Information to Support Appropriate Assessment Report						
2	Natural England welcomes the commitments from the Applicant listed here and considers they should be specifically conditioned on the face of the deemed marine licence (DML), particularly to ensure there is no concurrent piling between EA1N and EA2. Please see Point 11 in Appendix G.		These commitments are listed in section 6.1 of the ***In-Principle Site Integrity Plan*** (SIP) (APP 594) and other commitments are listed within the draft Marine ***Mammal Mitigation Protocol*** (MMMP) (APP 591). Final versions of the SIP and MMMP must be submitted to and approved by the MMO and must accord with the in-principle/draft plans. It is not considered necessary to include such commitments on the face of the DCO.	Natural England notes the Applicant's response, however we still consider that the commitments listed in the SIP and MMMP should be conditioned in the DML to ensure they are adhered to. Natural England agrees that the final SIP and MMMP documents will need to be submitted to and approved by the MMO. However, the commitments detailed in the documents are critical to the delivery of mitigation required to ensure the project(s) do not have an adverse effect on the integrity of the Southern North Sea SAC and therefore should be tightly secured in the DML. It is of particular importance to ensure no concurrent piling between EA1N and EA2. However, we are willing to discuss the possibility of amending the conditions relating to UXO detonation to allow clusters of UXO within a 5km radios of a central point to be detonated. As discussed with the Applicant in a workshop on 10 August.		See the Applicants' response at Point 11 of DCO / DMLs.
3	The SNS SAC covers an area of 36,951km^2, not 36,715km^2 as stated here.		Noted. This was an error within the assessment. Since the area assessed was smaller than the actual area, the Applicant considers the assessment to be conservative and therefore no additional clarification is required.	Natural England notes the Applicant's response and has no further comment.		No response required.
4	Although it is correct to say disturbance of harbour porpoise will not exceed 20% of the seasonal component of the site at any one time, the 20% threshold is for disturbance of harbour porpoise in any given day. Therefore detonation of 2 unexploded ordnance (UXO) in a 24		Modelling has currently been undertaken for a single UXO detonation to be carried out in 24hrs. The assessment was undertaken on the basis of no exceedance of *'20% at any one time'*. The assessment methodology was discussed and agreed through the Evidence Plan process and there were no comments on this either for EIA or	Natural England welcomes the recognition from the Applicant that on the basis of the current methodology for assessing noise impacts, 2 UXO clearance events in a single day would exceed the 20% threshold. We also note the points made by the Applicant in their response regarding the SIP providing the best and most flexible mechanism to manage the issue. However, Natural England considers		See the Applicants' response at Point 11 of DCO / DMLs.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix B - Marine Mammals	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix B1b – REP1-166)	RAG Status Assigned by NE	Applicants' Response
	hour period would easily exceed the 20% threshold and disturb harbour porpoise from 32% of the winter area of the site, assuming the 2 UXO detonations are spatially separate from each other. Natural England therefore disagrees with the conclusion drawn in paragraph 512 that there is no significant disturbance or potential adverse effect on the SNS SAC if more than 1 UXO is detonated on any given day. Natural England considers that UXO detonations should be limited to 1 on any given day and this should be secured in the DML.		HRA in NE's s42 comments. The Applicant notes that the assessment is based upon wording in assessment advice from NE which predates the publication of the updated Conservation Objectives for the SNS SAC in March 2019. In the updated Conservation Objectives the exceedance is based upon "*20% of the relevant area of the site in any given day*". This change in emphasis of the objective was not picked up in the finalisation of the assessment. Using this approach, as is now correct, the Applicant notes that on the basis of the current methodology for assessing noise impacts (i.e. using a 26km effective deterrent range (EDR)), 2 UXO clearance events in a single day would exceed the 20% limit for **the winter area only**. There is no exceedance for the summer area. The Applicant notes NE's request for a condition and makes the following observations. 1) The exceedance is only relevant to the winter area. 2) The Applicant considers that the SIP provides the best and most flexible mechanism to manage this issue. Recent JNCC guidance (see ***Appendix 8*** of this document) *("Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs."* dated 1st June 2020) acknowledges that the EDR for UXO is precautionary. The guidance suggests that the effect footprint may be 1/3 of the area of the monopile effect. Given this uncertainty and the fact that work is ongoing to understand the footprint of these effects, the Applicant considers that it would be over-precautionary to apply a blanket condition given that the SIP allows for adaptive management based upon a) the scheduling of UXO detonation at multiple projects to reduce the total in-combination area of disturbance b) noise mitigation which may allow for multiple UXO detonations in one day without exceeding the 20% limit. The precautionary 26km EDR for the high order detonation of unexploded ordnance (UXOs) has been used given that there is no empirical evidence of harbour porpoise avoidance. Given the uncertainty around the actual effect of UXO clearance and the potential to apply at-source	that, based on current understanding, limiting UXO detonations to one per day will ensure the spatial impact of UXO detonations will not exceed the 20% threshold in any given day and ensure there will not be an adverse effect on the integrity of the Southern North Sea SAC. However, as mentioned above we are willing to discuss the possibility of clusters of UXO's being detonated at the same time within a 5km radios of a central point. Therefore, limiting the projects to one detonation event per day, but the potential for multiple UXO's to be removed during that event.		

	Point Taken from NE's Relevant and Written Representations EA2 Appendix B - Marine Mammals	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix B1b – REP1-166)	RAG Status Assigned by NE	Applicants' Response
			mitigation, the Applicant considers that it would be overly precautionary to have a condition limiting it to a single event per day. In addition, the SIP would allow for at source mitigation to reduce the noise footprint, potentially reducing effects below the 20% exceedance for multiple events.			
5	As per comment 4 above, the 20% threshold applies to any given day so if 1 piling event disturbs harbour porpoise from 16% of the winter component of the Southern North Sea then 2 piling events on any given day will result in 32% of the SAC winter area being disturbed, therefore exceeding the 20% threshold. Therefore, Natural England disagrees with the conclusion of no significant disturbance and no potential adverse effect on the integrity of the SNS SAC if more than 1 piling event occurs on any given day. Natural England considers piling activities should be limited to 1 on any given day and this should be secured in the DML.		As above, the assessment was undertaken on the basis of no exceedance of *'20% at any one time'*. The Applicant notes that on the basis of the current methodology for assessing noise impacts (i.e. using a 26km effective deterrent range (EDR)), 2 piling events in a single day would exceed the 20% limit **for the winter area only**. There is no exceedance for the summer area. As for UXO, the Applicant notes NE's request for a condition and makes the following observations. 1) The exceedance is only relevant to the winter area. 2) The Applicant considers that the SIP provides the best and most flexible mechanism to manage this issue. Recent JNCC guidance (see ***Appendix 8*** of this document) *("Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs."* dated 1st June 2020) acknowledges that the EDR for pin piles may be much smaller than for monopiles. The guidance suggests that the effect footprint may be 1/3 of the area of the monopile effect. Given this uncertainty and the fact that work is ongoing to understand the footprint of these effects, the Applicant considers that it would be over-precautionary to apply a blanket condition given that the SIP allows for adaptive management based upon a) the actual size of piles required and b) noise mitigation which may allow for multiple piling events in one day without exceeding the 20% limit.	See point 4 above.		See the Applicants' response to Point 11 of DCO DML.
6	As per previous comments, if 1 UXO detonation and 1 piling event were to occur on the same given day as described in paragraph 626, the area of the winter component of the SNS SAC that harbour porpoise would be		As per previous responses, this is only relevant for the winter area and the Applicant considers that the SIP provides the most flexible and appropriate mechanism for managing potential impacts	See point 4 above.		See the Applicants' response to Point 11 of DCO DML.

	Point Taken from NE's Relevant and Written Representations EA2 Appendix B - Marine Mammals	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix B1b – REP1-166)	RAG Status Assigned by NE	Applicants' Response
	disturbed from would exceed the 20% threshold.					
7	Figures 9 and 10 do not show the overlap in disturbance figures as described in paragraph 747. Instead they relate to ornithology. Similarly figures 11 and 12 do not show what is described in paragraph 748.		Noted this was a typographic error, the correct figure references in paragraph 747 should be to Figures 12 and 13 and in paragraph 748 should be Figures 14 and 15.	Natural England notes the Applicant's response and has no further comment.		No response required.
8	Natural England queries how the figure of 5% has been arrived at as an increased collision risk in paragraph 833.		This is explained in ***Chapter 11 Marine Mammals*** (APP-059) ***in section 11.6.1.8 Impact 8: Vessel Interaction (Collision Risk) During Construction***. This rate is precautionary and based upon the percentage of all harbour porpoise post-mortem examinations from the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS area) which are thought to have evidence of interaction with vessels[11]. This approach was presented in the PEIR and draft HRA without comment, and has been used in previous project EIAs and HRAs (e.g. East Anglia THREE)	Natural England notes the Applicant's response and has no further comment.		No response required.
9	Natural England notes that it is predicted that a maximum of 11.7% of the grey seal from the Humber Estuary SAC could potentially be temporarily disturbed and overall 18.6% could be disturbed (table 5.79), however we agree with the approach considered by the Applicant of using the context of the wider in-combination reference population and recognising that not all of the impacted seals would be from the Humber Estuary SAC and that therefore the potential level of impact is more likely to be in the region of 3.5% and 5.5% respectively.		Noted.	Natural England notes the Applicant's response and has no further comment.		No response required.
Document Used: 8.14 Draft Marine Mammal Mitigation Protocol						
10	Natural England notes that additional noise abatement technologies may be subject to additional marine licensing if		Noted. The Schedule is indicative and intended to provide a road map for the process. The In-Principle-SIP will be developed into the SIP post-	Natural England notes the Applicant's response and has no further comment.		No response required.

[11] Evans, P. G., Baines, M.E., and Anderwald, P. (2011). Risk Assessment of Potential Conflicts between Shipping and Cetaceans in the ASCOBANS Region. 18th ASCOBANS Advisory Committee Meeting AC18/Doc.6-04 (S) rev.1 UN Campus, Bonn, Germany, 4-6 May 2011 Dist. 2 May 2011.

	Point Taken from NE's Relevant and Written Representations EA2 Appendix B - Marine Mammals	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix B1b – REP1-166)	RAG Status Assigned by NE	Applicants' Response
	required and queries whether the Schedule of Agreement described in table 2.1 allows sufficient time to acquire any additional licence(s) and source and implement additional mitigation measures or noise abatement systems that may be required.		consent and that will provide the opportunity to address issues such as these if they do indeed arise.			
Document Used: 8.17 EA2 In-principle Southern North Sea SAC Site Integrity Plan						
11	The SNS SAC covers an area of 36,951km^2, not 36,715km^2 as stated here.		Noted. This was an error within the assessment. Since the area assessed was smaller than the actual area, the Applicant considers the assessment to be conservative and therefore no additional clarification is required.	Natural England notes the Applicant's response and has no further comment.		No response required.
12	Natural England welcomes the commitments from the Applicant listed here and considers they should be specifically conditioned on the face of the DML, particularly to ensure there is no concurrent piling between EA1N and EA2. Please see Point 11 in Appendix G.		These commitments are listed in section 6.1 of the ***In-Principle Site Integrity Plan*** (SIP) (APP 594) and other commitments are listed within the draft ***MMMP*** (APP 591). Final versions of the SIP and MMMP must be submitted to and approved by the MMO and must accord with the in-principle/draft plans. It is not considered necessary to include such commitments on the face of the DCO.	See Point 2 above		See the Applicants' response to Point 11 of DCO/DML.
13	Natural England notes that additional noise abatement technologies may be subject to additional marine licensing if required and queries whether the Schedule of Agreement described in Table 2.1 allows sufficient time to acquire any additional licence(s) and source and implement additional mitigation measures or noise abatement systems that may be required.		Noted. The Schedule is indicative and intended to provide a road map for the process. The In Principle SIP will be developed into the SIP post-consent and that will provide the opportunity to address issues such as these if they do indeed arise.	Natural England notes the Applicant's response and has no further comment.		No response required.
14	As per Natural England's previous advice, a mechanism needs to be developed by the regulators to ensure continuing adherence to the statutory nature conservation bodies (SNCB) thresholds over time. Multiple Site Integrity Plans (SIPs) will be developed, piling can take place over several years, and new projects can come online during this time. Should potential exceedance of the thresholds occur, a		The Applicant notes NE's concerns, but highlights that the SIP is now the recognised framework by which impacts will be managed cumulatively, having been agreed for the consent of East Anglia THREE in 2017. The SIP provides an adaptive management framework to allow the MMO to regulate underwater noise, with the exact mechanism determined at a point in time where detailed design information is available. SIPs have also been applied retrospectively to projects which were consented prior to the	Natural England notes the Applicant's response and is in agreement that Site Integrity Plans (SIPs) have become the recognised framework by which impacts will be managed cumulatively. However, Natural England considers a mechanism is still required to manage multiple SIPs coming forward from multiple projects, but that this is for the regulators to develop rather than individual applicants. It is understood that there is a regulators group developing a mechanism to control multiple SIPs across the various noise causing industries and legislations. However, until a mechanism is produced and Natural England has a chance		Noted.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix B - Marine Mammals	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix B1b – REP1-166)	RAG Status Assigned by NE	Applicants' Response
	process for dealing with this issue needs to be in place – the affected developers / industries will need to work together with the regulator and SNCBs to prevent adverse effect on the Southern North Sea Special Area of Conservation (SNS SAC). Until the mechanism by which the SIPs will be managed, monitored and reviewed is developed, Natural England are unable to advise that this approach is sufficient to address the in-combination impacts described below and therefore the risk of Adverse Effect on Integrity (AEOI) on the SNS SAC cannot be fully ruled out.		designation of the SNS SAC as part of the Review of Consents process[12].	to review and agree the effectiveness of this mechanism our advice, provided in our relevant and written representations, cannot change.		

1.4 Terrestrial Ecology

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
Document used: 5.3 EA2 Information to Support the Appropriate Assessment Report						
1	Natural England strongly advises that all cable line construction works in the boundary, or within 200m of the Sandlings Special Protection Area and Leiston to Aldeburgh Site of Special Scientific Interest is undertaken outside of the breeding bird season to prevent damage or disturbance (noise, visual and vibration) to designated interest features. This should be included as a condition in the DCO and Code of Construction Practice (COCP). Natural England request consultation on the COCP and suggest that the relevant conservation bodies are included within the document to ensure contact details are accessible if and when required.		The seasonal restriction on construction works associated with crossing the SPA will be included within the SPA crossing method statement and the Breeding Bird Protection Plan which requires to be included within the final Ecological Management Plan to be submitted for approval by the Local Planning Authority in accordance with Requirement 21 of the ***draft DCO*** (APP-023) and on which NE will be consulted. It is noted that the seasonal restriction proposed by the Applicant applies only to works associated with crossing the SPA. This is specifically works associated with crossing the SPA which are within the SPA boundary and works associated with crossing the SPA within 200m of the SPA boundary. As noted within the ***Outline Landscape and Ecological Management Strategy*** (OLEMS) (APP-584), the Applicant will not undertake onshore cable route construction works to cross the Sandlings Special	Natural England is satisfied with the applicant completing all construction works within the SPA and within 200m of the SPA buffer outside of the bird breeding season. Regarding construction activities outside of the SPA and the SPA buffer zone, Natural England recommends these are also undertaken outside of the breeding season in order to minimise any impacts to breeding birds. It is noted that the applicant wishes to undertake construction activities outside the SPA crossing during the breeding bird season. Natural England welcomes the Breeding Bird Protection Plan (BBPP) as part of the OLEMS and being secured under requirement 21 of the draft DCO this should be agreed in consultation with NE. Natural England also welcomes being consulted on the pre-construction breeding bird surveys to enable any mitigation to be adopted.		The BBPP that will be submitted as part of the EMP requires to be approved by the local planning authority in consultation with NE. The Applicants have submitted an ***Outline SPA Crossing Method Statement*** at Deadline 1 (REP1-043) specifying the construction programme constraints for both open trench and trenchless SPA crossing techniques. This includes a firm commitment that SPA crossing works within the SPA boundary and within 200m of the SPA crossing will be undertaken outside the breeding bird season (refer to ***Section 2.4*** and ***Section 3.4*** of the

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/776725/Consultation_details.pdf

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
			Protection Area (SPA) / Leiston – Aldeburgh Site of Special Scientific Interest (SSSI) within the SPA/SSSI boundary or associated crossing works within 200m of the SPA/SSSI boundary during the breeding bird season unless otherwise agreed with Natural England that bird breeding activities within 200m of the SPA/SSSI crossing works area have ceased. The timing of this seasonal restriction will be based on monitoring information provided by the Ecological Clerk of Work (likely to be mid-February to end of August). The seasonal restriction will be included within the Ecological Management Plan (EMP) and SPA Crossing Method Statement, secured by Requirement 21 of the ***draft DCO*** (APP-023), which is the appropriate mechanism with which to secure the seasonal restriction. The Applicant does not consider that it is necessary for such a restriction to appear on the face of the DCO. The Applicant considers that the seasonal restriction need only apply to onshore cable route construction works to cross the SPA / SSSI within the boundary, or associated crossing works within 200m during the breeding bird season. The Applicant does not consider it appropriate for onshore cable route construction works within 200m of the boundary of the Sandlings SPA (with the exception of the crossing of the Sandlings SPA) to be undertaken outside the breeding bird season. Should a requirement for works to be undertaken within 200m of the Sandlings SPA during the breeding bird season be identified (with the exception of the crossing of the Sandlings SPA), the Applicant will undertake breeding bird surveys to determine the presence/absence of breeding birds within the work area, and NE will be consulted on this. Based on known breeding bird distribution and habitat requirements, onshore cable corridor work beyond 200m from the SPA crossing area may take place during the breeding season. In order to safeguard breeding individuals from disturbance, a Breeding Bird Protection Plan (BBPP) will be produced as detailed in ***section 6.4*** of the ***OLEMS***. This will be developed post-consent and is secured under Requirement 21 of the ***draft DCO***	Natural England still strongly advises and requests that all cable construction works within the SPA and the 200m buffer zone being undertaken outside the breeding season is included as a condition of the DCO and we are consulted on the Code of Construction Practice (COCP).		***Outline SPA Crossing Method Statement***). A final SPA Crossing Method Statement which accords with the ***Outline SPA Crossing Method Statement*** (REP1-043) will be prepared as part of the EMP post-consent, to be approved by the relevant planning authority in consultation with the statutory nature conservation body (NE) as secured through Requirement 21 of the ***draft DCO*** (APP-023). Requirement 21 will be updated to require the final SPA crossing method statement to be in accordance with the outline SPA crossing method statement and this will be reflected in the updated draft DCO to be submitted at Deadline 3. The commitment to undertake the SPA crossing works outside of the breeding bird season will therefore be carried forward from the ***Outline SPA Crossing Method Statement*** to the final SPA Crossing Method Statement. The Applicants consider this a robust and appropriate mechanism for securing this commitment and do not agree that it should be captured as a separate requirement within the DCO. Regarding NE's suggestion of a wider seasonal restriction beyond that already committed to by the Applicants in respect of the SPA crossing, the Applicants do not consider this to be proportionate to the level of impact upon onshore ornithological receptors as assessed within ***Chapter 23 Onshore Ornithology*** (APP-071) of the Environmental Statement (ES). The Applicants consider that the BBPP provides sufficient mitigation in the event that nesting ornithological receptors are encountered during construction.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
2	If an open cut trench method is selected habitat restoration should be implemented to compensate and improve supporting habitat lost. Any scrub removed should be reinstated by planting hawthorn and blackthorn. Areas of acid grassland should be created as heathland by ensuring that soil removed is appropriately stored, reinstated and capped with sandy topsoil. Locally sourced heather seed should be sown across the restoration area to recreate pioneer heath. The Applicant should provide information on the areas to be restored and methodology including timescales and species. The applicant should consider opportunities for net gain in improving and extending relevant and supporting habitats. We recommend consultation with the landowner and RSPB is sought regarding restoration works and net gain opportunity.		An ***Outline Landscape and Ecological Management Strategy*** (OLEMS) (APP-584) has been submitted with the application. The OLEMS (APP-584) outlines the requirement for landscape and ecological (including ornithological) mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. Requirement 14 of the ***draft DCO*** (APP-023), states that a Landscape Management Plan (LMP) and associated work programme must be submitted to and approved by the planning authority before any onshore works can commence. Requirement 15 of the draft DCO then states that all landscaping works must be carried out in accordance with the approved LMP. Requirement 21 of the draft DCO (APP-023), states that an Ecological Management Plan (EMP) (which will include an SPA Crossing Method Statement) must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. Both the LMP and the EMP must accord with the OLEMS. The SPA Crossing Method Statement will include mitigation measures specifically relating to the SPA crossing, including habitat restoration. Through submission and approval of the final LMP and EMP, NE can be assured that ecological management and provision of landscaping associated with the construction of the onshore infrastructure will be formally controlled and implemented. The information within these management plans would cover the species to be promoted, the habitats to be restored and the methodology and timescales in which this would be undertaken. A substantial portion of the open trench crossing is through an area currently utilised as horse paddock. The Applicant will set out proposals for the ongoing use and maintenance of areas of habitat to be reinstated following the potential open-cut trenched SPA crossing. These proposals for reinstatement of habitat within the SPA will be detailed within the EMP and associated SPA Crossing Method Statement.	As the development area for the project is currently within the Suffolk Coast and Heaths AONB, the provision of net gain is a mandatory requirement of the landscape policy. The Applicant will therefore need to provide net gain as per the requirement of the landscape policy. The provision of undertaking net gain is for the benefit of the natural environment and is something that Natural England supports and encourages on any NSIP. But as discussed at the workshop on 16th July 2020 for ecological matters we are keen to explore enhancement options prior to any mandatory requirements. Natural England recommends that the Applicant still considers using a trenchless crossing technique as this would be less impactful to the Sandlings SPA supporting habitat and cause less harm to any features of the SPA. Natural England welcomes the submission of the outline SPA crossing method statement. Natural England notes that the applicant favours the open cut trenching method to cross the SPA. As it stands options stated for the restoration of the crossing are welcomed. However, pre-construction ornithological survey data needs to be incorporated into the SPA crossing method statement to help finalise the post construction habitat restoration based on species present. Further information on the age and height of vegetation needs to be included, Natural England recommends the planting of different heights of vegetation and that of mature shrubs so that the form of function of the supporting habitat is restored as soon as possible. The Applicant should consider opportunities for net gain in improving and extending relevant and supporting habitats. We recommend consultation with the landowner and RSPB is sought regarding restoration works and net gain opportunity.		Regarding NE's recommendation for the Applicants to consider using a trenchless crossing technique to cross the Sandlings SPA, while this remains an available option, the Applicants consider that an open trench SPA crossing technique carries less impact overall (i.e. of a shorter duration and over a smaller area). The Applicants have submitted an ***Outline SPA Crossing Method Statement*** at Deadline 1 (REP1-043) which provides information on the possible construction methodologies for crossing the SPA, the timing of the works and the ornithological mitigation to be implemented (depending on which construction technique is used) (refer to ***Section 2*** and ***Section 3*** of the ***Outline SPA Crossing Method Statement***). Measures within the ***Outline SPA Crossing Method Statement*** will be refined post-consent and incorporated into a final SPA Crossing Method Statement. This final document will be prepared as part of the EMP and will accord with the outline document. Prior to the relevant stage of the onshore works commencing, the final SPA Crossing Method Statement must be approved by the relevant planning authority in consultation with the statutory nature conservation body (NE). The Applicants have incorporated ES survey data into the ***Outline SPA Crossing Method Statement*** and confirm that pre-constructions surveys will be undertaken and carried forward to the final SPA Crossing Method Statement to be prepared post-consent. The Applicants have carefully evaluated the potential impacts of the Projects on onshore ecology and ornithology during the iterative design of the Projects. The response to those findings has ensured

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
			The Applicant notes that if a trenchless technique is selected as the technique to cross the SPA then no opportunities to propose arrangements for the ongoing use and maintenance of areas of habitat restoration within the SPA will be sought by the Applicant, as no habitat will be lost and therefore mitigation will not be required. Regarding Net Gain, in December 2018, Defra consulted on plans to introduce the principle of Net Gain to the Planning System in England. Defra's recent response to consultation[13] affirms their intention to bring forward legislation to mandate Net Gain within the Environment Bill but confirms their position that Nationally Significant Infrastructure Projects (NSIP) and marine developments will remain out of scope of the mandatory requirement in the Environment Bill. There is currently no Net Gain policy applicable to NSIP projects, nor plans for Net Gain to be introduced for NSIP projects through the Environment Bill.			that if impacts cannot be avoided then appropriate mitigation or enhancement has been proposed in line with the EIA Regulations and the policy requirements set out in the relevant National Policy Statements and in particular the key sections of EN-1. The Applicants have sought the necessary land and rights to deliver those commitments. Biodiversity Net Gain is a different concept, is not a policy requirement for NSIPs and nor are NSIP projects covered by the draft legislation contained in the Environment Bill. The Projects have not been developed to meet a 'biodiversity gain' test and it would not be an appropriate basis on which to acquire land or rights on a compulsory basis. However, the Applicants have submitted an Ecological Enhancement Clarification Note (REP1-035) which provides further details on the ecological enhancements to be realised through the Projects. A landscaping scheme which includes planting that will deliver ecological enhancements will be delivered by the final Landscape Management Plan, which must accord with the ***Outline Landscape and Ecological Management Strategy*** (OLEMS) (secured by Requirement 14 of the draft DCO).
3	Natural England reiterate the preference for HDD under the Sandlings SPA to avoid supporting habitat loss, which will take some time to return to its previous condition. Should HDD be used, sufficient detail on methodology and safeguards to prevent a drilling mud outbreak should be produced. Should a bentonite outbreak occur the HDD document should specify that Natural England will be contacted		As stated in ***Table 3.2*** of the ***Information to Support Appropriate Assessment Report***, the Applicant's preference is for an open-cut trenching technique to cross the Sandlings SPA. As noted in ***section 22.6.1.1.2*** of ***Chapter 22 Onshore Ecology*** (APP-070), the onshore cable route will cross the Sandlings SPA at its narrowest point, towards the north of the SPA and the Applicant has committed to a reduced onshore cable route working width of 16.1m (reduced from 32m) within the SPA to minimise habitat loss.	Natural England reiterate the preference for HDD under the Sandlings SPA to avoid supporting habitat loss, which will take some time to return to its previous condition. Natural England however acknowledges that the Applicant favours using the open trench method. Therefore, there will need to be added emphasis on the adoption of mitigation measures to minimise impacts to an acceptable level Natural England provided comments to the applicant on the draft outline SPA crossing method statement on		The Applicants have submitted an ***Outline SPA Crossing Method Statement*** at Deadline 1 (REP1-043) which takes account of Appendix C2, namely to provide further detail on the construction methodologies proposed for crossing the SPA, the timing of the works and the ornithological mitigation to be implemented (depending on which construction technique is used) (refer to

[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/819823/net-gain-consult-sum-resp.pdf

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	within 24hours and prior to the commencement of any clean-up operations, as the clean-up may on occasion be more damaging than the outbreak. We advise that an outline bentonite frackout document should be provided during examination for each of the HDD locations		An open trench crossing will require two trenches to be constructed within a 16.1m swathe, whereas a trenchless technique such as HDD will require 10 bores to be drilled underground within an underground working width of 90m. The Applicant will submit an Ecological Management Plan (EMP) for approval by the LPA in consultation with NE. In accordance with requirement 21 of the DCO this will include a SPA crossing method statement. Additionally, as agreed at a SoCG meeting with NE on the 19th of February 2020, the Applicant will produce an outline SPA Crossing Method Statement to be submitted as early as possible during the Examination period that will provide further details on the methodology to be adopted for an open trench crossing, and for a trenchless technique (such as HDD). The outline SPA Crossing Method Statement will include details on how the risk of bentonite break-out would be reduced and break out contingencies in the event of a bentonite breakout.	October 6th (please see NE deadline 1 Appendix C2) and will provided further comment once the SPA crossing statement is submitted by the applicant into examination.		***Section 2*** and ***Section 3*** of the ***Outline SPA Crossing Method Statement***) (REP1-043). It should be noted that the measures currently incorporated within the ***Outline SPA Crossing Method Statement*** will be refined post-consent and captured within a final SPA Crossing Method Statement. This final document will be prepared as part of the EMP and will accord with the outline document. Prior to the relevant stage of the onshore works commencing, the final SPA Crossing Method Statement must be approved by the relevant planning authority in consultation with the statutory nature conservation body (NE).
4	Natural England support the seasonal restriction of construction works (outside of the breeding bird season) within the boundary, or 200m outside of the Sandlings SPA to prevent damage or disturbance to designated features of interest. This should be included as a condition in the DCO and COCP. Natural England request consultation on the COCP and suggest that the relevant conservation bodies are included within the document to ensure contact details are accessible when required.		See the response to Point 1 of Terrestrial Ecology which provides the Applicant's position on this matter.	Natural England supports the seasonal restriction of undertaking construction works associated with the SPA and 200 m buffer outside the breeding bird season. This should be included as a condition in the DCO and COCP. Natural England request consultation on the COCP and suggest that the relevant interested parties are included within the document to ensure contact details are accessible when required.		The Applicants have submitted an ***Outline SPA Crossing Method Statement*** at Deadline 1 (REP1-043) specifying the construction programme constraints for both open trench and trenchless SPA crossing techniques. This includes a firm commitment that SPA crossing works within the SPA boundary and within 200m of the SPA crossing will be undertaken outside the breeding bird season (refer to ***Section 2.4*** and ***Section 3.4*** of the ***Outline SPA Crossing Method Statement***). A final SPA Crossing Method Statement which accords with the ***Outline SPA Crossing Method Statement*** will be prepared as part of the EMP post-consent, to be approved by the relevant planning authority in consultation with the statutory nature conservation body (NE) as secured through Requirement 21 of the draft DCO (APP-023). The commitment to undertake the SPA crossing works outside of the breeding bird season will be carried forward from the ***Outline SPA Crossing Method***

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						Statement to the final SPA Crossing Method Statement. The Applicants consider this a robust and appropriate mechanism for securing this commitment and do not agree that it should be captured as a separate requirement within the DCO. Given that details of a seasonal restriction commitment for works within the Sandlings SPA and the 200m SPA crossing buffer will be included within the final SPA Crossing Method Statement (which will accord with the ***Outline SPA Crossing Method Statement***), the Applicants do not consider it necessary to include the commitment within the final CoCP. The final SPA Crossing Method Statement is considered the appropriate document in which to make this commitment, with Requirement 21 of the ***draft DCO*** (APP-023) the appropriate mechanism for securing the implementation of the measures within the final SPA Crossing Method Statement.
5	Natural England advises that should altered/new proposals be planned within a Site of Scientific Interest (SSSI), which are not currently considered as part of the DCO and Application then an assent may be required under the Wildlife and Countryside Act 1981 (as amended) from Natural England.		Noted.	Noted.		No response required.
6	Consideration should be given to Leiston to Aldeburgh SSSI and coastal vegetated shingle in the case of a bentonite or drilling mud outbreak. Information should be provided on engineering design, depth and break out contingencies. This should be provided in the form of outline plan and secured in the DCO/DML		Detailed design of the landfall will be undertaken post consent following pre-construction site investigations and final details will be specified in the landfall construction method statement which requires to be submitted to and approved by the relevant planning authority in accordance with Requirement 13 of the ***draft DCO*** (APP-023).In addition, the Applicant will produce an Outline Landfall Construction Method Statement (to be submitted as early as possible during the examination period) that will provide further details on the trenchless technique to be adopted at the landfall and will include details on how the	Agreed: Natural England has made comments on the Outline Landfall Construction Method Statement in a separate response (sent to the Applicant on 13 August 2020), see appendix C3 Deadline 1 and is satisfied with the detail provided regarding bentonite breakout. Natural England will provide further comment on the Outline Landfall Construction Statement, following submission into examination by the applicant, at Deadline 2. Please also see NE comments to the outline SPA crossing document at Deadline 1 Appendix C2.		No response required.

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			risk of bentonite break-out would be reduced and break out contingencies in the event of a bentonite breakout.			
7	We advise that all nationally protected species, are considered of at least moderate importance.		The assessment methodology and classification of species' importance levels have been discussed and agreed through the ETG and section 42 process (see ***Appendix 22.1*** of ***Chapter 22 Onshore Ecology*** (APP-070). In considering this comment, the Applicant discovered an error within the assessment presented within ***Chapter 22 Onshore Ecology*** (APP-070) with regard to the importance assigned to some nationally protected species. A review and reassessment of impacts on these misclassified species is being produced within a clarification note which will be submitted as early as possible during the examination.	Agreed: Natural England notes the applicant's response to this and will consider documents to be submitted in to examination.		No response required.
8	Within the Leiston to Aldeburgh SSSI the variety of water bodies and terrestrial habitats provides suitable breeding and hunting areas for many species of dragonfly and damselfly, including the nationally scarce hairy dragonfly *Brachytron pratense*. We advise consideration of this species, as previously requested in Natural England's advice letter dated the 26th March 2019.		The Applicant has committed to undertaking an assessment of impacts upon hairy dragonfly to be submitted and agreed as a clarification note as part of the SoCG process with NE.	Agreed: Natural England notes the applicant's response to this and will formally comment on documents once submitted into examination.		Noted, the updated assessment was submitted to NE on 21st September 2020 as part of the Onshore Ecology Clarification Note and was discussed during the workshop on 16th July 2020. The Onshore Ecology Clarification Note, including the assessment of impacts upon hairy dragonfly, was submitted at Deadline 1 (REP1-035).
10	Natural England strongly advises that all cable line construction works in the boundary, or within 200m of the Sandlings Special Protection Area SPA and Leiston – Aldeburgh SSSI is undertaken outside of the breeding bird season (1st February to 31st August for woodlark and 1st of April to 31st August for nightjar) to prevent damage or disturbance to designated interest features. This should be included as a condition in the DCO and COCP. Natural England request consultation on the COCP and suggest that the relevant conservation bodies are included within the document to ensure contact details are accessible when required		See the Applicant's response to this comment at Point 1 of Terrestrial Ecology.	Natural England acknowledges that construction works on the SPA crossing will not be undertaking during the bird breeding season (14th February to 31st August) as stated in the outline SPA crossing method statement. Natural England recommends that this is extended to the 1st of February to cover the entirety of the breeding season for the Woodlark (1st February to 31st August). This should be included as a condition in the DCO and COCP. Natural England request consultation on the COCP and suggest that the relevant interested parties are included within the document to ensure contact details are accessible when required.		The Applicants can confirm that, for an open trench construction technique, the seasonal restriction for Work No. 12 (the SPA crossing) and within a 200m buffer of Work No. 12 will be from the 1st February to 31st August. However, for a trenchless SPA crossing technique the seasonal restriction applicable to construction activities within a 200m buffer of Work No. 12 will remain from 14th February to the 31st August given the amount of time required to undertake a trenchless crossing. The ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043) included updates to reflect these commitments following the workshop on the 16th July 2020.

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						The Applicants consider a seasonal restriction start of 14th February to be acceptable for the species in question. This is the recommended survey period that has been used for the national woodlark censuses methodology, which recommends commencing surveys from mid-February onwards[14]. Given the reduced risk profile with regard to construction programming of the open trenching technique, the Applicants can agree with NE's request for the seasonal restriction to works within the SPA and SPA crossing buffer to start on 1st February for open trench works only. A final SPA Crossing Method Statement which accords with the ***Outline SPA Crossing Method Statement*** will be prepared as part of the EMP post-consent, to be approved by the relevant planning authority in consultation with the statutory nature conservation body (NE) as secured through Requirement 21 of the draft DCO (APP-023). The commitment to undertake SPA crossing works outside of the breeding bird season will be carried forward from the ***Outline SPA Crossing Method Statement*** to the final SPA Crossing Method Statement. The Applicants consider this a robust and appropriate mechanism for securing this commitment and do not agree that it should be captured as a separate requirement within the DCO. Given that details of a seasonal restriction commitment for works within the Sandlings SPA and the 200m SPA crossing buffer will be included within the final SPA Crossing Method Statement (which will accord with the ***Outline SPA Crossing Method Statement***), the

[14] https://www.rbbp.org.uk/downloads/Gilbert_et_al_PDFs/Woodlark%20Gilbert%20et%20al.pdf

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						Applicants do not consider it necessary to include the commitment within the final CoCP. The final SPA Crossing Method Statement is considered the appropriate document in which to make this commitment, with Requirement 21 of the draft DCO (APP-023) the appropriate mechanism for securing the implementation of the measures within the final SPA Crossing Method Statement.
10	Natural England welcome the mitigation prescribed for woodland, scrub and trees and encourage the Applicant to incorporate net gain into their strategy. We support the commitment to an aftercare period for all newly planted hedgerow, shelterbelts and woodlands.		See the Applicant's response to Point 32 of Terrestrial Ecology where this comment is also made by NE in respect of the ***OLEMS***.	Noted		No response required.
11	The impact on coastal habitat from bentonite and drilling mud break outs should be considered.		The Applicant will produce an Outline Landfall Construction Method Statement (to be submitted as early as possible during the examination period) that will provide further details on the trenchless technique to be adopted at the landfall. The Outline Landfall Construction Method Statement will include details on how the risk of bentonite break-out would be reduced, the break out contingencies in the event of a bentonite breakout and consideration of potential impacts on coastal habitat from bentonite and drilling fluid breakout.	Agreed: Natural England has made interim comments on the Outline Landfall Construction Method Statement in a separate response (sent to the Applicant on 13 August 2020) and is satisfied with the detail provided regarding bentonite breakout. Please see NE's Deadline 1 Appendix C3 for full details.		No response required.
12	The Hundred River feeds into Sandlings SPA and we would expect to see an assessment of alternatives to include HDD under this water course and impacts outlined. However, should HDD be used, sufficient detail on methodology and safeguards to prevent a drilling mud outbreak should be produced. Should a bentonite outbreak occur the HDD document should specify that Natural England will be contacted within 24hours and prior to the commencement of any clean-up operations, as the clean-up may on occasion be more damaging than the outbreak. We advise that an outline		There is insufficient space at the Hundred River crossing point to accommodate a trenchless (e.g. HDD) solution given the proximity of properties in the immediate vicinity. The Applicant engaged with NE through the Site Selection ETGs to demonstrate that a trenchless crossing of the Hundred River was not a feasible option and Natural England attended a site visit with the Applicant on 21st February 2018 where the feasibility of crossing the Hundred River (and Aldeburgh Road) was discussed. Alternatives to a trenchless solution were presented at that time. Given the Hundred River's narrow width, the preferred crossing technique would be open cut trenching. As per Requirement 22 of the DCO, the Applicant will submit a watercourse crossing statement for approval as part of the final CoCP. In addition, as agreed at a SoCG	Natural England still advises on using the HDD method in order to cross the Hundred River and welcomes the submission of a watercourse crossing method statement as part of the final COCP. The outline crossing method statement should address why the trenchless method (favoured by the applicant) has been chosen over other methods. The impacts to the Hundred River and the Sandlings SPA should be addressed, as well as the construction methods to be used, time scales and mitigation and compensation needed. Particular attention would need to be included if there was a risk of an instance in which habitats within the vicinity could be further damaged this could be from a pollution event. The Outline Water Course Crossing Method		The Applicants will submit an ***Outline Watercourse Crossing Method Statement*** at Deadline 3. This will provide further information on the method for watercourse crossings to provide assurance to NE regarding the measures to be implemented in order to minimise impacts upon the Hundred River. A trenchless technique (e.g. Horizontal Directional Drill (HDD)) is not feasible at the Hundred River due to spatial constraints. This will be explained further in the Outline Watercourse Crossing Method Statement (see the Applicants'

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	bentonite frackout document should be provided during examination for each of the HDD locations We welcome the commitment to reinstate and improve habitats.		meeting with NE on the 19th of February 2020, the Applicant will produce an Outline Watercourse Crossing Method Statement (to be submitted as early as possible during the examination period) which will outline the construction technique(s) available to cross the Hundred River and the mitigation measures that will be adopted to reduce the environmental impact of the works..	Statement should include information on how impacts will be reduced and/or addressed. If HDD was chosen as the crossing from the Hundred River, the Method statement would need to include methods which would be used for the clear up of a Bentonite break out, how this could be reduced and the impacts to habitats as a result of this. Natural England should be a consultee on the plan as we will need to be contacted within 24 hours of a bentonite breakout. Please also see Natural England's response to the Draft SPA Crossing Method Statement (October 6th 2020), Appendix C2 Deadline 1.		response to ExA written question 1.2.66 (REP1-107)).
13 and 14	Any works that directly impact upon badgers should be subject to mitigation, compensation and/or a protected species license from Natural England to avoid an offence under the Wildlife and Countryside Act 1981 (as amended). We refer to the Planning Inspectorates advice note 11 which advises early engagement with Natural England. We advise that an outline plan is provided. Mitigation should include micro-siting of cable route to avoid badger setts, and mitigation and compensation as outlined within Natural England standing advice. This should all be included in an outline plan during examination.		The Applicant has undertaken preliminary micrositing of the onshore infrastructure in order to avoid known badger setts and will undertake pre-construction surveys and ensure final design of the works avoid and mitigate disturbance to badger setts accordingly. There are areas within the Order Limits which can provide mitigation for badgers if required. As per Requirement 21 of the ***draft DCO*** (APP-023), the Applicant must submit an Ecological Management Plan (EMP) for approval by the LPA in consultation with NE which will include provision for badger mitigation before any onshore works can commence. The final approved EMP must accord with the ***OLEMS*** (APP-584) submitted with the Application.	Natural England acknowledges the applicants response and welcomes the preliminary micrositing of onshore infrastructure and pre-construction surveys of badger setts. Natural England awaits the submission of the Ecological Management Plan (EMP) and will review the documentation when submitted. And would recommend an outline plan being submitted in to examination. The Applicant is encouraged to apply for any Protected species licences where the construction works will impact on any badger setts and consult with Natural England as early as possible with regards to any protected species licences needed.		The Applicants note that the Outline Landscape and Ecological Management Strategy (***OLEMS***) (APP-884) submitted as part of the DCO application for the Projects includes an outline EMP to which the final EMP must accord. The Applicants therefore query the need for an outline EMP to be submitted during Examination and are of the view that this is not necessary. As per Requirement 21 of the ***draft DCO*** (APP-023) the final EMP must accord with the ***OLEMS*** (APP-584) and no stage of the onshore works can commence until the final EMP has been approved by the relevant planning authority in consultation with the statutory nature conservation body (NE). The requirement for protected species licences will be identified post-consent and informed by the results of pre-construction surveys, as referred to for badger and great crested newt within the ***OLEMS*** (APP-584). The Applicants will engage with NE for a Letter of No Impediment for protected species licences and will submit draft licence applications to NE for consultation at an early stage during the Examination.

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15	We welcome the mitigation prescribed for bats in principal, but advise that potential impacts to bat habitat should be clearly mapped with roosting, foraging and commuting areas shown in relation to the redline boundary. As consistent with Natural England's previous advice letter the 26th March 2019. The applicant should also consider any in combination impacts with proposed development at Sizewell C and any other foreseeable plans or projects. This should be provided as an outline plan as part of the examination.		***Figure 22.8a-g*** of ***Chapter 22 Onshore Ecology*** (APP-281) details the findings of the bat roost survey and ***Figure 22.7a-f*** (APP-280) details the bat roost and commuting / foraging habitat. The Applicant has agreed through the SoCG process to undertake an assessment of cumulative impacts with the Sizewell C development on roosting, foraging and commuting areas shown in relation to the order limits. This assessment will be undertaken following publication of the Sizewell C application if published during the examination phase of the Project. The assessment was not undertaken in the pre-application stage due to there being insufficient data on the Sizewell C project available to conduct an accurate assessment at the time. However, it should be noted that the CIA was undertaken in accordance with the Planning Inspectorate Advice Note 17 on cumulative assessment. An ***OLEMS*** (APP-584) has been submitted with the Application. The ***OLEMS*** outlines the requirement for landscape and ecological mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. The ***OLEMS*** states that bat roost surveys will be undertaken prior to construction. Requirement 21 of the ***draft*** DCO (APP-023), states that an Ecological Management Plan (EMP) must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. The EMP must accord with the OLEMS. Through submission and approval of the final EMP, NE can be assured that ecological management associated with the construction of the onshore infrastructure will be formally controlled and implemented.	Natural England notes that the Applicant has agreed through the SoCG process to undertake an assessment of cumulative impacts with the Sizewell C project. Since the Sizewell C development has been accepted by the planning inspectorate, Natural England will await further information that will arise as a result of discussions between the two projects. Natural England will also await the review of the Ecological Management Plan (EMP). However, NE would welcome further consultation on any outline EMP during examination.		The Applicants have reviewed the Sizewell C DCO application documents. As the onshore footprints of Sizewell C and the Projects do not overlap (outside of highway junctions) there is no pathway for direct cumulative impacts upon ecological receptors. The Projects considered cumulative impacts with Sizewell C in relation to nitrogen deposition from construction traffic in the vicinity of Sizewell Gap which concluded not significant impacts. The Sizewell C CIA did not consider nitrogen deposition impacts however for the SZC construction traffic air quality assessment the Projects (East Anglia TWO and East Anglia ONE North) were included in the baseline for the Sizewell C project-alone assessment, which concluded not significant impacts. Therefore, as noted in the Applicants' response to Procedural Deadline 18 submitted to the ExA. on the 13th August 2020 (AS-061), it is considered that an additional or supplementary terrestrial ecology assessment of cumulative impacts with Sizewell C is not required.
16	Any works that directly impact upon great crested newts should be subject to mitigation, compensation and/or a protected species license from Natural England to avoid an offence under the Wildlife and Countryside Act 1981 (as amended). We refer to the Planning Inspectorates advice note 11 which		The potential impact on great crested newt is assessed in ***section 22.6.1.10*** of ***Chapter 22 Onshore Ecology*** (APP-070) and concluded a residual impact of minor adverse. An ***OLEMS*** (APP-584) has been submitted with the Application. The ***OLEMS*** outlines the requirement for landscape and ecological (including great crested newt)	Natural England acknowledges the Applicants response and will await the submission of the Ecological Management Plan (EMP) for review. Natural England advises the applicant to consider if any of the works will directly impact upon Great crested newts. A Protected species licence to avoid any offence underneath the Wildlife and Countryside Act 1981 as amended with be required for this species. Natural England advises that the		Given the potential impacts upon great crested newt assessed within the ES, the Applicants note the requirement to engage with NE for a Letter of No Impediment and will prepare a draft licence application and submit this to NE for consultation at an early stage during the Examination.

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	advises early engagement with Natural England. Natural England advises that the Applicant approaches us for a Letter of No Impediment as early as possible.		mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. Requirement 21 of the ***draft DCO*** (APP-023), states that an Ecological Management Plan (EMP) must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. The EMP must accord with the OLEMS. Through submission and approval of the final EMP, NE can be assured that ecological management associated with the construction of the onshore infrastructure will be formally controlled and implemented.	Applicant approaches Natural England for a Letter of No Impediment as early as possible during this examination. Any construction works that will impact great crested newts will need to be also compensated and mitigated against under a protected species licence. Natural England encourages engagement as early as possible if protected species licences are required.		The requirement for protected species licences at the point of construction will be identified post-consent and informed by the results of pre-construction surveys. Thereafter, the Applicants will apply for any required protected species licences.
17	The Environmental Statement confirms suitable habitat within the vicinity of works and highlights the possibility of killing or injuring reptiles as a risk during construction. Natural England advises that reptile surveys are completed prior to construction to quantify potential impacts and to finalise mitigation works. Reptile mitigation should ensure that there is no net loss of local reptile conservation status, by providing sufficient quality, quantity and connectivity of habitat to accommodate the reptile population in the long term, either on site or at an alternative site nearby. We advise that an outline plan is provided as part of the examination.		The potential impact on reptiles is assessed in ***section 22.6.1.11*** of ***Chapter 22 Onshore Ecology*** (APP-070) and concluded a residual impact of minor adverse. An ***OLEMS*** (APP-584) has been submitted with the application. The ***OLEMS*** outlines the requirement for landscape and ecological (including reptile) mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. Requirement 21 of the ***draft DCO*** (APP-023), states that an Ecological Management Plan (EMP) must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. The EMP must accord with the ***OLEMS***. Through submission and approval of the final EMP, NE can be assured that ecological management and provision of landscaping associated with the construction of the onshore infrastructure will be formally controlled and implemented.	Natural England notes the applicant's response and will await the submission of the final Ecological Management Plan (EMP). However, NE would welcome further consultation on any outline EMP during examination.		The ***OLEMS*** (APP-884) submitted as part of the DCO application for the Projects includes an outline EMP to which the final EMP must accord. The Applicants therefore query the need for an outline EMP to be submitted during Examination and are of the view that this is not necessary. As per Requirement 21 of the draft DCO (APP-023) the final EMP must accord with the ***OLEMS*** (APP-584) and no stage of the onshore works can commence until the final EMP has been approved by the relevant planning authority in consultation with the statutory nature conservation body (NE).
18	We support the undertaking of pre-construction surveys to confirm the presence and/or absence of otters and water vole. In the event of either or both species being present in pre-construction surveys we refer to our protected species standing advice:		Noted.	Noted.		No response required.

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	https://www.gov.uk/guidance/reptiles-protection-surveys-and-licences.					
19	It is Natural England's advice that all cable line construction works within the boundary, or 200m outside of the Sandlings SPA and Leiston – Aldeburgh SSSI are undertaken outside of the breeding bird season (1st February to 31st August for woodlark and 1st of April to 31st August for nightjar) to prevent damage or disturbance to designated and sensitive interest features. This should be included as a condition in the DCO and CCP. Natural England requests consultation on the CCP and suggest that the relevant conservation bodies are included within the document to ensure contact details are accessible when required.		See the Applicant's response to this comment at Point 1 of Terrestrial Ecology.	See Natural England's response to Point 1.		The Applicants have provided a response to this at Point 1.
20	The open cut trench method of cable installation will result in the temporary loss of supporting habitat, including the breeding sites of turtle dove which are cited as a features of interest for Leiston to Aldeburgh SSSI. We understand that any habitat removed during the period of works will be reinstated, however there is a risk that the required mitigation will not be sufficiently established to provide suitable nesting habitat for the following breeding season. Natural England advises that the 3ha of compensatory turtle dove feeding habitat to be provided should be in place in advance of works. We understand that an HDD technique will avoid the loss of designated habitat and on this basis Natural England expresses a preference for an HDD method.		The Applicant's preference is for an open-cut trenching technique to cross the Sandlings SPA. As noted in ***section 22.6.1.1.2*** of ***Chapter 22 Onshore Ecology*** (APP-070) the onshore cable route will cross the Sandlings SPA at its narrowest point, towards the north of the SPA and the Applicant has committed to a reduced onshore cable route working width of 16.1m (reduced from 32m) within the SPA to minimise habitat loss. A substantial portion of the open trench crossing route through the SPA is through a horse paddock and therefore this area of the habitat is already disturbed by virtue of its current use. The Applicant will update the ***OLEMS*** (APP-584) and Outline SPA Crossing Method Statement with an outline of the timing of habitat creation areas. It is intended that an area within Work No. 14 will be used for turtle dove mitigation, the extent of this area will be dependent on the results of the pre-commencement breeding bird surveys to be undertaken.	Natural England notes the Applicant's response and awaits update of the OLEMS and Outline SPA Crossing Method Statement with timings. As stated in our response to the Draft Outline SPA Crossing Method Statement (23rd July 2020), Natural England recommends that sowing of the seed mix is undertaken as early as possible to ensure establishment prior to construction works being undertaken. We also consider that it may be beneficial to leave the turtle dove mitigation area in place for a period of time after reinstatement of the cable route while the site recovers.		The Applicants have submitted an ***Outline SPA Crossing Method Statement*** at Deadline 1 (REP1-043) which provides further clarity on the timings of the turtle dove mitigation proposed (refer to ***Section 2.11*** and ***Section 3.11*** of the ***Outline SPA Crossing Method Statement***). The updated ***Outline SPA Crossing Method Statement*** confirms that seed mix will be sown on suitably prepared ground between 1st August and 15th October in the calendar year prior to the commencement of construction of the cable route between the landfall and Snape Road.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
21	The open cut trench method of cable installation will result in the temporary loss of designated and supporting habitat, including the breeding sites of nightingale which is cited as a feature of interest for Leiston to Aldeburgh SSSI. To mitigate impacts, the Applicant proposes the provision of nesting sites for nightingale will be delivered through habitat management within and on the outskirts of the designated sites and in line with BTO habitat management guidelines. This mitigation method will need to be secured in the DCO and clearly set out in an outline habitat management / mitigation plan as there is the potential for the works themselves to be damaging to the designated sites. We advise that any scrub removal is restored with hawthorn and blackthorn. We understand that an HDD technique will avoid the loss of designated habitat and on this basis Natural England expresses a preference for an HDD method.		The Applicant's preference is for an open-cut trenching technique to cross the Sandlings SPA. As noted in ***section 22.6.1.1.2*** of ***Chapter 22 Onshore Ecology*** (APP-070) the onshore cable route will cross Sandlings SPA at its narrowest point, towards the north of the SPA and the Applicant has committed to a reduced onshore cable route working width of 16.1m (reduced from 32m) within the SPA to minimise habitat loss. The Applicant will submit an Outline SPA Crossing Method Statement as early as possible during the examination period. An ***OLEMS*** (APP-584) has been submitted with the application. The ***OLEMS*** outlines the requirement for landscape and ecological (including ornithological) mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. Requirement 21 of the ***draft DCO*** (APP-023), states that an Ecological Management Plan (EMP) (which will include an SPA Crossing Method Statement) must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. The EMP must accord with the OLEMS. The SPA Crossing Method Statement will include mitigation measures specifically relating to the SPA crossing, including habitat restoration. Through submission and approval of the final EMP, NE can be assured that ecological management and provision of landscaping associated with the construction of the onshore infrastructure will be formally controlled and implemented. The Applicant considers that an open-cut trenching method would reduce the impact (particularly for the local community) when compared with a trenchless solutions such as HDD given the shorter timescales, reduced vehicle movements and smaller spatial footprint required.	As stated in our response to the Draft Outline SPA Crossing Method Statement (October 6th 2020), see Appendix C2 Deadline 1, Natural England considers that the nightingale mitigation plan needs to be more detailed. For example we would expect to see a detailed plan outlining how the area will start to function as a habitat for nightingale as soon as possible, i.e. details on height and maturity of vegetation. We also note that Work No 12A is directly adjacent to the SPA crossing works area and this mitigation area would need to be well established and functioning in advance of works. Natural England queries how this will be secured?		The Applicants have submitted an ***Outline SPA Crossing Method Statement*** at Deadline 1 (REP1-043) which provides further clarity on the timings of the nightingale mitigation proposed for the SPA crossing works (refer to ***Section 2.11*** and ***Section 3.11***). The measures for establishing and managing habitat for nightingale to mitigate the potential impacts of the works undertaken within the SPA will be delivered through the final SPA Crossing Method Statement which will form part of the final EMP. This in turn will be secured by Requirement 21 of the ***draft DCO*** (APP-023) and must accord with the ***Outline SPA Crossing Method Statement*** (REP1-043).
22	We welcome the inclusion of barn owl mitigation and the commitment to consult with the Suffolk Community Barn Owl Project. We advise that any compensatory habitat is provided in appropriate		An ***OLEMS*** (APP-584) has been submitted with the application. The ***OLEMS*** outlines the requirement for landscape and ecological (including barn owl) mitigation measures that are reflective of the surveys and impact	Natural England notes the mitigation proposed for barn owls in Section 6.3 of the OLEMS and await the submission of the final Ecological Management Plan (EMP). However, NE would welcome further consultation on any outline EMP during examination.		The ***OLEMS*** (APP-884) submitted as part of the DCO application for the Project incorporates the outline EMP to which the final EMP must accord. As per Requirement 21 of the ***draft DCO*** (APP-

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
	timescales. And should that mitigation be required with the boundary of any designated site then Natural England must be consulted. This will need to be secured in the DCO and included in an outline management plan.		assessment carried out for the onshore infrastructure of the Project. Requirement 21 of the ***draft DCO*** (APP-023), states that an Ecological Management Plan (EMP) (which will include an SPA Crossing Method Statement) must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. The EMP must accord with the ***OLEMS***. The SPA Crossing Method Statement will include mitigation measures specifically relating to the SPA crossing, including habitat restoration. Through submission and approval of the final EMP, NE can be assured that ecological management and provision of landscaping associated with the construction of the onshore infrastructure will be formally controlled and implemented.			023) the final EMP must accord with the ***OLEMS*** (APP-584) and no stage of the onshore works can commence until the final EMP has been approved by the relevant planning authority in consultation with the statutory nature conservation body (NE).
23	We agree with the necessity of pre-construction surveys prior to any works taking place. If active nests are found, it should be noted that all wild birds, their nests and eggs are afforded legal protection under the Wildlife and Countryside Act 1981 (as amended), and therefore works in the vicinity of the nest may have to be delayed until any chicks have fledged. Or site preparation works need to be agreed upfront with relevant authorities in consultation with Natural England to be locations temporarily unsuitable for nesting. If exclusion or buffer zones are proposed, the size of the exclusion zone should be well researched to reflect the disturbance tolerance level of the species identified and be of a sufficient distance to prevent disturbance (noise, visual and vibration) to nesting birds.		An ***OLEMS*** (APP-584) has been submitted with the application. The ***OLEMS*** outlines the requirement for landscape and ecological (including ornithological) mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. Requirement 21 of the ***draft DCO*** (APP-023), states that an Ecological Management Plan (EMP) (which will include an SPA Crossing Method Statement) must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. The EMP must accord with the OLEMS. The SPA Crossing Method Statement will include mitigation measures specifically relating to the SPA crossing, including habitat restoration. Through submission and approval of the final EMP, NE can be assured that ecological management and provision of landscaping associated with the construction of the onshore infrastructure will be formally controlled and implemented.	Natural England notes the mitigation proposed for nesting birds in Section 6.3 of the OLEMS and await the submission of the final Ecological Management Plan (EMP). However, NE would welcome further consultation on any outline EMP during examination.		The ***OLEMS*** (APP-884) submitted as part of the DCO application for the Project incorporates the outline EMP to which the final EMP must accord. As per Requirement 21 of the ***draft DCO*** (APP-023) the final EMP must accord with the ***OLEMS*** (APP-584) and no stage of the onshore works can commence until the final EMP has been approved by the relevant planning authority in consultation with the statutory nature conservation body (NE).

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
24	We support the inclusion of an artificial light emissions management plan, which incorporates measures to minimise light spill following the recommendations regarding birds set out in the Bat Conservation Trust's Artificial Lighting and Wildlife guidance (2014).		As per Requirement 22 of the ***draft DCO*** (APP-023), the Applicant will submit an artificial light emissions management plan for approval by the relevant planning authority as part of the final CoCP. As per Requirement 25 of the ***draft DCO***, an operational artificial light emissions management plan providing details of artificial light emissions during the operation of Work No. 30, including measures to minimise lighting pollution and the hours of lighting, will require to be submitted to and approved by the relevant planning authority.	Noted.		No response required.
25	Monitoring: Natural England notes that detail on monitoring plans is currently lacking and advises that a commitment to post-construction monitoring is made, in particular in the following cases: 1 year post-completion of turf stripped and grassland areas which have been removed to assess that natural colonisation or reseeding has been successful, and whether additional mitigation works may be required following re-instatement of habitats (see Ref 5.12 in Onshore Schedule of Mitigation), in particular if open cut trenching is used. 7 years monitoring of hedgerows or until the hedgerows have recovered.		The Applicant notes NE's request for a commitment by the Applicant for 1-year post-completion monitoring of turf stripped and grassland areas which have been removed within the Sandlings SPA; and a commitment that further measures will be implemented to promote the reinstatement where monitoring identifies further measures are required. This request will be discussed with NE through the SoCG process and any agreed changes to the monitoring and reinstatement proposals will be captured in an updated OLEMS and SPA Crossing Method Statement and carried forward to the final EMP and/or LMP (where relevant) for approval by the LPA. Requirement 15 of the ***draft DCO*** (APP-023) requires that any trees or shrubs planted as part of the approved LMP that fail within a period of 5 years (and 10 years at the substation site) must be replanted. The Applicant will discuss hedgerow monitoring further with NE through the SoCG process.	Natural England notes that discussion on this issue is ongoing and will be progressed through the SoCG process.		Noted, the Applicants will continue engagement on this matter through the SoCG process.
26	We welcome the inclusion of a Soil Management Plan and refer to the DEFRA guidance on soil protection: Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. We advise its use in the design and construction of development, including any planning conditions. Should the development proceed, we advise that the Applicant uses an appropriately experienced soil specialist to advise on, and supervise soil handling, including identifying when soils		Noted. Soil management is detailed in section 8 of the ***Outline Code of Construction Practice*** (APP-578).	Noted.		No response required.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
	are dry enough to be handled and how to make the best use of soils on site.					
27	Natural England welcomes the preparation of a project specific Pollution Prevention and Response Plan and advises that we are consulted within 24 hours should there be a pollution incident within or in proximity to a designated site. We also advise that SNCBs, including Natural England are listed as consultees. This should be agreed in outline as part of the examination.		The Applicant will ensure that if a pollution incident occurs within a designated site or which may affect a designated site that NE will be consulted within 24 hours of the incident being detected. This commitment will be captured within an updated version of the ***Outline Code of Construction Practice*** (APP-578) prepared during the Examination. The relevant planning authority is considered to be the appropriate approval body for the final Code of Construction Practice (which includes the Pollution Prevention and Control Plan). An updated ***Outline Code of Construction Practice*** (APP-578) to be produced during Examination will confirm that the Applicant will consult NE during the preparation of the Pollution Prevention and Control Plan.	Noted.		No response required.
28	Natural England welcomes the preparation of a project specific Noise and Vibration Management Plan. We also advise that SNCBs, including Natural England are listed as consultees. This should be agreed in outline as part of the examination		The relevant planning authority is considered to be the appropriate approval body for the outline Code of Construction Practice (which includes the construction phase noise and vibration management plan). Further clarity is sought regarding the geographic extent of NE's interest in the noise and vibration management plan but in any event an updated ***Outline Code of Construction Practice*** (APP-578) to be produced during Examination will confirm that the Applicant will consult NE during the preparation of the Noise and Vibration Management Plan.	Noted.		No response required.
29	Natural England supports the seasonal restriction of construction works (outside of the breeding bird season; 1st February to 31st August for woodlark and 1st of April to 31st August for nightjar) within the boundary, or 200m outside of the Sandlings SPA to prevent damage or disturbance to designated features of interest. This should be included as a condition in the DCO and COCP. Natural England request consultation on the COCP and suggest that the relevant conservation bodies are included within		See the response to Point 1 which provides the Applicant's position on this matter.	See Natural England's response to Point 1.		The Applicants have provided a response to this at Point 1.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
	the document to ensure contact details are accessible if and when required.					
30	Natural England requests that Statutory Nature Conservation Bodies (SNCBs) including Natural England are consulted on the Ecological Management Plan. And that this is included in outline as part of the examination.		Requirement 21 of the ***draft DCO*** (APP-023), states that an EMP must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. An ***OLEMS*** (APP-584) has been submitted with the application. The ***OLEMS*** outlines the requirement for landscape and ecological mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. Requirement 21 states that the final EMP must accord with the ***OLEMS***.	Noted. Ongoing until we have reviewed the EMP.		An outline EMP is provided within ***Section 10*** of the ***OLEMS*** (APP-584). This document details the specific mitigation measures that have been identified based on the results of the surveys undertaken to date.
31	We agree with the necessity of pre-construction surveys prior to any works taking place. If active nests are found, it should be noted that all wild birds, their nests and eggs are afforded legal protection under the Wildlife and Countryside Act 1981 (as amended), and therefore works in the vicinity of the nest may have to be delayed until any chicks have fledged. Or site preparation works need to be agreed upfront with relevant authorities in consultation with Natural England to be locations temporarily unsuitable for nesting. If exclusion or buffer zones are proposed, the size of the exclusion zone should be well researched to reflect the disturbance tolerance level of the species identified and be of a sufficient distance to prevent disturbance to nesting birds.		An ***OLEMS*** (APP-584) has been submitted with the application. The ***OLEMS*** outlines the requirement for landscape and ecological (including ornithological) mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. Requirement 21 of the ***draft DCO*** (APP-023), states that an Ecological Management Plan (EMP) (which will include a Breeding Bird Protection Plan) must be submitted to and approved by the planning authority in consultation with the relevant statutory nature conservation body, before any onshore works can commence. The EMP must accord with the ***OLEMS***. Through submission and approval of the final EMP, NE can be assured that ecological management and provision of landscaping associated with the construction of the onshore infrastructure will be formally controlled and implemented.	Natural England notes the mitigation proposed for nesting birds in Section 6.3 of the OLEMS and await the submission of the final Ecological Management Plan (EMP). However, NE would welcome further consultation on any outline EMP during examination.		The ***OLEMS*** (APP-884) submitted as part of the DCO application for the Project incorporates the outline EMP to which the final EMP must accord. As per Requirement 21 of the ***draft DCO*** (APP-023) the final EMP must accord with the ***OLEMS*** (APP-584) and no stage of the onshore works can commence until the final EMP has been approved by the relevant planning authority in consultation with the statutory nature conservation body (NE).
Documents used: 8.7 EA2 Outline Landscape and Ecological Management Strategy						
32	Natural England welcomes the mitigation prescribed for woodland, scrub and trees and encourage the Applicant to incorporate net gain into their strategy. We		Noted.	Noted that discussions are ongoing regarding hedgerow management. However, Natural England continues to recommend that Net Gain is incorporated where possible		The Applicants have carefully evaluated the potential impacts of the projects on onshore ecology and ornithology during the iterative design of the Projects. The

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
	support the commitment to an aftercare period for all newly planted hedgerow, shelterbelts and woodlands. Natural England advises that: • Replacement of hedgerows should be in line with Suffolk Biodiversity Partnership BAP Priority Habitat guidance; • Post-construction monitoring should be undertaken for 7 years or until the hedgerows have recovered • Mature hedgerows plants should be used to fill gaps to reduce time required for gapping up. • Replanting should follow in the first winter after construction. • Subject to landowner permissions, those hedgerows should be left to become overgrown either side of the section to be removed prior to construction. • Hedges should be double-planted with 2m grassland strips or rough grassland / scrub on both sides so there is always a leeward side to forage. • A Hedgerow Mitigation Plan should be developed in consultation with Natural England prior to the removal of hedgerows. This mitigation plan should be included within Ecological Management Plan, Landscape Management Plan or OLEMS as appropriate		The Applicant is currently in discussion with NE through the SoCG process regarding NE's expectations for hedgerow management. Regarding Net Gain, in December 2018, Defra consulted on plans to introduce the principle of Net Gain to the Planning System in England. Defra's recent response to consultation[15] affirms their intention to bring forward legislation to mandate Net Gain within the Environment Bill but confirms their position that Nationally Significant Infrastructure Projects (NSIP) and marine developments will remain out of scope of the mandatory requirement in the Environment Bill. There is currently no Net Gain policy applicable to NSIP projects, nor plans for Net Gain to be introduced for NSIP projects through the Environment Bill.	as an example of best practice so that NSIP projects leave a lasting legacy within the landscape.		response to those findings has ensured that if impacts cannot be avoided appropriate mitigation or enhancement has been proposed in line with the EIA Regulations and the policy requirements set out in the relevant National Policy Statements and in particular the key sections of EN-1. The Applicants have sought the necessary land and rights to deliver those commitments. Biodiversity Net Gain is a different concept, is not a policy requirement for NSIPs and nor are NSIP projects covered by the draft legislation contained in the Environment Bill. The Projects have not been developed to meet a 'biodiversity gain' test and it would not be an appropriate basis on which to acquire land or rights on a compulsory basis. The Applicants have submitted an Ecological Enhancement Clarification Note (REP1-035) which provides further details on the ecological enhancements to be realised through the Projects. A landscaping scheme which includes planting anticipated to deliver ecological enhancements will be delivered by the final Landscape Management Plan, which must accord with the ***OLEMS*** (APP-884) (secured by Requirement 14).
33	We support the engagement of an ecologist when undertaking maintenance works to assess impacts to protected species, breeding birds, designated sites and features to provide guidance on appropriate mitigation.		Noted. As stated in ***section 8*** of the ***OLEMS*** (APP-584): *During any required inspections and/or routine maintenance work, best practice procedures would be followed and be in accordance with the relevant standards at that time. If intrusive works were required at any point, an ecologist would be contacted to assess whether there*	Noted.		No response required.

[15] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/819823/net-gain-consult-sum-resp.pdf

Point	Taken from NE's Relevant and Written Representations EA1N Appendix C - Terrestrial Ecology	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix C1b)	RAG Status Assigned by NE (Appendix C1b)	Applicants' Response
			are any impacts associated with the work, before that work can proceed.			
34	Natural England requests that Statutory Nature Conservation Bodies (SNCBs) including Natural England are consulted on the Ecological Management Plan.		Requirement 21 of the ***draft DCO*** (APP-023) states that the EMP will be approved by the LPA in consultation with the relevant SNCB.	Noted. However, NE would welcome further consultation on any outline EMP during examination.		The ***OLEMS*** (APP-884) submitted as part of the DCO application for the Project incorporates an outline EMP to which the final EMP must accord. As per Requirement 21 of the ***draft DCO*** (APP-023) the final EMP must accord with the ***OLEMS*** (APP-584) and no stage of the onshore works can commence until the final EMP has been approved by the relevant planning authority in consultation with the statutory nature conservation body (NE).

1.4.1 Outline SPA Crossing Method Statement

5. As noted in NE's Appendix C2 (REP1-163) the Applicants consulted NE on the second draft of the SPA crossing statement on 15th September 2020. The NE advice and the Applicants responses provided below reflects NE's review of the document, discussions held during the Onshore Ecology and Ornithology Multi-Party Stakeholder Workshop carried out on the 16th July 2020 and NE discretionary advice letter to the Applicant dated 23rd July 2020.

Table 2 General Comments

Reference	NE General Comment	Applicants Comments
1.1	Natural England welcomes the baseline ornithological surveys results being included in Appendix 3. Natural England agrees that based on the evidence presented that the area of the SPA/SSSI crossing is likely to be of low ecological value. But this should be confirmed by pre-construction surveys to inform the final SPA crossing statement methodologies and mitigation measures.	Noted. The Applicants will submit an updated ***Outline Landscape and Ecological Management Strategy*** (***OLEMS***) (APP-584) to the Examination at Deadline 3 which sets out the pre-construction surveys to be undertaken within the SPA. The results of pre-construction surveys will inform the final SPA Crossing Method Statement.
1.2	Natural England recognises that SPR's preferred technique for crossing the Sandlings Special Protection Area (SPA) is open trenching. Whilst we recognise that the updated version includes more detail to address our previous concerns, this is still a high level document. We believe that suitable mitigation measures can be adopted to minimise the impacts of open cut trenching to an acceptable level. However, there are remaining concerns that we believe should be addressed in the consent phase in order to support the open trenching technique. Please see detailed comments.	Noted. See full responses in ***Table 3***.

Reference	NE General Comment	Applicants Comments
1.3	Natural England welcomes the maps in Appendix 3 that include the 200m buffer zone. Pre-construction evidence of breeding birds within and close to these locations is required to ensure that the methodologies and mitigation measures are fit for purpose.	See response to 1.1 above.
1.4	Natural England requires assurance that we will be consulted prior to construction on the updated documents under Requirement 21. Equally the discharge of any requirement e.g. that management measures are no longer required and the area has fully recovered should be in consultation with NE and RSPB.	In accordance with Requirement 21 of the ***draft DCO*** (APP-023) the final SPA Crossing Method Statement requires to be approved by the relevant planning authority in consultation with the statutory nature conservation body (NE) prior to SPA crossing works commencing.

Table 3 Detailed NE comments on the Outline SPA Crossing Method Statement

Paragraph	Initial NE Comment Received in Respect of draft Outline SPA Crossing Method Statement and Actioned by the Applicants	Further NE Comments in Appendix C2	Applicants Response
13 [new paragraph 23]	SPR states that no adverse effects on the integrity (AEoI) of the SPA are predicted as the SPA qualifying features have not been recorded within the SPA crossing. Whilst Natural England believes that mitigation can be adopted to remove an AEoI; we do not agree that the absence of SPA species in the surveys means an AEoI can be excluded. Maintaining SPA supporting habitat is a Conservation Objective (CO) for the site and any conclusions should be linked to the COs. It should also be recognised that the surveys are a snapshot in time so may have not captured usage depending on the timings of the surveys. It would be useful to state what distance from the crossing the closest records of nightjar and woodlark are, and similarly, how close suitable habitat for nightjar and woodlark is.	NE notes that consideration of the SPA conservation objectives have not been included in the document. Whilst BTO guidance has been used to determine the best methods to make the habitats suitable for particular bird species; for HRA purposes and to demonstrate that open trench methods will not hinder the conservation objectives of the site the conservation objects for the SPA must be considered. Therefore we advise that there needs to be a clear link to the conservation objectives and how they will be met during the construction works and beyond.	The Applicants made this change in the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043). The SPA conservation objectives are set out within Appendix 3 and are referenced within Section 1.4 and Section 2.9 of the ***Outline SPA Crossing Method Statement***.
[new paragraph 28]	It would useful here to state the expected trench width for context.	Not addressed	The anticipated trench width is included within the second footnote on page 7 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043).
18 & 19 [new paragraphs 30 & 31]	Para18 states that open trenching will allow for a significant reduction in order limits and work areas within and around the SPA crossing. However, Para 19 states that the cable route would revert to the typical 32m within the SPA crossing buffer. It is Natural England's view that while there is a potential to impact the SPA and SSSI (i.e. within the buffer), the cable route width should be minimised as much as	It is not clear to NE that this point has been addressed by the Applicant	The anticipated trench width is included within the second footnote on page 7 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043). The Applicants are unable to commit to a reduced onshore cable route working width of 16.1m within the SPA crossing buffer given the spatial constraints for storing spoil. This is explained within paragraph 33 of the

Paragraph	Initial NE Comment Received in Respect of draft Outline SPA Crossing Method Statement and Actioned by the Applicants	Further NE Comments in Appendix C2	Applicants Response
	possible and as a minimum the 16.1m reduction should be adopted.		***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043). As outlined in the Project Update Note submitted at Deadline 2 (document reference ExA.AS-4.D2.V1), the Applicants can now confirm that should both the East Anglia ONE North project and the East Anglia TWO project be consented and then built sequentially, when the first project goes into construction, the ducting for the second project will be installed along the whole of the onshore cable route in parallel with the installation of the onshore cables for the first project. This will include installing ducting using a trenchless technique at the landfall for both Projects at the same time. Further information will be provided at Deadline 3.
20 [and 38 and Table 2.1 of revised document]	Based on the previous comment, if the two projects are constructed at the same time there would be 16.1m corridor per project within the SPA crossing, i.e. 32.2m. Natural England advises that a further assessment should be made to determine the worst case scenario for the SPA based on extended working time from sequential operations at the SPA vs. wider working corridor. We advise that appropriate mitigation methods may need to be adopted to each of these options to identify the option with the least environmental impact.	It is still unclear to NE what sequential installation means in relation to impacts to supporting SPA habitats. Will the works happen on consecutive breeding seasons for each individual project and/or none parallel installation of the projects. OR will there be a time lapse between each project which may result in recovering areas being further impacted by the second project cable installation. How will further impacts to previously impacted areas be avoided?	Clarification on the sequential and simultaneous installation has been provided within paragraph 40 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043). As outlined in the Project Update Note submitted at Deadline 2 (document reference ExA.AS-4.D2.V1), the Applicants can now confirm that should both the East Anglia ONE North project and the East Anglia TWO project be consented and then built sequentially, when the first project goes into construction, the ducting for the second project will be installed along the whole of the onshore cable route in parallel with the installation of the onshore cables for the first project. This will include installing ducting using a trenchless technique at the landfall for both Projects at the same time. Further information will be provided at Deadline 3.
21 [new paragraph 36]	Natural England advises a seasonal working restriction beginning 1st February until 31st August to account for woodlark breeding season.	NE welcomes the adoption of the 1st February restriction.	Noted.
22 [new paragraph 37]	Reinstatement works using noisy machinery should not be undertaken during the breeding season due to the potential to disturb nesting birds.	NE welcomes commitment to avoid the breeding season for noisy activities.	Seasonally dependant reinstatement works within the SPA crossing and SPA crossing buffer may be undertaken at any time subject to the provisions of the Ecological Management Plan, approved in accordance with Requirement 21 of the ***draft DCO*** (APP-023). The nature of these reinstatement works and the machinery required to be used will be detailed within the final SPA Crossing Method Statement to be submitted post consent and which will require the approval of the relevant planning authority in consultation with the relevant statutory nature conservation body (i.e. Natural England). The preference of the Applicants is to undertake reinstatement works outside of the breeding bird season wherever possible. Reinstatement works will be undertaken sensitively, using appropriate equipment and in line with the breeding bird protection plan where reinstatement is required to be undertaken within the breeding bird season.

Paragraph	Initial NE Comment Received in Respect of draft Outline SPA Crossing Method Statement and Actioned by the Applicants	Further NE Comments in Appendix C2	Applicants Response
23 & 24 [new paragraphs 38 & 39]	Natural England notes SPR's commitment to complete works associated with the SPA crossing (including within the SPA buffer) within a single non-breeding bird season, including works in parallel with the other East Anglia project. We would welcome more detail on the duration of works. However, we note that this commitment is caveated in the next paragraph saying that the works may extend into subsequent non-breeding bird seasons. Please could further clarity be provided on what this would mean and also the likelihood of this happening.	We believe that this still requires further clarity please see previous points.	Further detail on the duration of works in the event the SPA crossing works span into subsequent non-breeding bird seasons has been provided in paragraphs 42 and 43 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043). Also see response in above row.
28 [and 107 and 120 of revised document]	Natural England would welcome more detail on all plant and machinery required for excavating and backfilling within the SPA crossing and the SPA buffer.	NE notes that the further detail will be provided prior to construction in the final version of this plan. We advise that impacts should be considered as much as possible during the consenting phase and by not considering this in more detail now, some yet to be identified likely significant effect, may require a further HRA. The further HRA would need to be undertaken by the local planning authority as the regulator for the DCO prior to construction to ensure that there remains no adverse effect on integrity from the proposed works	The Applicants do not agree that *"some yet to be identified likely significant effect, may require a further HRA"*. The Applicants have assessed the worst case within the ES and Information to Support Appropriate Assessment and therefore any works undertaken will fall within the envelope assessed should therefore not give rise to likely significant effects that have not yet been considered. Specific detail on the equipment to be used is not available at this stage, but the specifications of plant and the measures to which they must be operated in compliance with will be set out within the final Code of Construction Practice. Paragraphs 46-53 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043) include measures which will be adopted specifically for works associated with the crossing of the SPA.
31 [new paragraph 48]	Natural England welcomes the proposal to use 'trackmat' roads to minimise ground disruption, however, further measures may be required to ensure the successful removal should they become depressed into the sediment and/or on removal they also remove vegetation matting.	As per the above point	Paragraphs 46-53 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043) include some measures which will be adopted specifically for works associated with the crossing of the SPA.
35 [new paragraph 52]	Natural England welcomes the commitment to no jointing bays being located within the SPA crossing or the SPA buffer to avoid further excavations in these areas.	No further comment	Noted.
39 [new paragraph 57]	Natural England welcomes SPR's commitment to provide a turtle dove mitigation area in response to possible loss of turtle dove foraging habitat. We recommend that sowing of the seed mix is undertaken as early as possible to ensure establishment prior to construction works being undertaken.	Please see comment 43-46.	Paragraph 58 of the ***Outline SPA Crossing Method Statement*** states that 'the seed mix will be sown on suitably prepared ground between 1st August and 15th October (with sowing of the seed mix undertaken as early as practicable during this period) in the calendar year prior to the relevant (turtle dove) construction period'.
42 [new paragraph 61]	Natural England also considers that it may be beneficial to leave the turtle dove mitigation area in place for a period of time, after reinstatement of the cable route while the site recovers. However, that will be dependent on the mitigation measures proposed.	Natural England welcomes the consideration of 1 year for this species, but again would welcome further consideration of this remaining in place to ensure that the conservation objectives for the site are not hindered.	Noted.

Paragraph	Initial NE Comment Received in Respect of draft Outline SPA Crossing Method Statement and Actioned by the Applicants	Further NE Comments in Appendix C2	Applicants Response
43 – 46 [new paragraphs 63-66]	Natural England considers that the nightingale mitigation plan needs to be more detailed. For example, we would expect to see a detailed plan outlining how the area will start to function as a habitat for nightingale as soon as possible, i.e. details on height of vegetation, maturity of vegetation. We also note that Work No 12A is directly adjacent to the SPA crossing works area and this mitigation area would need to be well established and functioning in advance of works.	We believe that further detail is required in relation to this point especially in relation ensuring ecological functionality of the mitigation areas prior to works commencing.	The Applicants have provided further details in section 2.9.3 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043).
47 [new paragraph 68]	More detail is required regarding habitat reinstatement and monitoring within the SPA crossing. Natural England understands that it is intended to reinstate and improve Work No. 12A. The proposed habitat reinstatement plan appears to be quite ambitious for the area of land available. More detail is required around which mitigation measures are targeting which species. More detail is required regarding the size and age of plants. The planting of mature vegetation may help functioning habitat establish quicker.	Whilst we recognise that this has been considered in more detail within the crossing method statement of what will be planted; the justification as to why and what function they will provide and over what time frame is still required	The Applicants have provided further details in section 2.10 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043).
52 [new paragraph 79]	Horizontal Directional Drilling (HDD) entry and exit pits within Work No. 11 and Work No. 13 may be located within the SPA crossing buffer. We therefore advise either the buffer area is avoided using long HDD techniques or depending on the timing and duration of the works that any working window restriction is also adopted for trenchless crossing as set out below.	NE believes that this has now been addressed through the working window restriction	Noted.
58 [new paragraph 87]	Natural England welcomes the commitment of a seasonal restriction on construction works associated with HDD entry or exit pits within the SPA crossing buffer, however, we wish to reiterate that such a restriction should extend from 1st February until 31st August due to the breeding season of woodlark.	NE believes that this has now been addressed through the working window restriction. However, please confirm if the 5 year of habitat management will be 5 years from the completion of each project, but this will be reset if the area is impacted further by the construction of the second project. Alternative is that the mitigation is in place and functioning prior to the start of the first project until 5 years after the end of the second project.	The Applicants clarified this within paragraph 111 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043).
59 [new paragraph 88]	As for Para 22 above, reinstatement works using noisy machinery should not be undertaken during the breeding season due to the potential to disturb nesting birds.	NE welcomes commitment to avoid the breeding season for noisy activities.	Noted.
75 – 79 [new paragraphs 104-109]	Natural England's comments regarding turtle dove mitigation are as above under Section 2.	See previous comments	The Applicants carried forward all the relevant updates made to text in ***section 2*** of the ***Outline SPA Crossing Method Statement*** regarding turtle dove mitigation, to ***section 3*** of the ***Outline SPA Crossing Method Statement***.
82 – 87 [new	Natural England is satisfied with the detail of the measures to prevent bentonite breakout.	Please note that at 111 there needs to be a caveat that discussion with NE is required prior to any clean up activity as these can be more damaging then leaving bentonite in situ.	The Applicants clarified that Natural England is the relevant statutory nature conservation body within paragraph 119 of the ***Outline SPA Crossing Method Statement*** submitted to the Examination at Deadline 1 (REP1-043).

Paragraph	Initial NE Comment Received in Respect of draft Outline SPA Crossing Method Statement and Actioned by the Applicants	Further NE Comments in Appendix C2	Applicants Response
paragraphs 113-117]			

1.4.2 Outline Landfall Construction Method Statement

Paragraph	NE Comment	Applicants Comments
11	Documentation and evidence presented for other offshore wind farm developments along the east coast of the UK has identified that 2 km horizontal directional drilling (HDD) is not viable. Please could more evidence be presented to support the viability of the proposal?	The Applicants note that their response to Examining Authority's question 1.11.4 addresses this comment by Natural England (see document reference ExA.WQ-1.D1.V1_13). In response to this request, the Applicants have clarified the text within paragraph 10 of the ***Outline Landfall Construction Method Statement*** submitted to the Examination at Deadline 1 (REP1-042).
14	With geotechnical investigations yet to be undertaken, how can SPR be certain that HDD is possible at this location?	The Applicants' response to Examining Authority's question 1.11.6 addresses this point (see document reference ExA.WQ-1.D1.V1_13).
16	Can it be clarified that none of the equipment and machinery associated with onshore geotechnical investigations will be operated or stored within designated sites?	Yes, as per paragraph 15 of the ***Outline Landfall Construction Method Statement*** submitted to the Examination at Deadline 1 (REP1-042), none of the equipment and machinery associated with onshore geotechnical investigations will be operated or stored within designated sites.
21	How will SPR address any conflict between archaeological and environmental features when siting the exit pits and/or cable routes?	This will form part of the detailed design undertaken post-consent and reflected within the final Landfall Construction Method Statement and discussions with the Councils and Natural England. .
23	Please provide justification as to why there will be a separate exit and entry for telecommunications when these are shared for other projects? Apart from the points raised above, Natural England welcomes the outline landfall construction method statement at this time and notes the lessons learnt from East Anglia ONE.	As per paragraph 24 of the ***Outline Landfall Construction Method Statement*** submitted to the Examinations at Deadline 1 (REP1-042), each Project will require two bores to be installed to accommodate each of the two offshore export cables required for each Project. The impact assessment undertaken by the Applicants provides for up to four bores for each Project to ensure contingency in the design and delivery of the Projects. The Applicants confirm however that should only two bores be required and constructed by each Project, no further bores will be installed. Based on supply chain engagement, it is anticipated that separate bores for fibre optic / telecommunications cables will not be required.

1.5 Landscape and Visual Impact Assessment

Point	Taken from NE's Relevant and Written Representations EA1N Appendix D - LVIA – Terrestrial aspects of the project	RAG Status Assigned by NE	Applicant's Comments	NE Response (Received Appendix D1b)	RAG Status Assigned by NE (Appendix D1b)	Applicants' Response
Document Used: 6.1.29 EA2 Environmental Statement Chapter 29 Landscape and Visual Impact Assessment						
1	A vital mitigation measure, should both projects be approved, is for the onshore cabling to be installed for both simultaneously and not sequentially. The former will restrict construction phase impacts to the short term, but the latter would produce medium term impacts on the AONB. The Applicant discusses some ducting possibly being installed to accommodate both schemes when one is being constructed, but the importance of the AONB (a nationally designated landscape with the highest level of planning policy protection) justifies the most effective mitigation being applied i.e. both onshore cabling stages to be completed together and the landscape fully restored as soon as possible.		The East Anglia TWO and East Anglia ONE North projects are being developed by two separate companies, are two separate projects and will have two separate Development Consent Order consents. The assessment presented in the ES assesses the impacts of the Project, through the use of appropriate assessment scenarios, cumulatively with the East Anglia ONE North project. The determining factor in which construction scenario is adopted will be the outcome of the Contract for Difference (CfD) auction and subsequent financing arrangements for each project. It is clear that the UK Government is continuing to drive the offshore wind sector to reduce costs – a challenge that the offshore wind sector has been and is continuing to embrace. This downward pressure will continue into future CfD auctions which both Projects are expected to compete in. This drive to reduce costs represents a significant challenge for the offshore wind sector to reduce construction costs and is likely to result in only the most competitive projects securing finance and proceeding to construction. Acknowledging the extremely competitive market, in order to ensure the capital cost of both Projects are as competitive as possible, each project must bear its own construction cost. Therefore, in the event that financing is not secured for both projects in parallel, the financed project cannot carry the significant cost of the duct installation for the other unfinanced project, as this would make the financed project less competitive and potentially jeopardising its ability to secure a CfD and financing in its own right.	Natural England notes that the applicant is advising that there would be a significant adverse effect on the AONB because of a technical bidding and contractual issue between it and the government. It cannot be the intention of the government that its policy and procedures for CfD should conflict with: • The Department's statutory duty under s85 of the Countryside and Rights of Way Act to 'have regard' to the statutory purpose of AONBs 'in exercising or performing any functions in relation to, or so as to affect, land' in these areas'. • The Government's own national planning policies, providing the highest level of policy protection for the landscape and scenic beauty of AONBs, as set out in the National Planning Policy Framework and in National Policy Statements. We suggest that the Applicant should approach the Department to advise them of this apparent conflict and request that the need to equip a cable route for both schemes simultaneously be discounted in the bidding exercise or that some other allowance is made for it.		The Applicants can confirm that should both the East Anglia ONE North project and the East Anglia TWO project be consented simultaneously and then built sequentially, the first project to go into construction will install ducting for the second project along the whole of the onshore cable route in parallel with undertaking the installation of the onshore cables for the first project. This will include undertaking trenchless technique works at the landfall for both Projects. An assessment of landscape and visual impacts for simultaneous and sequential construction scenarios for the Projects cumulatively is presented within ***Chapter 29*** (APP-077). It should be noted that the difference in assessed effect significance upon the character of the AONB is the same for one Project alone or cumulatively. It is the duration for which the effect persists which differs. The LVIA assessed an adverse short-term temporary significant effect for the construction of one Project upon the character of the AONB within the localised area of the onshore cable route between Thorpeness, Sizewell and Leiston (Area A) (***Section 29.6.1.2***, ***Chapter 29*** (APP-077)). The significance of effect of one Project alone is unrelated to the significance of cumulative effect between both Projects (which is assessed separately as an adverse medium-term temporary significant effect), and therefore unrelated to the interaction of construction programmes between the Projects. Given the parallel submission of the Applications, the Projects were presented to stakeholders in a joint review process to aid stakeholder resourcing. Deliverability of the Projects is a key consideration in the planning process, with

Point	Taken from NE's Relevant and Written Representations EA1N Appendix D - LVIA – Terrestrial aspects of the project	RAG Status Assigned by NE	Applicant's Comments	NE Response (Received Appendix D1b)	RAG Status Assigned by NE (Appendix D1b)	Applicants' Response
						NPS EN-1 recognising the relevant temporal, contractual, commercial and regulatory constraints for delivering energy generating stations and related infrastructure in a timely manner. Regarding NE's queries in relation to the statutory purpose of the AONB, the Applicants have submitted at Deadline 2 a note titled 'Effects with Regard to the Statutory Purposes of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and Accordance with NPS Policy' (ExA.AS-5.D2.V1). It is the Applicants position that due regard to the impact of the Projects on the purpose of the AONB has been given and that for each Project, appropriate design iteration has taken place which has reduced the effect on the AONB whilst maintaining the generation capacity of the Projects. The Applicants do not consider it appropriate to approach the Government regarding this matter, on the basis that there is not considered to be an incompatibility between policy and the Contract for Difference (CfD) process.
2	We believe that more information concerning the schedule for the undergrounding works within and in the immediate setting of the AONB is warranted, covering both the topsoil stripping/trenching (and HDD if relevant) and backfilling/reinstatement of the cable route. We would therefore like to see an anticipated timetable / schedule for how construction activities would progress along the cable route within and in the immediate setting of the AONB, what construction consolidation sites and associated or other construction infrastructure and equipment would be present and how long after commencement all signs of active construction activity would be		The Applicant notes that there is no commitment to an anticipated timetable and / or schedule for how construction activities would progress along the cable route within the immediate setting of the AONB and specific durations of Construction consolidation Sites (CCSs) and construction activity. These decisions will be made as a result of the supply chain engagement and procurement process that would commence post consent and which would provide the information necessary to effectively plan the construction works in line with the DCO requirements. ***Section 6.10*** in ***Chapter 6 Project Description*** (APP-054) provides an indicative construction plan. ***Plate 6.32*** illustrates an indicative onshore cable route construction sequence and timing, that shows approximate timings for removal of CCS and welfare, site clearance and reduction in working areas. The full specification for the construction phase will be addressed as part of detailed design, post-consent once a contractor is appointed for implementation.	Natural England notes the Applicant's response, but we advise the ExA of the implications which means that the actual impact of the construction phase on the AONB could be more difficult to assess than it otherwise would be. Therefore consideration could be given to key elements at the same time such as ducting for both projects especially at designated sites including landscape.		***Chapter 6 Project Description*** (APP-054) provides details of the indicative construction programme and methodologies to be adopted. The Applicants can confirm that should both the East Anglia ONE North project and the East Anglia TWO project be consented simultaneously and then built sequentially, the first project to go into construction will install ducting for the second project along the whole of the onshore cable route in parallel with undertaking the installation of the onshore cables for the first project. This will include undertaking trenchless technique works at the landfall for both Projects. The Applicants consider that a robust assessment of construction phase effects upon the AONB for both Projects individually and cumulatively (for a simultaneous and sequential

Point	Taken from NE's Relevant and Written Representations EA1N Appendix D - LVIA – Terrestrial aspects of the project	RAG Status Assigned by NE	Applicant's Comments	NE Response (Received Appendix D1b)	RAG Status Assigned by NE (Appendix D1b)	Applicants' Response
	removed from the AONB. This information would complement the stated expectation that the landfall construction site and infrastructure for each scheme being present for twenty months.					construction scenario) has been provided within ***Chapter 29*** (APP-077).
3	Natural England welcomes the assessment of cumulative impacts of the EA1N and EA2 OWFs with the construction and operational phases of Sizewell C nuclear power plant. In addition to the outlined mitigation to reinstate the landscape character and special qualities of the AONB post-construction, Natural England advises that all parties consider landscape enhancement/net gain opportunities within the AONB. We advise that there is an agreement put in place on how this could be achieved with the AONB partnership in consultation with Natural England and others.		As mentioned above, there is no policy requirement to deliver Net Gain for NSIP projects such as the Projects. An ***OLEMS*** (APP-584) has been submitted with the application. The ***OLEMS*** outlines the requirement for landscape mitigation measures that are reflective of the surveys and impact assessment carried out for the onshore infrastructure of the Project. Requirement 14 of the ***draft DCO*** (APP-023), states that a Landscape Management Plan (LMP) and associated work programme must be submitted to and approved by the planning authority before any onshore works can commence. Requirement 15 of the draft DCO then states that all landscaping works must be carried out in accordance with the approved LMP. The Applicant will continue to consult with EDF Energy regarding the Sizewell C development as the examination phase of the Project progresses. Through submission and approval of the final LMP, NE can be assured that provision of landscape works associated with the construction of the onshore infrastructure will be formally controlled and implemented.	Natural England interprets the applicant's response to mean that they are not offering any landscape enhancements because they don't have to. This isn't something that we can insist upon, but wish to highlight the issue for the Examining Authority's information and in case the Local Planning Authority and AONB want to press for compensation for significant adverse effects on the designated area which cannot be mitigated. In addition to this Natural England highlights that the Applicant has already obtained a DCO/dML for another two projects and is therefore a statutory undertaker and as such had a duties to not only maintain, but to enhance designated sites.		The onshore site selection process described in ***Chapter 4*** (APP-042) has given high priority to the AONB for example through avoiding locating the onshore substations within it and through careful consideration of the landfall location. Regarding design mitigation, the Applicants made an additional early commitment to underground cabling. The Applicants have now committed to the parallel installation of ducting for the second project (should the Projects be developed sequentially). This commitment has implications for the on-going discussions with NE. Further details will be provided at Deadline 3. The Applicants have carefully evaluated the potential impacts of the Projects on landscape and visual, onshore ecology and ornithology receptors during the iterative design of the Projects. The response to those findings has ensured that if impacts cannot be avoided then appropriate mitigation or enhancement has been proposed in line with the EIA regulations and the policy requirements set out in the relevant National Policy Statements and in particular the key sections of EN-1. The Applicants have sought the necessary land and rights to deliver those commitments. Biodiversity Net Gain is a different concept, is not a policy requirement for NSIPs and nor are NSIP projects covered by the draft legislation contained in the Environment Bill. The Projects have not been developed to meet a 'biodiversity gain' test and it would not be an appropriate basis on which to acquire land or rights on a compulsory basis. The Applicants have submitted an Ecological Enhancement Clarification Note (REP1-035)

Point	Taken from NE's Relevant and Written Representations EA1N Appendix D - LVIA – Terrestrial aspects of the project	RAG Status Assigned by NE	Applicant's Comments	NE Response (Received Appendix D1b)	RAG Status Assigned by NE (Appendix D1b)	Applicants' Response
						which provides further details on the ecological enhancements to be realised through the Projects.

1.6 Seascape Landscape and Visual Impact Assessment (SLVIA)

1.6.1 Summary of NE Comments Submitted at Deadline 1

Taken from NE's Relevant and Written Representations EA2 Appendix E –SLVIA – offshore elements of the project	Applicant's Comments
Summary of Comments	
Summary: Natural England's (NEs) overall conclusions remain unchanged from our Relevant/Written Representation Our concern is that, for East Anglia Two (EA2), commercial viability can only be achieved through design and technological choices which will result in significant adverse effects on the statutory purposes of the Suffolk Coast and Heath Area of Outstanding Natural Beauty (SCHAONB). It is agreed between The Applicant and NE that there will be multiple significant effects on both landscape and visual receptors located within the SCHAONB and that as a result there will be significant adverse effects upon some of the special qualities of the AONB.	The Applicants refer to the 'Effects with Regard to the Statutory Purposes of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and Accordance with NPS Policy' (ExA.AS-5.D2.V1) note submitted at Deadline 2 which considers the matters raised by NE.
Within the Environmental Statement (ES) The Applicant has concluded that the statutory purposes of the designation will not be adversely effected '*overall*' despite concluding that some of the special qualities of the designation will be significantly harmed.	
Based on our review of The Applicant's evidence (as submitted in the PIER and ES) and site visits undertaken in the summer months of 2018 and 2019, NE concludes that the statutory purpose of the SCHAONB to conserve and enhance natural beauty, will be significantly harmed/adversely effected by the turbines of EA2.	
Please note that following confirmation of the height of the turbines to be used for the EA1N and EA2 arrays (282m) the apparent height figures have been recalculated and used where NE presents new values for this measurement (NE - 3.3.4 for instance). Where we have done so a clear statement is provided. Therefore, unless otherwise stated all other comments are based on height values of blade tip height of 300m as set out in the ES. We will provide further advice should when a revised assessment is submitted into examination.	The Applicant can confirm 282m blade tip height as the maximum height of the turbines that would be installed for the East Anglia TWO project. The Applicant notes that the apparent height of the 282m proposed maximum height turbines will also be smaller than for the originally assessed 300m maximum turbine height. The Applicant considers that this reduced maximum turbine height parameter provides a reduction in the apparent height/vertical scale of turbines visible.
Mitigation Measures Whilst Natural England welcomes the reduction in turbine heights at EA2, we wish to highlight that there is likely to be conflict between potential mitigation to reduce SLVIA concerns with those of offshore ornithology with opposing requirements in relation turbine heights in reducing the scale of particular thematic impacts. Therefore, the Examining Authority may need to weigh up the overall merits of potential mitigation proposals and how the project design could be further adapted to meet all of the varying mitigation requirements. For example, turbines with higher draft height could be located further away from shore to avoid an increase in visual impact while still providing a reduction to collision mortality.	The Applicants agree with NE that a balance needs to be found in terms of impacts across different receptor topics (e.g. SLVIA and ornithology) to ensure that the Projects can be delivered with minimum impacts. The Applicants consider that a commitment to a reduction in the maximum wind turbine tip height to 282m should not be considered as mitigation. Rather, it is a reduction in the Rochdale Envelope parameters following recent discussions with the supply chain on the likely turbine sizes to be available for installation at the Projects. This reduction should not be considered by the ExA to be at the expense of potential increases in air draught and therefore it is inaccurate to consider that a weighting between these two proposals is required. Given that site-specific conditions are not confirmed until post-consent and that turbine technology is evolving quickly there is a need to retain flexibility both within the Rochdale Envelope and on specific locations of infrastructure within the order limits in order to maintain a viable project.

1.6.2 Detailed SLVIA Comments Submitted at Deadline 1

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
Section 2 – Note about visible height of offshore wind turbines in respect of East Anglia TWO			
NE-2.1	Note about visible height of offshore turbines in respect of EA2 Ongoing: We note the Applicant's requirement to make the schemes '*economically competitive'* by maximizing energy gain through the use of technology which offers the best capacities and efficiencies available. And the contribution offshore wind makes towards meeting climate change targets. However, the scheme's design also needs to comply with planning policy as set out in the relevant National Policy Statements.		The Applicant considers that the East Anglia TWO project's design complies with planning policy as set out in the relevant National Policy Statements. Table 6.23 of the 'Development Consent and Planning Statement' (APP-579) details the compliance with both National and Local policies.
NE-2.2	Ongoing: The Applicant has concluded that significant adverse effects on landscape and visual receptors will occur from the proposed EA2 offshore windfarm along a stretch of coast which extends in length up to 35 km. The entirety of the affected is area is defined as a Heritage Coast and located wholly within the SCHAONB. The Applicant has also concluded that these significant adverse effects will harm some of the special qualities of the SCHAONB. Therefore, the portion of the SCHAONB affected is immaterial as the statutory purpose of the AONB applies to the entirety of the designated area. It should be noted that the coastal portion of the Suffolk Coast and Heaths AONB is a critical element of the natural beauty of the designation. In addition the classification of the Suffolk Heritage Coast reinforces the value of this stretch of coastline. It is therefore Natural England's view it would be inappropriate to conclude the designation 'overall' is not adversely effect on the basis that as only the coastal portion of the designation is adversely effected by the turbines of EA2.		The Applicant's SLVIA has identified significant effects on some specific aspects of special qualities as a result of the East Anglia TWO windfarm, as experienced along part of the AONB coast, however the submitted special qualities assessment does not use the term 'harm' to special qualities, instead focusing on assessment of significance. The SLVIA does not necessarily equate significance with harm or unacceptability, which are considered to be further judgements beyond the assessment of significance. In its conclusions, the SLVIA does consider the issue of 'harm' to the AONB in overall terms. The conclusion provided at paragraph 340 of Chapter 28 – Offshore Seascape, Landscape and Visual Amenity of the East Anglia TWO Environmental Statement (APP-076) is that: '*It is not the overall character or physical features of the coastal edges of the AONB that will be changed, but instead it is specific aesthetic/perceptual aspects of its character relating to panoramic views offshore at the coast that will experience change. The construction and operation of the offshore infrastructure will have a relatively low change to the strong overall character of the AONB and will not result in harm to the special qualities of the AONB in overall terms, with the varied and distinctive landscapes of the AONB continuing to define its overall and fundamental character.*' The Applicant continues to uphold this finding and provides the following points in support of this conclusion, on the basis that: The natural beauty (as expressed by the special qualities) can still be experienced across the AONB, regardless of the presence of the East Anglia TWO windfarm. This includes large areas not affected by visibility of the East Anglia TWO windfarm, where there would be no effect on special qualities. The non-coastal portions of the SCHAONB are also a critical element of the natural beauty of the designation and they will remain unaffected by the East Anglia TWO windfarm. The natural beauty can still be experienced from coastal parts of the SCHONAB despite the presence and effects resulting from the East Anglia TWO windfarm, which does not prevent the ability to appreciate the special qualities in these coastal areas. The SLVIA identified, and it is agreed by NE, that significant effects do not occur on all SCHAONB special qualities, only on certain special qualities (and in certain geographic locations). The SLVIA defines these as those relating specifically to changes in perceived character in offshore panoramic views. There is no effect at all on many of the defined special qualities of the SCHAONB. Significant effects on special qualities are also defined as having geographic extent contained to the coastal edge and are not geographically widespread across the SCHAONB (although it is accepted that the thin strip of coastal edge landscape effected does extend over a notable length of coast from Aldeburgh north to Covehithe).

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
			Where significant effects to special qualities occur, i.e. at the coast in this northern portion of the SCHAONB, in the perception of offshore panoramic views, significance is finely balanced near the threshold of significance. In other words, the magnitude of change is of medium or medium-low magnitude on special qualities (and therefore either just 'significant' or just 'not significant') and in no cases are the impact of higher levels of magnitude, which may typically be those effects that may be expected to result in 'harm'. The context and character of parts of the coastal landscape of the SCHAONB is affected by other forms of development, often seen within it or at substantially closer range than the East Anglia TWO windfarm. The East Anglia TWO windfarm would be visible in the associative seascape setting of the SCHAONB, beyond the horizon and separated from the SCHAONB by a substantial depth of seascape. With regards to the Statutory Purpose of the AONB, the SLVIA in the submitted ES (Chapter 28) (APP-076) did not make judgements about 'harm' to the statutory purpose of the AONB. The Applicant's response to NE Relevant Representation (NE 2-11) did however, state in response to Natural England's representation about statutory purpose, that the East Anglia TWO windfarm *'would not result in harm to the statutory purposes of the AONB'*, on the basis of the assessments in the SLVIA and conclusions above. The Applicant would refer the ExA to its 'Effects with Regard to the Statutory Purposes of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and Accordance with NPS Policy' (ExA.AS-5.D2.V1). In essence, the statutory duty, as defined in the Countryside and Rights of Way Act 2000 (CRoW) is to have regard to the purpose of conserving and enhancing the natural beauty of the AONB (Section 85). This duty to have regard to the purposes of the SCHAONB also applies to development outside designated areas that might affect them, as defined in NPS EN-1 (Para 5.9.12 – 5.9.13): *'The duty to have regard to the purposes of nationally designated areas also applies when considering applications for projects outside the boundaries of these areas which may have impacts within them. The aim should be to avoid compromising the purposes of designation and such projects should be designed sensitively given the various siting, operational, and other relevant constraints'.* The Applicant considers that it has clearly had regard to the purpose of conserving the natural beauty of the SCHAONB. It is clear from the attention being paid to this matter in the application and pre-examination procedural decisions and representations, that regard is indeed being had and is likely to be continued to be had through the process of the examination, to the statutory purpose of the SCHAONB. In particular, both the onshore and offshore infrastructure of the East Anglia TWO project have been 'designed sensitively' in respect of the purpose of conserving the natural beauty the SCHAONB. Design iteration has taken place which has reduced the effect on the SCHAONB, whilst maintaining the generation capacity and commercial viability of the project. The Applicant reduced the area of the East Anglia TWO windfarm site, and its lateral spread, whilst maintaining commercial viability on the basis of the original generation capacity and wind turbine generator envelope. The north-south extent of the East Anglia TWO windfarm site was subsequently reduced (by 9.68km on the western boundary and 8.03km on the east) in order to mitigate potential seascape effects, without a reduction in wind turbine numbers or generation capacity. The windfarm boundary was reduced by a total area of 37km^2. This refinement is shown in Figure 4.3: Refinement of the East Anglia TWO Windfarm Site Boundary of the ES (APP-082). As a consequence, the magnitude of change on seascape, landscape and visual receptors and on the setting and key coastal viewpoints within the AONB was reduced. Chapter 28 'Seascape, Landscape and Visual Amenity' of the ES (APP-076), confirms that, while a reduction in the defined magnitude of impact (i.e. low / medium / high) has not occurred from all viewpoints, this refinement has resulted in a reduction in the

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
			landscape and visual effect of the offshore elements of the East Anglia TWO project, including a reduction in effects on the AONB. This mitigation applied to the East Anglia TWO windfarm site is recognised by Natural England, particularly in respect of the reduced lateral spread of turbines on the skyline and its reduced cumulative effect with East Anglia ONE North. The Applicant also notes that the reduced maximum turbine height parameter (from 300m to 282m blade tip) provides further mitigation of the apparent height/vertical scale of turbines visible in views from the SCHAONB. The Applicant considers that the East Anglia TWO project has achieved the aim stated in NPS EN-1 to design sensitively given the relevant constraints and that the East Anglia TWO windfarm site does not compromise the purposes of the SCHAONB designation.
NE-2.3	Ongoing: NE, as the Government's statutory adviser for landscapes in England, considers the formula shown in Figure 1 of NE's Appendix E, which is an elementary application of Euclidean geometry, to be the most suitable for measuring the apparent height of structures for comparative purposes. Whilst we agree that the formula represented in Figure 1 does not appear in the SNH 2017 Guidance; an interpretation of it does in Annex D: Earth Curvature and Refraction of Light, page 49. The use of the diagram obtained from the Challenge Navitus website was purely due to expediency. NE consider it helpful to provide a diagrammatic representation of the formula as it illustrates the various components of the calculation, such as the height of the viewer, which we believe better aids understanding. Please note that whilst NE does not know why SNH choose not to use this formula in the recent updating of their guidance; we do note their emphasis on the presence of the Earth's atmosphere as a critical factor i.e. the influence of the refraction of light in defining the apparent height of structures when seen from a distance. Therefore, the formula used by NE incorporates this emphasis on light refraction through the use of a refraction correct value (0.075) which is universally applied. If effects of light refraction on apparent height are to be excluded from the formula this value is switched to 0. The apparent height values provided by NE in our Relevant/Written Representation and this document have the light refraction value set at 0.075.		As noted in the Applicant's Response to NE Relevant Representation, the Applicant agrees with the vertical difference in visibility of offshore structures introduced by earth curvature and the diagrammatic representation shown in Figure 1. The Applicant would note that the effect of earth curvature and atmospheric refraction is included in the ZTV calculations presented in the SLVIA (Figures 28.15 - 28.19 (APP-329 to APP-344)).
NE-2.4	Ongoing: Please be advised that we always acknowledge that the ES for EA1N and EA2 accounted for the Earth's curvature on apparent height. NE's comment/advice was provide Applicant '…comparisons between the apparent height of the turbines with existing offshore wind turbines, such as those at Galloper and Greater Gabbard, as a scale reference to assist in the judgement of visual influence…'. Please be advised that the inclusion of Figure 2 was never intended to provide a 'true relationship of the Project [EA2 and EA1N] with the existing offshore turbines at Galloper and Greater Gabbard' as none of the parameters set out in Figure 2 apply to EA2, EA1N, Galloper or Greater Gabbard. The purpose of Figure 2 is illustrative and simply represents the comparative appearance of turbines of differing heights located at differing distances from the observer. The BEIS 2020 Review and Update of Seascape and Visual Buffer study for Offshore Wind Farms (OSSEA) guidance uses the similar approach in order to illustrate comparative heights (see diagrams on page 204 to 206). NE notes the Applicant's recommendation that the photomontages included in the ES (Figures 28.25 – 28.54 [APP-355 to APP-384]) are the best way to appreciate the scale of the turbines. We		The Applicant notes and welcomes the clarified illustrative purpose of Figure 2. The Applicant notes and agrees with the recommendation that the photomontages included in the ES (Figures 28.25 – 28.54 [APP-355 to APP-384]) are the best way to appreciate the scale of the turbines, and that they provide a close representation, best interpreted (when printed at the correct scale and at a high resolution) at the site from which the original photography was captured.

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	agree that they provide a close representation, but we advise that the images are best interpreted (when printed at the correct scale and at a high resolution) at the site from which the original photography was captured. NE also agrees that it is the wireline diagrams which provide the best tool for assessment purposes.		
NE-2.5 to NE-2.8	Ongoing: NE agrees 'that judgements on significance should be properly based on the assessment material provided in the ES which have been undertaken with best practice GLVIA3)'. We also agree that there is 'no established guidance which reduces seascape, landscape and visual assessment to a quantitative assessment of values in a tabular matrix.' At no point in our advice has NE advocated against the use of GLIVA3 or for an approach based on the latter. NE presented the comparative analysis of apparent height simply to provide additional evidence in order to assist the ExA in their decision making. As noted above the Applicant considers that evidence on comparative apparent height analysis to be useful. We note the brief analysis (p.399, 3rd paragraph) which measures the difference in degrees between the turbines of EA2, Greater Gabbard and Galloper stating that is a 'very small value' - which indeed it is. However, we advise that the percentage value of the difference is most the useful evidence for comparative purposes. It is for this reason that the Environmental Statement (ES) has concluded that the turbines of EA2 will have a significant effect whereas the turbines for the Greater Gabbard and Galloper do not. Hence our statement that the 300m turbines of EA2 'would be around 1.54 times greater [i.e. 1.54 times taller] than those of Galloper'. The figure 1.54 was based on the difference between the quoted values for EA2 (0.467*) and that for Galloper (0.309). NE recognises that this was a misleading figure; this will now be revised to '51% taller'. The other specific comments on the issues listed below are addressed later in our comments. • Degrees of arc. • Observer height (m) • Closest distance to shore values (km) • Atmospheric visibly • Comparisons between the height of the Galloper and EA2 turbines south Thorpeness. *The EA2 apparent height values presented here have now been updated. Please see recalculated apparent angles values presented under section NE – 3.3.4 (p.419 to p.423) below		The Applicant welcomes agreement that judgements on significance should be properly based on the assessment material provided in the ES. It is noted that NE is not advocating quantitative assessment of values and that NE's comparative analysis of apparent height simply provides additional evidence to assist in decision making. The Applicant welcomes agreement that the difference in vertical angle/apparent height (in degrees) between the turbines of EA2, Greater Gabbard and Galloper is 'very small'. The Applicant notes that the apparent height of the 282m proposed maximum height turbines will also be smaller than for the originally assessed 300m maximum turbine height. The Applicant considers that this reduced maximum turbine height parameter (from 300m to 282m blade tip) provides further mitigation of the apparent height/vertical scale of turbines visible.
NE-2.9	Ongoing (p.402 of original RR response): NE agrees that the Greater Gabbard and Galloper Environmental Statements were correct in predicting that the visual effects of these turbines would not be significant at minimum separation distances from Orford Ness. NE also agrees that this 'is a finely balanced judgement for the threshold of significance' NE notes the reference to apparent height for EA1N is 0.370 degrees (Applicant's figure) from Viewpoint 1 (Lowestoft). NE advises that is not relevant as the viewpoint is located outside of the SCHAONB and the SHC and therefore located within a landscape of lower value (in SLIVA terms). NE notes that the Applicant considers the horizontal spread of the turbines is the primary factor in reaching this judgement. NE advises that it is the combination of the horizontal spread and the apparent height of the turbines which jointly form the primary factor for the judgement of significant landscape and visual effects upon the northern portion of the coastline of the SCHAONB.		The Applicant welcomes confirmation that NE considers that the Greater Gabbard and Galloper Environmental Statements were correct in predicting that the visual effects of these turbines would not be significant. The Applicant agrees that it is the combination of the horizontal spread and the apparent height of the East Anglia TWO project turbines, which jointly form the primary factors in judging the significance of seascape, landscape and visual effects on coastal receptors, together with the intrinsic landscape/seascape context in each viewpoint (for example a large scale open seascape, as experienced off the Suffolk coast, is better able to accommodate development than an enclosed one sitting adjacent or in front of an island), The Applicant noted other locations where the apparent height of offshore windfarms is greater than predicted for the East Anglia TWO project. It is accepted the closest parts of the coast to Scroby Sands and Gunfleet Sands are outside nationally designated landscapes, however they remain relevant as examples of operational offshore wind turbines in the region that have larger apparent heights than the East Anglia TWO windfarm.

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	Ongoing (p.403 of original RR response): We note the list of other locations where the apparent height is greater that the figure quoted (*0.467) by Natural England. However, all of the locations listed are outside of a nationally designated landscape, and are therefore of a lower value in SLIVIA terms and are not relevant in the context of EA2 and the SCHAONB. In relation to the two other OWF examples provided which are located within the seascape setting of a designated where the apparent (angular) height exceeds 0.467 degrees* there is insufficient information about the elevation (viewing height; a value needed in order to calculate the apparent height) from which these structures are seen to support the use of these examples. NE provides the following context for these examples to demonstrated the limited comparability to the SCHAONB: - Clwydian Range AONB: there is an intervening strip of undesignated land between the northern boundary of the AONB and the coastline through which the A548 runs. South Downs National Park (SDNP): the section of coastline in question is located between Rottingdean and the eastern edge of Brighton Marina, extending for appropriately 2.7km, with the A259 running through it. Neither stretch of coastline has been defined as a Heritage Coast. The predicted significant adverse effect of the EA2 turbines on the Suffolk Heritage Coast (which is wholly contained with the Suffolk Coast and Heath AONB) extends to approximately 35 km. It is stated at p.397 (final paragraph) that the effect of the EA2 on the statutory purposes of the Suffolk Coast and Heath AONB, as set out in the PEIR and ES, upon which the scheme should be determined and that comparisons with other OWF in the setting of other designated landscapes are not relevant. Hence NE has not sought to make comparisons with other arrays beyond the coastline of the SCHAONB and nor do we think it is helpful to do so. The apparent height values included in our advice for the Galloper and Greater Gabbard arrays are a 'like for like' comparison which could be made for Suffolk Coast and Heath AONB. It is for this reason that NE has not proposed a definite apparent degree value beyond which significant adverse effects will result. From the evidence presented in the ES and PIER a value of at least 0.407* (Aldeburgh) and potentially 0.382* (Orfordness Lighthouse) would result in harmful effect on the natural beauty of the SCHAONB. The importance of assessing the scheme within the context of the adjacent designated landscape was recognised by the ExA during the examination of the Navitus Bay OWF in 2014. The apparent visible angles of these turbines (when viewed from Durlston Castle, viewing height 51m, separation distance 19km, 210m turbines) would have been 0.573 degrees; so slightly more than the figure quoted for the SDNP and less than that for the Clwydian Range AONB. *The EA2 apparent height values presented here have now been updated. Please see recalculated apparent angles values presented under section NE – 3.3.4 (p.419 to p.423) below Ongoing (p.402 of original RR response): NE believes that there may have been a misunderstanding in the relevance of our advice. On land not knowing the actual height of a structure does not prevent one from understanding how big it is in relation to other objects around it. When viewed from Hempstead Heath both 30 St Marys Axe (the 'Gherkin') and 20 Fenchurch Street (the 'Walkie-Talkie') are tall and therefore amongst the most conspicuous features of the City of London's skyline. The former is taller (by 20m) to the latter but when viewed from Hempstead Heath they appear to be of a very similar height (180m compared to 160m). The same applies when views out to sea are experienced. However because of the lack of reference points against which the height of a proposed or new structure can be gauged and the		The Applicant considers that comparisons with other OWF in the setting of other designated landscapes are relevant and can be helpful to the consideration of the East Anglia TWO Project. NPS EN1 states that '*It may be helpful for applicants to draw attention, in the supporting evidence to their applications, to any examples of existing permitted infrastructure they are aware of with a similar magnitude of impact on sensitive receptors. This may assist the IPC [now the Secretary of State] in judging the weight it should give to the assessed visual impacts of the proposed development*'. The apparent height values for other OWFs included in the Applicant's response to NE's relevant representation (Rampion and Burbo Bank Extension) provide a comparison to the apparent height of other existing permitted infrastructure in the seascape setting of nationally designated landscapes. Further information on the assumptions made to calculate the apparent height of these projects is provided as follows: • Rampion Offshore Wind Farm consists of 116 x 140m blade tip turbines located approximately 14.4km from the South Downs National Park. At its closest point near Brighton Marina (E534432, N102960), which has a viewing height of 0m, the closest turbines would have an apparent height of approximately 0.51˚. • Burbo Bank Extension consists of 32 x 190m blade tip turbines located approximately 14.6km from the Clwydian Range AONB. At its closest point near Gronant (E308930, N383294) which has a viewing height of 30.7m, the closest turbines would have an apparent height of approximately 0.73˚. The Applicant considers that the apparent height angles for the 300m and 250m Project turbines are comparable to or smaller than other consented and operational windfarms located offshore from nationally designated landscapes. The Applicant agrees that the Galloper and Greater Gabbard arrays in the seascape setting of the SCHAONB provides a guide against which the predicted effects of the East Anglia TWO windfarm site can be gauged. The Applicant would note that the Projects are located at greater (minimum) distance offshore than the Galloper and Greater Gabbard windfarms. In addition to height and horizontal spread, the Applicant notes that distance offshore is a factor in the comparison due to the reduced clarity of vision (visual acuity) of objects located at greater distance.

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	greater difficulty in judging distances out to sea, NE provided the information it did in sections 2.1 to 2.11. It is the presence of the Galloper and Greater Gabbard arrays in the seascape setting of the SCHAONB which provides a *guide* against which the predicted adverse effects of the EA2 turbines can be gauged.		
NE-2.10	Please see response to NE 3.9.2, this issue is still ongoing.		Please see response to NE 3.9.2.
NE-2.11	Ongoing (p.405 of original RR response): Please see below for our comments in respect of landscape and visual receptors south of Aldeburgh; not Thorpeness as stated. NE agrees that use of the phrase '*50% upscale of the visual impact'* is imprecise. NE advices that the sentence should read; '*…and would also represent at least a 50% upscaling of the apparent height turbines located off SCHAONB coastline'.* NE agrees that other factors, as listed by the Applicant's response, come into the significance assessments made in the SLVIA. These factors have combined to conclude that adverse significant landscape and visual effects will occur along the northern portion of the SCHAONB coastline. NE disagrees with the conclusion that the statutory purpose of the SCHAONB would not be harmed by the EA2 turbines. It is our conclusion, based upon the evidence presented in the ES, that the statutory purpose of the SCHAONB will experience significant adverse effects by the proposed design of EA2. As acknowledged by the Applicant '*specific aesthetic and perceptual aspects of its character relating to panoramic views offshore from the coast that will experience change'. And it is* these aspects set out in the sites special qualities which contribute to the natural beauty of the designation. Therefore, it is our view that the coastal landscapes of the northern portion of the SCHONB will be significantly adversely effected which leads NE to the conclusion that the statutory purpose of the designation will be harmed and it is immaterial if other landscapes within the SCHAONB are not adverse effected.		The Applicant welcomes the clarification of the phrase '*50% upscale of the visual impact'*. The Applicant still considers that it is not advisable to quantify visual impact in terms of a percentage and has some concerns that even with the amended wording, there is potential for overstatement of the increase in the apparent height of the East Anglia TWO turbines when drawing conclusions in this way. Principally, as set out in its original response to NE-2.11, this is because the apparent height of the Project 282m turbines will only be greater than that of the existing offshore windfarms in views from northern parts of the seascape setting of the AONB. In other parts of the seascape setting of the AONB, particularly from Thorpeness southwards, the apparent height is predicted to be similar or less than the existing Greater Gabbard and Galloper windfarms. The Applicant welcomes recognition that other factors (to apparent height) come into the judgement of significance of effects made in the SLVIA. The Applicant would refer the ExA to the response provided above to NE-2.2 with regards to the statutory purpose of the AONB and to its 'Effects with Regard to the Statutory Purposes of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and Accordance with NPS Policy' (ExA.AS-5.D2.V1).
Section 3 – EA2 Detailed Comments			
Comments on Good Design			
NE-3.1.1	Good Design Ongoing: Whilst NE welcomes the reduced lateral (horizontal) spread of the array, it NE's view that the reduction in spread of the array as illustrated by the diagram on p.419 does not represent sufficient mitigation i.e. significant adverse effects on landscape and visual receptors and some special qualities of the SCHAONB concluded within the ES . Although it does provide an important contribution to reducing cumulative effects with the E1N scheme. NE is aware of the 375m turbines being proposed for the Hornsea 4 project and notes that site of this array is located 65km from the nearest coastline. We note that the Applicant's commentary on the trade-off between fewer large turbines and a larger number of relatively smaller machines if the same generation capacity for the EA2, as set out in the project description is to be maintained. Ongoing (p.408 of original RR response) Natural England RR/WR advice remains unchanged.		The Applicant considers that the measures incorporated into the revised design of the East Anglia TWO project windfarm site afford sufficient mitigation of the seascape, landscape and visual effects on the SCHAONB. The Applicant has proposed, by way of mitigation, a reduced windfarm site area. The north-south extent of the East Anglia TWO windfarm site was reduced (by 9.68km on the western boundary and 8.03km on the east) in order to mitigate potential seascape effects, without a reduction in wind turbine numbers or generation capacity. This refinement is shown in Figure 4.3: Refinement of the East Anglia TWO Windfarm Site Boundary of the ES (APP-082). The embedded mitigation afforded is described in Section 28.3.3 of Chapter 28 of the ES. In summary, the Applicant considers that the embedded mitigation would have a positive effect on mitigating the impact of the proposed windfarm on the SCHAONB, by reducing the horizontal/lateral spread of the windfarm in views out to sea from the SCHAONB, forming a more concentrated grouping and reducing cumulative effects with East Anglia ONE North. All the relevant interested parties that expressed an opinion have been supportive of this mitigation. The Applicant welcomes the recognition from Natural England that the reduced lateral spread of the wind turbines

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
			and offshore platforms located within the East Anglia TWO windfarm site does provide an important contribution to reducing cumulative effects with the East Anglia ONE North project. The Applicant also notes that following submission of the ES, the maximum turbine height parameter has also been reduced from 300m to 282m blade tip. This provides a reduction in the apparent height/vertical scale of turbines visible in views from the SCHAONB. The Applicant notes the general advice at EN-1 paragraph 5.9.8 that *'virtually all nationally significant energy infrastructure projects will have effects on the landscape'*. While the mitigation does not prevent significant effects on certain specific special qualities of the AONB occurring, the Applicant considers that the measures incorporated into the revised design of the East Anglia TWO windfarm site in respect of effects on the SCHAONB afford sufficient mitigation.
Comments on Visibility			
NE-3.2.1	Comments on Visibility Ongoing: We welcome the additional information contained in the table provided (p.412). We note that 8 turbines could be located within 35.8km of the coastline and with a further 8 potentially within 37.4km. Significant adverse effects on the SCHAONB (the portion located within the SCH) are predicated to occur up to distances of 35.9km (Aldeburgh) and potentially as far as 37.4km (Orfordness Lighthouse). This would mean that approximately 13% and potentially 26% of the array will be the primary source of these significant adverse effects. It would be helpful if the Applicant could confirm this point. We note that the minimum distance quoted is for turbine 58 (33.6km) whereas in Table 28.3 the minimum distance is 32.6km for Viewpoint 4 Southwold (referred to as 'Distance from the Project'). We note also that Figure 28.28b (Viewpoint 4) states that the nearest turbine is 33.614km distant. Please could this also be clarified?		The Applicant notes that Natural England have used the information in the table of turbine distances as a guide to how much of the East Anglia TWO windfarm site is the primary source of significant effects. Broadly speaking, it is accepted that the closest parts within the East Anglia TWO windfarm site are likely to be those where the siting of turbines would contribute more to the significant effects, given their larger apparent size/vertical scale and apparency in views, compared to those located at greater distances in the array, which will become decreasing visible with distance and have less effect on views, especially if factoring in the requirement for excellent visibility to see wind turbines at such distances. Even the small proportion of closer turbines within the East Anglia TWO windfarm site would remain at long distance from the SCHAONB. The Applicant considers that significant effects should not be defined in terms of a percentage/proportion of the site, given that there are multiple factors relating to sensitivity and magnitude of change that lead to significance, which are assessed fully in the SLVIA. The minimum distance quoted to turbine 58 (33.6km) is the distance to the closest point on UK land, whereas in Table 28.3 the minimum distance of 32.6km (for Viewpoint 4 Southwold) is measured from the windfarm site boundary to this viewpoint. The measurement for Viewpoint 4 in Figure 28.28b is also to the nearest turbine.
NE-3.2.2	Ongoing: We thank the Applicant for providing a copy the report quoted in both the PEIR and ES. Unfortunately in the limited time available we have not had the opportunity to thoroughly review the contents and understand how these relate to the EA1N and EA2 schemes. We will do so over the coming months and provide any comments or observations we believe to be of help as part of our statutory response at Deadline 1 2nd November 2020.		This is noted.
Comments on the revised layout design:			
NE-3.3.1 NE-3.3.2 NE-3.3.3	Natural England is in agreement with SPR based on the turbine heights included within the Application. However, we note that further consultation will be required on any revised assessments reflecting reduce turbine heights. However, we note that there may be conflict here between potential mitigation to reduce SLVIA concerns with those of offshore ornithology with opposing requirements in relation to turbine heights.		The Applicant notes agreement with Natural England that the revised design of the East Anglia TWO windfarm site will reduce the magnitude of change and the effect that results. The Applicant notes agreement that the revised layout will reduce the magnitude of seascape, landscape and visual effects on the setting and key coastal viewpoints of the AONB; and that the revised design results in a notable reduction in the lateral spread. The Applicant considers that the mitigation embedded in the design of the windfarm site and its proposed turbines will provide an important contribution to reducing the seascape, landscape and visual effect of the East Anglia TWO windfarm on the AONB. The Applicant has undertaken a Zone of Theoretical Visibility (ZTV) exercise for which wireframes and a discussion of the potential implications will be submitted to the Examination at Deadline 3.

<table>
<tr><th>Point Reference</th><th>NE Comments Submitted at Deadline 1</th><th>Risk</th><th>Applicants' Response</th></tr>
<tr><td>NE-3.3.4</td><td>Revised layout design (p.419 to 423 in original RR response)

NE welcomes the corrected 'Distance from the Project (km)' (p.420) values and accompanying clarification that there has been 'no reduction of the minimum separation distance between the PIER windfarm site and the ES windfarm site'. NE accepts the reasons for this.

Ongoing: As a consequence of this the NE analysis of apparent height values has been amended. For completeness we take this opportunity to present the values for the following viewpoints. Additionally, and following commentary provided by the Applicant at 2.5 to 2.8 (p.399) and 3.11.1 (p.459) NE has also amended the eye level height of viewer figure from a standardised value of 6.5m to the stated figures used in Figures 28.25 to 28.41 (ES SLVIA chapters) for each viewpoint.

NB: a turbine height of 282m has been used
<table>
<tr><th>View point</th><th>Name
(see full resp.)</th><th>Stated Eye Level height of viewer (m)</th><th>Turbine height to blade tip (m)</th><th>Distance from the Project (km)</th><th>Apparent Height (°)</th></tr>
<tr><td>3</td><td></td><td>7.73</td><td>282</td><td>33.0</td><td>0.433</td></tr>
<tr><td>4</td><td></td><td>11.07</td><td>282</td><td>32.6</td><td>0.450</td></tr>
<tr><td>5</td><td></td><td>9.84</td><td>282</td><td>32.6</td><td>.0447</td></tr>
<tr><td>6</td><td></td><td>3.89</td><td>282</td><td>33.2</td><td>0.412</td></tr>
<tr><td>7</td><td></td><td>6.34</td><td>282</td><td>34.6</td><td>0.399</td></tr>
<tr><td>8</td><td></td><td>18.28</td><td>282</td><td>34.7</td><td>0.429</td></tr>
<tr><td>9</td><td></td><td>15.55</td><td>282</td><td>35.2</td><td>0.416</td></tr>
<tr><td>10</td><td></td><td>7.24</td><td>282</td><td>34.8</td><td>0.399</td></tr>
<tr><td>11</td><td></td><td>11.34</td><td>282</td><td>34.8</td><td>0.412</td></tr>
<tr><td>12</td><td></td><td>4.68</td><td>282</td><td>35.1</td><td>0.383</td></tr>
<tr><td>13</td><td></td><td>5.96</td><td>282</td><td>35.9</td><td>0.376</td></tr>
<tr><td>18</td><td></td><td>5.8</td><td>282</td><td>37.4</td><td>0.352</td></tr>
<tr><td>A</td><td>*</td><td>13.0</td><td>282</td><td>32.1</td><td>0.464</td></tr>
<tr><td>B</td><td></td><td>7.0</td><td>282</td><td>31.4</td><td>0.460</td></tr>
</table>
As a result of this recalculation the maximum apparent height value has decreased from 0.467 to 0.450.

*EA2 is not visible from this viewpoint.</td><td></td><td>The Applicant notes the updated NE analysis of apparent height values, including the amended eye level height of the viewer to the stated height used for each viewpoint in the ES. It is noted that as a result of this recalculation, the maximum apparent height value has decreased from 0.467 to 0.450.</td></tr>
<tr><td>NE 3.3.4</td><td>Ongoing (p.423 cont in original RR response): NE notes the reduction in the magnitude of change judgements for Covehithe. For the reasons we set out at NE 3.7.2 (p.432) we disagree with this adjustment from medium to medium-low.</td><td></td><td>The ES assessment reduced the magnitude of change assessed on the view experienced from Covehithe (Viewpoint 3) from medium to medium-low due to the reduced horizontal/lateral spread and increased distance of the East Anglia TWO windfarm site from the viewpoint, compared to that assessed at PEIR. This assessment was based on a combination of the increased separation distance of the East Anglia TWO windfarm site at 33.0km offshore (increased from 30.4km at PEIR), and its reduced horizontal/lateral spread to</td></tr>
</table>

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
			26.1° degrees (descreased from 37.5° at PEIR). The decrease in horizontal angle in particular represents approximatey 30% (one-third) decrease in the visual extent of development in the view. The Applicant accepts that this is a finely balanced judgement and on balance, the ES assessment still found the effect to be significant (even after the design change), given the high sensitivity of the receptors at this viewpoint.
NE-3.3.5	Ongoing: NE advices that there are still cumulative effects from the presence of EA2 in conjunction with EA1N		The Applicant notes and agrees that there will still be residual cumulative effects from the presence of the wind turbines and offshore platforms located within the East Anglia TWO windfarm site in conjunction with the wind turbines and offshore platforms located within the East Anglia ONE North windfarm site, although it is agreed that that the cumulative effect will be reduced through the creation of a clear gap in the seascape between the two windfarms and the avoiding of a 'curtaining' effect.
Comments on night-time effects:			
3.4.1 (p.425)	Night-time effects NE welcomes the Applicant's commitment to reduce the intensity of the aviation lighting to 200cd whenever atmospheric conditions permit this.		Noted.
NE-3.4.1 (p.425)	Please be advised that the notion that '*landscape character is not really perceived at night'* is incorrect. The guidance on landscape character assessment (Landscape Character Assessment. Guidance for England and Scotland (CAX84). The Countryside Agency and Scottish Natural Heritage (2002) is clear that landscape character is '*not just about the visual perception or how we see the land but also how we hear, smell and feel our surroundings, and the feelings, memories or associations that they evoke.* See Figure 1.1 p.2. These aspects of landscape character do not cease to exist when the sun goes down. And at night time a different of aspect of landscape character emerges, that of the night sky. The character of the night sky, how dark or free from light pollution the night sky is, contributes to the landscape character of a given place in the same why as the 'big Suffolk skies' contribute to the special qualities of the SCHAONB. This is the reason why we have asked for photomontages for coastal rural locations as it is in these locations that these dark skies are too be found. Whilst we accept that dark skies do not feature significantly in the description of the special qualities of the SCHAONB they nevertheless are an important component of the natural beauty of the designation. The opportunity to experience a dark night sky is limited within England due the extensive distribution of urban light pollution. England's designated landscapes provide locations from which dark night skies, which extend down to the horizon, can be more readily viewed. It is Natural England's advice that this resource/ landscape characteristic, does contribute to the natural beauty of these places. However NE notes the Applicant's commitment to reduce the intensity of aviation lighting to 200cd and we therefore accept that there is no longer a need to produce night-time effect photomontages for viewpoints 03, 06, 08, 11, 12 and 18. Having reviewed again Figure 28.35f (Viewpoint 13 Aldeburgh) we advise that the effect of the 200cd lighting will not be significant for all receptors and the special qualities of the SCHAONB. Although the photomontage has some foreground light spill the image of the night sky out to sea is sufficiently dark for a judgement to be reached on the likely effect of the scheme.		The Applicant notes and welcomes NE advice that given the Applicant's commitment to reduce the intensity of aviation lighting to 200cd (when visibility conditions permit) there is no longer a need to produce night-time effect photomontages for viewpoints 03, 06, 08, 11, 12 and 18. The Applicant intends to secure this commitment through an amendment to Requirement 31 of the draft DCO, which will be updated and submitted in the Examination at Deadline 3 The Applicant welcomes NE's conclusion that the effect of the 200cd lighting will not be significant for all receptors and the special qualities of the SCHAONB.
Comments on the AONB baseline:			

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
NE-3.5.1	Ongoing: In addition to the comment provided in our Relevant/Written Representation please note that Sizewell C has now been submitted.		The Applicant notes that Natural England recognised the relevance of Sizewell C in the trends section of the SLVIA baseline, and that the DCO application for Sizewell C has now been submitted. The impact assessment is undertaken against the existing landscape baseline, against which the significance of the project is judged. An update to the onshore assessment of effects within the AONB has been undertaken and submitted at Deadline 2, see the Landscape and Visual Sizewell C CIA Clarification Note (ExA.AS-7.D2.V1).
NE-3.5.2	AONB baseline Ongoing: NE agrees that EA2 will have '*significant effects on the perception of panoramic offshore views from parts of the AONB coastline*' but disagrees that this *'will not result in harm to the statutory purposes of the AONB*'.		The Applicant would refer the ExA to the response provided above to NE-2.2 with regards to the statutory purpose of the AONB and to its 'Effects with Regard to the Statutory Purposes of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and Accordance with NPS Policy' (ExA.AS-5.D2.V1).
Comments on seascape character assessment			
NE-3.6.1	Seascape baseline Resolved: We thank the Applicant for confirming that maintenance activities have been incorporated into the assessment of the operational effects of the project. NE agrees that no further assessment of maintenance activities is required.		The Applicant welcomes agreement that no further assessment of maintenance activities is required.
Comments on landscape receptors			
NE-3.7.1 Table 3.7	Please see more details comments on Landscape Character Types (LCTs) below where we have outstanding issues.		NE comments on LCTs with outstanding issues are noted and responses are provided below.
NE-3.7.2	LCT 06 Coastal Levels – Area B Please refer to our comments for LCT 29 below. Ongoing: NE maintains its advice that the magnitude of change should be medium for the coastal portions of this LCT (as it is for LCT 07 Areas A and C) and that a significant adverse effect will result from placing the 300m turbines in the seascape setting of this portion of LCT 06 Area B. As the Applicant states '*there is very limited visibility from the Town Marshes / Havenbeach Marshes*'; but the ES (6.3.28.4 Appendix 28.4 p.22) makes clear there are '*localised areas* [where] *the construction and operation of the offshore infrastructure will result in some changes to the open, wide, exposed characteristics near the sea, resulting in a partial loss of open sea skyline on the seaward backdrop and the addition of distant vertical elements which may change the wide/horizontal emphasis of the LCT'.* As with LCT 07 Areas A and C therefore there is still inter-visibility between this LCT and its' seascape setting. It is immaterial that there is '*limited access to perceive changes to its character'* as the LCT is the receptor and not people (the visual receptors) within it.		The Applicant maintains its assessment of LCT 06 Coastal Levels (Area B) that the magnitude of change should be medium-low, as set out in the ES and expanded in its response to Natural England's relevant representation at NE-3.7.2. The Applicant considers that the large majority of Area B of the Coastal Levels LCT 06 does not have a seascape setting and is in fact, set back and covering marshland 'behind' or inland of Southwold and Reydon. On balance, the magnitude of change on character of this area AB of the LCT is considered to be lower than other areas of this type that have more associative seascape setting. Areas of inter-visibility between this LCT and its' seascape setting and thereby the East Anglia TWO project are very limited. The Applicant considers that it is not immaterial that there is *'limited access to perceive changes to its character*'. Development located outside a landscape may only impact on its perceived character. Due to the location of the East Anglia TWO windfarm site outside the Coastal Levels LCT (over 32.6km distant), the effects resulting are indirect effects i.e. it does not affect the physical elements that make up the LCT (land cover, physical influences and so on), affecting only its aesthetic and perceptual aspects. Aesthetic and perceptual aspects of character are qualities which people experience within the LCT. The degree to which these aesthetic and perceptual aspects of character are altered by the wind turbines and offshore platforms located within the East Anglia TWO windfarm site is ultimately an indirect effect on the perception of the landscape as experienced by people (and not a direct effect on the landscape itself). GLVIA3 para 3.15 notes that for the landscape baseline '*the way the landscape is experienced'* is an aspect of the landscape that should be understood in order to understand the area that may be affected by a proposed development. The degree to which a landscape can be accessed by people to perceive its character (and the resultant changes arising from development outside its area), is therefore a relevant consideration in the assessment. In

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
			the case of LCT 06 Coastal Levels (Area B), it is the Applicant's assessment that much of the LCT is marshland and has limited access to people to perceive changes to its character, notwithstanding that large parts of this area of the Coastal Levels LCT do not have a seascape setting given its location extending inland behind Southwold/Reydon. It is the Applicant's assessment that, the aesthetic and perceptual aspects that define its baseline marshland character will not be lost and will remain fundamental to defining its character, and that on balance, the perceived character of this area of the Coastal Levels LCT will not be significantly affected.
NE-3.7.3	LCT 06 Coastal Levels – Area D Please refer to our comments for LCT 29 below. Ongoing: NE maintains its advice that the magnitude of change should be medium for the coastal portions of the LCT (as it is for LCT 07 Areas A and C) and that a significant adverse effect will result from placing the 300m turbines of EA2 in the seascape setting of this portion of LCT 06 Area D. As the Applicant states *'there is very limited visibility from within the LCT'* but the ES (6.3.28.4 Appendix 28.4 p.22) makes clear there are '*there are long distance and panoramic views to the seaward horizon which form a key component of the character of this area'.* As with LCT 07 Areas A and C therefore there is still inter-visibility and its' seascape setting.		The Applicant maintains its assessment of LCT 06 Coastal Levels (Area D) that the magnitude of change should be medium-low, as set out in the ES and expanded in its response to Natural England's relevant representation at NE-3.7.3. The coastal side of Area D of the Coastal Levels does not have a direct 'coastal portion' or edge to the seascape, as such, being entirely separated from the sea by an approximately 200m wide strip of intervening Coastal Dunes and Shingle Ridges LCT 05. The eastern, coastward side of the LCT is often the area that is most screened behind the raised shingle ridge contained in LCT 05 (as is evident in the ZTV and from field survey assessment), which limits directs views of the sea and is predicted to provide screening of the turbines within the East Anglia TWO windfarm site from the low coastal levels behind the Shingle Ridges LCT 05. It is the Applicant's assessment that the aesthetic and perceptual aspects that define its baseline character as a former mere will not be lost and will remain fundamental to defining its character, and that on balance, the perceived character of this area of the Coastal Levels LCT will not be significantly affected.
NE-3.7.4	LCT 29 Covehithe Broad and Easton Broad The landscapes of Covehithe Board and Easton Broad are rare landscapes within Suffolk. Covehithe Broad and Easton Broad are the only two occurrences of this LCT. Both areas are located wholly within the SCHAONB and to a lesser extent within the SHC. They are '*generally in excellent condition'*. See Suffolk CC LCA http://www.suffolklandscape.org.uk/landscapes/Wooded-fens.aspx NE was in attendance on the site visits of Wednesday 19th June 2019. NE mistakenly stated this to be 23rd June 2019 in our Relevant/Written Representation. NE can confirm that the site visit took place on the 19th June and included a visit to Covehithe Beach (Viewpoint 3). At this location, as the ES Figure 28.27c in part shows, this is a very small LCT. Easton Broad, located to the south is bigger and extends further inland. In both instances these LCTs extend to the coast. As the image in Figure 28.27c shows there is clear inter-visibility between the Covehithe Board and the sea. The shingle ridge is low and does not interrupt views out to sea. Panoramic views out to see from this LCT 29 are therefore possible. Ongoing: NE notes the Applicant's observation that the *'eastern edges of LCT 29 extends to the shoreline'.* It is however immaterial that that these '*consist of short sections'* (which when combined extent to over a 1km) as the Suffolk CC LCA has judged these features to be a part of the landscape character of LCT 29. NE agrees that these areas within LCT 29 have a distinct character '*which is typically part of LCT 05 (Coastal Dunes and Shingle Ridges)'.* The ES has concluded significant adverse effects on Area C of LCT 05 (Southwold to the north side of Orford Ness) which is located further away from the western boundary of EA2 than LCT 29 at Covehithe Broad and Easton Broad. In addition there is little difference in the lateral spread of the array at these locations (see figures		The Applicant maintains its assessment that the effect of the wind turbines and offshore platforms located within the East Anglia TWO windfarm site on the perceived character of LCT 29 Wooded Fens (Covehithe Broad and Easton Broad) is not significant as a whole, as set out in the ES and expanded in its response to Natural England's relevant representation at NE-3.7.4. While the Applicant notes the potential for localised significant effects to the perceived character of small areas of the coastal edges of the LCT with offshore sea views, it is the Applicant's assessment that the aesthetic and perceptual aspects which define its baseline character as a low-lying wooded fen/broad will not be lost and will remain fundamental to defining its character, and therefore on balance, the perceived character of LCT29 Covehithe Broad and Easton Broad will not be significantly affected.

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	28.27b and 28.36b). We note (as set out at NE 3.3.4 p. 423 3rd para.) that the due to the reduction in lateral spread of the array that the magnitude of change judgement has been lowered from medium to medium-low for Viewpoint 3 (Covehithe, located within LCT 29). Therefore, we disagree with this reduction in the magnitude of change judgement. Ongoing: The Applicant's argument that adverse effects would only effect the coastal margins of LCT 29 is also inconsistent with the judgements made for LCT 07 Areas A and C. LCT 07 also extends inland from where views out to sea are also interrupted by either woodland or landform. For these 'coastal' areas of LCT 07 the judgement for magnitude of change was medium. NE maintains its advice that the seascape setting of both Covehithe Broad and Easton Broad will be adversely and significantly affected by the turbines of EA2. This significant effect will also apply to the natural beauty of the designation as expressed through multiple special qualities.		
EA2 Comments on the AONB Special Qualities			
Table 4:	Special Qualities of the SCHAONB Ongoing: This is the critical point of disagreement between the Applicant and NE. Table 4 lists in total 18 special qualities for the SCHAONB and where we agree and disagree with the Applicant. The Applicant concludes significant adverse effects on 5 of these and not significant effects on the remaining 13. NE agrees that no significant effects will occur on 5, but disagrees with the conclusion for another 6 meaning that we judge that significant adverse effects will occur on 11 of the 18 listed special qualities. The assessment of special qualities has sought to determine if there will or will not be an adverse effect on the natural beauty (as expressed by the special qualities) of the SCHAONB. The ES has concluded that there will be significant adverse effects on some of the special qualities of the SCHAONB and that the natural beauty of that portion of the designation defined as Heritage Coast will experience significant harm. Therefore the statutory purpose of the SCHAONB to conserve and enhance natural beauty, will be significantly harmed by the turbines of EA2. The Applicant concludes that in '*overall terms*' (3.12.8 p.464) there is not a significant effect on the special qualities (and hence the statutory purpose) of the SCHAONB. NE disagrees. We have reached this conclusion based on our review of the Applicant's evidence (as submitted in the PIER and ES) and site visits undertake in the summer months of 2018 and 2019. We have provided our reasoning for this in our Relevant/Written Representation and submission for the s42 consultation and this advice remains unchanged. The Applicant refers to the EA2 site rather than the EA2 windfarm at 3.12.8 p.464. NE sets out below why we consider this to be misleading. See NE comments for NE 3.12.8 (p.463) below.		The Applicant notes this key area of disagreement between the Applicant and Natural England regarding the effects of the wind turbines and offshore platforms located within the East Anglia TWO windfarm site on the natural beauty of the AONB, as expressed by its Special Qualities. The Applicant would refer the ExA to the response provided above to NE-2.2 with regards to 'harm' to special qualities/statutory purpose of the AONB, and to the following note submitted at Deadline 2: 'Effects with Regard to the Statutory Purposes of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and Accordance with NPS Policy' (ExA.AS-5.D2.V1). Further to this, the Applicant notes that there is agreement that significant effects do not occur on all of the special qualities of the SCHAONB. The Applicant's assessment finds significant effects on specific aesthetic/perceptual aspects of its character relating to panoramic views offshore from the coast that will experience change, with the varied and distinctive landscape of the AONB continuing to define the fundamental character of the SCHAONB. The Applicant considers that the existing natural beauty of the AONB will remain fundamental to its perceived qualities, regardless of the presence of the East Anglia TWO windfarm site located over 32km outside its boundary. The Applicant's responses to NE comments on special qualities are provided below at points NE-3.8.2 to 3.8.7.
NE-3.8.1	Introductory comment with no further actions. Please see our response to 3.8.2 – 3.8.7.		Noted, with responses provided below to 3.8.2 – 3.8.7.
NE-3.8.2	Summary of comments for the special qualities assessment Ongoing (p.437 to 450 of original RR response): Please be advised that the principal point of disagreement between the Applicant and NE centres around the assessment of the magnitude of effect. GLIVA3 defines magnitude as comprising 3 factors; size or scale of the scheme, the geographical extent of the area influenced and the duration and reversibility of the scheme. For the 6 special qualities where there is disagreement the Applicant judges the magnitude of effect to be medium-low; NE judges it to be at least medium. This difference results in the concluding		The Applicant concurs that the principal point of disagreement between the Applicant and Natural England centres around the 'medium-low' or 'medium' level of magnitude of effect assessed on certain special qualities; and therefore the concluding judgements on the significance of effect as not significant (Applicant) and significant (NE) for the 6 special qualities in question. As noted and agreed in earlier responses, the judgements being made are finely balanced near the threshold of significance.

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	judgements on the significance of effect of not significant (Applicant) and significant (NE) for the 6 special qualities in question. Having reviewed the further narrative provided by the Applicant in their response to our Relevant/Written Representation our position remains unchanged for those 6 special qualities where we disagree with the Applicant's conclusion. For clarity we provide a response to the Applicant's additional commentary for these 6 special qualities. <u>Landscape Quality – Influence of Incongruous Features</u> Ongoing (p.437 to 450 of original RR response): The Applicant lists 4 examples of incongruous features currently present in the landscape and seascape setting of the SCHAONB. These are: Sizewell A and B nuclear power stations (within designation) The Greater Gabbard and Gallop OWFs, which when viewed from the SCHAONB appear as a single feature in the seascape (in setting) Orford Ness Transmitting Towers (within designation) Lowestoft Ness Point Wind Turbine (a single wind turbine) (in setting) With the exception of the Sizewell nuclear power stations NE advises that the influence of these features is localised, does not detract from the natural beauty of the SCHAONB and does not extend far along the coastline in either direction. Whilst the visual influence of the Sizewell A and B nuclear power stations complex is more prominent it should be noted that the former was consented (in 1960) before the SCHAONB was designated in 1970 (the SHC was defined in 1973). The visual influence of Sizewell A is however now less prominent in long distance views as it is seen within the context of Sizewell B. The design of the Sizewell B power station was the subject intense scrutiny via a lengthy public enquiry in the 1980s where the relationship of the new power station with the landscape and natural beauty of the SCHAONB was a significant consideration. The housing of the PWR reactor resulted in current Reactor Dome which is, by its uniqueness (both locally and nationally), an incongruous feature of the SCHAONB landscape. However it is the uniqueness of this structure, it's strange or even bizarre nature within the context of the SCHAONB landscape which is recognized within this special quality of the designation. It may not contribute to natural beauty of the SCHAONB, but it does help make the landscape of the designation exceptional and hence special. In comparison offshore windfarms are not unique features in either landscapes or seascapes and can be seen in the seascape setting a number of designated landscapes. In the majority of instances they do not adversely affect landscape quality and unlike the predicated effects of the EA2 turbines, the natural beauty of these designations. The ES has concluded that the significant adverse effect of the EA2 turbines will extend for approximately 35 km along the SCHAONB coastline (all of which is defined as a Heritage Coast). For multiple landscapes types and viewpoint locations along the SCHAONB coast between Covehithe and Aldeburgh the Applicant has judged the magnitude of effect to be medium; on 4 occasions for landscape receptors and 9 visual receptors. But in the assessment of this special quality the magnitude of effect has been judged to be medium-low. NE fails to understand this		Having reviewed the further narrative provided by Natural England in their comments to the Applicant's response to Natural England's Relevant/Written Representation, the Applicant's position remains that the East Anglia TWO windfarm site, on balance, would not significantly affect these 6 special qualities. The reasons for this are described in the Applicant's comments to Natural England's relevant representation, with further commentary provided below in response to Natural England's comments. <u>Landscape Quality – Influence of Incongruous Features</u> The Applicant considers that the influence of Orford Ness Transmitting Towers and Greater Gabbard/Galloper is not 'localised'. The Orford Ness Transmitting Towers, at 11 in number and 106.7m in height, are seen widely in views across Orford Ness and Sudbourne Marshes, to Aldeburgh to the north and from the River Ore/Hollesley Bay to the south. The Zone of Theoretical Visibility (ZTV) of the Greater Gabbard and Galloper windfarms is shown in Figure 28.21c of the ES. It is clear from the extent of the ZTV that their visibility is not 'localised', as it covers a lengthy section of coastline extending from Southwold in the north to Felixstowe/Walton on the Naze in the south. The AONB special qualities report describes their visibility as follows: *'Offshore wind turbines at Greater Gabbard, Galloper and the more distant London Array are visible from some stretches of the coastline. These create a cluttered horizon and, like the large scale elements onshore, also divide opinion'*. Natural England acknowledges that the visual influence of Sizewell A and B Nuclear Power Station is more prominent, not localised and detracts from the natural beauty of the SCHAONB, however it refers to the design of the Sizewell B power station and its reactor dome as mitigating factors. There are other examples of domed power plants nationally, however it is accepted that it is locally unique and that the reactor dome has a distinctive design and response to its context, which contributes to the distinctiveness of the SCHAONB. While the appearance and outline of Sizewell B partially mitigate the adverse visual impacts, it is often viewed in the context of Sizewell A, which does not benefit from such 'sensitive' design. It appears as a large-scale, 'brutalist' concrete mass next to Sizewell B in views along the coastline, particularly from the south, creating complexity and contrast in the otherwise simple appearance of Sizewell B. The Applicant considers that NE may have underestimated the adverse baseline influence on landscape quality arising from the Sizewell A and B Nuclear Power Stations, which are visible for much of the same section of SCHAONB coast between Southwold and Aldeburgh that would afford views of the East Anglia TWO project windfarm. The Applicant notes that the levels of magnitude of effect on landscape receptors (and special qualities) are sometimes found to be lower than levels of magnitude of effect on landscape types or views/viewpoints where special qualities are experienced. In terms of landscape character type (LCT) receptors, magnitude of change is not just about change to landscape quality – that is just one component in the consideration. Landscape quality is *'a measure of the physical state of the landscape'*. It may include *'the extent to which typical character is represented in individual areas, the intactness of the landscape and the condition of the individual elements'* (GLVIA3, p157). The East Anglia TWO project would only marginally affect these aspects of the landscape quality of the AONB, as it would not affect its physical state, only its setting through perceived change. The landscape change to a specific special quality, such as landscape quality, may therefore be lower than the assessment of landscape effects on LCT when all factors are considered. With respect to views, if a viewpoint was assessed to undergo a medium magnitude of change, it does not necessarily follow that the landscape receptor within which it lies would necessarily undergo a medium magnitude of change. This is because the effects on viewpoints are assessed within the context of a specific outlook of the East Anglia TWO windfarm and the specific locations were specifically selected to gain a direct

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	mismatch in assessments when landscape quality is key a component of the natural beauty of the designation, which the quality of the views out to sea greatly contributes to.		view towards the windfarm site. The East Anglia TWO windfarm is the principal consideration in the viewpoint selection and assessment, and influences that lie in other areas of the view are considered to a lesser degree. In contrast the landscape character of a receptor, including its special qualities, is not determined so specifically by the outlook to the East Anglia TWO windfarm, and there are many other wider considerations, both visual and perceptual, that combine to give an area its landscape character and qualities. Due to its location at long distance offshore from the SCHAONB, the East Anglia TWO windfarm gives rises to indirect changes to LCTs within the SCHAONB and to the perception of special qualities, whereas changes to views are direct effects. This generally means that the degree of effect of the East Anglia TWO windfarm will typically be slightly less on the perception of landscape character receptors and qualities than on a specific view. Viewpoints are referred to in the SLVIA as they give a useful indication of the appearance of the East Anglia TWO windfarm from the SCHAONB, but the level of magnitude of effect may vary between the viewpoint assessment and the landscape character assessment and special qualities assessment. In this case, this resulting in landscape character effects or effects on special qualities sometimes being assessed as medium-low and on the not significant side of the significance threshold. GLVIA3 provides the following note on this possible divergence in assessment between effects on the landscape as a resource and effects on views and visual amenity at paragraph 3.20 stating that ' *It is also possible, although less common, that there may be likely significant visual effects on visual amenity without effects on the landscape resource*.'
3.8.3	Scenic Quality – Appeal to the senses; Sensory stimuli and 'big Suffolk Skies' Ongoing: Generally people visually experience a place in three dimensions; this is best envisaged as a sphere or dome with the viewer located in the centre of its base. The Applicant refers to these views as panoramic (NE 3.5.2 p.428) and predicts that '*significant effects on the perception of panoramic offshore views from parts of the AONB coastline*' will occur. The sense of openness and lack of enclosure which currently predominates in many locations along the Suffolk Heritage Coast e.g. Dunwich Heath and Covehithe Beach is the result of the opportunity to take in and be a part of these 360 degree, three dimensional views. Big Suffolk skies not only extend vertically, but also horizontally to the far horizon. In views out to sea, to the place where the sea meets the sky, are as much a part of big Suffolk skies as the large cumulonimbus clouds which form above one's head on a hot June afternoon. It is the combination of the generally flat or low lying landscapes of the SCHAONB with the uninterrupted views to the far horizon available of offshore which makes these views special. NE agrees with the Applicant's assertion that the turbines of the EA2 windfarm would only form a small part of 'big Suffolk skies' on the basis that the turbines would occupy of a small portion of the '*180 degree of sky visible from coastal locations'*. NE notes that if this vertical 180 degree approach to defining views of the sky is applied to views from within mountainous landscapes then views of the sky still occupy the vast majority of the 'view' even from valley floors; the difference of course is that open uninterrupted views to the far horizon are not possible from such locations. The Applicant makes reference to 3 specific '*development elements*' within the SCHAONB which influence 'big Suffolk Skies' to a greater degree than the turbines of EA2 would. Taking each of these in turn: Communication masts of the Orford Transmitting station (total number 11, height 106.7m). These structures are free standing steel lattice towers of triangular construction with 6 being driven i.e. rotatable and the other 5 being fixed. They are positioned in two groups, one of which is orientated approximately NW – SE and the other as a grouping of 5. They are seen at their widest in views		Scenic Quality – Appeal to the senses; Sensory stimuli and 'big Suffolk Skies' The Applicant notes NE comments about the open uninterrupted views to the far horizon available offshore and considers that the significant effect on these 'expansive views offshore' has been assessed as significant in respect of Special Quality 'Relative Wildness – A sense of openness and exposure' in the ES (Appendix 28.4). The ES assessment of Special Qualities differentiated the significant effect of the wind turbines and offshore platforms located within the East Anglia TWO windfarm site on 'expansive views offshore' from its not significant effects on 'Big Suffolk Skies'. The assessment acknowledged and concurs with NE's assessment, that the wind turbines and offshore platforms located within the East Anglia TWO windfarm site will introduce a further visible element that may compete with the sense of openness, which may appear to define the limit of the offshore view, giving rise to a significant effect on the special quality of 'expansive views offshore'. It does also recognise however, that the fundamental sense of openness and exposure on the coastline and Sandlings Heaths would not be lost as a result of the wind turbines and offshore platforms located within the East Anglia TWO windfarm site. This would continue to be experienced in the presence of the East Anglia TWO windfarm site. In relation to the effects on 'big Suffolk skies', the Applicant notes agreement that the East Anglia TWO wind turbines would only form a small part of 'big Suffolk skies' on the basis that the wind turbines would occupy of a small portion of the *'180 degree of sky visible from coastal locations'.* It is on this basis that the effect on big Suffolk skies was assessed as not significant, as described in the ES special qualities assessment (Appendix 28.4) and expanded in the Applicant's response to NE relevant representation (NE-3.8.3). The vertical scale and influence of the East Anglia TWO project turbines on the 'big Suffolk skies' can be gauged with reference to viewpoints in Aldeburgh (Figure 28.37a) and Dunwich Heath (Figure 28.32f). The sky element of these views still occupy the vast majority of the view with the East Anglia TWO windfarm site present on the horizon. The Applicant would also note that the sensory stimuli to which this special quality refers, including sounds, smells, characteristics of the weather, and quality of light/space will not be affected by the East Anglia TWO windfarm site. Fundamentally these stimuli would continue to be experienced regardless of the presence of the East Anglia TWO windfarm site. Due to the lack of effect on these qualities, combined with the small part of 'big

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	from the north and south although even when viewed side-on they still only occupy a small percentage of the available horizon. Their height is however readily apparent when viewed from the south of Aldeburgh (approximately 4.5km distant, 4.5m eye height, 1.362 apparent height) or Quay at Orford (approximately 2.75km distant, 2.5m eye height, 2.229 apparent height). However, and unlike wind-turbines, these are 'light-weight' steel lattice towers which allows light to pass through thus affording views of the sky to their rear. Even from the locations mentioned above they do not obscure the sky and have transparent quality to them; unlike a wind turbine they do not appear 'solid' and nor are they kinetic. Generally at distances beyond 6kms they are not readily apparent within the landscape. Their influence, such that it is, is confined to the landscape located south of Aldeburgh and north of Orford. Their influence on views of the 'big Suffolk skies' can be gauged using the Figures 28.38c and 28.38e (Viewpoint 14 Orford Castle) of the ES. Figure 28.38e also allows for a direct comparison with the EA2 turbines. Sizewell nuclear power stations complex - this complex is oblong in shape with the longest sides being oriented north to south i.e. parallel to the coast. When viewed form the north and south the complex is viewed from its narrow side. Viewpoint 8 Dunwich Heath and Beach (Coastguard Cottages), located to the north, affords one the clearest views of the complex from this orientation. As can be seen in Figure 28.32d the complex occupies a very narrow portion of the horizon and although clearly visible, sits low on the horizon. At 65m the height of the Reactor Dome (approximately 4.5km distant, 18.25m eye height, 0.828 apparent height from Viewpoint 8) and, just as importantly the mass of the complex, is readily apparent. South of the power station complex clear views from coastal locations are more infrequent with the complex being glimpsed, rather than seen in plain view as it is from Viewpoint 8. NE considers that, for views along the coastline, these structures do have a localised influence on 'big Suffolk skies' but do not influence views available of the sky out to sea. With the exception of Viewpoint 10 (and then only for views inland) none of these structures significantly detracts from the opportunity to experience 'big Suffolk skies' Urban development within urbanised areas. NE understands this to mean Aldeburgh, Thorpeness and Southwold. The relatively low elevations of these settlements means that they detract little from the opportunity to experience 'big Suffolk skies'. See Figure 28.32b. As agreed with the Applicant the turbines of EA2 will occupy a small vertical portion of the 'big Suffolk skies' (NE judges this to be less than that of the Reactor Dome of Sizewell B when viewed from Viewpoint 8) but the turbines will be spread horizontally across the far horizon for a considerable distance. The turbines will occupy a far greater portion of the horizon than both the Orford Transmission Towers and Sizewell power stations complex, and this when viewed from distances which are considerably greater. As the Applicant has committed to using 200cd intensity aviation lighting on all occasions where weather conditions permit NE offers no further advice on the issue of fixed night time lighting. Please refer to our comments at NE – 3.4.1(p.425). NE accepts that marine traffic operating in and out of Lowestoft is already an influence on the far northern seascape setting of SCHAONB, but maintains that it is less pronounced, particularly in respect of vessel size, than in views out to sea from the southern portion (south of Orfordness). In addition these are not fixed in the seascape i.e. they are transiting through. Please also see response to 3.8.2.		Suffolk skies' affected, it is considered that the effect of the East Anglia TWO windfarm site is not significant on the appeal to the senses; sensory stimuli and 'big Suffolk Skies' described in this special quality. Notably, the combination of the generally flat or low-lying landscapes of the SCHAONB, and the extent of woodland cover and localised landforms at the coast, also ensure that from the majority of locations within it, particularly away from the coast, the East Anglia TWO windfarm site would not be visible (despite theoretical visibility being shown in the ZTV, which does not factor in vegetation cover or localised landform). The Applicant's reference to 3 specific 'development elements' within the SCHAONB aimed to contextualise the vertical scale effects of the East Anglia TWO windfarm site with other development that influences the appreciation of big Suffolk skies. Communications masts at the Orford Transmitting station. The Applicant agrees with much of the description of the masts provided by Natural England. It would however note the considerably larger vertical scale of the masts and their interruption of the sky component of the view in Figure 28.38e (Viewpoint 14 Orford Castle) of the ES in comparison to the East Anglia TWO wind turbines. Sizewell A and B nuclear power stations. The Applicant notes the view of Sizewell A and B nuclear power stations in Viewpoint 8 (Figure 28.32d) and would note that even when seen at is narrowest, it forms an eye catching modern structure and landmark in the view along the SCHAONB coastline. Its lateral visual effect goes beyond the power station itself, extending to include the overhead transmission pylons clearly visible above Dunwich Forest extending across the AONB, and in the other direction to the intake and outfall structures in the adjacent seascape. The 65m height of the reactor dome at 4.5km, 18.25m eye height and 0.828° apparent height is approximately double the apparent height of the East Anglia TWO wind turbines (0.442°) from the same location, and yet it is described by NE as sitting low to the horizon. The wind turbines and offshore platforms located within the East Anglia TWO windfarm site would sit lower to the horizon. The vertical scale and influence of Sizewell A and B nuclear power stations on the 'big Suffolk skies' from its immediate locality to the south, can be gauged using Figures 28.34b-c (Viewpoint 10), in comparison to the scale of the East Anglia TWO wind turbines (Figure 28.34f). Urban development within urbanised areas. The vertical scale and influence of urban development on the 'big Suffolk skies' from urban areas in the SCHAONB can be gauged with reference to Figures 28.28b-d (Viewpoint 4, Southwold) and 28.37c (Viewpoint 13, Aldeburgh). The Applicant notes that Natural England consider the portion of horizontal spread of development as a factor in its effect on the big Suffolk skies. The Applicant's assessment is that effects on the big Suffolk skies qualities primarily arise as a result of the vertical scale of development, rather than horizontal effects, which are assessed separately in relation to the quality 'expansive views offshore'.

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
3.8.4	Relative Wildness – Sense of remoteness; pockets of relative wildness Ongoing: NE agrees that the project '*will not increase the proximity of habitation to the AONB'* and that '*it may, as recognised in the ES increase the perceived influence of apparent human activity as result of the introduction of other, man-made structures in the seascape setting'*. Along with the rest of the English landscape the SCAONB has been transformed by the impact of people. However unlike many other English landscapes this transformation has not been total and there remain multiple 'pockets of relative wildness' along the coastline. The Applicant is correct to assert that specific landscape character types such as LCT 08 (Open Coastal Fens) and LCT 05 (Coastal Dunes and Shingle Ridges) are the locations where 'pockets of relative wildness' are most likely to be experienced at the coast. NE advices that an experience of 'relative wildness' is also afforded by LCT 29 (Covehithe Broad and Easton Broad). Additionally 'pockets of relative wildness' can also be experienced within other LCTs. For instance at Dunwich Heath (LCT 07 Estate Sandlands) and Minsmere (LCT 06 Coastal Levels). Not all of these LCTs will be adversely effected by EA2. However for some of these LCTs the Applicant has predicted that significant adverse effects will result from the turbines of EA2. The LCTs affected adversely are: LCT 05 (Area C: Southwold to the North side of Orfordness)* LCT 07 (Area C: Dunwich Heath)* The Applicant did not predict significant effects for: LCT 05 (Area D and E) LCT 06 (Areas B to F) LCT 08 (Areas A to C) LCT 29 (Covehithe Broad and Easton Broad)*. For those LCTs where the seascape setting is an integral component of landscape character and which also contributes to the experience of relative wildness afforded (these have been marked *) NE advises that in these locations a significant adverse effect on this special quality will result from the construction and operation of the EA2 windfarm. NE advises that any significant adverse effects to the LCTs where this experience is possible will also have a significant adverse effect on the statutory purpose of the SCHAONB. The Applicant asserts that these pockets of 'relative wildness' are geographically limited within the SCHAONB and therefore the '*changes to the sense of remoteness is not widespread, and will be very limited to these isolated pockets*'. However, it is our view that because these pockets are geographically and spatially limited i.e. they are both small in number and small in area, they are special and thereby contribute to the natural beauty of the designation. It is because these 'pockets of relative wildness' are confined to the '*narrow coastal strip'*, within the SCAONB and SCH which are most adversely effected by the turbines EA2, that this special quality will be significantly harmed. On p.445 it is asserted that '*at distances over 32km* [the turbines of EA2] *it is considered to be relatively remote from the AONB in terms of distance'. However,* 'relatively remote' remains undefined. Please see response to 3.8.2.		Relative Wildness – Sense of remoteness; pockets of relative wildness The Applicant's assessment identified significant effects on the coastal areas of LCT 05 (Area C: Southwold to the North side of Orfordness) and LCT 07 (Area C: Dunwich Heath), resulting from perceived changes to the long distance open sea views occurring through partial loss of open sea skyline in the simple landscape composition. The Applicant's assessment does not directly associate these effects on long distance open sea views with significant effects on the perception of relative wildness – which is a product of people's perceptual response to certain physical attributes in the landscape. Due to the location of the East Anglia TWO windfarm site outside the SCHAONB, no physical attributes contributing to wildness special qualities will be changed. As described fully in the Applicant's comments on NE's relevant representation, the Applicant considers that the location of the East Anglia TWO windfarm site 32.5km outside the SCHAONB boundary makes it unlikely to experience significant effects to the perception of its relative wildness. Significant effects on the wildness qualities of these areas have been substantially overcome by embedded design mitigation applied to the wind turbines and offshore platforms located within the East Anglia TWO windfarm. The Applicant's assessment in the ES special qualities assessment notes that while on the one hand wind energy development may contrast with the perception of wildness, such as those associated with physical elements in the SCHAONB, the East Anglia TWO windfarm site may also relate legibly to the coastal exposure and inclement conditions experienced, particularly in areas with wildness associated with the coast. The location of the East Anglia TWO windfarm site out at sea influences its perceived effect on wildness. The perception of wildness associated with the sea is different to the landward areas of the SCHAONB as it is shaped by many other factors and associations of the sea, which has shaped the lives of local inhabitants, with its ships and fishing, storms and lifeboats, maritime trade and transport. The influence on relative wildness of an offshore windfarm in the seascape well outside the boundaries of the SCHAONB is different and less contrasting from some of the perceived coastal/seascape wildness attributes in this context. The wildness experienced along the coast is often most readily experienced where the grey seas are whipped by north-easterly winds that challenge the land, where the bleakness of the sea, its dynamism and coastal exposure are readily evident. The East Anglia TWO windfarm site readily relates to and conveys in its aesthetic and kinetic form, these wildness attributes associated with the coast and the seascape setting of the SCHAONB. The Applicant noted in its comments on NE's relevant representation that at distances over 32km it is considered to be 'relatively remote' from the SCHAONB in terms of its distance and therefore its subsequent influence on the experience of wildness within the SCHAONB is diminished. It is noted that 'remote' remains somewhat undefined. The Applicant points to evidence from the Rampion Windfarm examination (Recommendation Report to the Secretary of State, 2014) as helpful in considering the term 'remote'. The examination explored the use of the term 'remote' to describe the location of the Rampion Windfarm from the South Downs National Park and Sussex Heritage Coast. In the context of that project, the ExA panel accepted the definition of 'remote' as a location over 20km away from the viewing point. The ExA panel further noted that the distance of Rampion Windfarm over 20km from the National Park and Heritage coast would mean that it would be regarded as 'remote' from a number of viewpoint locations. In terms of the special qualities identified for the SCHAONB, the Applicant considers that the East Anglia TWO windfarm site would be perceived as being distant and/or remote from the SCHAONB, despite the clear context association between the AONB and its seascape setting.

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
3.8.5	Relative Wildness – Sense of remoteness; relative lack of human influence Ongoing: NE accepts the Applicant's correction in the second paragraph (p.446) and thanks the Applicant for drawing attention to this. NE agrees that the '*largely undeveloped coastline and offshore areas is the key area of relevance'*. Semi-natural habitats are covered in Relative Wildness – Sense of remoteness; 'pockets of relative wildness'. Accessing the coastline of the SCHAONB, particularly at certain locations such as Orford Ness, Minsmere, Dunwich and Covehithe is not easy. The Suffolk Coastal Path is currently the only linear route along the coast and in order to maintain linearity at certain locations the path has to divert inland due to the physical nature of the landscape. Access by vehicle is only possible on roads which end at the coastline. Even from within Suffolk these locations feel remote. There is a real sense of arrival in a place which feels separate (in space and to some extent time) due to it having a '*largely undeveloped coastline'*. With a few notable exceptions the influence of the 20th and 21st centuries, 'modern development', on this landscape is limited. It is this quality, the sense of being physically remote from the rest of the county and in a place which has a relative lack of human influence which makes the coastline of the SCHAONB special and thereby contributes to the natural beauty of the designation. This characteristic is shared with other designated landscapes, the coastlines of the Dorset AONB, North Devon AONB and Exmoor National Park for instance. But for the Suffolk coast its importance is such that the very title of the SCHAONB includes the word 'coast'. The character of the four locations listed above, (Ordford Ness, Minsmere etc.), along with other places along the coastline of the SCAONB, is generally free of intrusive man-made structures which would otherwise adversely affect and thereby detract from this 'relative lack of human influence'. NE agrees with the Applicant that the EA2 windfarm will not '*render it* [the coastline] *largely developed'*. For the reasons we set out in our Relevant/Written Representation, we advise that the introduction of the EA2 turbines into the seascape setting of the SCHAONB (for the northern portion of the coastline) would in all likelihood lead to a loss of a sense of having an undeveloped coastline i.e. it would add a significant development into a seascape which is currently completely free of fixed man-made structures, and thereby erode that sense of having a 'relative lack of human influence'. Should the EA2 turbines be built visitors arriving at the coastline would no longer see an empty seascape with clear uninterrupted views to far distant horizon. They would see the turbines EA2 and be instantly reminded of human influence on the landscape and seascape setting of the SCHAONB. Therefore, the introduction of the EA2 turbines would increase the human influence on the seascape setting of the SCHAONB. On p.447 the Applicant states that the '*apparent height of the turbines is relatively small'*. NE requests that the Applicant provides evidence to substantiate this statement. The Applicant also states that it '*would expect that a development would need to have such a fundamental change to this special quality to be significant'*. NE maintains that the change which the turbines of EA2 would bring about such a fundamental change and that the effect on this special quality will therefore be significant and adverse. NE disagrees '*that a relative lack of human influence will continue to prevail'*. If built the project would place up to 50 visible 300m turbines (see Figure 28.27f) into the seascape setting of the SCHAONB and that rather than a '*few built elements*' there would be many built elements.		Relative Wildness – Sense of remoteness; relative lack of human influence The Applicant and NE agree that his special quality relates to the 'sense of remoteness; relative lack of human influence'. The *'largely undeveloped coastline and offshore areas'* is the key indicator of relevance described in the AONB special qualities report, but we would emphasise again that it is as one aspect of many other indicators of the relative lack of human influence, including semi-natural habitats, isolated villages, built heritage assets and a small number of large scale and industrial elements described in the AONB special qualities report. The Applicant notes and agrees with the challenging access to parts of the SCHAONB coastline, although there is vehicular access along roads that end at the coastline, and occasionally along linear roads along the coast, such as between Thorpeness and Aldeburgh, although it is accepted that this is the exception not the norm, with the main linear coastal route being the Suffolk Coast Path. While there is a sense of remoteness from within some of these locations traversed by the Suffolk Coast Path, in fact they are often no more than a few kilometres from human influences, in the form a public car park, settlement, tourism facilities, farmland or forestry plantation. The influence of a *'small number of large scale and industrial elements on the coast of the AONB'*…. *'notably Sizewell A and B and the former military site at Orford Ness'*…. and *'offshore wind turbines at Greater Gabbard Galloper and the more distant London Array'* is also recognised in the AONB special qualities report, which also highlights '*these create a cluttered horizon'*. The SLVIA in Chapter 28 of the ES describes the presence of these offshore windfarms on the southern part of the SCHAONB coastline. While accepting that these existing windfarms have less influence than the East Anglia TWO windfarm site, we find it important to note that the seascape setting of the SCHAONB is not currently 'completely free of fixed man-made structures'. While the wind turbines and offshore platforms located within the East Anglia TWO windfarm site may reduce the sense of having a 'relative lack of human influence', it will not, in the Applicant's assessment, result in significant effects on the perception of this quality. The perceptual qualities are diminished to a degree by other influences, which is acknowledged in the published landscape character assessments (see below) and evident during the survey work undertaken for the SLVIA. In its earlier comments, Natural England acknowledges that the visual influence of Sizewell A and B Nuclear Power Station is prominent, not localised and detracts from the natural beauty of the SCHAONB. The Touching the Tide LCA (Touching the Tide Partnership, 2012)[16] is a useful reference in this regard and describes some of these human influences as follows: *'Large built structures such as Sizewell power station and the presence of holiday settlements such as Southwold, Aldeburgh and Felixstowe, which lie inland of this landscape, can also have a profound effect on the character of the area' (p55).* *'Recreation development including car parks, golf courses, caravan parks are impacting upon the remote character of this landscape' (p55).* *On the coast itself it is the white dome of Sizewell B and the concrete hulk of Sizewell A power stations which are a key landmark. In close proximity to the power station the scale of the buildings and associated power lines dominate the landscape such that other landscape features and activities feel small and insignificant' (p23).* *'Dramatic and contrasting developments such as Sizewell nuclear power station, Orford Ness transmitting station and commercial dock development at Felixstowe' (p50).*

[16] Touching the Tide Partnership, (2012). Touching the Tide Landscape Character Assessment 2012. Available at: http://www.touchingthetide.org.uk/assets/Documents/FinalReport.pdf [Accessed 09 October 2020]

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	NE maintains that the EA2 would provide a sense of enclosure in views out to sea from the SCHAONB. The Applicant asserts that the '*apparent height of the turbines is relatively small and would not provide a sense of enclosure, due to the large portion of the big skies that will remain undeveloped'*. It is our view that features, both onshore and offshore, which generate a sense of enclosure do not extend far into the sky. The portion of the sky which is obscured does not need to be large; with a few notable exceptions neither hedges, walls or fences are especially high yet all act as enclosing features. Please see response to 3.8.2.		*Large-scale structures such as Sizewell and Port of Felixstowe will have a continuing and significant visual impact on the character of this landscape type (p59).* *A steady pressure of suburbanisation and tourism related development associated with coastal settlement is evident within this landscape, eroding the rural character* (p62). The Applicant considers that larger scale features generally provide higher levels of enclosure than those with smaller vertical scale, although it is accepted that the portion of sky which is obscured does not always need to be large for some degree of enclosure to occur. Other factors can create enclosure, such as horizontal spread and distribution of elements across a view, for example. Enclosure of an offshore view would however, typically indicate that the view would be enclosed to the short distance by a barrier. The Applicant would note that the East Anglia TWO windfarm site is relatively 'permeable', with views between turbines to the sky beyond and between (while varying with the density of the turbine array) as evident in the ES photomontage visualisations, such as Figure 28.27e. The ES assessment frequently notes that due to its long distance offshore and the simple form of the coastline, the East Anglia TWO windfarm site will be seen on and beyond the horizon, as a 'horizon development' to a large open seascape, rather than being viewed 'within' its seascape/landscape and it does not enclose sections of complex or indented coastline or bays. Natural England request that the Applicant provides evidence to substantiate the statement that the '*apparent height of the turbines is relatively small'*. The Applicant has checked its assessment in the ES Appendix 28.5, which describes that '*the vertical height of the turbines will be relatively moderate in scale, due to their long distance offshore and the large scale of the seascape in the view'*. This description is more precautionary and adopted in favour of 'relatively small', given the medium-low and medium levels of magnitude assessed in the visual assessment (although it should be noted that these assessments of magnitude arise from the horizontal/lateral spread of the wind turbines and offshore platforms located within the East Anglia TWO windfarm site as well as the vertical scale). The Applicant's previous comments on the relatively small vertical scale of the Project turbines were informed by the analysis of apparent height values provided by Natural England (see 3.3.4) and subsequently checked in its own analysis. The maximum apparent height/vertical angle value of the wind turbines is 0.450° from Viewpoint 4 (Southwold). As described previously, the Applicant considers that this vertical angle/apparent height value is 'relatively small', although it accepts a more precautionary definition of 'relatively moderate in scale' as presented in the ES assessment. The Applicant maintains its assessment that the wind turbines and offshore platforms located within the East Anglia TWO windfarm site would not bring about such a fundamental change or significant change to the perceived sense of remoteness/human influence described in this special quality and that significant effects on this special quality have been substantially overcome by embedded design mitigation applied to reducing the size and influence of the wind turbines and offshore platforms located within the East Anglia TWO windfarm site.
3.8.6	Relative Wildness – Sense of passing of time and a return to nature Ongoing: NE agrees with the Applicant that the '*sense of passing of time'* is one of the more abstract qualities of the defined AONB special qualities. If the time depth of a landscape is considered then nearly all landscapes to a greater or lesser extent exhibit a sense of passing time. However, how this is valued varies from place to place. Fundamentally it is how natural and man-made modern, historic or even ancient features combine together in a given landscape which determines how much that place is valued. This mixture is clearly valued in the landscape of the SCHAONB as it is expressed as a special quality; it contributes to the natural beauty of the designation.		Relative Wildness – Sense of passing of time and a return to nature The Applicant welcomes agreement with Natural England that the 'sense of passing of time' is one of the more abstract qualities of the defined AONB special qualities. The Applicant was not suggesting that the East Anglia TWO windfarm site would necessarily 'enhance the natural beauty of the SCHAONB', but sought to make the point that the perception of time depth could feasibly be increased in certain situations, for example, when viewing an old windmill and modern offshore windfarm in the same landscape context/view (historic and modern features combining together in a given landscape). The ES does not conclude that enhancement will occur, but that the East Anglia TWO windfarm site will not result in significant effects to the sense of passing of time and a return to nature defined in this special quality – which are not considered to be substantially eroded or lost to a significant degree. The Applicant notes agreement that the East Anglia TWO windfarm site would

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	However, it does not follow that the introduction of further man-modern features into the seascape setting of the AONB will positively contribute i.e. enhance the natural beauty of the designation. So whilst the '*sense of passing of time could be increased by the presence of an offshore windfarm*' (i.e. EA2 turbines could enhance the natural beauty of the SCHAONB); but the ES does not conclude that enhancement will occur. This would be contrary to the conclusions reached in the ES which predict significant adverse effects on the seascape setting component of the landscape character of numerous landscape character types located within the designation. NE notes that the Applicant agrees that '*it is unlikely that the EA2 windfarm…would contribute to the sense that nature is returning'*. NE agrees that land use within the SCHAONB will not be directly influenced by the EA2 turbines (although it will be temporary influenced by the associated onshore underground cabling operations). However, the seascape setting component of the landscape character will be significantly and adversely effected, as detailed by the Applicant in the ES. For further commentary on semi-natural habitats see our advice for sense of remoteness; pockets of relative wildness above at 3.8.5. We note the Applicant makes no reference to the extensive habitat restoration projects, for instance at Minsmere, which have been active along this coastline for decades. NE fails to understand the reference to the lost settlements of Sizewell and Dunwich in the context of the baseline landscape character against which the effects of the project are being assessed. Please also see response to 3.8.2.		not contribute to the 'sense that nature is returning' and that land use within the SCHAONB will not be directly influenced by the East Anglia TWO windfarm site.
3.8.7	Relative Tranquillity – Distractors from Tranquillity Ongoing: There is frequent misunderstanding of the term 'tranquillity' as it relates to the natural environment. For this reason The Countryside Agency (a founder body of Natural England) and others undertook a thorough and robust study of the subject in 2006. The findings of this study are contained in 'Tranquillity Mapping: Developing a Robust Methodology for Planning Support: Technical Report on Research in England. Northumbria University, 2006'. The principle conclusion of this study is that multiple factors, environmental, spatial, temporal and anthropocentric need to come together in particular combinations in order that, for a given person, an experience of tranquillity induced by a natural environment can be achieved. Natural England highlights that tranquillity, or a lack of, is often incorrectly equated to noise, often 'excessive' man-made noise. In addition to dismiss tranquillity as purely '*particularly subjective'*, and therefore not within the discipline of social-science, is also incorrect as the study referenced here demonstrates. The Applicant maintains that for the EA2 turbines to have a significant effect on tranquillity (i.e. the experience of tranquillity) they would need '*to be audible and/or viewed in close proximity, with large scale, surrounding and prevailing visual movement of the rotor-blades'*. NE disagrees with this assertion. We advise that simply seeing the EA2 turbines, which from locations such as Covehithe beach would number up to 50 machines (see Figure 28.27f) spread across the seaward horizon would be sufficient to negate opportunities to experience tranquillity. In certain lighting conditions the movement of the rotor blades would be visible and we doubt a feeling of '*calm*' would be universally induced by this. In addition NE disagrees with the conclusion that the other '*natural heritage*		Relative Tranquillity – Distractors from Tranquillity The Applicant is aware of CPRE's work on national tranquillity mapping, contained within the CPRE Tranquillity Report (Northumbria University, 2008 revised)[17] and its associated 'Tranquillity Map' and an 'Intrusion Map' of England. The mapping data is now somewhat out of date and it is understood that CPRE have been lobbying to produce an updated 'Tranquillity Map' of England since their 'give peace a chance' report in 2015 (CPRE, 2015)[18]. Nevertheless, the Applicant has sourced the 2007 mapping data from CPRE and has presented this in the Tranquillity Map in Figure 1 (***Appendix 3***) and Intrusion Map in Figure 2 (***Appendix 4***) covering the SLVIA study area and SCHAONB. The following observations are made: Large scale urban areas located just outside and to the north of the SCHAONB at Kessingland and Lowestoft form notable areas of intrusion (in Figure 2) with least tranquillity (Figure 1). Urban areas at Southwold, Reydon and Aldeburgh within the SCHAONB, and Leiston on its inland edge, also form notable areas of intrusion with least tranquillity. Areas disturbed by noise and visual disturbance in the Intrusion Map (Figure 2) include the land around these settlements; together with areas alongside main transport routes, particularly the A12, running along the inland northern edge of the SCHAONB; but also extending along certain B roads towards the coast and along overhead power lines. There is a large area in the Intrusion Map (Figure 2) shown as being disturbed by noise and visual disturbance associated with the area around Sizewell, between Aldeburgh, Thorpeness, Sizewell, Leiston and Minsmere.

[17] Tranquillity Mapping: Developing a Robust Methodology for Planning Support, Technical Report on Research in England (Northumbria University, January 2008 (revised).
[18] Give Peace a Chance. Has Planning Policy Contributed to Rural Tranquillity? (CPRE, May 2015)

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
	features' would prevail i.e. aspects of the natural environment which positively contribute to experiences of tranquillity, would be sufficient in extent to negate the negative influence of the turbines.		This area splits the 'undisturbed areas' of the AONB to a northern section, between Dunwich, Southwold and Coverhithe; and a southern section formed by Orford Ness, the River Ore/Butley and inland areas around the Tunstall and Rendlesham Forests. Pockets of corresponding more tranquil areas are shown in Figure 1 around Covehithe/Easton Broad area in the north of the AONB; Dunwich Forest/Heath/Westwood Marshes and Minsmere in the central part of the AONB; and Orford Ness/River Ore/Butley areas in the south of the AONB. The Applicant fully agrees that tranquillity cannot solely be equated to noise. The Applicant's comments on Natural England's relevant representation refer to other factors, including visual impacts (such as proximity, scale, movement etc) as well as noise. Given the GLVIA3 definition of tranquillity, 'a state of calm and quietude associated with peace', and the many references to noise/hearing forming a key part of tranquillity in the CPRE Tranquillity Report 2008 (along with other factors), noise is clearly a factor in people's experience of tranquillity. The CPRE Tranquillity Report 2008 is useful in defining the terms 'seeing, tranquillity' and 'hearing, tranquillity' in its GIS modelling (Figure 8). The Applicant would simply re-iterate that with respect to the hearing (noise) aspect of tranquillity, the wind turbines and offshore platforms located within the East Anglia TWO windfarm site will have no effect. Clearly the effect of the East Anglia TWO Project will be on the visual aspects of tranquillity, relating to what is seen by people and whether its visible elements detract from the perception of such tranquillity. The Applicant notes that many of the visual aspects of tranquillity relate to the perception of natural landscapes, trees, woodland, streams, rivers, lakes etc. The AONB Special Qualities report defines these as *'the presence and / or perceptions of natural landscape, birdsong, peace and quiet, natural looking woodland, stars at night, streams, sea, natural sounds and similar influences'.* The East Anglia TWO project has no effect on all these indicators, except for 'the sea'. The Applicant disagrees with Natural England that simply seeing wind turbines on the sea horizon would be sufficient to negate opportunities to experience tranquillity. This would suggest that all other visual aspects of tranquillity, such as those described above in the AONB special qualities report, would be denied in the presence of the East Anglia TWO windfarm site. The Applicant considers that other aspects of the natural environment which contribute to the experiences of tranquillity within the SCHAONB would continue to prevail and do provide some mitigation to the influence of the wind turbines. On balance, it is the Applicant's assessment that the that the resulting effect of the wind turbines and offshore platforms located within the East Anglia TWO windfarm site on the relative tranquillity of the AONB is not significant. It is agreed that in certain lighting conditions the movement of the rotor blades would be visible, however the Applicant doubts that a material sense of unrest/ disturbance of calmness and quietude would be induced by this slow and consistent visual movement, especially at such distance outside the SCHAONB. The Applicant does not intend to dismiss tranquillity as purely subjective. The intention was to highlight that responses to, and effects on, perceived tranquillity is a more subjective aspect of such assessments of 'wildness'. The nature of this subjectivity is clear in the CPRE Tranquillity Report 2008
3.11.1 (p.461); 3.2.12 (p.463)	Resolved: Following confirmation that the maximum blade tip height for EA1N will be 282m NE agrees with the Applicant that further mitigation of turbine height for EA1N is not required.		The Applicant welcomes agreement from Natural England that following confirmation that the maximum blade tip height for East Anglia ONE North will be 282m, further mitigation of turbine height for East Anglia ONE North is not required.
Comments on summary and conclusions			
3.12.1	Nothing to add further at this point		This is noted by the Applicant

Point Reference	NE Comments Submitted at Deadline 1	Risk	Applicants' Response
3.12.2	Please refer to our comments at NE – 3.3.4. Nothing to add further at this point.		This is noted by the Applicant
3.12.3	We thank the applicant for clarification provided. Nothing further to add for this point.		This is noted by the Applicant
3.12.4	Please refer to our comments at NE - 3.7.4. Nothing further to add for this point'.		This is noted by the Applicant
3.12.5	Please refer to our comments at NE - 3.8.3. Nothing further to add for this point.		This is noted by the Applicant
3.12.6	Nothing further to add for this point.		This is noted by the Applicant
3.12.7	Nothing further to add for this point.		This is noted by the Applicant
3.12.8	Summary and Conclusions It is immaterial that the adverse significant effects are confined to '*a narrow strip avoiding widespread effects on the AONB further inland*'. This adversely affected coastal strip extends for approximately 35km in length, and is also defined as a Heritage Coast. The SLIVA has predicted that significant adverse effects on landscape and visual receptors, along with some of the SCHAONB's special qualities, will result from EA2 turbines in the seascape setting of the SCHAONB. Based on our review of the Applicant's evidence (as submitted in the PIER and ES) and site visits undertake in the summer months of 2018 and 2019 NE concludes that the statutory purpose of the SCHAONB to conserve and enhance natural beauty, will be significantly harmed/adversely effected by the turbines of EA2.Therefore it is the adverse effect on the statutory purpose of the designation which is the key consideration. The phrase '*EA2 Wind Farm site is misleading'* because it refers to the site of the array i.e. an area of open water and associated sea floor and not the array itself. It is the latter, specifically the 300m (282m) high turbines of EA2, which are the source of the predicted significant adverse effects and not their site. We note the Applicant's use of the phrase '*overall terms'.* For the reasons set out in this response NE considers this conclusion is incorrect.		The Applicant would refer the ExA to the response provided above to NE-2.2 with regards to the statutory purpose of the AONB and to its 'Effects with Regard to the Statutory Purposes of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and Accordance with NPS Policy' (ExA.AS-5.D2.V1) note.

1.7 All Other Matters

1.7.1 Site Selection and Assessment of Alternatives

Point	Taken from NE's Relevant and Written Representations EA1N Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Received Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
Document used: 6.1.4 EA2 Environmental Statement Chapter 04 Site Selection and Assessment of Alternatives						
1.2.1	Although the decision to cross the Sandlings SPA at the narrowest section is welcomed, it should be noted the decision to HDD or trench through this section has yet to be determined. There is still the potential for impacts and disturbance to occur to species using the SPA despite this narrowest route.		The Applicant's preference is for an open-cut trenching technique to cross the Sandlings SPA. As noted in ***section 22.6.1.1.2 of Chapter 22 Onshore Ecology*** the onshore cable route will cross the Sandlings SPA at its narrowest point, towards the north of the SPA and the Applicant has committed to a reduced onshore cable route working width of 16.1m (reduced from 32m) within the SPA to minimise habitat loss. It is noted that a substantial portion of the open trench crossing is through a horse paddock. The Applicant will update the ***OLEMS*** with an outline of the timing of habitat creation areas (i.e. the 3ha of compensatory turtle dove feeding habitat and nightingale nesting habitat). The Applicant will submit an EMP for approval by the LPA in consultation with NE. In accordance with requirement 21 of the DCO this will include a SPA crossing method statement. Additionally, as agreed at a SoCG meeting with NE on the 19th of February 2020 the Applicant will produce an outline SPA Crossing Method Statement to be submitted during the examination that will provide further details on the methodology to be adopted for an open trench crossing, and for a trenchless technique (such as HDD).	Please see Deadline 1 Appendix C3 on the draft SPA crossing method statement. Natural England suggests that this issue is discussed under Onshore Ornithology issues.		The Applicants acknowledge NE's response which is in relation to a draft version of the outline SPA crossing method statement (also see ***section 1.4.1***) and have taken account of this in the Outline SPA Crossing Method Statement (REP1-163). The Applicants agree that this matter should be considered under Onshore ornithology issues and therefore request the RAG status for this matter to be updated to Green.
1.2.2	Natural England queries if the removal of a section of woodland been fully considered within the ES? Signposting to this would be useful. Has the applicant considered alternatives to		***Section 22.5.2* of *Chapter 22 Onshore Ecology*** (APP-070) covers the baseline for all woodland types within the study area, impacts upon woodland (including removals) are covered in ***section***	Natural England notes the Applicant's signposting to the relevant sections and documents and is satisfied that the issue has been considered.		No response required.

Point	Taken from NE's Relevant and Written Representations EA1N Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Received Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
	not removing the woodland? Will the woodland be replaced?		***22.6.1.4*** with the areas affected shown in ***Table 22.18*** of the chapter. Mitigation for impacts upon woodland is covered in ***Table 22.4*** of the chapter and ***sections 5.1, 6.2*** and ***6.3*** of the ***OLEMS*** APP-584). During the early stages of site selection, options were considered which would avoid removal of woodland at Aldeburgh Road, however these options were not taken forward, as discussed in ***section 4.9.1.2.4* of *Chapter 4 Site Selection and Assessment of Alternatives*.** The initial site selection study area (which originally extended from the coast to Aldeburgh Road) was extended westward by considering removal of woodland and potentially crossing Aldeburgh Road, as recommended by the Site Selection ETG feedback in July 2017.			
1.2.3	Although Natural England recognises the options of crossing the SPA, trenching or HDD, the Applicant needs to make it clear what the impacts will be if the EA2 and EA1N cable routes are put in sequentially rather than at the same time (see point 4 below). This applies to other scenarios such as Aldeburgh road woodland.		The two construction scenarios are compared in full in ***Appendix 23.2*** (-509), Scenario 2 (sequential) is deemed to be the worst case and this is carried into the assessment in ***Chapter 23 Onshore Ornithology*** (APP-071) (see ***section 23.7***). ***Table 23.20*** summarises the potential impacts of sequential construction.	Natural England notes the applicant's signposting to the relevant sections and documents. The worst case scenario of sequential construction of the onshore cabling remains a concern for Natural England **for both nature conservation and landscape matters.** .		The Applicants have continued to work with NE to provide detail on how the SPA would be crossed and this detail is reflected in the Outline SPA Crossing Method Statement (REP1-163).

1.7.2 Project Description

Point	Taken from NE's Relevant and Written Representations EA1N Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
Document used: 6.1.6 EA2 Environmental Statement Chapter 06 Project Description						
1.2.4	It is not clear whether the cable corridor area described is intended for both EA1N and EA2, i.e. will all cable installation for both projects take place within the same 32m wide corridor or will there be 2x 32m cable corridors, one for EA1N and one for EA2? If the cable routes for both EA1N and EA2 are installed within the same 32m wide corridor, will this occur sequentially or at the same time?		The onshore cable route for the Projects is located within the Order Limits. The onshore cable route is independent for each Project and so there is flexibility around where each Project cable can be installed within the Order Limits. ***Chapter 6 Project Description*** (APP-054) illustrates the onshore cable route (i.e. construction area) for each project (see ***Plate 6.18***) which will be 32m for each project. The onshore cable corridor is identical for both Projects and the onshore cable route for each project must be located within this onshore cable corridor. The onshore cable route is reduced at certain points (e.g. at a number of Important Hedgerow crossings, where the onshore cable route reduces to 16.1m) and is increased at other points (e.g. to accommodate a trenchless crossing of the SPA,). ***Appendix 6.4*** (APP-453) describes the options for constructing both Projects, either concurrently or sequentially.	Natural England notes that the cable route will be 32.2 m wide for each project, and that both of these cable routes would be located within the wider cable corridor. We recognise that the cable route for each project would be reduced to 16.1m width at certain points and is increased at other points. Natural England notes the applicant's signposting to the relevant documents regarding concurrent or sequential construction. However, this remains an outstanding concern.		As outlined in the Project Update Note submitted at Deadline 2 (document reference ExA.AS-4.D2.V1), the Applicants can now confirm that should both the East Anglia ONE North project and the East Anglia TWO project be consented and then built sequentially, when the first project goes into construction, the ducting for the second project will be installed along the whole of the onshore cable route in parallel with the installation of the onshore cables for the first project. This will include installing ducting using a trenchless technique at the landfall for both Projects at the same time. Further information will be provided at Deadline 3.

1.7.3 Marine Geology Oceanography and Physical Processes

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
Document used: 6.1.7 EA2 Environmental Statement Chapter 07 Marine Geology, Oceanography and Physical Processes						
2.2.1	Natural England advises that evidence needs to presented to support statements that the maximum volumes of sediment released from sea bed preparation is five times greater than is likely to be released by scour? This currently seems quite arbitrary to base the assessment of scour during the operational phase on. Does this only apply to near-surface sediments as indicated by table 7.3?		The worst-case maximum volumes of sediment released from seabed preparation during *construction* is calculated at 25,875m^3 for each wind turbine foundation and based on an assumed worst-case of the 300m wind turbine with a 60m gravity base basal diameter. *Section 7.6.2.4*, paragraphs 273 and 274 of *Chapter 7 Marine Geology, Oceanography and Physical Processes* (APP-055) refer to previous studies in which the worst-case *operational* scour volume per turbine is 5,000m^3. As the Project has similar foundation types and sizes (and physical environment) to the previous studies this figure of 5,000m^3 is considered appropriate for the likely scour volume for the Project. 5,000m^3 is approximately one fifth of 25,875m^3. This figure only applies to near-surface sediments as it is those which will be released by scour.	Natural England is satisfied with the applicant's comments.		No response required.
2.2.2	Natural England welcomes the commitment by the Applicant to ensure sediment arising from any sand wave clearance would be deposited in locations which avoid sensitive features and enable sandwave recovery. These sensitive features are most likely to be Sabellaria spinulosa reef and by depositing the sediment within the vicinity of where it was dredged means the sediment will be retained within the sandbank system. Much of the cable corridor sits within the Outer Thames Estuary SPA and there is the potential for disturbance to this species during any proposed works. Likewise, these		A separate clarification note regarding cross-receptor impacts on the Outer Thames Estuary SPA has been prepared and is provided in *Appendix 5* of this document.	Natural England remains concerned that impacts to the Outer Thames Estuary SPA from sandwave levelling and cable protection have not been screened into the Habitats Regulation Assessment. Please note that as there is an impact pathway due to changes to supporting habitat, we believe that there is likely significant effect. Please see Appendix F2b of this document for our detailed response to the applicant's Appendix 5 Outer Thames Estuary Cabling Note.		The Applicants have now received detailed mapping from NE for the supporting habitats of the SPA. The Applicants will provide an updated assessment taking account of NE's comments in Appendix F2b (REP1-158). This assessment will be submitted at Deadline 3.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
	subtidal sandbanks are key feeding areas for designated features such as red-throated diver. Therefore, for works including disposal within the sandbank areas there will need to be an assessment of the impacts against the conservation objectives for the site.					
2.2.3	Assuming some of the cable protection will be laid within the SPA boundary, has the Applicant considered the loss of supporting SPA habitat for the designated features? This will need to be considered across several thematic areas including offshore ornithology, sediment transportation and benthic					
2.2.4	Natural England welcomes bullet point 2, to allow local scour around the piles to minimise the scour protection footprint. This will minimise the habitat loss due to additional scour protection.		Noted.	No further comment.		No response required
2.2.5	It is clear from this section (7.5.1.2 para 106-111) that both project sites exhibit large areas of sandwaves and megaripples. This suggests to Natural England that a significant amount of sandwave clearance may be needed. If so, then it is essential that the applicant sufficiently considers the impact of disturbance and prey availability upon the interest features of the Outer Thames Estuary SPA, plus the potential loss of *Sabellaria spinulosa* reef such as *Sabellaria spinulosa* which should be avoided by micro-siting where possible.		A separate clarification note regarding cross-receptor impacts on the Outer Thames Estuary SPA has been prepared and is provided in *Appendix 5* of this document. With respect to *Sabellaria spinulosa,* results from the side scan sonar survey carried out in 2018 (*Appendix 9.3 Benthic Factual Data Report* (APP-460)) show that there is no evidence of *Sabellaria* reef in the offshore cable corridor. However, it is noted that side scan sonar data would need to be ground-truthed with drop-down video in order to accurately determine the presence or absence of *Sabellaria* reef. As stated in *section 9.3.3.1.4* of *Chapter 9 Benthic Ecology*, a detailed pre-construction geophysical survey will identify any areas of *Sabellaria* reef	Ongoing. Please see Appendix F2b of this document for our detailed response to the applicant's Appendix 5 Outer Thames Estuary Cabling Note. See Point 3.2.5 in Table 4 Benthic Ecology regarding disposal location.		See Point 2.2.2 above. See 3.2.5 in Benthic Ecology for disposal location response.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
			which are required to be avoided, as agreed with the MMO and secured through the *Offshore In-principle Monitoring Plan* (APP-590), submitted with the application material and Design Plan which will be submitted post-consent. Regarding disturbance to *Sabellaria* reef from sand wave levelling, sediment arisings from sand wave clearance in the offshore cable corridor would be deposited back within the offshore cable corridor at locations which avoid any *Sabellaria* reefs (if their presence is determined from pre-construction surveys) (as described in *section 9.3.3.2.3 of Chapter 9 Benthic Ecology*). Agreement is being sought for a single disposal site encompassing the offshore cable corridor which avoids overlap with existing disposal sites (*Site Characterisation Report (Offshore Cable Corridor*) (APP-593)). However, the Applicant will consult with the MMO and their advisors post-consent on the results of the preconstruction surveys and any sensitive features that may require avoidance during sediment disposal activity. No sand wave levelling / pre-sweeping or disposal is anticipated in the near shore section of the offshore cable corridor, subject to findings of the detailed pre-construction geophysical survey.			
2.2.6	Paragraph 130 indicates that a relatively large area of the export cable corridor is predominantly silt. Has this change in sediment been fed into the impact assessment to determine the impact of trenching cables within this area? A greater percentage of silt within the sediment will result in a more persistent		As described in *section 7.5.6* of *Chapter 7 Marine Geology, Oceanography and Physical Processes*, grab samples collected within the offshore export cable corridor revealed the majority of sediments to be slightly gravelly sand (using the Folk scale). The central section of the offshore cable corridor has the highest percentage of fines in	Natural England welcomes the confirmation that sediments with a greater silt component have been incorporated into the assessment to determine the impact of cable installation and notes the applicant's expectation that the majority of cables will be installed using a ploughing method.		Noted.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
	suspended sediment concentration following disturbance.		samples collected with sediment mainly falling within the sandy mud classification on the Folk scale. Areas of the export cable corridor where silt is a greater sediment component are highly localised to the inshore area where trenchless (such as HDD) techniques will be used (see *Figure 9.3a* (APP-177)) however this has been incorporated into the assessment and the resulting conclusions in *section 7.6.1.5* regarding export cable installation and settlement rates (full dispersion of any plumes after 180 hours following cessation of installation activities). Jetting is considered the worst-case export cable installation technique since it results in the largest volume of suspended sediment being released from the sea bed and into the water column however based on experience from East Anglia ONE it is anticipated that the majority of cables would be installed using a ploughing method which is the cable installation method that gives rise to the lowest increases in suspended sediment concentrations.			
2.2.7	Is there any site specific evidence from the EA One construction of the actual sediment concentrations that were experienced during foundation installation?		There were no requirements for suspended sediment concentration monitoring during construction of East Anglia ONE. The modelling and assessments for East Anglia ONE (and subsequently East Anglia ONE North and East Anglia TWO as per *section 7.6.1* of *Chapter 7 Marine Geology, Oceanography and Physical Processes*) were informed by monitoring evidence from Nysted (Denmark) and Thornton Bank (Belgium) which used gravity base foundations (considered to be the worst-case).Thornton Bank has similar environmental conditions to the Project in terms of hydrodynamic and sedimentary	Noted.		No response required.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
			environment. This is based on information in *section 6.4.2.4.1* of *Chapter 7 Marine Geology, Oceanography and Physical Processes* (APP-055) for East Anglia ONE.			
2.2.8	Natural England clearly sees the benefits in assessing the worst case scenario for the impacts associated with the windfarm. However, for a greater perspective it would be interesting to understand the level of drilling that is likely to occur especially in these substrates. Can any predictions be drawn from EA One and the levels of drilling that occurred there?		With regard to the drilling of foundations, feedback from the East Anglia ONE team was that there was no requirement for East Anglia ONE, however it should be noted that ground conditions may differ at the windfarm site and therefore drilling for foundations may be required subject to the findings of the pre-construction site investigations.	Noted.		No response required
2.2.9	Paragraph 180 states "the resulting mound would be a measurable protrusion above the existing sea bed (likely to be tens of centimetres to a few metres high)" This is a large range in the size of the potential mound that could be formed. It is not clear from the resulting text why this variation would exist. We assume it would be due to the varying sediment particle size from the drill arising, the sheer force of the foundations being installed or general sea bed preparation, however confirmation regarding this would be welcome. In addition the persistence of any mound/s would also need to be considered. If this is hard substrata then it would need to be potentially added to the in-combination assessment of any cable/scour protection; especially in relation to potential impacts to the conservation objectives for the Outer Thames SPA.		*Section 7.6.1.2* of *Chapter 7 Marine Geology, Oceanography and Physical Processes* (APP-055) refers to resulting localised mounds from suspended sediment from near-surface sediments as likely being tens of centimetres to a few metres high. This variation is likely across the windfarm site as the heights of mounds will depend on the prevailing physical conditions and underlying geology at each location. For sediment forming a passive plume, expert-based assessment suggests the thickness of these deposits across the wider area would be in the order of millimetres. With regards to persistence, any potential sediment mounds are expected to become re-mobilised and therefore would rapidly become incorporated into the mobile sea bed sediment layer, thereby reducing any potential effect (*section 7.6.1.2.1* of *Chapter 7 Marine Geology, Oceanography and Physical Processes* (APP-055)).	As with LID and Lincs OWFs Natural England is concerned about any residual mounds and their ability to winnow away especially where sensitive habitats are present and/or within designated sites. Therefore if pre- construction surveys of the array area show that mounds are likely to be persistent then we advise that they are located away from NERC habitats and preferably in areas of similar sediment type.		Mounds formed by drilling and or cable installation would be in the same habitat type given that they are adjacent to the foundation / cable. Given that mounds would be adjacent to the infrastructure and given that the Applicants are required as far as practicable to avoid *Sabellaria* reefs, they would be located away from reefs. A new condition will be included within the updated draft DCO to be submitted at Deadline 3 which will require the submission of a plan detailing *Sabellaria* reef management to be in accordance with the ***Outline Sabellaria Reef Management Plan*** (REP1-044) submitted at Deadline 1.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
			In all cases the sediment within the mound would be similar to that on the existing sea bed. This would mean that there would be no discernible change in sea bed sediment type. Therefore, additional in-combination assessment with cable and scour protection is not considered necessary.			
2.2.10	Although the overall sediment release volumes would be low and confined to near the sea bed; it is not clear if there has been an assessment of the impacts at varying depths? This may apply more to the export cable installation further inshore.		The assessments provided with respect to changes in suspended sediment concentrations and changes in sea bed level have taken into account differences in potential impacts at varying depths. The assessment for offshore export cable installation has been considered separately from those for the inter-array and platform link cables because parts of the offshore cable corridor are in shallower water and closer to the identified morphological receptor groups.	Noted.		No response required.
2.2.11	As highlighted above, a relatively large area of the export cable corridor is predominantly silt. There seems to be no assessment of how this would affect the dispersion and settlement rate, particularly in nearshore shallow waters and any designated sites. Further information would be welcome.		As described above, grab samples collected within the offshore export cable corridor revealed the majority of sediments to be slightly gravelly sand. The central section of the offshore cable corridor has the highest percentage of fines in samples collected with sediment mainly falling within the sandy mud classification on the Folk scale (*section 7.5.6* of *Chapter 7 Marine Geology, Oceanography and Physical Processes* (APP-055)). Areas of the export cable corridor where silt is a greater sediment component are highly localised to the inshore area where trenchless techniques will be used (see *Figure 9.3a*) however this has been incorporated into the assessment and the resulting conclusions in *section 7.6.1.5* regarding export cable installation and impacts on designated sites (which	Natural England welcomes the confirmation that sediments with a greater silt component have been incorporated into the assessment to determine the impact of cable installation and notes that trenchless techniques will be used in the inshore area where sediments have a greater silt component.		No response required.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
			concluded minor adverse to negligible significance on Suffolk Natura 2000 site).			
2.2.12	Natural England queries if there is an opportunity to microsite jack up vessels legs if habitats of conservation interest are found in the area during pre-construction surveys?		Through the Design Plan (Condition 17 of the generation DML and Condition 13 of the transmission DML), the Applicant will set out how the Project has been designed and micro-sited around reefs and sensitive habitats which will be submitted to the MMO for approval.	This is welcomed and but would wish this document to be approved in consultation with NE. NE note the Applicant intends to an provide outline *Sabellaria spinulosa* management plan at Deadline 1 - NE will respond at Deadline 2.		The Applicants understand that the MMO will consult with NE on the Design Plan. The Applicants await NE comments upon the outline *Sabellaria* reef management plan submitted at Deadline 1 (REP1-044)
2.2.13	Although the worst case scour volume of 50,000 m^3 is considerably less than the worst case volume of sediment released following sea bed preparation activities, this impact could be considered longer term as scour is likely to continue during the lifetime of the wind farm. It is not clear how this been considered and assessed by the applicant?		It is understood that the figure cited by NE is a typographic error and should be 5,000m^3. As described in *section 7.6.2.4* of *Chapter 7 Marine Geology, Oceanography and Physical Processes* (APP-055), the worst-case scour volume of 5,000m^3 has been assessed under a 1 in 50-year return period event (exceeding the lifetime of the Project) and under typical conditions, the volume of scour (in the worst case of no scour protection) will be much less than the worst-case assessed value of 5,000m^3. After each scour-inducing event (in the worst-case scenario of no scour protection being provided), the suspended sediment concentrations would rapidly settle within a few hundred metres of each foundation structure.	Natural England confirms that 50,000m^3 was used in error, this should be 5,000m^3 and welcomes the clarification by the applicant.		No response required.
2.2.14	Table 7.31 concludes that the magnitude of effect on sea bed morphology due to the presence of foundations is high in the near field. Further expansion within this section on what this means for the receptors concerning this chapter would be useful. We understand the effect will be raised in other chapters, but it is hard to understand what this magnitude means for this particular topic.		As described in *section 7.6.2.5 of Chapter 7 Marine Geology, Oceanography and Physical Processes* (APP-055) the sea bed morphology would be directly impacted by the footprint of each foundation structure on the sea bed within the windfarm sites. This would constitute a 'loss' in natural sea bed area during the operational life of the Project. This direct footprint could be further increased due to the presence of foundation structures and associated scour protection (which is the worst case when considered against scour hole	Natural England notes the clarification provided and has no further comment.		No response required.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
			formation). With the installation of scour protection, the sea bed would be further occupied by material (e.g. concrete mattresses) that is 'alien' to the baseline environment and which as a worst case would result in a maximum footprint of 1,719,856m^2, associated with GBS foundations. While the near-field magnitude of effect from this would be high, these effects are confined to within the footprint of scour protection (should it be provided) and would not cover the whole of the windfarm sites. The identified receptor groups[19] for this assessment are located remotely from the windfarm site and therefore, there is no impact associated with the proposed project on the identified receptor groups for this Chapter.			
2.2.15	The Applicant identifies this impact (changes to the sea bed morphology due to the presence of foundation structures) as not having the potential for cumulative impacts, as the foundation structures affects a discrete area of seabed. However, in-combination with other windfarms and their associated foundation footprints could these discrete areas be combined to create a large overall impact?		The footprint effect is discrete to each turbine foundation location. The overall foundation area (1.5km^2 and 1.3km^2 for East Anglia TWO and East Anglia ONE North respectively) is low with respect to the total windfarm area (218.4km^2 and 208km^2 for East Anglia TWO and East Anglia ONE North respectively). When other wind farms are considered in-combination, the total sea bed area under consideration increases, so proportionally the effect still remains small. Therefore, no interactions with the other windfarms considered in *Table 7.37* **of** *Chapter 7 Marine Geology, Oceanography and Physical Processes* **are predicted.**	Natural England notes the clarification provided and has no further comment.		No response required.
2.2.16	Natural England queries what is this accepted threshold of 5% and less for cumulative effect on baseline wave regime based upon? What are the		The figure of 5% is the agreed nominal threshold of significance for changes to the baseline wave climate. This was agreed with MMO, Cefas and NE	Natural England notes the clarification provided and has no further comment.		No response required.

[19] The sensitive 'East Anglia' coast, the 'Norfolk' Natura 2000 site, the 'Suffolk' Natura 2000 site, the 'non-designated sandbanks' and the Orford Inshore MCZ.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
	predicted impacts of a greater than 2% increase upon the sensitive receptors for marine geology, oceanography and physical processes?		following an Expert Topic Group meeting on the 18/10/2017. Under some wave approach directions, the zone of cumulative effect can impinge upon some of the identified sensitive receptors as presented in ***Figure 7.8*** (APP-110) of the ES. The effects under all approach directions are seen to extend over the greatest area under the lower (1 in 1 year) return period event for the reason associated with the higher (1 in 50 year) return period events having longer wave periods, which are less affected by the foundation structures. This is described further in ***Appendix 7.2 Individual Project and Cumulative Wave Modelling*** (APP-455). However, the magnitude of change in baseline significant wave heights across these zones of extended influence is <1% where it reaches the location of the identified receptors (***section 4.1.4.2***). This magnitude of change is therefore insignificant with regards to potential impacts.			

1.7.4 Benthic Ecology

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
Document used: 6.1.9 EA2 Environmental Statement Chapter 09 Benthic Ecology						
3.2.1	Natural England wishes to highlight that the worst case scenario for benthic ecology should be related to the foundation type and not the blade tip height. We believe that this has been covered in the chapter so raises as a point to note to the examiner.		The Applicant appreciates the opportunity to clarify this point. Paragraph 17 explains that the worst case scenario for benthic ecology is based on either 67 or 75 wind turbines depending on the foundation types used. Maximum blade tip height references are provided to distinguish between the maximum number of each turbine type i.e. 75 x 250m blade tip height or 67 x 300m blade tip height wind turbines.	This was a point to the examiner so no further response from NE.		Noted.
3.2.2	Natural England highlights that the Rochdale envelope remains all-encompassing including the use of Gravity Based foundations that have not been used in English waters to date. Therefore, we would question why these have continued to be included in the Environmental Statement (ES). Especially as it unrealistically skews some of the assessments.		Assessing a wide ranging design envelope ensures flexibility in the consent which is required to account for potential technology advancements during the long lead-in times to project construction. Gravity-base foundations are currently in operation in the UK at the Blyth offshore windfarm demonstrator project and there is potential that this foundation type could become used more widely in the future.	This was a point to the examiner so no further response from NE.		Noted.
3.2.3	Please be advised that there should be a commitment that is secured in one of the DCO/DML reference docs relating to the clearance of boulders should be away from habitat of conservation important.		Through the Design Plan, Condition 17 of the generation DML and Condition 13 of the transmission DML, the Applicant will set out how the Project has been designed and micro-sited around reefs and sensitive habitats which will be submitted to the MMO for approval.	Ongoing. How will a commitment in relation to boulder clearance be secured as part of the consenting process? We have advised for other OWFs currently in examination that outline plans should be provided		The Applicants will include a condition within the DMLs requiring submission of a plan detailing *Sabellaria* reef management which would be in accordance with the ***Outline Sabellaria Reef Management Plan*** (REP1-044) submitted at Deadline 1. This condition will be included in the updated DCO to be submitted at Deadline 3.
3.2.4	Natural England supports the undertaking of sandwave levelling if as stated it reduces the need for cable protection. However, we do recognise that sandwave levelling activities (including sediment disposal), is likely to have a significant effect (LSE) on the interest features of the Outer Thames Estuary SPA and will need to be considered against the		A separate clarification note regarding cross-receptor impacts on the Outer Thames Estuary SPA has been prepared and is provided in *Appendix 5* of this document.	Ongoing. Please see Appendix F2b of this document for our detailed response to the applicant's Appendix 5 Outer Thames Estuary Cabling Note. Natural England have provided the Applicant with GIS layers to form a supporting habitat map (08.10.20).		The Applicants have now received detailed mapping from NE for the supporting habitats of the SPA. The Applicants will provide an updated assessment taking account of NE's comments in Appendix F2b. This assessment will be submitted at Deadline 3.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
	conservation objectives for the site in an Appropriate Assessment.					
3.2.5	We also welcome the commitment to avoid sensitive receptors when undertaking sandwave levelling works, but where possible sand should be disposed in similar particle sized areas.		Noted.	Ongoing. How will similar particle size for disposal be secured? We note that in Appendix 5 there is no mention of disposal location and in addition we have requested further information to be included in AS-043 in our Deadline 1 Appendix F4.		Both the windfarm site and the offshore cable corridor are proposed as disposal areas as detailed in the Site Characterisation Report (Windfarm Site) (APP-592) and Site Characterisation Report (Offshore Cable Corridor) (APP-593). The proposed locations for disposal licensing are provided in these documents (see Figure 1 in APP-592 and APP-593). Only the offshore cable corridor overlaps with the SPA. The reason for designating both the windfarm and the offshore cable corridor as disposal sites is to avoid the need for lengthy transits for disposal of material. It is therefore likely that material will be disposed of in close proximity to the location of dredge and therefore it follows that particle sizes at both locations would be similar. The Applicants will provide an updated assessment of effects on the supporting habitats of the Outer Thames Estuary SPA taking account of NE's comments in Appendix F2b. This will include discussion of disposal. This assessment will be submitted at Deadline 3.
3.2.6	It would be helpful if the Applicant could provide context from East Anglia ONE in relation to the amount and location of cable protection placed along the export cable.		The East Anglia ONE project installed cable protection along 2.11% of its first export cable and 2.12% along its second export cable. This was mainly in areas of hard ground or at cable crossings.	Whilst welcome the information on EA ONE being included this could be expanded up and used as supporting evidence in Appendix 5 when considering the potential risk/likelihood of habitat changes from cable protection.		This information will be included in the revised assessment of SPA supporting habitats to be submitted at Deadline 3 however the extent of cable protection required will be determined following collection of detailed geophysical and geotechnical site information for the Projects and this may be different to that required at EA1.
3.2.7	Natural England notes that the placement of new cable protection over the life time of the project is not included in the assessment. Is this		As per the Applicant's response to Point 2 of DCO, DMLs and Related Certified Documentation below, this matter is under consideration by the Applicant. Through the	Ongoing. Awaiting further response from the applicant.		The Applicants will include a condition within the DMLs requiring approval prior to **any new scour or cable protection be**ing installed **during the operation**

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
	because a separate marine licence will be applied for at the time?		SoCG process, the Applicant has requested sight of the joint paper by the MMO and NE which the MMO state will offer guidance on the expected marine licensing requirements for such activities. Following review of this guidance, the Applicant will prepare a response on this matter.			**period in areas** where scour or cable protection was not installed during construction. This will be included in the updated draft DCO to be submitted at Deadline 3.
3.2.8	Please be advised that the assessment of cable protection is not consistent with Natural England recent draft advice position paper as provided for Boreas examination. Please see Appendix F2. Ideally drill arisings should be deposited in areas of scour protection against to turbines and/or similar habitats.		This advice paper was submitted post-DCO application submission and therefore the Applicant considers that an updated assessment of cable protection is outwith the scope of the application and disproportionate since the relevant assessments with regards to benthic ecology (see *sections 9.6.1.1.2* and *9.6.2.1.2* of *Chapter 9 Benthic Ecology* (APP-057) concluded impacts of no greater than minor adverse significance. It is noted that Appendix F2 states that cable protection installed during the operation period requires a new licence. As per the Applicant's response to Point 2 of DCO, DMLs and Related Certified Documentation below, this matter is under consideration by the Applicant. Through the SoCG process, the Applicant has requested sight of the joint paper by the MMO and NE which the MMO state will offer guidance on the expected marine licensing requirements for such activities. Following review of this guidance, the Applicant will prepare a response on this matter. Drill arisings will be deposited in areas of scour protection against turbines.	Ongoing. Whilst we recognise that the impacts in terms of EIA are considered to be minor adverse, NEs comment is in relation to authorising the placement of protection over the lifetime of the project. The application still needs to be in line with advice from the SNCBs and the Regulators. There also needs to be a clear understanding of the potential HRA impacts and any parameters for Operation and Maintenance use of protection agreed up; which will then be taken forward and assessed against post consent. Please note that reference/assessment in the ES doesn't equate to permission in this instance.		With respect to cable protection employed during construction, cable protection within this area can be maintained through the Operation and Maintenance plan. This position has been confirmed by the MMO. The Applicants will work with the MMO to reflect this in updates to the SoCG with the MMO. With respect to cable protection installed in areas where cable protection was not installed during construction, see Point 3.2.7 above. Potential effects on supporting habitats of the OTE SPA during operation will be considered in revised assessment of SPA supporting habitats which will be submitted at Deadline 3.
3.2.9	Please be advised that mitigation in the form of micro-siting is not normally secured as part of the In Principle Monitoring Plan. Further consideration should be given to how best to do this.		Through the Design Plan, Condition 17 of the generation DML and Condition 13 of the transmission DML, the Applicant will set out how the Project has been designed and micro-sited around reefs and sensitive habitats which will be submitted to the MMO for approval.	Ongoing. Please could the principles that will be applied within the design plan Condition 17 (generation) and 13 (transmission) for how areas to be micro sited will be identified. This could be in the form of an outline plan. Please note that this outline plan should also consider how conflicts benthic sensitives and archaeological finds will be managed in relation to micro siting options. The aforementioned condition should also be signed off by the MMO in consultation with NE. NE note the Applicant intends to provide an outline *Sabellaria spinulosa* management plan at Deadline 1 - NE will respond at Deadline 2		The Applicants will include a condition within the DMLs requiring submission of a plan detailing *Sabellaria* reef management which would be in accordance with the ***Outline Sabellaria Reef Management Plan*** (REP1-044) submitted at Deadline 1. This condition will be included in the updated DCO to be submitted at Deadline 3.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
3.2.10	Please be advised that the 50m buffer around Sabellaria spinulosa reef outside of designated sites is consistent with the advice provided to the aggregates industry. However, we note that for East Anglia ONE that micro siting wasn't feasible at all locations. Please note that under NERC Act 2006 Section 40 there is a duty to avoid impacts to priority habitats such as Sabellaria spinulosa.		Noted.	No further comments. However, NE note the Applicant intends to provide an outline *Sabellaria spinulosa* management plan at Deadline 1 - NE will respond at Deadline 2 and will ensure this is covered.		No response required.
3.2.11	Natural England notes that no benthic ecology monitoring is proposed. However, this differs from what is outlined the In-Principal Monitoring Plan (Page 10, Table 2 within Section 1.6.4). Natural England agrees with the IPMP and advises that potential impacts to *Sabellaria spinulosa* reef areas will be required.		Noted, for clarification, the reference to no benthic monitoring is with regard to general benthic monitoring. However, as described in *section 9.3.3.2.1 of Chapter 9 Benthic Ecology* (APP-057), pre-construction surveys will be undertaken to identify *Sabellaria* reef upon which consultation on micrositing with the MMO and its advisors would be undertaken. The requirement for these pre-construction surveys is secured within condition 20 of the generation DML and condition 16 of the transmission DML and in the *In-Principle Monitoring Plan* (APP-590).	No further comment as for examining authority		No response required.
3.2.12	Please be advised that all reef is reef no matter the quality and is therefore protected as such.		See the response to Point 3.2.3.	Ongoing. Ref to 3.2.3 response is not helpful in this instance. As all reef is protected can we take it that the Applicant agrees with NE and will be addressed accordingly through the Design Plan?		Through the Design Plan, Condition 17 of the generation DML and Condition 13 of the transmission DML, **t**he Applicants will set out how their respective Projects have been designed and micro-sited around reefs which will be submitted to the MMO for approval and on which the Applicants understand the MMO will consult with NE. In addition, the Applicants will include a condition within the DMLs requiring submission of a plan detailing *Sabellaria* reef mitigation which would be in accordance with the ***Outline Sabellaria Reef Management Plan*** (REP1-044) submitted at Deadline 1. This condition will be included in the updated DCO to be submitted at Deadline 3.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
3.2.13	Natural England welcomes the proposal to use horizontal directional drilling (HDD) under the beach to avoid impact to vegetated shingle, however, we query what would happen in relation to a bentonite outbreak?		The Applicant will produce an Outline Landfall Construction Method Statement (to be submitted as early as possible during the examination period) that will provide further details on the trenchless technique to be adopted at the landfall and will include details on how the risk of bentonite break-out would be reduced and break out contingencies in the event of a bentonite breakout.	Ongoing. Please see Natural England's comments on Outline Landfall Construction Method Statement, provided at Deadline 1 Appendix C3		The Applicants question the change in RAG status from green to amber given NE's comment at Point 11 of Terrestrial Ecology which states: *Resolved: Natural England has made interim comments on the Outline Landfall Construction Method Statement in a separate response (sent to the Applicant on 13 August 2020) and is satisfied with the detail provided regarding bentonite breakout.*
3.2.14	Natural England notes that impacts to mapped sandbanks will be avoided. However, there remains an impact to 1,000,000m^3 of sediment, which is not small. It would therefore be useful know footprint/spatial extent to the impacts. However, at this stage we can advise that there would be a LSE which would require further consideration as part of an Appropriate Assessment.		A separate clarification note regarding cross receptor impacts on the Outer Thames Estuary SPA has been prepared and is provided in *Appendix 5* of this document.	Ongoing. Please see Appendix F2b of this document for our detailed response to the applicant's Appendix 5 Outer Thames Estuary Cabling Note. Natural England have provided the Applicant with GIS layers to form a supporting habitat map (08.10.20).		See response to 3.2.4
3.2.15	Natural England notes that cable protection is proposed at the HDD exit point. Please be advised that there will need to be join up in relation to potential impacts to coastal processes and sediment transport.		The assessment of cable protection at the HDD exit point in relation to morphological and sediment transport pathways is provided in *Chapter 7 Marine Geology, Oceanography and Physical Processes, section 7.6.2.7* (APP-055). This concluded no impact on the relevant receptors.	Ongoing. Please be advised that Appendix 5 identified potential issues with elevated protection in shallower water. Therefore more justification is required to demonstrate that this is not an issue. Please see NE deadline 1 Appendix F2b		See response to 3.2.4.
3.2.16	Natural England doesn't support the view that reef on artificial substrate is Annex I reef. Please see Appendix F3 for our advice on the Boreas offshore windfarm application. But it is recognised that as the works are not within a designated site there is no legislation under pinning this advice.		Noted. For clarification, the Applicant has only stated that introduced hard substrate could be colonised by *Sabellaria* not that this newly colonised substrate would represent Annex I reef.	No further comments		Noted
3.2.17	Inclusion of assessment for potential interactions between impacts is welcomed.		Noted.	No further comments		Noted

1.7.5 Fish and Shellfish Ecology

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
Document used: 6.1.10 EA2 Environmental Statement Chapter 10 Fish and Shellfish Ecology						
4.2.1	Although larval abundances between 2007-2017 have been relatively low as described by Figures 10.15 to 10.17, there is little mention of the nursery grounds in relation to Herring. Figure 10.14 indicates that the cable corridor in particular is a high intensity nursery ground. Natural England would welcome further consideration of how impacts to nursey grounds may effect prey availability for the interest features of the marine protected areas.		An error in the data processing stage means that ***Figures 10.15, 10.16*** and ***10.17*** (APP-143, APP-144, APP-145) have now been updated with IHLS data from all three larvae surveys carried out in specific periods and areas, following autumn and winter (September, December and January) spawning activity of herring from north to south. These amended figures are shown in the Fish and Shellfish Ecology Clarification Note ***Figures 1-3 (Appendix 3*** of this document***)***. The impact on habitat loss for herring has been considered with sandeel in ***section 10.6.1.1.1*** of ***Chapter 10 Fish and Shellfish Ecology***. The impact is determined as ***minor adverse*** significance. Regarding impacts to nursery grounds potentially affecting prey availability, a separate clarification note regarding cross receptor impacts on the Outer Thames Estuary SPA has been prepared and is provided in ***Appendix 5*** of this document.	Natural England welcomes the inclusion of additional data for all three larvae surveys in Figures 1-3 of Appendix 3. The updated figures show that East Anglia TWO overlaps with the January herring larvae data, suggesting that herring spawning activity is occurring in this area. Furthermore, Figure 10.14 of the ES shows that the area of the export cables is considered a high intensity herring nursery ground. Following review of Appendix 5, Natural England considers that impacts to prey availability for the interest features of the Outer Thames Estuary SPA still need to be considered through HRA. Please see our Deadline 1 Appendix F2b response		***Figure 10.14*** (APP-142) shows the offshore cable corridor within an area of high intensity nursery ground. However, this fact should be seen in the context that the high intensity nursery ground stretches from Lowestoft to the English Channel. Any impact from cable works needs to be seen in proportion to this area. The Applicants have provided extensive consideration of prey impacts within Appendix 5 (AS-042). The Applicants will provide revised assessment of SPA supporting habitats taking account of NE's comments in Appendix F2b (REP1-158). This assessment will be submitted at Deadline 3.
4.2.1a	Natural England also advises that the impacts of climate change, particularly the redistribution of species as a result, is considered within the assessments against the variety of species considered. Much of the spawning, nursery and larval abundance data ranges from 1998 to 2017.		Noted. Anticipated trends in baseline conditions have been included within ***section 10.5.7*** of ***Chapter 10 Fish and Shellfish Ecology*** (APP-058).	Natural England doesn't consider that this short paragraph accounts for considering climate change within the assessments.		The fish and shellfish baseline environment of the Southern North Sea is primarily influenced by global environmental factors (such as climate change) and by commercial fishing activity. The impacts of the Projects are not significant. The impacts of the Projects are highly localised in comparison to these wider influences. The Applicants consider the information provided is proportionate to the scale of effect and in line with industry standards (i.e. other recent EIAs)
4.2.2	As raised in our Preliminary Environmental Information Report (PEIR) response, the reference used within this paragraph is very old, nearly 40 years. Is there any more recent evidence to show herring tolerance to elevated suspended sediment concentrations? Also what does Kiorboe et al. 1981 define as "short term" exposure?		In response to the NE PEIR comment in ***Appendix 10.1*** (APP-462) it was confirmed that an extensive literature review has been conducted which has not found any new studies with regards to effects of Suspended Sediment Concentrations (SSCs) on herring eggs. Best practice guidance will be followed at the time of construction which will account for any new research which may have been conducted in the interim.	Natural England notes the applicant's commitment to account for new research into herring tolerance to elevated suspended sediment concentrations at the time of construction. We note the additional information regarding short term exposure. NE consider this matter is ongoing until the proposal is secured.		No response required.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
			With regards to short term exposure, Kiorbie et al (1981)[20] exposed the eggs to silt (at day 2, 4 and 6 after fertilisation) kept in suspensions for 2 hours and then allowed to settle.			
4.2.3	With regards to sand eels and their limited capacity to flee, Figure 10.14 highlights the site sits within the nursery and spawning grounds as defined by Coull et al. 1998 and low intensity nursery grounds as identified by Ellis et al. 2010. Is there any further site specific information to determine the likelihood of being in direct contact with sand eel habitat and linking this to the noise modelling impacts to have a greater understanding of the risk given to sand eels?		As described in ***section 10.2.4.3*** in ***Appendix 10.2*** (APP-463), Particle Size Analysis (PSA) data from benthic surveys undertaken across the former East Anglia Zone were analysed to provide an indication of the suitability of the offshore development area in terms of potential for provision of habitat for sandeel. This is shown in ***Figure 10.2.4*** of ***Appendix 10.2.*** As expected, given the sandy nature of the sediment across the offshore development area, preferred and marginal sandeel habitat was identified, with unsuitable areas identified at discrete locations particularly along the offshore cable corridor. It should be noted, however, that the habitat classification on which this analysis is based (Marine Space, 2013)[21] relies on sediment composition rather than evidence of sandeel usage of the area. This is further supported by Jensen et al. (2011)[22] and ***Figure 10.26*** of the ES (APP-154) which shows that the main sandeel habitats do not overlap with the offshore development area. The presence of suitable sediment does not necessarily imply that sandeels are present or that a given area would ever be colonised by sandeels. ***Figure 10.41*** (APP-169) and ***Figure 10.3.8*** of ***Appendix 10.3*** (APP-464) display the noise impact ranges against sandeel nursery and spawning groups for both the fleeing and stationary animal model respectively. As discussed in ***section 13.5.6.1*** of ***Chapter 13 Commercial Fisheries*** (APP-059), analysis of VMS data for the sandeel fleet (***Figure 13.37*** (APP-218)) suggests that activity by sandeel industrial trawlers is mainly concentrated in areas such as the Dogger Bank (Central North Sea) and the Norwegian coast (Northern North Sea). Although not restricted to these areas activity is considerably lower in the Southern North Sea. In the offshore development area activity by these vessels occurs at negligible levels therefore it is very likely that there is a	Natural England notes the further detail provided by the applicant regarding sand eel habitat and sensitivity to noise impacts, however, we defer to Cefas for their expertise on this topic.		No response required.

[20] Kiørboe, T., Frantsen, E., Jensen, C. and Sorensen, G. (1981). Effects of suspended sediment on development and hatching of herring (Clupea harengus) eggs. Eastuarine, Coastal and Shelf Science. 13(1), 107-111.
[21] Marine Space (2013). Screening Spatial Interactions between Marine Aggregate Application Areas and Sandeel Habitat. A Method Statement produced for BMAPA.
[22] Jensen, H., Rindorf, A., Wright, P.J. and Mosegaard, H. (2011) Inferring the location and scale of mixing between habitat areas of lesser sandeel through information from the fishery, ICES Journal of Marine Science, 68(1), pp. 43–51.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
			low presence of sandeels in the offshore development area. ***Section 10.6.1.4.1*** of ***Chapter 10 Fish and Shellfish Ecology*** (APP-058) details that sandeels are a fish species with no swim bladder or other gas chamber. These species are less susceptible to barotrauma and only detect particle motion, not sound pressure. ***Section 10.6.1.4.5.1*** assesses the potential for mortality and recoverable injury on sandeel from piling and ***section 10.6.1.4.5.2*** assesses the behavioural impacts on sandeel from piling. Given sandeels' burrowing behaviour and substrate dependence, they may have limited capacity to flee the area compared to other fish species. They are therefore considered to be of medium sensitivity. Taking account of the spatial extent of the impact with the overall short duration of piling and its intermittent nature, together with the fact that any effect associated with Temporary Threshold Shift (TTS) and behavioural impacts would be temporary, the magnitude of effect for **all species** is considered to be low. This results in an impact of **minor adverse** significance for both mortality and recoverable injury and behavioural impacts on sandeel from piling. ***Section 2.4.2*** of ***Appendix 3*** discusses potential impacts on prey species such as sandeel and herring due to underwater noise.			
4.2.4	Is there a reason why the applicant cannot commit to burying their cable to a minimum depth of 1.5m?		Cable burial depth presented in the Preliminary Environmental Information report was a minimum of 0.5m. In response to concerns expressed by Natural England in the Section 42 consultation over this depth and a request to increase burial depth to 1.5m, the Applicant made a commitment to increase burial depth to a minimum of 1m where possible against the argument that this was in line with current best practice and the engineering limitation based on the department for Business Enterprise and Regulatory Reform review of cabling techniques and environmental effects applicable to the offshore wind farm industry (BERR 2008)[23]. Final details regarding cable installation will be provided to the MMO for approval in the cable laying plan secured under Condition 17(1) of the Generation DML and 13(1) of the Transmission DML which will include a detailed cable laying plan for the Order Limits, incorporating a burial risk assessment. This plan will be	Noted. This concern is ongoing for Natural England.		The offshore export cables would be buried at a depth between 1m and 3m for the majority of the route as stated in ***Chapter 6 Project Description*** (APP-054). The Applicants reiterate that a 1m minimum burial depth is in line with current best practice, recently consented projects e.g. Norfolk Vanguard, and the engineering limitation based on the department for Business Enterprise and Regulatory Reform review of cabling techniques and environmental effects applicable to the offshore windfarm industry (BERR 2008). The Applicants will continue to engage with NE on this matter throughout the Examination and post-

[23] BERR. (2008). Review of Cabling Techniques and Environmental Effects applicable to the Offshore Windfarm Industry.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix F1 - All Other Matters	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix F1b)	RAG Status Assigned by NE (Appendix F1b)	Applicants' Response
			developed once detailed site investigation information has been collected post-consent.			consent, through the design plan and cable laying plan.

1.8 Appendix 5 Outer Thames Estuary Cabling Note

Point	Taken from NE Appendix F2 Received 18th of August 2020	Applicants' Response
1	Summary: Natural England is concerned that impacts to Outer Thames Estuary SPA from sandwave levelling have not be screened into the Habitats Regulation Assessment (HRA). Please note that as there is an impact pathway due to changes to supporting SPA habitat, we believe that there is likely significant effect. In addition, we advise that including evidence from East Anglia ONE would strengthen some of the statements made in relation to cable protection, e.g. the amount and locations of cable protection along the export cable for that project.	The Applicants will provide an updated assessment talking account of NE's comments in Appendix F2b (REP1-158). This assessment will be submitted at Deadline 3.
2	Para 13: It is not clear where any dredged sand will be deposited. We would welcome this to remain within the boundary of the SPA and upstream of the works so that no sediment is lost from the sandbank system and to aid recovery.	Major known sandbanks have been avoided through project design and smaller unmapped sandbanks will be avoided through micrositing. The extent of any required sandwave levelling will be shown in the design plan and the process for levelling them described within the construction method statement post consent. Both the windfarm site and the offshore cable corridor are proposed as disposal areas as detailed in the Site Characterisation Report (Windfarm Site) (APP-592) and Site Characterisation Report (Offshore Cable Corridor) (APP-593). The proposed locations for disposal licensing are provided in these documents (see Figure 1 in APP-592 and APP-593). Only the offshore cable corridor overlaps with the SPA. The reason for designating both the windfarm and the offshore cable corridor as disposal sites is to avoid the need for lengthy transits for disposal of material. It is therefore likely that material will be disposed of in close proximity to the location of dredge.
3	Para 17: Please note that Natural England advises that it is not appropriate to compare the impacts against the total area of the Outer Thames Estuary SPA. Our main concern is the supporting habitats of the interest features of the SPA. Therefore we advise that the impacts should relate to each of the supporting habitat types and how installation and operation and maintenance activities may alter the structure and function of these habitats and in turn the SPA features.	The Applicants requested mapping of the supporting habitats pre-application through the ETGs. The Applicants can confirm that this has now been provided by NE
4	Paras 18 & 19: Points 18 and 19 present a series of statements indicating that sandwaves and sandbanks will recover, but no evidence is presented to support these statements, or that specifies the duration of any recovery. This occurs throughout the document, but is highlighted in these points. Such evidence would support the understanding of potential impacts, *i.e.* recovery of sandbanks will take *X* months/years, which will impact *Y* species for *Z* seasons. Currently, the focus is on EIA impacts rather than HRA, such as impacts to supporting habitats of the SPA species.	The Applicants will provide an updated assessment talking account of NE's comments in Appendix F2b. This assessment will be submitted at Deadline 3.
5	Point 32 Onwards: Unexploded Ordnance (UXO) clearance should also consider how detonations impact on sediment.	The Applicants will provide an updated assessment talking account of NE's comments in Appendix F2b. This assessment will be submitted at Deadline 3.
6	This while section is focused on the EIA rather than changes to the structure and function of supporting habitat of the interest features of the SPA. Further consideration should be given to these interest features and the conservation advice package for the site.	The Applicants will provide an updated assessment talking account of NE's comments in Appendix F2b. This assessment will be submitted at Deadline 3.

1.9 East Anglia TWO Disposal Site Locations

Point	Taken from NE Appendix F2 Received 18th of August 2020	Applicants' Response
1	We note that Figure 1 shows the disposal locations for both locations, but with no reference to the habitats in those locations and/or the project infrastructure. Until these are provided NE is unable to comment further on any potential nature conservation concerns.	The Applicants will include consideration of disposal site locations and potential impacts of disposal within the revised assessment of SPA supporting habitats to be submitted at Deadline 3. The Site Characterisation Report (Windfarm Site) (APP-592) and Site Characterisation Report (Offshore Cable Corridor) (APP-593) consider the volumes of sediment to be disposed and the potential impacts on the relevant receptors. AS-043 was provided at Deadline 1 as a result of an MMO request to provide clarity on the proposed disposal site locations.

1.10 DCO / DML

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
Document used: 3.1 EA2 Draft Development Consent Order						
1	Natural England cannot agree to the definitions of "commence" and "offshore preparation works". As currently drafted the wording the work permits damaging works such as UXO detonation. The wording is also open to the inclusion of more activities than specified and thus could lead to works such as boulder removal, sandwave levelling, pre lay grapnel runs and a range of other potentially environmentally damaging works. These works could commence before the appropriate methodologies and documentation have been approved. As there would be no regulatory involvement it is not certain if pre construction surveys would be completed to sufficiently inform and agree micro siting requirements. Thus leading to an increased risk of impact to features of conservation value, such as biogenic reef. The words 'but not limited to' should be removed, as should reference to UXO detonation works.		In order to clarify the activities that fall within the definition of "offshore preparation works", the definition will be updated in the next version of the draft DCO as follows: *"offshore preparation works" means surveys, monitoring and UXO clearance ~~any activities within the Order limits seaward of MHWS~~ undertaken prior to the commencement of construction to prepare for construction~~, including but not limited to surveys, monitoring and UXO clearance.~~* The Applicant does not agree that reference to UXO clearance should be removed from the definition of "offshore preparation works" as such activities are assessed within the Environmental Statement and are controlled by the conditions of the DMLs. The DMLs do not permit any UXO clearance activities to be undertaken without the requirements of condition 16 of the generation DML and condition 12 of the transmission DML first being complied with which require the following to be submitted to and approved by the MMO: *(a) a method statement for UXO clearance which must include—* *(i) methodologies for—*	Natural England notes the proposed changes and in large part welcomes them. However still has issues related to the control of UXO detonations and the other conditions related to UXO. Until these concerns are addressed we are unable to agree with this definition of commence. We note the response that pre construction surveys under condition 20 and 16 of the generation and transmission surveys will allow for protection of benthic features. However, as the conditions referenced are linked to commencement and the UXO is not, there is no certainty and it is not secured in the DCO/DML that the surveys will have been conducted and exclusion zones identified prior to any UXO detonation.		In order to address NE's concerns, the Applicants intend to amend the UXO clearance condition (condition 16 of the generation DML and condition 12 of the transmission DML) to require environmental micrositing to be considered in the method statement for UXO clearance which must be submitted to and approved by the MMO prior to any UXO clearance activities taking place. The proposed amendment to the DMLs is as follows: *(1) No removal or detonation of UXO can take place until the following have been have been submitted to and approved in writing by the MMO—* *(a) a method statement for UXO clearance which must include—* *(i) methodologies for—* *(aa) identification and investigation of potential UXO targets;* *(bb) clearance of UXO;* *(cc) removal and disposal of large debris;*

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
			(aa) identification and investigation of potential UXO targets; *(bb) clearance of UXO;* *(cc) removal and disposal of large debris;* *(ii) a plan showing the area in which clearance activities are proposed to take place;* *(iii) a programme of works;* *(b) a marine mammal mitigation protocol in accordance with the draft marine mammal mitigation protocol, the intention of which is to prevent injury to marine mammals, following current best practice as advised by the relevant statutory nature conservation bodies; and* *(c) an East Anglia TWO Project Southern North Sea SAC Site Integrity Plan for UXO Clearance which accords with the principles set out in the in principle East Anglia TWO Project Southern North Sea SAC Site Integrity Plan.* With regard to the risk of UXO clearance to *Sabellaria* reef, the pre-construction reef survey, secured under condition 20 of the generation DML and condition 16 of the transmission DML, will be undertaken prior to UXO clearance. Therefore, the plans submitted to the MMO for approval under condition 16 of the generation DML and condition 12 of the transmission DML will include details of exclusion zones/environmental micro-siting requirements.			*(ii) a plan showing the area in which clearance activities are proposed to take place;* *(iii) a programme of works; and* *(iv) any exclusion zones/environmental micrositing requirements;* Furthermore, the Applicants will include a condition within the DMLs requiring submission of a plan detailing *Sabellaria* reef management which would be in accordance with the ***outline Sabellaria Reef Management Plan*** (REP1-044) submitted at Deadline 1. This condition will be included in the updated DCO to be submitted at Deadline 3.
2	Natural England does not agree with the definition of "maintain". Specifically that works linked as ancillary works (listed in schedule 1 part 1) are part of maintenance. Works such as cable protection and scour protection deployment are construction activities which can have significant environmental impact. They should not be included within the definition of maintenance. Please see Natural England and the MMO positions on deployment of cable protection.		Under consideration by the Applicant. Through the SoCG process, the Applicant has requested sight of the joint paper by the MMO and NE which the MMO state will offer guidance on the expected marine licensing requirements for such activities. Following review of this guidance, the Applicant will prepare a response on this matter.	Natural England notes the applicant is considering and has provided the cable paper referenced. However, must also note this paper is not a joint paper with the MMO but a paper produced by Natural England.		The Applicants will include a condition within the DMLs requiring approval prior to any new scour or cable protection being installed during the operation period in areas where scour or cable protection was not installed during construction. This will be included in the updated draft DCO to be submitted at Deadline 3. With respect to scour and cable protection employed during construction, scour and cable protection within this area can be maintained through the Operation and Maintenance plan. This position has been

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
						confirmed by the MMO. The Applicants will work with the MMO to reflect this in updates to the SoCG with the MMO.
3	Arbitration: Natural England does not consider that it is appropriate for post-consent sign-off of DML conditions to be subject to arbitration. Natural England suggests that this wording be amended to that which was used by the Secretary of State (SoS) while deciding on this issue in the Tilbury 2 application. Natural England also refers to the representations and submissions on arbitration submitted during the recent Hornsea 3, Vanguard and Thanet Extension applications.		The Applicant considers it necessary to ensure that there is an appropriate appeals mechanism available to the undertaker during the process of discharging requirements of the DCO and conditions of the DMLs so that this nationally significant infrastructure project is not delayed due to the failure of discharging authorities to determine applications for approval within the agreed timescales. *DML conditions* The Applicant will therefore seek to modify the provisions of the Marine Licensing (Licence Application Appeals) Regulations 2011 so that they apply where the MMO refuses an application for approval under one of the conditions of the DMLs or alternatively where the MMO fails to determine an application within the timescales. This is to ensure that the undertaker has an appropriate appeals mechanism in order to resolve matters in a timely manner to reduce the risk of delays to the Project. *DCO requirements* The Applicant also intends to include a new schedule within the draft DCO which sets out a procedure in respect of the discharge of requirements which provides timescales for decisions to be made and an appeals process where an approval is refused or where the discharging authority fails to issue a decision within the timescales. This approach is in accordance with PINS Advice Note 15: Drafting Development Consent Orders and largely follows the text proposed by PINS within Appendix 1 of that Advice Note. This will not apply in respect of the discharge of conditions of the DMLs. *Arbitration* The Arbitration provisions are not intended to apply to decisions of the MMO in discharging DML conditions.	Natural England notes the response, however, its position has not changed. It also noted that in the Norfolk Vanguard Offshore Wind Farm decision similar arbitration and appeals mechanisms for the DML conditions were removed by the SoS at the recommendation of the Examining Authority. We would refer you to the Vanguard decision letter and the Examining authority's recommendation report for the Norfolk Vanguard application. Our position, therefore, remains that these provisions should be amended/removed to make it clear they do not apply to decisions made under a deemed marine licence.		As noted in the Applicants' Comments, the arbitration provisions are not intended to apply to decisions of the MMO in discharging DML conditions. The Applicants do however maintain their position that an appropriate appeals mechanism should be available to the undertaker during the process of discharging requirements of the DCO and conditions of the DMLs to ensure that issues can be resolved in a timely manner and to reduce the risk of delays to the Project, a NSIP.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
4	Many areas and volumes are given as m2 and m3, they should be m^2 or m^3		This will be updated in the next version of the draft DCO.	Noted, we will review the next DCO to confirm.		No response necessary.
5	No volumes or areas of cable protection are provided. Given the potential for significant impact from these works they should be appropriately recoded here. However, it is noted these volumes and areas are recorded within the DMLs. However, the Environmental Statement (ES) project descriptions have separate areas of cable protection for the cable crossings. Clarification is needed to explain whether these volumes are recorded within the totals provided within the DMLs or if they are additional to the DML volumes. If additional then these additional volumes should be recorded in the DCO/DML appropriately to ensure the maximums are clearly stated and enforceable. No volumes or areas of disposal are provided here. Maximum amount of disposal should be provided and split into hard substrate (drill arisings) boulder relocation and soft sediments (sandwave levelling and ground preparation). However, it is noted the total volumes are recorded within the DMLs and split according to activity. This application and project description includes detonation of UXO. If these works are to be licenced and given the significant potential for impact the maximum number of detonations and the maximum size of detonation (size of UXO in kg) should be recorded. These factors should also be recorded in the DMLs to ensure no works outside of the scope of the ES details take place.		Deposits (including of cable and scour protection and drill arisings, etc.) are licensable marine activities and are therefore regulated by the DMLs, There is therefore no need for these areas or volumes to be specified in Schedule 1 of the DCO. Such parameters should be specified in the DMLs only so that if there is any need to vary the figures in the future, they can be dealt with by way of a DML variation. Specifying these figures in Schedule 1 of the DCO may cause unnecessary difficulties in the event that the figures require to be varied. The Applicant's assessment has been based on a more realistic worst case scenario drawing on experience from the neighbouring East Anglia ONE project, rather than absolute worst case scenarios that may have assumed greater volumes and areas to mitigate a situation where the site investigation surveys demonstrate that sufficient cable protection and/or disposal has not been provided for. Given this approach, there is a significant programme risk associated with inclusion of such detailed parameters under Schedule 1, Part 3 of the DCO should any changes be required which necessitate an amendment to the DCO. Specifying deposit volumes and areas in the DMLs alone provides for full regulatory control and should any amendments to these figures be necessary, a DML variation will be required and any application for a DML variation will need to be supported by appropriate environmental information at that time. As with disposal activities, UXO clearance activities are regulated by the DMLs and there is no need for details of such activities to be included within Schedule 1 of the DCO. The DMLs include conditions requiring various documents to be approved by the MMO prior to UXO clearance activities being permitted to proceed. Details of the	Natural England notes that the cable protection, disposal and UXO activities are controlled through the DML and that limitations are recorded there to allow for variation should there be a need. Natural England notes that the justification is the use of a more realistic worst case scenario to refine the impact scope, rather than an absolute worst case scenario. Our preference at this juncture is for the details of these activities to be appropriately included within the DCO Schedule 1. However, we will further consider your response and may provide an update in the future.		The Applicants request that NE explains and justifies why it is necessary for such activities to be specified in Schedule 1 of the DCO when these are licensable marine activities that are regulated by the MMO and controlled by way of marine licence. The Applicants maintain their position that it is not necessary for such details to be included within Schedule 1 of the DCO as the relevant activities are sufficiently controlled within the DMLs, and only require to be controlled by marine licence.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
			number and size of detonations will be set out within these documents for approval by the MMO and such details will be within the scope of the impacts assessed within the ES.			
6	The relevant statutory nature conservation body should be named as a consultee on the updated Code of Construction Practice. This is to ensure the appropriate environmental considerations are provided within these documents.		The Applicant will consult with NE during the preparation of the Code of Construction Practice (CoCP) and the Outline Code of Construction Practice (OCoCP) will be updated to reflect this commitment. The Applicant does not consider it necessary to name NE as a consultee on the face of the DCO in respect of the CoCP.	Natural England notes this response and has had further discussed this issue with the applicant at a meeting on 5 October and agrees that we do not need to be named as consultee upon all sections of the CoCP, only on those sections with relevance to nature conservation. We understand an update to requirement 22 and the OCoCP will be made.		As noted in the Applicants' Comments, the Applicants will consult with NE during the preparation of the Code of Construction Practice (CoCP) and the Outline Code of Construction Practice (OCoCP) will be updated to reflect this commitment. The updated OCoCP will be submitted at Deadline 3. The Applicants do not consider it necessary to name NE within Requirement 22.
7	The relevant statutory nature conservation body should be named as a consultee on the onshore decommissioning plan. This is to ensure appropriate ecological mitigation and considerations are made within the decommissioning works.		The Applicant will update requirement 30 (Onshore decommissioning) of the draft DCO to include the relevant statutory nature conservation body as a consultee in respect of the onshore decommissioning plan.	Natural England welcomes the proposal to update the draft condition and ensure appropriate consultation with the SNCB on the decommissioning plan. Once we have seen an updated draft including this change this issue will be considered resolved.		No response necessary.
8	This requirement makes it clear that onshore connection works built under one order can only be built on one order and not both. However, Natural England questions if this requirement adequately ensures that any ongoing monitoring or mitigation works for those areas are clearly secured. Natural England considers it logical that the party who constructed the works should hold responsibility for any required ongoing requirements.		In accordance with the requirements of the draft DCO, the party constructing the grid connection works will require to submit various plans and documents for approval prior to construction. Some of these plans will contain monitoring obligations for the construction and operational period and so the party constructing and operating the works will be required to comply with the monitoring commitments approved within the relevant plans and documents. The transfer provisions within Article 5 of the draft DCO make the exercise by transferees and lessees of any benefits or rights conferred by the DCO subject to the same restrictions, liabilities and obligations as would apply if those benefits or rights were exercised by the undertaker. Therefore, in the event of a transfer of benefits or rights under the DCO, any associated restrictions or obligations (such as construction or operational monitoring requirements) would also be transferred and the transferee would be required to comply with such obligations.	Natural England notes this response and is satisfied that under Article 5 the obligations would transfer to the new owner.		No response necessary.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
9	Definitions of "commence", "offshore preparation works" and "maintain" are not acceptable, see points 1 and 2.		See responses to Points 1 and 2 of DCO, DMLs and Related Certified Documentation above.	See points 1 and 2		See points 1 and 2 above.
10	This condition requires a notification of completion of construction activities. Does this condition adequately ensure that no further construction activities can be undertaken under this DML? Natural England considers that this is a notification only. To ensure clarity on the end of the construction period and the start of the operation period and to appropriately trigger the post-construction conditions, Natural England considers that a separate condition may be needed to require the applicant to inform once all construction activities have completed and that no further construction works will be required under this licence. Recent projects have implied that as their DCO and DML has no requirement or condition ending construction they can complete construction activities throughout the lifetime of the project. Natural England does not consider this appropriate.		The Applicant does not consider that the condition proposed by NE is required for the following reasons: • Condition 17 of the generation DML and condition 13 of the transmission DML require submission of a construction programme which will define the construction period; • Condition 10 of the generation DML and condition 6 of the transmission DML requires notifications to various stakeholders that construction is complete; Condition 17 of the generation DML and condition 13 of the transmission DML secure the requirement for an offshore operations and maintenance plan to be submitted to the MMO at least six months prior to commencement of operation which will provide details of the activities required during the operations and maintenance phase and will specify when the operational phase will commence.	Natural England notes the response. However, also notes that the conditions referenced do not secure that the construction phase cannot be re-opened.		The Applicants do not consider that a condition prohibiting the construction phase from being re-opened is necessary. Such a condition does not appear in other DMLs or marine licences.
11	Natural England notes the inclusion of these conditions to ensure removal of UXO can proceed without inclusion under commencement. However, these works also require consideration of potential benthic impacts, such as biogenic reef. The requirement to preform pre-construction surveys to inform micro-siting of cables must be included here to ensure appropriate mitigation. The current drafting has no timing requirements for submission. They need to be submitted a minimum of 6 months prior to the detonation of UXOs. However, Natural England considers this work to lead to significant duplication of effort for post-construction document approval. Therefore, Natural England advises inclusion of UXO within the definition of "commence" and the sign off of plans within the pre-construction conditions.		*Reefs* As stated in the Applicant's response to Point 1 of DCO, DMLs and Related Certified Documentation above, the pre-construction reef survey, secured under condition 20 of the generation DML and condition 16 of the transmission DML, will be undertaken prior to UXO clearance. Therefore, the plans submitted to the MMO for approval under condition 16 of the generation DML and condition 12 of the transmission DML will include details of exclusion zones/environmental micro-siting requirements. *Submission of UXO plans* The Applicant proposes to submit the plans required under condition 16 of the generation DML and condition 12 of the transmission DML three months prior to the planned commencement of UXO clearance activities. This period is in line with the	As noted in response to point 1, the DML conditions securing survey of the benthic habitat and establishment of any exclusion zones are linked to commencement. There is no condition which ensures these surveys must take place prior to UXO removal, which the current draft DML has excluded from the definition of commence. Natural England notes the plan to submit 3 months prior to UXO detonation works. We will consider this further and may update our position or provide further response in due course. We also note that the 3 month period is not secured within the draft DML and thus does not address our concerns in this matter. The condition should be amended to make this commitment clear and to ensure		The Applicants intend to amend the UXO clearance condition (condition 16 of the generation DML and condition 12 of the transmission DML) to require environmental micrositing to be considered in the method statement for UXO clearance which must be submitted to and approved by the MMO prior to any UXO clearance activities taking place. The condition will also be amended to require submission of the plans at least three months prior to the planned commencement of UXO clearance activities. Furthermore, the Applicants will include a condition within the DMLs, requiring submission of a plan detailing *Sabellaria* reef management which would be in accordance with the ***outline Sabellaria Reef Management Plan*** (REP1-044) submitted at Deadline 1. This condition will be included in

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	Furthermore, Natural England considers that conditions should be added to DMLs ensure that: • Only 1 UXO is detonated across both EA2 and EA1N within a 24 hour period. • No piling will occur concurrent to the UXO detonation or within 24 hours of a detonation. • Only 1 piling event can occur across EA2 and EA1N within any 24 hour period. • A Co-operation Plan/Agreement will be required between EA1N and EA2 in the event that construction periods overlap. These are key mitigations proposed within the outline Site Integrity Plan (SIP) page 30 section 6.1 and should be appropriately secured through condition.		determination period for new marine licences and is therefore considered to be appropriate. Additionally, as the impact assessment for UXO clearance has already been undertaken and is detailed within the Environmental Statement (notwithstanding that there are requirements for a method statement, marine mammal mitigation protocol (MMMP) and site integrity plan (SIP)), the volume of information required to be submitted will be slightly less than that required for a new marine licence application. Furthermore, given that UXO clearance is intended to proceed prior to commencement of construction, submission of the UXO plans would occur prior to submission of the information associated with construction (i.e. design plan, construction method statement, etc) and therefore not during a period where stakeholders are required to review a large number of documents in parallel (which we understand to be the key reason that has driven the general requirement for a six month review period for other pre-construction documentation). *Inclusion of UXO clearance within the definition of 'commence'* See response to Point 1 of DCO, DMLs and Related Certified Documentation above. *Proposed conditions* Such conditions are not considered to be appropriate or necessary for the reasons set out in our responses to Points 4, 5 and 6 of Marine Mammals above. As noted by NE, these commitments are set out within the In-Principle SIP (APP 594), and a final version of this plan requires to be submitted to the MMO for approval in accordance with the conditions of the DMLs. The Applicant considers that the SIP provides the most flexible and appropriate mechanism for managing potential impacts.	appropriate time to consider the UXO works ahead of any planned works. Natural England notes the response to the proposed conditions, that the SIP provides a more flexible control mechanism. However, Natural England does not consider these mitigations to be flexible, as noted in Appendix B1b the mitigations are essential mitigation for impact to marine mammals. Therefore, we consider that they need to be secured within the drafting of the DML. However, as discussed in the workshop on the 10 August, we are willing to consider the detonation of clusters of UXO's around a 5km centre point to be detonated.		the updated DCO to be submitted at Deadline 3. The Applicants note that Natural England has responded to the Applicants' comment that *'the SIP provides a more flexible control mechanism'* stating that '*Natural England does not consider these mitigations to be flexible'*. Through the SoCG process and 10th August workshop on marine mammals and other offshore matters, Natural England requested that the Applicants consider inclusion of further conditions within the DMLs for the Projects. The Applicants have provided a response to NE's comment on 'flexibility' and have also considered the request for additional DML conditions below, but first would like to reiterate the commitments that are currently secured in the draft DCOs. For UXO clearance, condition 16 of the generation DML and condition 12 of the transmission DML states that: *(1) No removal or detonation of UXO can take place until the following have been have been submitted to and approved in writing by the MMO—* *…* *(b) a marine mammal mitigation protocol in accordance with the draft marine mammal mitigation protocol, the intention of which is to prevent injury to marine mammals, following current best practice as advised by the relevant statutory nature conservation bodies; and* *(c) an East Anglia TWO Project Southern North Sea SAC Site Integrity Plan for UXO Clearance which accords with the principles set out in the in principle East Anglia TWO Project Southern North Sea SAC Site Integrity Plan.* *(2) In approving the East Anglia TWO Project Southern North Sea SAC Site Integrity Plan*

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
						for UXO Clearance the MMO must be satisfied that the plan provides such mitigation as is necessary to avoid adversely affecting the integrity (within the meaning of the 2017 Offshore Regulations) of a relevant site, to the extent that harbour porpoise are a protected feature of that site. *(3) Any UXO clearance activities must be undertaken in accordance with the method statement, marine mammal mitigation protocol and East Anglia TWO Project Southern North Sea SAC Site Integrity Plan for UXO Clearance approved under paragraph (1).* With regard to piling, condition 17 of the generation DML and condition 13 of the transmission DML states that: *(1)The licensed activities or any part of those activities must not commence until the following (as relevant to that part) have been submitted to and approved in writing by the MMO—* *…* *(f) In the event that driven or part-driven pile foundations are proposed to be used, a marine mammal mitigation protocol in accordance with the draft marine mammal mitigation protocol, the intention of which is to prevent injury to marine mammals, following current best practice as advised by the relevant statutory nature conservation bodies.* *(2) In the event that driven or part-driven pile foundations are proposed to be used, the licenced activities, or any phase of those activities must not commence until an East Anglia TWO Project Southern North Sea SAC Site Integrity Plan for Piling which accords with the principles set out in the in principle East Anglia TWO Project Southern North Sea SAC Site Integrity Plan has been submitted to the MMO and the MMO is satisfied that the plan provides such mitigation as is necessary to avoid adversely affecting the integrity*

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
						(within the meaning of the 2017 Offshore Regulations) of a relevant site, to the extent that harbour porpoise are a protected feature of that site. It is the Applicants' view that the commitments secured in the conditions currently included in the DMLs prevent the introduction of high noise levels associated with UXO clearance and piling into the marine environment of the Southern North Sea SAC without further consideration of the project alone and cumulative position through the approval process of the SIP and the MMMP. The control mechanism currently set out within the DMLs allows for the review of currently available mitigation techniques as well as consideration of new techniques that may become available during the pre-construction phase. It will also enable changes to the science on the issue, changes in guidance and regulatory advice and any changes to the conservation objectives for the SAC to be taken into consideration prior to approval of the SIP and MMMP by the MMO. Additionally, the Applicants have committed to consulting with Natural England (and The Wildlife Trust) through the in-principle SIP and have proposed a consultation programme within the in-principle SIP (Table 2.1) that commences more than 12 months in advance of the first noisy activity (UXO clearance). The Applicants' statement that the SIP provides the most flexible and appropriate mechanism for managing potential noise impacts is based on the above points (i.e. that it allows for consideration of the issue against the latest science, guidance and latest mitigation options available). The Applicants did not intend the statement to infer that there is flexibility in the need to address noise impacts. With regard to NE's request for additional conditions within the DMLs, it is the

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
						Applicants' view that the commitments already made allow for robust control of this issue by the MMO and that no further conditions are necessary. Furthermore, the Applicants consider that any condition which builds in the necessary flexibility to ensure that future advances in technology and mitigation and changes in science, guidance and conservation objectives can be taken into account would not meet the legal tests for a DML condition. The Applicants would therefore re-emphasise that the approval process of the SIP and MMMP together with the associated DML conditions are the appropriate mechanisms in which to secure the commitments that have been made. The Applicants note that NE are willing to consider the detonation of clusters of UXOs around a 5km centre point. The Applicants will include this as a potential mitigation measure within the updated In-Principle SIP which is being submitted at Deadline 3.
12	The condition allows for changes to the cable protection if proposed following cable laying operations. However, there is no end date within the condition. Natural England's joint position with the MMO is that it is not appropriate for cable protection to be deployed throughout the operation and maintenance (O&M) phase of a project. This is due to the very large spatial and temporal scale of these licenced works, giving a Rochdale Envelope that is too undefined to appropriately assess. An end date should be included based on the proposals within the Natural England and MMO joint position statement. Any cable protection works after this end date should be licenced separately. It should also be noted that further surveys would be required to confirm the presence/absence of Sabellaria reef, such as is required prior to construction.		As per the Applicant's response to Point 2 of DCO, DMLs and Related Certified Documentation above, this matter is under consideration by the Applicant. Through the SoCG process, the Applicant has requested sight of the joint paper by the MMO and NE which the MMO state will offer guidance on the expected marine licensing requirements for such activities. Following review of this guidance, the Applicant will prepare a response on this matter.	Natural England notes that this position is under consideration. However, to clarify the position is a joint position, but the paper is a Natural England document.		See point 2 above.
13	Natural England considers that within these conditions the requirements to conduct		Under consideration by the Applicant.	Noted, awaiting further response		The Applicants intend to update conditions 20 and 22 of the generation DML and conditions 16 and 18 of the transmission DML to make

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G – DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response in Appendix G1b (REP1-155)	RAG Status Assigned by NE	Applicants' Response
	ornithological monitoring (as outlined in the In Principle Monitoring Plan) should be secured.					provision for pre-construction and post construction ornithological monitoring. This will be reflected in the updated draft DCO to be submitted at Deadline 3.
14	Natural England notes that this condition includes a requirement to monitor the first four piles and that under sub-paragraph (2) the MMO may require further monitoring. This requirement is in line with previous requirements for similar projects. However, Natural England would consider the first four piles represent the minimum requirement and would welcome discussion on expanding this proposed monitoring to include an agreed selection of the most resistant piles. The most resistant piles are likely to represent the largest noise impacts and could be further used to validate the noise impact predictions of the ES.		The Applicant will discuss this comment with NE through the SoCG process but does not consider any changes are required to the conditions of the DMLs.	Noted, Natural England welcomes engagement on this topic.		No response required.
15	All issues raised under Schedule 13 also apply to Schedule 14 where similar conditions exist.		Noted	Noted		No response required.
16	Please see point 3 regarding Arbitration.		See response to Point 3 of DCO, DMLs and Related Certified Documentation above.	Please see Point 3		See point 3 above.

1.10.1 Outline Offshore Operations and Maintenance Plan

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response (in Appendix G1b REP1-155)	RAG Status Assigned by NE	Applicants' Response
17	The definition of green items states that these items may go ahead and that no additional Marine Licences are needed, but that notification may be required. This is not entirely accurate, some of the items listed as green require resubmission of plans and documentation and further approvals from the MMO. Natural England suggests that the text is amended to reflect that some green items will require approval and not just notification.		It is not entirely clear what items are being referred to and the Applicant would request further clarification from Natural England on this point.	Activities such as additional cable laying are identified within the document as not requiring a new licence, provided they are within the scope of the original ES, but requiring consultation with MMO and NE and approval prior to works. However, the definition of green implies these works may continue with only notification. Natural England considers that the document should be updated to ensure that these important approvals are made clear to avoid any misunderstandings during operation. It is noted that the applicant will be updating and resubmitting the OOMP at Deadline 3. Natural England will review the		As discussed at a workshop on the 10th of August the outline OOMP will be updated and resubmitted into the Examination at Deadline 3.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response (in Appendix G1b REP1-155)	RAG Status Assigned by NE	Applicants' Response
				updated submission and advise if this issue remains.		
18	Cable burial using surface protection: Natural England assumes this refers to deployment of cable protection, although the table is not clear on this point. This is listed as green indicating that a further marine licence is not required. Natural England does not agree and considers this should be amber. Please see point 2 and the MMO and Natural England position statements on cable protection. This issue is replicated in the transmission section of the plan and both sections should be amended.		See response to Point 2 of DCO, DMLs and Related Certified Documentation.	Please see Point 2 (of DCO/DML)		See the Applicants' response to Point 2 of DCO/DML comments.
19	Scour protection is listed within the table as green. Therefore, it may be deployed with no additional licence required. This should be changed to amber. Scour protection may be deployed up until the maximum assessed in the ES. Any additional protection above the amount assessed in the ES would need additional licences. Natural England advises that maximum amount allowed should be based on the maximum amount assessed in the ES for the individual foundation type. Not the total assessed volume of scour for the entire project and the document should be amended to reflect this. This issue is replicated in the transmission section of the plan and both sections should be amended.		The Applicant will review the OOMP in light of NE's comments and, where considered appropriate, will update the OOMP. With respect to scour and cable protection during O&M see the Applicant's response to NE Point 2 of DCO, DMLs and Related Certified Documentation.	Noted, Natural England awaits updated document at Deadline 3. See point 2 (of DCO/DML) re scour protection during Operations.		No response required.
20	Natural England does not consider it appropriate to grant a licence to detonate UXO over such a long period of time as the lifetime of the project. This is especially relevant to projects located within the Southern North Sea Special Area Of Conservation (SAC) where detonation could have significant impacts and should be assessed based on updated information to show consideration of such things as in-combination impacts. Notwithstanding our arguments above, if it is decided that it is appropriate to include UXO detonation for the lifetime of the project, then Natural England notes that UXO detonations are listed as green. Natural England would advise that this should be listed as amber as the ES has assessed only a total of 80 detonations up to a maximum size of 700kg and therefore if more than 80 UXO's are found, or a UXO of size greater than 700kg, a new Marine Licence would be required. Additionally, consent will be required for disturbance of European Protected Species (EPS) for all instances and, therefore, it may be more appropriate to list this as red. However, in all instances the need for the EPS consent should be appropriately reflected		The intention is not to carry out UXO clearance activities throughout the operational period and therefore this reference will be corrected in the OOMP. With respect to the comments about EPS licences being required, this is not relevant in the context of the OOMP as the OOMP relates to maintenance activities authorised by DML or marine licence. Separate EPS licences will be sought outwith the DCO as and when required.	Natural England notes that this will be updated in the plan to be submitted at Deadline 3. It also notes that any EPS licences required will be sought at an appropriate time. Once an updated plan has confirmed the changes then this item may be considered resolved.		As discussed at a workshop on the 10th of August the outline OOMP will be updated and resubmitted into the Examination at Deadline 3.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response (in Appendix G1b REP1-155)	RAG Status Assigned by NE	Applicants' Response
	in this document to ensure appropriate consent is sought within a reasonable time frame.					

1.10.2 In-Principle Monitoring Plan

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix G1b)	RAG Status Assigned by NE (Appendix G1b)	Applicants' Response
21	The proposed benthic monitoring only considers construction activities. The requirement for monitoring for O&M activities, which directly impact the seabed, should be included. This monitoring will be required in the form of geophysical and ground truthing (drop down video) surveys for any areas which have no monitoring and no construction activity within 2 years prior to the proposed O&M works. The post-construction structural/engineering surveys suggested in Table 1 could be used to inform any monitoring should they be in the appropriate location and within an appropriate timeframe.		Under consideration by the Applicant. This matter is linked to NE Point 2 of DCO, DMLs and Related Certified Documentation. The Applicant requests sight of the Natural England / MMO joint positions on deployment of cable protection, which the MMO state will offer guidance on the expected marine licensing requirements for such activities. Following review of this guidance, the Applicant will prepare a response on this matter.	As noted above the cable protection paper by Natural England has been shared. We await the Applicant's further response.		See the response to Point 2 of DCO / DML.
22	Natural England notes that we would like to engage with the applicant on the potential monitoring requirements for marine mammals and the potential for contribution to strategic monitoring. Following this discussion there may be a need to update this section to better reflect the monitoring that will be required.		The Applicant is a subsidiary of ScottishPower Renewables (UK) Limited (SPR) and SPR has a strong track record of engagement on strategic monitoring projects for marine mammals including: • providing technical input and funding to develop the DEPONS [24] model. • commissioning the collection and managing the ongoing assessment of project level	Noted, Natural England will consider further and advise.		No response required at this stage.

[24] The Disturbance Effects of Noise on the Harbour Porpoise Population in the North Sea (DEPONS) model was developed to simulate individual animal's movements, energetics and survival for assessing population consequences of sub-lethal behavioural effects. Also see Nabe-Nielsen, J., van Beest, F.M., Grimm, V., Sibly, R.M., Teilmann, J. and Thompson, P.M. (2018). Predicting the impacts of anthropogenic disturbances on marine populations. Conserv Lett. 2018;e12563. https://doi.org/10.1111/conl.12563.

Point	Taken from NE's Relevant and Written Representations EA2 Appendix G DCO, DML and related certified documentation	RAG Status Assigned by NE	Applicant's Comments	NE Response (Appendix G1b)	RAG Status Assigned by NE (Appendix G1b)	Applicants' Response
			piling data on East Anglia ONE with the intent that this could be used to advance understanding of the effectiveness and limitations of the DEPONS and iPCOD population effect models; • the intent to provide underwater noise data collected during UXO detonation at East Anglia ONE to support ongoing BEIS work contracted to Hartley Anderson to understand the noise profiles of underwater explosions which would be used to produce new industry guidance; • participation in the Joint Cetacean Protocol and commitment to data sharing. The Applicant will engage with Natural England however it is not considered that strategic monitoring is appropriate at a project level in the context of the application.			
23	Natural England refers to our points 42 and 43 in Annex A Offshore Ornithology.		See the responses to points 47 and 48 of Offshore Ornithology above.	See Natural England's further comments on points 47 and 48 in Deadline 1 Appendix A1b Offshore Ornithology of this document. For completeness, this issue will remain open in the DCO DML Appendix.		See the Applicants' responses to Points 47 and 48 of Offshore Ornithology.

Appendix 1 Offshore Wind Turbine Visibility and Visual Impact Threshold Distances (Sullivan et al., 2013)

Offshore Wind Turbine Visibility and Visual Impact Threshold Distances

Robert G. Sullivan, Leslie B. Kirchler, Jackson Cothren, Snow L. Winters

Potential visual impact on coastal lands has emerged as a major concern in the development of offshore wind facilities in the United States and Europe. Optimal siting of offshore facilities requires accurate knowledge of the relationship between distance and the visibility of wind turbines. Past assessments of offshore wind turbine visibility were based on smaller turbines and facilities in use at the time and underestimate visibility for current projects, which use more and larger larger turbines. This study is a preliminary assessment of the visibility of offshore wind facilities in the United Kingdom. Study objectives included identifying the maximum distances the facilities could be seen in both daytime and nighttime views and assessing the effect of distance on visual contrasts associated with the facilities. Results showed that small to moderately sized facilities were visible to the unaided eye at distances greater than 42 km [26 miles (mi)], with turbine blade movement visible up to 39 km (24 mi). At night, aerial hazard navigation lighting was visible at distances greater than 39 km (24 mi). The observed wind facilities were judged to be a major focus of visual attention at distances up to 16 km (10 mi), were noticeable to casual observers at distances of almost 29 km (18 mi), and were visible with extended or concentrated viewing at distances beyond 40 km (25 mi).

Environmental Practice Page 1 of 17

The Energy Policy Act of 2005 provided the United States (US) Department of the Interior's Bureau of Ocean Energy Management with the authority to issue leases for renewable energy facilities on the Outer Continental Shelf. In 2009, the bureau released a new regulatory framework for reviewing and approving proposed offshore wind projects. In 2010, the department announced the *Smart from the Start* initiative to facilitate offshore wind development in federal waters by streamlining the approval process for proposed projects, implementing a leasing framework that includes identification of wind energy areas along the Atlantic Outer Continental Shelf, and moving aggressively to process offshore transmission applications (US Department of the Interior, 2010a). These actions demonstrate the federal government's commitment to promoting and accelerating commercial US offshore wind development. Many states are also actively seeking to encourage offshore wind development in waters under their jurisdiction. Although no utility-scale offshore wind facilities are currently located in US federal or state waters, development proposals have been submitted in more than 10 states, and active projects exist in 4 (OffshoreWind.net, 2010).

The large-scale deployment of offshore renewable energy seems inevitable; equally inevitable is that some offshore wind projects will face significant public opposition because of potential visual impacts. As the US begins large-scale deployment of offshore wind energy facilities, an important challenge developers and regulators will face is to minimize potential visual impacts to important coastal scenic, historic, and recreational resources; tribal properties and treasured seascapes; commercial interests dependent on tourism; private property of coastal residents; and the quality of life for millions living and working along the coasts.

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doi:10.1017/S1466046612000464

Visual impacts from offshore wind facilities have been a long-standing public concern in Europe and are quickly emerging as an important issue for US offshore wind development (National Oceanic and Atmospheric Administration, n.d.). Public and tribal concerns about visual impacts were major factors in the years-long delay of the Cape Wind Energy Project, which finally was approved for development in 2010 (US Department of the Interior, 2010b). Visual impacts have recently emerged as major concerns for offshore wind energy development in the Great Lakes and were cited as a factor in Ontario's recent moratorium on all offshore wind energy development along its entire Great Lakes coastline, as well as for projects in Texas (Clark, 2011; Mahony, 2011; National Oceanic and Atmospheric Administration, n.d.). As additional projects are proposed, visual impacts will certainly be a key issue in determining the ultimate success of offshore wind projects in the US as the need to protect local interests and landscape quality is balanced with the need to respond to changing energy policies that promote renewable energy development (Phadke, 2010).

The seascape visual impacts associated with offshore wind facilities are without precedent; the facilities are very large, with enormously tall structures having colors and geometry that contrast strongly with natural seascapes. The synchronized sweeping movement of the massive blades during the day and the synchronized flashing of the lighting at night contribute to the facilities' visibility over very long distances. These impacts are extremely difficult to mitigate, and the only truly effective means of reducing the impacts in a seascape is to site the facilities away from sensitive visual resource areas and viewing locations. Because distance is so important to reducing or avoiding impacts, an accurate understanding of the relationship between distance and the visibility of utility-scale offshore wind facilities in real settings is critical to the optimal siting of new facilities.

Over the past 20 years, several authors have studied proposed or operating facilities to explore the distance-visibility relationship for onshore and offshore wind turbines. The results were subsequently applied in visual impact analyses for proposed facilities. The visibility limits specified in these studies were sometimes used to determine the area of potential effects, to set the maximum radii for viewshed analyses, and to evaluate potential impacts likely to be observed at various distances from the proposed facility—one of the key elements of the analyses.

The use of these previous results to inform visual impact analyses for wind projects is appropriate when the proposed projects are similarly sized projects that involve similarly sized turbine models. A long-term, ongoing trend of developing and deploying larger wind turbines in larger facilities, however, is well documented for both onshore and offshore projects (Kessler, 2011), and visibility limits calculated for older wind facilities with fewer and smaller turbines could be invalid for the larger facilities and turbines currently being deployed.

Offshore wind turbines have increased substantially both in height and in rotor diameter in the last decade, and continued growth in size is predicted. Turbines exceeding 187 m (613 ft) in height (to blade tip) are already in production (ClimateWire, 2011; European Wind Energy Association, 2011b; Vestas, 2011; Weber, 2011), and even larger turbines are under development (European Wind Energy Association, 2011a; Kessler, 2011). Similarly, since the 1990s, the number of turbines deployed per project also has increased greatly, from a few or a few dozen turbines to several hundred turbines per facility today. Even larger projects are in the planning stages (Johns Hopkins University, 2011). As the early distance-visibility studies do not account for turbines or projects of these sizes, it is inappropriate to use limits of visibility established in these studies as the basis for current visual impact assessments. Clearly, impact assessments and siting decisions must rely on accurate, up-to-date knowledge regarding the visibility of today's offshore wind facilities.

This article presents the results of fieldwork undertaken to assess (a) the visibility of utility-scale offshore wind facilities currently operating in actual seascape settings and (b) the effects of distance and variable atmospheric and lighting conditions on offshore wind turbine visibility. The fieldwork was undertaken as part of a larger effort to develop the Visual Impact Evaluation System for Offshore Renewable Energy, a geographic information system–based software tool for developing accurate, highly realistic visualizations of offshore renewable energy facilities (including wind technologies) for use in visual impact assessment. The fieldwork was conducted by staff of the Environmental Science Division of Argonne National Laboratory, the University of Arkansas Center for Advanced Spatial Technologies, and the Bureau of Ocean Energy Management. Because there are no utility-scale offshore wind facilities in the US, the United Kingdom (UK) was chosen as the study site.

Literature Review

A standard approach to quantifying visibility is to determine the farthest distance at which a large, black object

can be distinguished from the sky at the horizon. This distance estimate typically is referred to as the *visual range*. Distance between the viewer and the viewed object, properties of the atmosphere, the intensity and distribution of light, characteristics of the observed object, and properties of the human eye all influence the visual range (Hyslop, 2009) by affecting the ability to perceive the contrast between a viewed object and its background.

Over the last 20 years, several studies have been conducted in the UK and mainland Europe to explore the visibility of onshore and offshore wind farms. An early analysis of the effect of distance on onshore turbine visibility was conducted for the Penrhyddlan and Llidartywaun wind facilities in Wales in the early 1990s (European Commission, 1995). The authors of this study suggested that in conditions of very good visibility, at a distance of 20 km [12.4 miles (mi)], turbines with tower heights of 30 m (98 ft) and rotor diameters of 28 m (92 ft) would be invisible to the naked eye. This distance (20 km) became a standard measure for the visibility of turbines and was used in various environmental assessments to determine their visual impact.

Subsequent evaluations of the visual impact of onshore wind facilities often used standard guidelines for determining the farthest distance at which a wind turbine was visible. One such standard includes a division of the landscape into three areas—a distant area (a radius of over 10 km), an intermediate area (a radius of 1–10 km), and an immediate area (a radius of less than 1 km). In the distant area, wind turbines would be visible, but the nearest objects generally would dominate perception. However, in an "empty" landscape, the wind turbines could become the visual focus of observers. In the intermediate area, wind turbines would dominate the space because of their height and movement. In the immediate area, wind turbines would be extremely dominant because of their size and the rotational movement of the blades (Jallouli and Moreau, 2009; University of Newcastle, 2002).

In response to the trend toward larger turbines, various UK government agencies sought to determine the potential impacts of wind turbines out to 30 km (18.6 mi), an expansion beyond many of the typical guidelines. In response, Bishop (2000) developed an Internet survey in which paired animations of wind turbines were shown to respondents; one depicted a rotating turbine and one an expanding tower. Bishop suggested that modeling potential impacts out to 30 km (18.6 mi) was justified. However, he suggested that effects beyond 20 km (12 mi) might be rare and would depend on exceptional viewing conditions, a result similar to the findings in Wales.

To date, no systematic US study specific to onshore wind turbine visibility has been published. However, the ongoing investigations and repeated observations of onshore wind facilities reported here suggest that turbines are visible at greater distances than was previously noted in published research.

To address the seascape issues surrounding offshore wind developments, the Scottish Natural Heritage commissioned an assessment of the visual sensitivity of the Scottish seascape. A portion of this study focused on determining the distance at which wind turbines were visible. As a starting point, Scott et al. (2005) began with a review of existing guidance. Among these documents was the UK Department of Trade and Industry's strategic environmental assessment for offshore wind. As part of this review, the authors suggested that if a wind facility were sited 0–8 km (0–5 mi) from shore, a high visual impact would occur; at 8–13 km (5–8 mi), 13–24 km (8.1–14.9 mi), and more than 24 km (>14.9 mi), visual impacts would be moderate, low, and insignificant, respectively.

To test these standards, Scott et al. (2005) made observations from a ferry and determined that details on shore were clearly visible at a distance of around 30 km (19 mi) in clear, sunny conditions. As a result of these observations and previous guidance, the distance for visual analyses was extended to 35 km (21.7 mi) as a precaution.

Bishop and Miller (2007) also tested the impact of distance on offshore turbine visibility in a formal analysis including an assessment of a wind facility at three different distances [4, 8, and 12 km ($2\frac{1}{2}$, 5, and $7\frac{1}{2}$ mi)], in five different lighting and weather conditions, and in two movement conditions. Unlike previous analyses of visibility, Bishop and Miller argued that contrast between the turbines and the sky backdrop was just as important as distance in determining wind turbine visibility and needed to be quantified. Their research involved the creation of simulations and surveys to determine the visibility of the turbines. Their findings suggested that, in all atmospheric and lighting conditions, impact declined with distance and increased with rising levels of contrast.

Additional research for both onshore and offshore turbines has been conducted to determine the influence of blade movement in conjunction with distance. Studies of onshore wind facilities have suggested that motion can extend the

Table 1. Offshore wind facilities observed, facility descriptions, and onshore viewpoints

Wind facility	Description	Viewpoints/distance to facility/elevation[a]
Barrow	30 Vestas V90/3000; 3.0 MW 75-m hub height; 90-m rotor diameter 90 MW total installed power One offshore substation	V1: Walney Island, 11.5 km/10 m
Burbo Bank	25 Siemens SWT-3.6-107; 3.6 MW 83.5-m hub height; 107-m rotor diameter 324 MW total installed power	V2: Formby Point, 8.2 km/4 m V3: Clieves Hill, 18.4 km/57 m V4: Crosby Marina, 7.4 km/7 m V5: Leasowe Castle, 7.9 km/17 m V6: Thurstaston Common, 14.1 km/85 m V7: A55 Footbridge, 24.6 km/256 m V8: Point of Ayr, 16.7 km/8 m V9: Prestatyn Nova Center, 21.9 km/5 m
Greater Gabbard	140 Siemens SWT-3.6-107; 3.6 MW 78-m hub height; 107-m rotor diameter 504 MW total installed power	V12: Greater Gabbard Viewpoint, 31.0 km/6 m V13: Orford Castle, 29.7 km/13 m V14: Felixstowe Seafront, 34.2 km/8 m V15: Felixstowe Road, 34.4 km/9 m V17: Naze Tower, 41.0 km/48 m
Gunfleet Sands	48 Siemens SWT-3.6-107; 3.6 MW 75-m hub height; 107-m rotor diameter 172.8 MW total installed power One substation	V13: Orford Castle, 43.9 km/13 m V14: Felixstowe Seafront, 27.8 km/8 m V16: Landguard Fort Beach, 22.2 km/4 m V17: Naze Tower, 14.1 km/48 m V18: Great Holland, 10.1 km/21 m V19: Greensward, Friston-on-Sea, 10.9 km/13 m V20: Great Holland County Park, 7.7 km/8 m V21: Clacton Pier Area, 6.8 km/13 m V24: Reculver Castle/Towers, 38.6 km/6 m V25: Coldswood Road, 42.3 km/47 m
Kentish Flats	30 Vestas V90/3000; 3.0 MW 70-m hub height; 90-m rotor diameter 90 MW total installed power	V22: Bayview Road/Windmill Road, 12.8 km/48 m V23: Clapham Hill, 13.5 km/62 m V24: Reculver Castle/Towers, 10.4 km/6 m V28: Haine Road Roundabout/Margate, 22.5 km/54 m
Lynn and Inner Dowsing[b]	54 Siemens SWT-3.6-107; 3.6 MW 85-m hub height; 107-m rotor diameter 194.4 MW total installed power	V10: Candlesby Hill, 16.9 km/59 m V11: Skegness Beach Lagoon Walk, 5.5 km/4 m
North Hoyle	30 Vestas V80/2000; 2.0 MW 67-m hub height; 80-m rotor diameter 60 MW total installed power	V2: Formby Point, 25.7 km/4 m V5: Leasowe Castle, 21.1 km/17 m V9: Prestatyn Nova Center, 7.9 km/5 m
Rhyl Flats	25 Siemens SWT-3.6-107; 3.6 MW 75-m hub height; 107-m rotor diameter 90 MW total installed power	V2: Formby Point, 39.2 km/4 m V5: Leasowe Castle, 34.1 km/17 m V6: Thurstaston Common, 32.0 km/85 m V9: Prestatyn Nova Center, 13.9 km/5 m
Thanet	100 Vestas V90/3000; 3.0 MW 70-m hub height; 90-m rotor diameter 300 MW total installed power One offshore substation	V24: Reculver Castle/Towers, 28.6 km/6 m V26: Fort Lower Promenade, 15.3 km/11 m V27: Fayreness Hotel, 12.3 km/20 m V29: Marina Road, Margate, 15.8 km/20 m
Walney Island	102 Siemens SWT-3.6-107; 3.6 MW 80- to 90-m hub height 107- to 120-m rotor diameter 367.2 MW total installed power	V1: Walney Island, 17.0 km/10 m
Ormonde	30 REpower 5M; 5.0 MW 90-m hub height; 126-m rotor diameter 150 MW total installed power	V1: Walney Island, 9.5 km/10 m

[a] Viewpoint elevation; includes 2 m added to ground elevation to account for observer height.
[b] Two neighboring developments combined into one by Centrica Renewable Energy Limited.
Source: Wind Power (2011).

viewshed of wind turbines to beyond 8 km (5 mi) (Tsoutsos et al., 2007). The University of Newcastle (2002) reported that blade movement could be detected up to 15 km (9.3 mi) in clear conditions, but that a casual observer would not notice blade movement beyond 10 km (6.2 mi). As will be shown, the findings of our present study suggest that the actual distance for blade movement visibility is much greater than was indicated in these previous studies.

Several US offshore wind evaluations have focused on the proposed Cape Wind Energy Project. For evaluation of visual impacts, Environmental Design and Research (2006) used three distance zones [0–10 km (0–6 mi), 10–19 km (6–12 mi), and 19–29 km (12–18 mi)] to determine the potential visibility of wind turbines from the shoreline of Nantucket Sound. These zones are similar to those used for onshore evaluations. The visibility was documented as a percentage of the total mileage of the shoreline that would have potential views of the wind turbines. The results indicated that the turbines would be visible from 99% of the Nantucket Sound shoreline at distances of 0–10 km (0–6 mi), from 71% of the shoreline at 10–19 km (6–12 mi), and from 66% of the shoreline at 19–29 km (12–18 mi). This study did not evaluate impacts beyond 29 km (18 mi) or seek to determine the maximum distances at which turbines would be visible.

The visual impacts of aviation obstruction lighting and marine navigation lighting have remained largely unaddressed in research; however, Scott et al. (2005) acknowl-

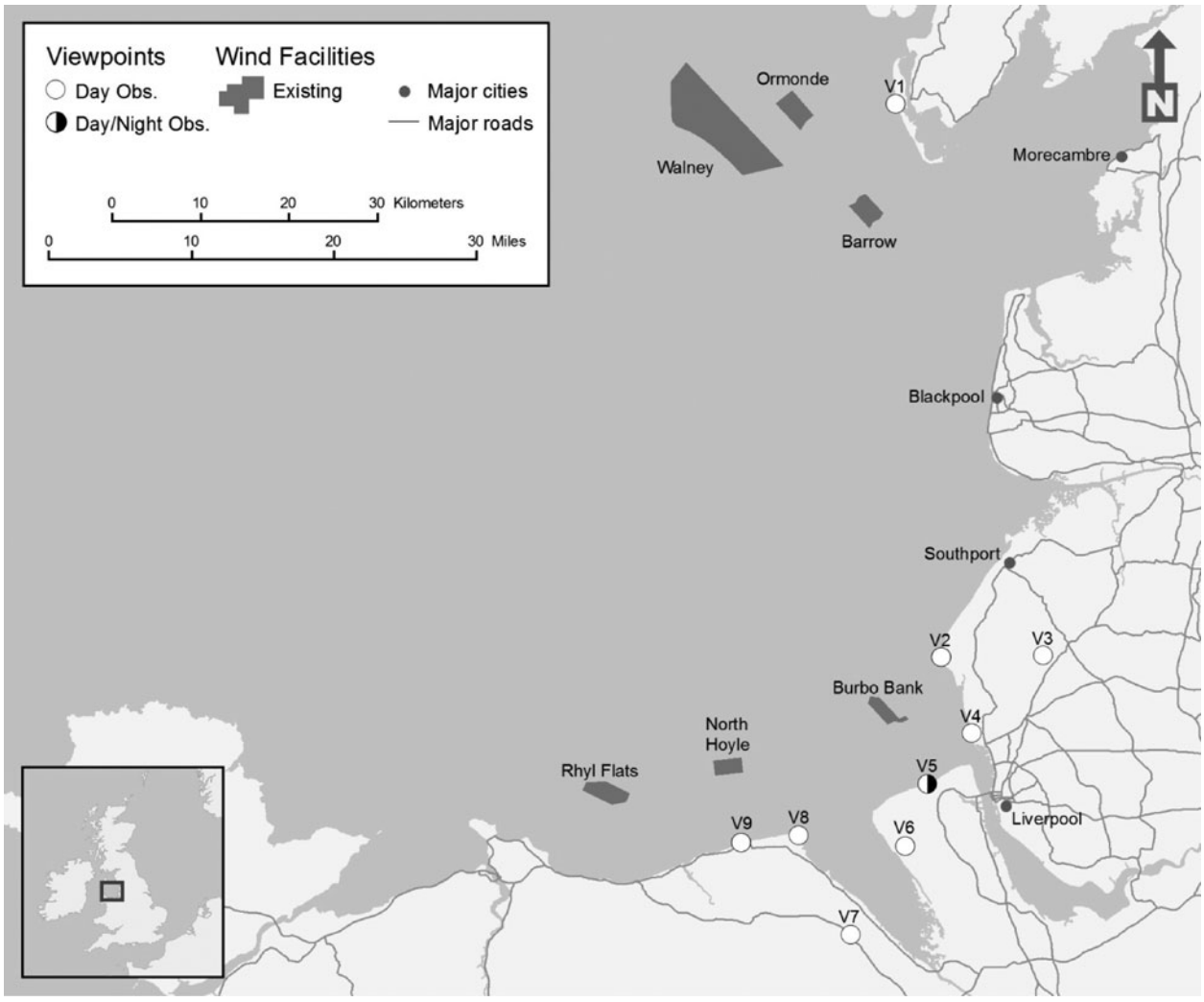

Figure 1. Irish Sea offshore wind facilities and onshore viewpoints.

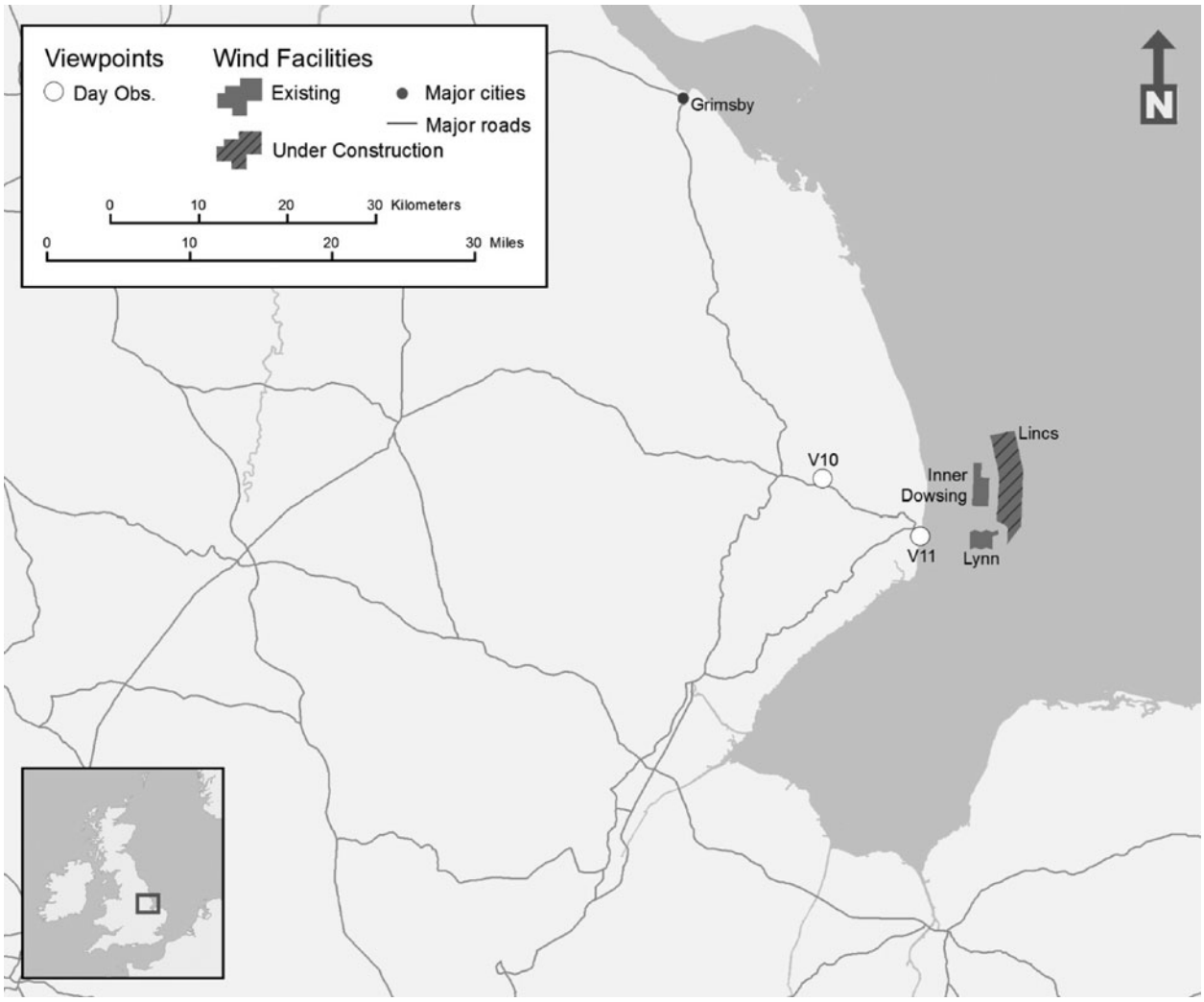

Figure 2. North Sea offshore wind facilities and onshore viewpoints.

edge that in some settings wind facility lighting could cause significant impacts at night because of changes in the character of the seascape. In a study conducted for the Cape Wind environmental assessment, the authors stated that, in evaluating the realism of night-sky impact simulations for the visual impact assessment, staff found aviation obstruction lighting on an operating commercial wind facility to be clearly visible at distances of 16–21 km (10–13 mi); visibility at longer distances was not evaluated. The authors further stated that the marine navigation lighting for Cape Wind "has a range of approximately 2 nautical miles" (Environmental Design and Research, 2003). As will be discussed, our present study shows that the visibility distances for both aviation obstruction lighting and marine navigation lighting are much greater than 16–21 km (10–13 mi).

Methodology

The fieldwork for this study was conducted in three regions of the UK from August 24 to September 1, 2011. Participants included a landscape architect, a geospatial visualization developer, and an archaeologist. A total of 49 daytime observations of 11 offshore wind facilities were made from 29 onshore locations, and 6 additional observations were made at night. The facilities observed were located in the Irish Sea near Liverpool, the North Sea near Skegness, and in or near the Thames Estuary. The facilities ranged from 25 to 140 turbines and were located within 6.0–52.0 km (3.4–32.3 mi) of the viewpoints. Viewpoints for the observations were chosen to represent key observation points used for the original preconstruction visual

impact analyses in the facilities' environmental assessments. The facilities observed, the viewpoints, and the distances from the viewpoints to the facilities are listed in Table 1; maps of the facilities and viewpoint locations are in Figures 1–3. Elevations for the observations varied from near sea level for shots taken from beaches to 256 m (840 ft) for an inland hill. Observation elevations are included in Table 1.

For each observation, single-frame photographs and panoramic sequences were taken at a variety of focal lengths; at many locations, short videos also were recorded to capture the motion of the turning blades. Data recorded included descriptions of the location of the viewpoint; weather, general lighting, and visibility conditions; and the backdrop content and color. In addition, observers collected information about the solar azimuth and elevation, the layout and height of the visible turbines, the shading and/or sunlight on the turbines, and the overall lighting angle. If observed, information about aviation and marine navigation marking/lighting was included, as well as whether blade movement or other transitory effects were noted. For nighttime observations, additional data collected included the number, type, and cycle of the aviation and/or marine lighting.

Visibility assessments for the facilities were also made for 39 of the observations, by using a methodology developed for the Visual Impact Threshold Distance Study—a study for the US Department of the Interior, Bureau of Land

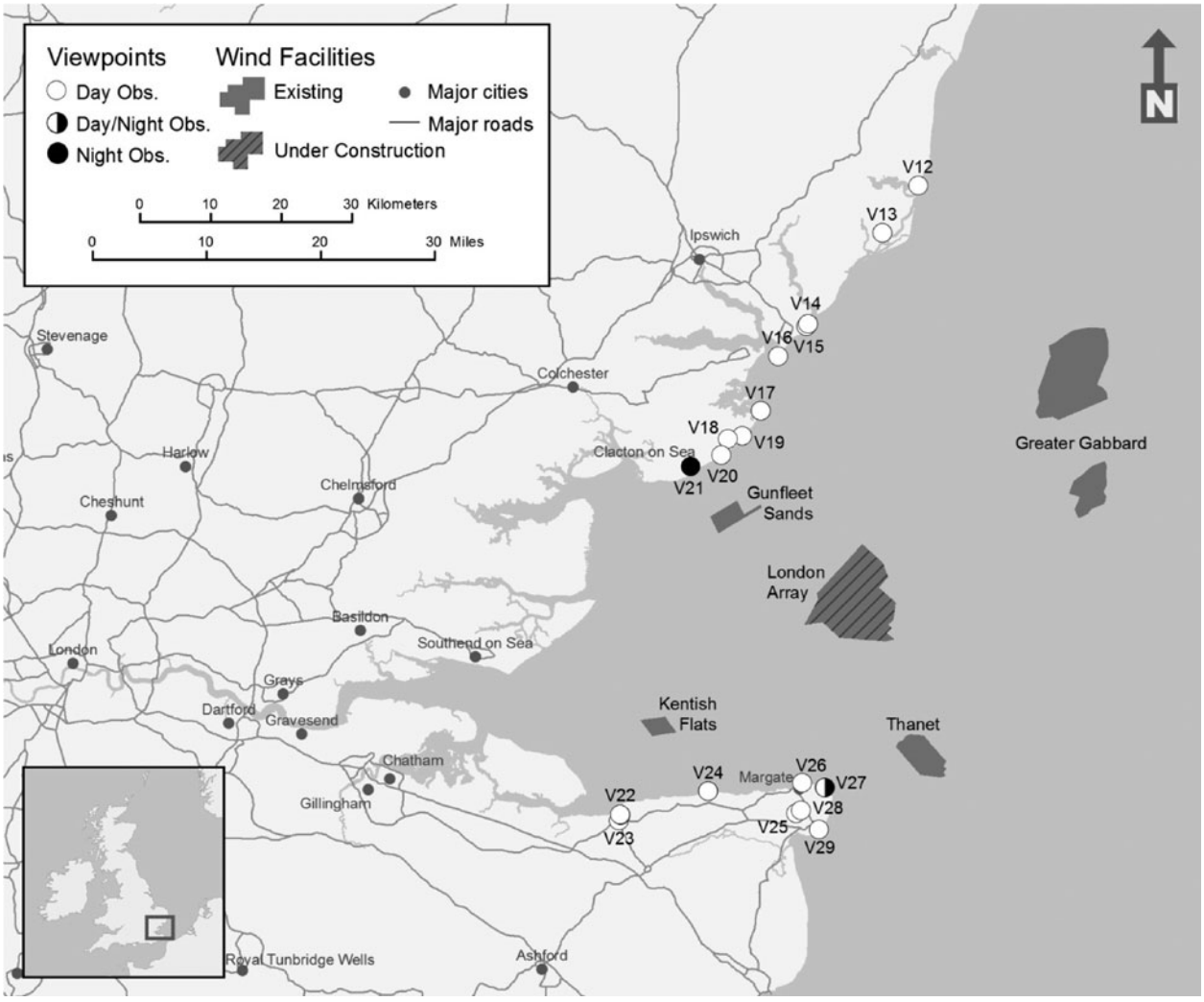

Figure 3. Thames Estuary offshore wind facilities and onshore viewpoints.

Table 2. Visibility Rating Form instructions used to rate visibility of offshore wind facilities

Visibility Rating Form instructions	
Visibility rating	**Description**
Visibility level 1. Visible only after extended, close viewing; otherwise invisible.	An object/phenomenon that is near the extreme limit of visibility. It could not be seen by a person who was unaware of it in advance and looking for it. Even under those circumstances, the object can be seen only after looking at it closely for an extended period.
Visibility level 2. Visible when scanning in the general direction of the study subject; otherwise likely to be missed by casual observers.	An object/phenomenon that is very small and/or faint, but when the observer is scanning the horizon or looking more closely at an area, can be detected without extended viewing. It could sometimes be noticed by casual observers; however, most people would not notice it without some active looking.
Visibility level 3. Visible after a brief glance in the general direction of the study subject and unlikely to be missed by casual observers.	An object/phenomenon that can be easily detected after a brief look and would be visible to most casual observers, but without sufficient size or contrast to compete with major landscape/seascape elements.
Visibility level 4. Plainly visible, so could not be missed by casual observers, but does not strongly attract visual attention or dominate the view because of its apparent size, for views in the general direction of the study subject.	An object/phenomenon that is obvious and with sufficient size or contrast to compete with other landscape/seascape elements, but with insufficient visual contrast to strongly attract visual attention and insufficient size to occupy most of an observer's visual field.
Visibility level 5. Strongly attracts the visual attention of views in the general direction of the study subject. Attention may be drawn by the strong contrast in form, line, color, or texture, luminance, or motion.	An object/phenomenon that is not large but contrasts with the surrounding landscape elements so strongly that it is a major focus of visual attention, drawing viewer attention immediately and tending to hold that attention. In addition to strong contrasts in form, line, color, and texture, bright light sources (such as lighting and reflections) and moving objects associated with the study subject may contribute substantially to drawing viewer attention. The visual prominence of the study subject interferes noticeably with views of nearby landscape/seascape elements.
Visibility level 6. Dominates the view because the study subject fills most of the visual field for views in its general direction. Strong contrasts in form, line, color, texture, luminance, or motion may contribute to view dominance.	An object/phenomenon with strong visual contrasts that is so large that it occupies most of the visual field, and views of it cannot be avoided except by turning one's head more than 45° from a direct view of the object. The object/phenomenon is the major focus of visual attention, and its large apparent size is a major factor in its view dominance. In addition to size, contrasts in form, line, color, and texture, bright light sources and moving objects associated with the study subject may contribute substantially to drawing viewer attention. The visual prominence of the study subject detracts noticeably from views of other landscape/seascape elements.

Form designed and developed by Argonne National Laboratory.

Management, to assess the effects of distance and atmospheric variables on the visibility and visual contrast levels of onshore wind facilities (Sullivan et al., 2012). The visibility assessments consist of numeric ratings on a scale of 1 to 6, scored on the visibility of a wind facility within its landscape/seascape setting and for the weather and lighting conditions at the time of the observation. The *visibility rating* is an observer judgment made by comparing the wind facility in view with language described on a visibility rating form that accounts for the visual characteristics of the wind facility appropriate to each rating level. Photographs were not used for visibility ratings; the ratings were conducted through naked-eye observations of the facilities in the field.

The rating scale is based on the US Bureau of Land Management's Visual Resource Management system (US BLM, 1984)—specifically, the Visual Contrast Rating (US BLM, 1986), which is used to predict the visual contrast of a proposed project with the surrounding natural landscape. The visibility rating form was customized for use with existing rather than proposed facilities. The form

also included several open-ended questions soliciting information from the observer to justify, explain, and/or expand upon the numeric visibility rating. The visibility ratings and instructions used by the observers to rate visibility are reproduced in Table 2.

Visibility ratings of 1 or 2 would generally correspond with low levels of visual contrast in the framework of the Visual Contrast Rating, ratings of 3 or 4 would correspond with moderate levels of visual contrast, and ratings of 5 or 6 would correspond with high levels of visual contrast.

Each observer completed a separate visibility rating form for each observation, rating the visibility and answering the questions for each form independently without consulting the other observers. Observers could discuss their ratings after each observation but were not allowed to change the ratings once the form was completed.

Figures 4–6 are photographs of the Burbo Bank wind facility in the Irish Sea near Liverpool (see Figure 1 for facility location) taken during the visibility rating process for this facility. The photos, taken at different distances and in different lighting conditions, illustrate how distance and lighting affect visibility of offshore wind turbines. Burbo Bank is a relatively small wind facility with 25 Siemens SWT 3.6-MW wind turbines. The turbines have a hub height of 83.5 m (274 ft) and a 107-m (351-ft) rotor diameter, for a total height at blade tip of 137 m (449 ft).

Figure 7 is a photograph of the much larger Thanet wind facility near the mouth of the Thames Estuary off the coast of Kent (see Figure 3 for facility location). The Thanet facility consists of 100 Vestas V90/3000 3-MW wind turbines. The turbines have a hub height of 70 m (230 ft) and a 90-m (295-ft) rotor diameter, for a total height at blade tip of 115 m (377 ft).

Figure 4. Burbo Bank wind facility photographed from Leasowe Castle Golf Course (Viewpoint V5 in Figure 1), approximately 7.9 km (4.9 mi) from the closest turbine. The turbines are sidelit from the left but largely shaded. Visibility rating = 5.00. Equivalent 35-mm focal length = 57 mm.

Figure 5. Burbo Bank wind facility photographed from Thurstaston Commons (Viewpoint V6 in Figure 1), approximately 14.2 km (8.8 mi) from the closest turbine. The turbines are sidelit from the right, with 19 turbines in full sun, 6 partly shaded. Average visibility rating = 5.00. Equivalent 35-mm focal length = 55 mm.

Results

As already noted, a total of 49 daytime observations of 11 offshore wind facilities were made from 29 onshore locations, and 6 additional observations were made at night. Weather and visibility conditions varied widely during the 10 days allotted for fieldwork. Most days were partly to mostly cloudy; 1 day included significant, prolonged rainfall; and 3 days were sunny, although, for 1 of those days, fog at sea obscured visibility of the designated wind facilities entirely. In general, visibility was judged to be good, though many observations included low contrast levels between shaded wind turbines and cloudy-sky backdrops.

A total of 98 visibility rating forms were completed for 39 of the 49 daytime observations, and the form data were entered into a database for analytical purposes. For 21 of the 39 observations, three observers completed visibility rating forms; for 17 of the 39 observations, two observers completed forms; and, for the remaining observation, one observer completed a form. Caution should be used in interpreting the results of this preliminary assessment because biases could have been introduced by having a small number of observers with differing levels of visual acuity and potential individual biases, as well as a small number of observations for each wind facility.

Analysis of the visibility rating data indicated very good agreement between the raters. In many cases, the observers gave identical numeric visibility ratings, and in the vast majority of cases with three observers, at least two of the three were in agreement. In only two cases did observers differ in their numeric rating by more than one point; in

Figure 6. Burbo Bank wind facility photographed from Point of Ayr (Viewpoint V8 in Figure 1), approximately 16.7 km (10.4 mi) from the closest turbine. The turbines are fully shaded. Average visibility rating = 3.13. Equivalent 35-mm focal length = 52 mm.

one of these cases, the ratings were not made at exactly the same time; clouds that had shaded the turbines moved in the few minutes between evaluations, such that the ratings were made in different lighting conditions.

Analysis of the visibility rating data indicates a gradual drop-off in ratings with distance; the change is nonlinear, perhaps because of variability in lighting, contrast of the wind turbines with the background, facility size and layout, blade orientation and rotation rate, and various other factors that affect visibility in real landscape/seascape settings. Figure 8 is a graph of the relationship between distance and the visibility rating for all daytime assessments, regardless of weather and lighting conditions. The drop-off in visibility with distance was consistent regardless of weather, sun angle, blade movement, or blade orientation (although there was some variation in slope), suggesting that distance is indeed a prime determinant of visibility for a given design, size, and color of wind turbine.

Although caution is warranted because of the relatively small number of observations, the results suggest that, at a distance of approximately 16 km (10 mi), visibility drops below a rating of 5, indicating that, beyond this distance, the observed wind facilities were not a major focus of visual attention. At a distance of approximately 29 km (18 mi), visibility drops below a rating of 3, indicating that, beyond this distance, the observed wind facilities would likely not be noticed by a casual observer.

The observations made during this study suggest that, under favorable but not exceptional viewing conditions, moderately sized offshore wind facilities may frequently be visible at distances exceeding 35 km (22 mi); in this study, they were visible at a maximum distance of 44 km (27 mi) (Gunfleet Sands, Viewpoint V13, elevation 13 m). It should be noted that objects on the horizon may be seen at greater distances from elevated viewpoints because the screening effect of earth curvature is affected by viewer and target height. As would be expected, at these distances, the wind facilities were barely visible. However, when atmospheric conditions and lighting angles resulted in higher contrasts between the turbines and the sky backdrops, the facilities were judged likely to be seen easily by casual observers as

Figure 7. Thanet wind facility photographed from Fayreness Hotel (Viewpoint V27 in Figure 3), approximately 12.3 km (7.6 mi) from the closest turbine. The turbines are backlit in the early morning. Average visibility rating = 5.00. Equivalent 35-mm focal length = 57 mm.

far away as 29 km (18 mi) for a relatively large wind facility (100 turbines). Smaller wind facilities (25–48 turbines) were generally judged to be easily visible at distances of 22–25 km (14–15 mi).

With few exceptions, regardless of facility size or lighting conditions, on days with good visibility conditions, offshore wind facilities were judged to be major foci of visual attention at distances of 16 km (10 mi) or less, suggesting potentially high levels of visual impact for sensitive viewers. That these distances are greater than those reported in previous studies is likely a function of the long-term trend toward larger facilities with more and larger turbines than were assessed in previous studies.

Turbine blade movement was visible at distances as great as 42 km (26 mi) in 42 of the 49 daytime observations (Gunfleet Sands, Viewpoint V25, elevation 47 m) and was observed routinely at distances of 34 km (21 mi) or less. Contrary to expectations, lighting conditions, sun angle, and apparent contrast between the turbines and the sky backdrop did not substantially affect the likelihood of observing blade motion; blade motion was visible at distances beyond 30 km (19 mi) regardless of sun angle, lighting conditions, or contrast levels. Again, these distances are greater than those reported in previous studies.

Blade motion was noted by at least one observer as a major contributor to contrast levels for 24 of the 42 observations where blade motion was visible. All observers noted blade motion as a major contributor to contrast levels for 12 observations, one of which was at a distance of 34 km (21 mi) (Greater Gabbard, Viewpoint V14, elevation 8 m). Of the 24 observations where blade motion was judged to contribute substantially to visual contrast, 15 (62%) were at viewing distances of 16 km (10 mi) or less, suggesting that blade motion may contribute relatively more to visual contrast at shorter viewing distances.

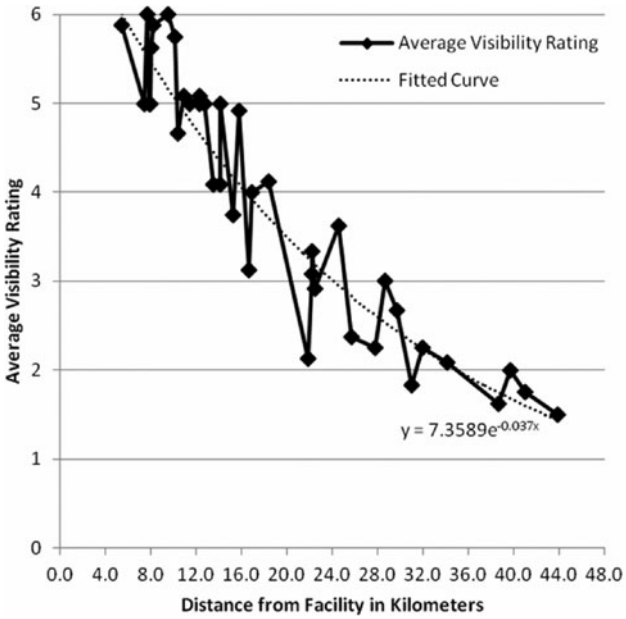

Figure 8. Offshore wind facility visibility-distance curve for 39 daytime observations of 11 offshore wind facilities in a variety of lighting conditions. The average visibility rating (y-axis) decreases as a function of increasing distance from the facilities (x-axis).

The base of each wind turbine tower must be painted yellow as an aid to marine navigation. The paint is reflective because it is designed to be easily seen, and it can contrast strongly with the white of turbine towers and dark sky or sea backgrounds. The yellow was noted as visible in 18 of the 49 study observations and at 8 of the 11 wind facilities observed, at a maximum distance of 17 km (11 mi) (Walney, Viewpoint V1, elevation 10 m). Marine paint was not stated to be a major contributor to visual contrast but was described as easily visible at distances up to 13 km (8 mi).

Our informal, qualitative opinion is that the photographs taken in the field generally show lower visual contrast levels than were actually observed during the visibility ratings. The photographs show lower contrast and less detail than was actually apparent in the naked-eye observations, and they do not capture the blade motion that attracted the visual attention of observers in the field.

Six observations were at night. Moderately sized offshore wind facilities were visible for long distances at night, with the red flashing aviation obstruction lighting visible at just under 40 km (25 mi) (Thanet, Viewpoint V27, elevation 20 m). At these long distances, the lights were not as bright as other lights visible at sea at the time but were recognizable as wind facility lights because of the spatial configuration and flashing. At a distance of 21 km (13 mi), both red aviation obstruction lighting and amber marine navigation lighting were visible at one facility, as seen from an elevated viewpoint (North Hoyle, Viewpoint V5, elevation 17 m). At shorter distances [7–12 km (4–7 mi)], amber and/or white marine lights and red aerial lights were visible for all observations and judged to be a major focus of attention within the visible seascape, in part because of the variable flashing rates and contrasting colors of the different lighting types. In some cases, at these shorter distances, the lights were judged to detract from seaward views, depending on the number and brightness of other visible lights and structures in the views. Although visibility ratings were not made for nighttime observations, an observer noted that lighting on a 30-turbine facility was bright enough to be visible from the interior of a normally lit room at a distance of 21 km (13 mi). Figure 9 is a nighttime photograph of Thanet Wind Facility (100 turbines) taken from Fayreness Hotel (V27 in Figure 3, elevation 20 m).

The visibility ratings for the fieldwork did not explicitly address cumulative effects when multiple offshore wind facilities are in view simultaneously from a given observation point, but the potential significance of the cumulative effects was noted by project staff, and local inhabitants mentioned this concern in several unsolicited comments. Because of the large size of offshore wind facilities, the existence of multiple facilities close to the observation point might limit the possibility for views of the seascape that do not include wind turbines, which some local inhabitants reported as a negative visual impact.

Figure 10 depicts another important type of cumulative visual impact: multiple wind facilities in a single line of sight. In this instance, two wind facilities at different distances from shore [Walney and Ormonde (viewed from V1 in Figure 1)] are visually juxtaposed so that the turbines appear to be interspersed. The line of sight is perpendicular to the long axis of the turbine arrays in both facilities, maximizing visibility of the turbines. Furthermore, one of the wind facilities (Ormonde) uses steel-lattice quadruped foundations that are partially visible projecting above the waterline and add substantially to the visual contrast of the turbines. The differing turbine size, style, and spacing between the two facilities create visual discordance that the observers felt strongly attracted and held visual attention.

Figure 9. Thanet wind facility photographed from Fayreness Hotel (Viewpoint V27 in Figure 3) at night, approximately 12.3 km (7.6 mi) from closest turbine. Most of the white lights visible in the photograph are marine navigation lights; red lights are aviation obstruction lights. The bright light in the center of the photograph is an offshore substation. The photograph is slightly overexposed.

Conclusion

This preliminary study has clearly shown that even small offshore wind facilities of a few dozen turbines can be seen easily at distances exceeding 25 km (15 mi) and that moderately sized facilities of 100 turbines are seen easily at distances of 35 km (22 mi) or even farther, in a variety of weather and lighting conditions. At distances of 14 km (9 mi) or less, even isolated, small facilities will likely be a major focus of visual attention in seaward views, again in a variety of weather and lighting conditions.

To date, most assessments of potential visual impacts of offshore wind facilities have identified lower levels of visibility at a given distance than the results of this study suggest. This is likely a result of reliance on earlier field studies of smaller turbines and facilities than are currently in use.

Applying visual ranges for those smaller turbines and facilities to today's technology might result in a systematic underestimate of the visibility of offshore wind facilities. Ultimately, this could result in siting of facilities close enough to sensitive visual resource areas and sensitive viewing locations to result in major visual impacts to these receptors. This, in turn, could engender stakeholder opposition that will delay or halt deployment of some offshore wind facilities. As nations move toward offshore siting of multiple wind facilities of hundreds or even thousands of large wind turbines, the visual impacts will increase dramatically, with significant potential cumulative impacts. Accurate knowledge of visibility of current and future wind

Figure 10. Ormonde (foreground) and Walney (background) wind facilities photographed from Walney Island (Viewpoint V1 in Figure 1), approximately 9.5 km (5.9 mi) from the closest turbine in the Ormonde facility and 17.0 km (10.6 mi) from the closest turbine in the Walney facility. Ormonde turbines are mounted on quadruped structures. An offshore substation is at center left. Equivalent 35-mm focal length = 157 mm.

technology as deployed at current and future scales will be even more critical to optimal siting.

It is essential to our national and global well-being to move toward less carbon-intensive energy sources, including offshore wind resources. Doing so in the most environmentally and socially responsible manner is also essential, if for no other reason than that failure to do so will invariably result in strong opposition from parties having an interest in or commitment to protecting potentially affected resources. Large-scale deployment of offshore wind facilities will involve major changes to the visual qualities of seascapes, from treasured views at national seashores and at historic and tribal properties to the everyday sea views of residents and visitors in coastal communities. Complete, accurate knowledge of the potential impacts to the nations' coastal visual resources is essential to achieving important national energy goals while fully considering ways to minimize potential environmental and social impacts.

Acknowledgments

Argonne National Laboratory's work was supported through the Fiscal Year 2010 National Oceanographic Partnership Program Broad Agency Announcement with the Bureau of Ocean Energy Management, US Department of Energy, and by the National Oceanic and Atmospheric Administration through US Department of Energy contract DEAC02-06CH11357. The authors express their appreciation to Chad Cooper and Malcolm Williamson (Center for Advanced Spatial Technologies) and to Kevin Beckman, Pamela Richmond, and Elizabeth Parent (Argonne National Laboratory) for their assistance in conducting this study and preparing this report.

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Submitted January 5, 2012; revised June 4, 2012; accepted June 11, 2012.

Appendix 2 London Array Offshore Windfarm Offshore Ornithology Monitoring Report


London
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Final Ornithological Monitoring Report for London Array Offshore Wind Farm – 2018

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Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1.0	02.11.17	1-3	All	'Front End': Creation	BG / LJ
1.1	15.11.17	1-3	All	'Front End': Internal review	RB
1.2	15.11.17	1-3	All	'Front End': Revision internal review	BG
1.2	17.11.17	1-4	All	'Front End': Ørsted & NIRAS review	TN / KL
1.0	21.11.17	4, 7	All	Barrier Effect: Creation	BG / LJ
1.0	23.11.17	5, 7	All	Collision Risk: Creation	BG / LJ
1.1	24.11.17	4, 7	All	Barrier Effect: Internal Review	MR
1.1	24.11.17	5, 7	All	Collision Risk: Internal Review	RB
1.3	29.11.17	1-4	All	'Front End': Revision external review	RB
1.2	05.12.17	4, 7	All	Barrier Effect: Revision internal review:	MR
1.2	06.12.17	4, 7	All	Barrier Effect: Ørsted & NIRAS review	TN / KL
1.0	06.12.17	6, 7	All	Displacement: Creation	BG / LSH / LJ
1.1	06.12.17	6, 7	All	Displacement: Internal Review	RB / SM
1.2	07.12.17	5, 7	All	Collision Risk: Revision internal review	RB
1.3	07.12.17	5,7	All	Barrier Effect: Revision external review	MR
1.2	07.12.17	6, 7	All	Displacement: Revision internal review	RB / SM
1.2	14.12.17	6, 7	All	Displacement: Ørsted & NIRAS review	TN / KL
1.3	04.01.18	6, 7	All	Displacement: Revision external review	RB / SM
1.4	04.01.18	All	All	Compilation of sections: 'Front End', Barrier Effect, Collision Risk, Displacement	RB / SM
1.5	12.01.18	All	All	Internal review of compiled report	MR
1.6	05.02.18	All	All	Ørsted (KL) & NIRAS (TN) review II	RB

Contents

1. Executive Summary 1

1.1 Assessment of Barrier Effect Summary 1

1.2 Assessment of Collision Risk Summary 2

1.3 Assessment of Displacement Summary 2

2. Introduction 4

2.1 Background 4

2.2 London Array Offshore Wind Farm 5

2.2.1 Monitoring requirements 7

2.3 Potential wind farm effects and the identification of key species 8

2.3.1 Overview 8

2.3.2 Barrier effect 8

2.3.3 Collision risk 8

2.3.4 Displacement effects 9

3. Survey Methods 11

3.1 Overview 11

3.2 Survey timings, design, and locations 12

3.2.1 Boat-based and aerial visual surveys undertaken to characterise the EIA baseline 12

3.2.2 Aerial digital monitoring survey timings 14

3.2.2.1 The pilot study (2009-2010) 17

3.2.2.2 The pre-, during-, and post-construction programme of aerial digital surveys 17

3.2.3 Locations surveyed by the pilot study and the pre-, during- and post-construction programme of aerial digital surveys 17

4. Survey Results 20

4.1 Overview 20

4.2 EIA boat-based survey abundance estimates 20

4.3 EIA aerial visual survey abundance estimates 21

4.4 Post-consent (2009-2016) aerial digital survey report summary 21

4.5 Monitoring period (2010-2016) aerial digital results species overview 23
4.5.1 Wildfowl 26
4.5.2 Divers 26
4.5.3 Fulmar 27
4.5.4 Shearwaters 27
4.5.5 Gannet 27
4.5.6 Cormorants and shags 28
4.5.7 Grebes 29
4.5.8 Waders 29
4.5.9 Skuas 29
4.5.10 Small gulls 29
4.5.11 Large gulls 33
4.5.12 Auks 37
5. Assessment for Barrier Effect 39
5.1 Introduction 39
5.2 Methods 39
5.2.1 Data preparation 39
5.2.2 Analysis 40
5.3 Results 41
5.4 Discussion 46
5.5 Summary 49
6. Assessment for Collision Risk 51
6.1 Introduction 51
6.2 Methods 51
6.3 Results 53
6.4 Discussion 56
6.5 Summary 56
7. Assessment for Displacement 57

7.1 Introduction 57
7.2 Methods overview 57
7.2.1 Modelling approach overview 58
7.2.2 Modelling approach in-detail 58
7.2.3 Prediction grid 59
7.2.4 Spatially explicit inference 59
7.3 Results: Divers 60
7.4 Results: Auks 73
7.5 Discussion 86
7.5.1 Discussion: Divers 86
7.5.2 Discussion: Auks 88
7.6 Summary 88
8. Conclusions 90
9. References 92

List of Figures

Figure 1 Full extent of the Outer Thames Estuary SPA. 6

Figure 2 London Array offshore wind farm site (black outline was the planned wind farm extent, blue is the extent of Phase 1 as constructed) and buffer zone surveyed during the aerial and boat-based surveys (green outline) conducted between 2002 and 2007. 14

Figure 3 Example of 500 m grid survey image nodes in Zone 1 used since the 2010-2011 surveys. 18

Figure 4 London Array offshore wind farm site (Zone 1) and control zone (Zones 2 and 3) surveyed during the 'pilot study' conducted in 2009 / 10. 18

Figure 5 Zones 1-7 surveyed during the period November 2010 – February 2013. Zone 4 was only flown in November 2010 due to overlapping danger areas (D138, 138A and 138B). 19

Figure 6 Post-construction survey areas of Zone 1 and Zone 2 19

Figure 7 Mean densities per development phase of gannets recorded in Zone 1 and Zone 28

Figure 8 Mean densities per development phase of kittiwakes recorded in Zone 1 and Zone 2 30

Figure 9 Mean densities per development phase of black-headed gulls recorded in Zone 1 and Zone 2.....31

Figure 10 Mean densities per development phase of common gulls recorded in Zone 1 and Zone 2 32

Figure 11 Mean densities per development phase of small gull species recorded in Zone 1 and Zone 2 33

Figure 12 Mean densities per development phase of lesser black-backed gulls recorded in Zone 1 and Zone 2.....34

Figure 13 Mean densities per development phase of herring gulls recorded in Zone 1 and Zone 2 35

Figure 14 Mean densities per development phase of great black-backed gulls recorded in Zone 1 and Zone 2.....36

Figure 15 Mean densities per development phase of black-backed gull species recorded in Zone 1 and Zone 2.....36

Figure 16 Mean densities per development phase of large gull species recorded in Zone 1 and Zone 2 37

Figure 17 Distribution of flying divers recorded during the pre-construction phase digital aerial surveys (November 2010 to February 2011) 42

Figure 18 Distribution of flying divers recorded during the construction phase digital aerial surveys (November 2011 to February 2013) 43

Figure 19 Distribution of flying divers recorded during the post-construction phase digital aerial surveys (November 2013 to February 2016) 44

Figure 20 Differences in flying diver densities between the pre-, during-, and post-construction phases. 45

Figure 21 Difference in peak density of flying birds between the pre- and post-construction phases within the LAW footprint, Zone 1, and Zone 2 for each of the key species. 54

Figure 22 Pre-construction, during construction, and post-construction mean observed diver density (birds per sq km) 61

Figure 23 Pre-construction diver density (birds per sq km) lower and upper confidence limits 62

Figure 24 During construction diver density (birds per sq km) lower and upper confidence limits 63

Figure 25 Post-construction diver density (birds per sq km) lower and upper confidence limits 64

Figure 26 Mean diver density (+ 95% confidence intervals generated during the modelling process) within the London Array Wind Farm (LAW), Zone 1, and Zone 2 per development phase 65

Figure 27 Predicted differences in average diver numbers per 1 km x 1 km square comparing pre- and during construction. Statistically significant increases are indicated using '+', and statistically significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '*'. 66

Figure 28 Predicted differences in average diver numbers per 1 km x 1 km square comparing pre- and post-construction. Statistically significant increases are indicated using '+', and statistically significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '*'. 67

Figure 29 Predicted differences in average diver numbers per 1 km x 1 km square comparing during and post-construction. Statistically significant increases are indicated using '+', and statistically significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '*'. 68

Figure 30 Diver density (+ 95% confidence intervals generated during the modelling process) at different distances from the London Array Wind Farm 70

Figure 31 Proportion of divers (+ 95% confidence intervals generated during the modelling process) by distance to the London Array Wind Farm....71

Figure 32 Percentage change in proportion (+ 95% confidence intervals generated during the modelling process) of divers between construction periods....72

Figure 33 Pre-construction, during construction, and post-construction mean observed auk density (birds per sq km)....74

Figure 34 Pre-construction auk density (birds per sq km) lower and upper confidence limits 75

Figure 35 During construction auk density (birds per sq km) lower and upper confidence limits 76

Figure 36 Post-construction auk density (birds per sq km) lower and upper confidence limits 77

Figure 37 Mean auk density (+ 95% confidence intervals generated during the modelling process) within the London Array Wind Farm (LAW), Zone 1, and Zone 2 per development phase 78

Figure 38 Predicted differences in average auk numbers per 1 km x 1 km square comparing pre- and during construction. Statistically significant increases are indicated using '+', and significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '*'....79

Figure 39 Predicted differences in average auk numbers per 1 km x 1 km square comparing pre- and post-construction. Statistically significant increases are indicated using '+', and significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '*'....80

Figure 40 Predicted differences in average auk numbers per 1 km x 1 km square comparing during and post-construction. Statistically significant increases are indicated using '+', and significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '*'....81

Figure 41 Auk density (+ 95% confidence intervals generated during the modelling process) at different distances from the London Array Wind Farm 83

Figure 42 Proportion of auks (+ 95% confidence intervals generated during the modelling process) by distance to the London Array Wind Farm 84

Figure 43 Percentage change in proportion (+ 95% confidence intervals generated during the modelling process) of auks between construction periods 85

List of Tables

Table 1 Summary of collision risks from the London Array Offshore Wind Farm (London Array Limited, 2005). 9

Table 2 Summary of displacement impact assessment from the London Array Offshore Wind Farm (London Array Limited, 2005) 10

Table 3 Timeline of surveys and events of the London Array Offshore Wind Farm (LAW) 11

Table 4 Information on survey dates for baseline EIA boat-based surveys. 12

Table 5 Information on survey dates for baseline EIA aerial visual surveys 13

Table 6 Information on survey dates and zones surveyed during pre-, during- and post-construction surveys. 14

Table 7 Percival and distance analysis peak abundance estimates and density values of red-throated divers for each winter from baseline EIA boat-based surveys. CL: 95% Confidence Limits. 20

Table 8 Peak total population estimates and densities comprising distance estimates plus scaled up 'in flight' counts of red-throated divers for each winter from baseline EIA boat-based surveys. 21

Table 9 Peak distance analysis estimates and density values of red-throated divers for each winter from the baseline EIA aerial visual surveys. 21

Table 10 Mean density per species per Zone (1, 2, 3, 4, 5, 6 and 7) per development phase: pre-construction, during construction, and post-construction 25

Table 11 Counts of flying divers per construction phase and per buffer region (LAW = London Array Offshore Wind Farm). 45

Table 12 Counts of flying divers during the post-construction phase per buffer region. Directions are relative to the nearest turbine of the London Array Wind Farm. 46

Table 13 Raw counts and proportion of bootstrapped samples of flying divers present in each buffer region during the post-construction phase and the probability that such a proportion of bootstraps would occur by chance 46

Table 14 Turbine parameters used to generate the ratio between the total turbine rotor swept zones used for the ES collision calculations and as exists in the LAW. 53

Table 15 Peak flying bird densities within the wind farm footprint pre- and post-construction of LAW. Numbers in bold represent the peak value recorded during the pre- and post-construction periods. Numbers in italics contain apportioned individuals. 53

Table 16 Mean flying bird densities used in the ES to estimate collisions and within the LAW footprint post-construction. No small gull densities are provided in the ES. 55

Table 17 Predicted change in the numbers of collisions in built LAW from the numbers predicted in ES. No change is presented for small gulls as they were not included in the ES. 55

Table 18 Final diver model covariates. 60

Table 19 Final auk model covariates. 73

Table 20 Displacement effects for divers and auks from other offshore wind farms taken from Welcker & Nehls (2016): '-' and '0' indicates statistically significant negative effect on abundance and no effect detected respectively. Symbols in parentheses indicate no significant effect, but response suggested by authors. 89

1. Executive Summary

- This report provides a summary of the results of surveys undertaken from 2009 until 2016, evaluating them against the requirements of the Marine Licence and its stated objectives in order to determine whether these requirements have been discharged.
- A process, informed by the conclusions of the Environmental Statement and consultation with the Marine Management Organisation, Natural England and the RSPB (organised through the Ornithological Review Panel [ORP]), determined the key species in relation to each monitoring objective. This report primarily presents analysis and conclusions with respect to the following effects and key species:
    - Barrier effects of divers;
    - Collision risk in relation to divers, gannet, large gulls, and small gulls; and
    - Displacement effects of divers and auks.
- Since 2009 APEM, on behalf of London Array Ltd., has conducted digital aerial surveys over the London Array Offshore Wind Farm (LAW) and associated control zones over the winter months November to February.
- The monitoring period began in November 2010 and concluded in February 2016. Zone 1 (which contained the LAW) and Zone 2 (surveyed as the 'reference' site), were consistently surveyed from 2010 until 2016.
- The period 2010 until 2016 was classified as the monitoring period with three phases: pre-construction (2010-2011), during construction (2011-2013), and post-construction (2013-2016). Annual monitoring reports were produced for the programme of surveys conducted each winter across this period.
- The survey months were selected to coincide with the key season for the occurrence of non-breeding red-throated divers, as agreed as part of the ORP process.
- The most abundant species recorded was divers (peak density: 15.86 birds km^{-2} recorded for red-throated divers) and the second most abundant was auks (peak density: 5.58 birds km^{-2} recorded for guillemot / razorbills).
- Non parametric analysis was undertaken for gannets, small gulls and large gulls to investigate if there was any significant difference in densities between the development phases for Zone 1 and Zone 2. A significant difference was observed for common gull (P=0.01) in Zone 1 and herring gull in Zone 2 (P=0.01).
- Analysis was not undertaken for species recorded sporadically (scaup, common scoter, unidentified seaduck species, fulmar, shearwater, grebes, waders and skuas) during the monitoring period (2010-2016) as too few were recorded.

1.1 Assessment of Barrier Effect Summary

- To assess barrier effect, the relative bearing of each bird to the closest turbine was estimated. Directions were subdivided in to four quadrants: towards, away, and two for flying parallel in relation to the nearest turbine based on the relative angle.
- Two approaches were used to test the relative direction of flying divers in relation to the nearest turbine of the LAW. The null hypothesis that divers were likely to fly in all directions was tested using first a chi-squared (χ^2) test and second a randomisation approach.
- The first analysis found no significant difference in the number of divers flying towards the LAW compared to that which would be expected by chance (P >0.05). However the number of flying divers recorded was low, especially in the buffer regions nearest to the LAW.
- To further investigate, additional analysis of flight directions was undertaken based on data bootstrapping. The results of this analysis showed that in the 2 to 4 km buffer

region, significantly fewer divers than expected by chance were recorded flying toward the wind farm ($P > 0.05$). For the remaining buffer regions, LAW to 2 km and greater than 4 km, no significant difference was found between the number of divers flying towards the OWF and in other directions

- No flying birds within the footprint and a trend for increasing densities of flying divers away from the LAW post-construction suggest displacement that could be in part brought about by a possible barrier effect. The evidence that divers avoided flying towards the LAW when between 2 km and 4 km of it provides stronger evidence of a possible barrier effect created by the LAW.
- This analysis was specifically conducted in relation to individual flight direction relative to the nearest turbine, rather than in relation to areas of suitable habitat (e.g. within the Outer Thames Estuary Special Protection Area [OTE SPA]). The area covered by the OTE SPA consists of large areas of favourable habitat for divers and any effect on energy expenditure created by a barrier would be expected to be negligible as rather than flying around any obstruction the divers may be able to utilise other feeding or roosting areas in other directions.

1.2 Assessment of Collision Risk Summary

- The density of flying individuals within the LAW was calculated for each species for each survey month based on the number of individuals in flight and the area surveyed. The peak density estimates per development phase of each key species were identified and qualitatively compared between pre-construction and post-construction.
- The expected number of collisions in the LAW was extrapolated from the estimated number of collisions in the ES. Assuming that the flight behaviour of each species does not change between the pre- and post-construction phases, and that comparable survey data have been gathered for the two phases the change in the estimated number of collisions for each species in the LAW from that predicted in the ES would be directly proportional to (1) the change in the species' densities used for the ES and those recorded post-construction, and (2) the ratio of the total rotor swept zones used in the built wind farm to that estimated in the ES. If these assumptions are correct the following should be exact.
- Red-throated divers were not recorded in flight during the post-construction phase of the LAW and therefore the species is not expected to be at collision risk from the turbines. For gannet, lesser black-backed, herring gull, and great black-backed gull the estimated number of collisions is lower than that predicted in the ES primarily due to the reduced number of turbines installed at LAW compared to the number used in the ES predictions. The lower flying bird densities measured in the post-construction surveys compared to that included in the ES predictions also contributes to lower collisions estimates for all but great black-backed gull. These results do not support the need for further collision monitoring.

1.3 Assessment of Displacement Summary

- APEM Ltd was commissioned by Natural England in 2016 with permission from London Array Ltd to undertake spatial modelling of diver and auk density based on relevant environmental variables following the first year of post-construction surveys.
- The purpose of the modelling was to identify any potential displacement impacts and to set up a suitable model framework for any subsequent analysis of the data collected at the LAW.

- Using the same spatial modelling approach, but including the final two years of post-construction surveys, the Centre for Research into Ecological and Environmental Modelling (CREEM) repeated the assessment of displacement using the MRSea package in the R statistical program. The modelling outputs were summarised and presented graphically according to distance from the London Array Windfarm.
- The density profile of divers increased gradually throughout the buffer regions with a peak at 9 km pre-construction. This may be indicative that other factors, apart from the construction activities at the LAW, are compounding any displacement effects on divers in the region. Year-to-year fluctuations in diver numbers and distribution should be an important consideration when interpreting the results. The displacement distance estimated for divers was between 4.5 km and 11 km. However these results have not been subjected to any statistical analysis and therefore may not indicate significant changes. Overall, the displacement effects of divers appeared to be less than expected but occurred over a larger distance.
- A decreasing proportion of auks were estimated to be displaced up to approximately 5 km from the LAW but, as for divers, complete displacement was not detected at any distance. However these results have not been subjected to any statistical analysis and therefore may not indicate significant changes.

2. Introduction

2.1 Background

London Array Ltd commissioned APEM Ltd (APEM) to undertake the analysis of the aerial survey data that APEM has acquired to demonstrate that the monitoring requirements of the Marine Licence, including the achievement of the objectives set out in its Annex 2, have been fully discharged following completion of the programme of ornithological monitoring for the London Array Windfarm (LAW).[1]

Since 2009 APEM, on behalf of London Array Ltd. has conducted digital aerial surveys over the LAW and associated control zones over the winter months November to February. These survey months were selected to coincide with the key season for the occurrence of non-breeding red-throated divers agreed as part of the Ornithological Review Panel[2] (ORP) process.

Previous analysis has provided information on the abundance and distribution of divers, and other species recorded, within Zone 1 and associated control zones, with that information summarised within survey reports (APEM, 2010; 2011a; 2012; 2013a; 2014; 2015a; 2017). In addition to these annual reports, an additional analysis report was provided as an addendum to the first year of post-construction aerial surveys (APEM, 2015b). The scope and analysis of that report was agreed with Natural England (NE) and the Royal Society for the Protection of Birds (RSPB) as part of the ORP process. The primary objective of that report was to provide additional information regarding the density profile of divers (predominantly, but not exclusively red-throated divers) pre-, during, and the first year post-construction of the LAW.

There are now sufficient data available (following the completion of the full three years of post-construction surveys) to conduct more detailed analysis to assess the magnitude of any reduction in diver density with increasing distance from the LAW. Part of the analysis presented herein follows on from analysis carried out by APEM on behalf of NE to assess the density of divers and auks in relation to the LAW following the first year of post-construction surveys (APEM, 2016). That analysis has been updated following completion of the further two years of post-construction surveys.

The scope of the analysis presented herein has been agreed with NE and the Marine Management Organisation (MMO), as part of the ORP process (that includes RSPB), in order to discharge the Marine Licence Conditions of the LAW.

The purpose of this report is to provide a complete summary of the methods and results of pre-, during- and post-construction monitoring surveys and to evaluate those results against the objectives in the Marine Licence in order to discharge the requirements. Specifically this report presents analysis and conclusions with respect to:

- Barrier effects;

[1] Predominantly red-throated diver *Gavia stellata* but also including black-throated diver *G. arctica* and great northern diver *G. immer*.

[2] The ORP was a formal process established to oversee the monitoring and decisions about the development of Phase 2 (the plan for which was subsequently terminated in 2014 due to potential impact on the red-throated diver population in the vicinity combined with technical challenges).

- Collision risk; and
- Displacement effects.

2.2 London Array Offshore Wind Farm

The London Array Windfarm (LAW) is a 630 MW offshore wind farm located in the outer part of the Thames Estuary. The wind farm comprises 175 3.6 MW wind turbine generators (WTG) and occupies approximately 100 km^2 of the outer Thames Estuary. The offshore components of the project were constructed and installed between March 2011 and December 2012.

Located off the coast of Kent, Essex, Suffolk and Norfolk is an area of sea that supports an internationally important wintering population of red-throated diver (Stroud *et al*., 2001; Musgrove *et al*., 2011). Protection for this population has been given by the classification of an area as the Outer Thames Estuary Special Protection Area (OTE SPA) in 2010 (Figure 1). The Outer Thames Estuary SPA has been identified by Natural England using data collected from aerial surveys during the period from January 1989 to winters of 2005 / 06 and 2006 / 07 and analysed by the Joint Nature Conservation Committee (JNCC) Seabirds and Cetaceans Team. These data show that the Outer Thames Estuary SPA regularly supports numbers of wintering red-throated diver that are of European importance, exceeding 1% of the Great Britain (GB) population of 17,000 birds. The red-throated diver is listed under Annex I of the EU Birds Directive (79/409/EEC) as being a rare or vulnerable species, meaning that EU member states are obligated to identify and designate key areas of habitat used by the species as SPAs. Sites supporting 1% or more of the GB population of an Annex I species are automatically considered for SPA designation (Stroud *et al*., 2001). Visual aerial survey estimates for the Outer Thames Estuary SPA place the wintering total at 6,466 individuals or 38% of the GB estimate (O'Brien *et al*., 2008). The SPA covers over 379,268 ha of offshore habitat between Kent and Norfolk. Over the wider Greater Thames area, estimates of 8,130 red-throated divers have been made, representing 47% of the national estimate (O'Brien *et al*., 2008). In the winter of 2012 / 13 the peak estimate of the population in the SPA was 14,161 (Goodship *et al*., 2015) the highest number ever found in one place in north-west Europe.

The potential impact of LAW on the red-throated diver interest feature of the OTE SPA was a key consideration in the determination of the consent for the wind farm. As a result, a requirement for ornithological monitoring was included as part of the consented development's Marine Licence (L/2011/00152) and Environmental Monitoring Plan (EMP).

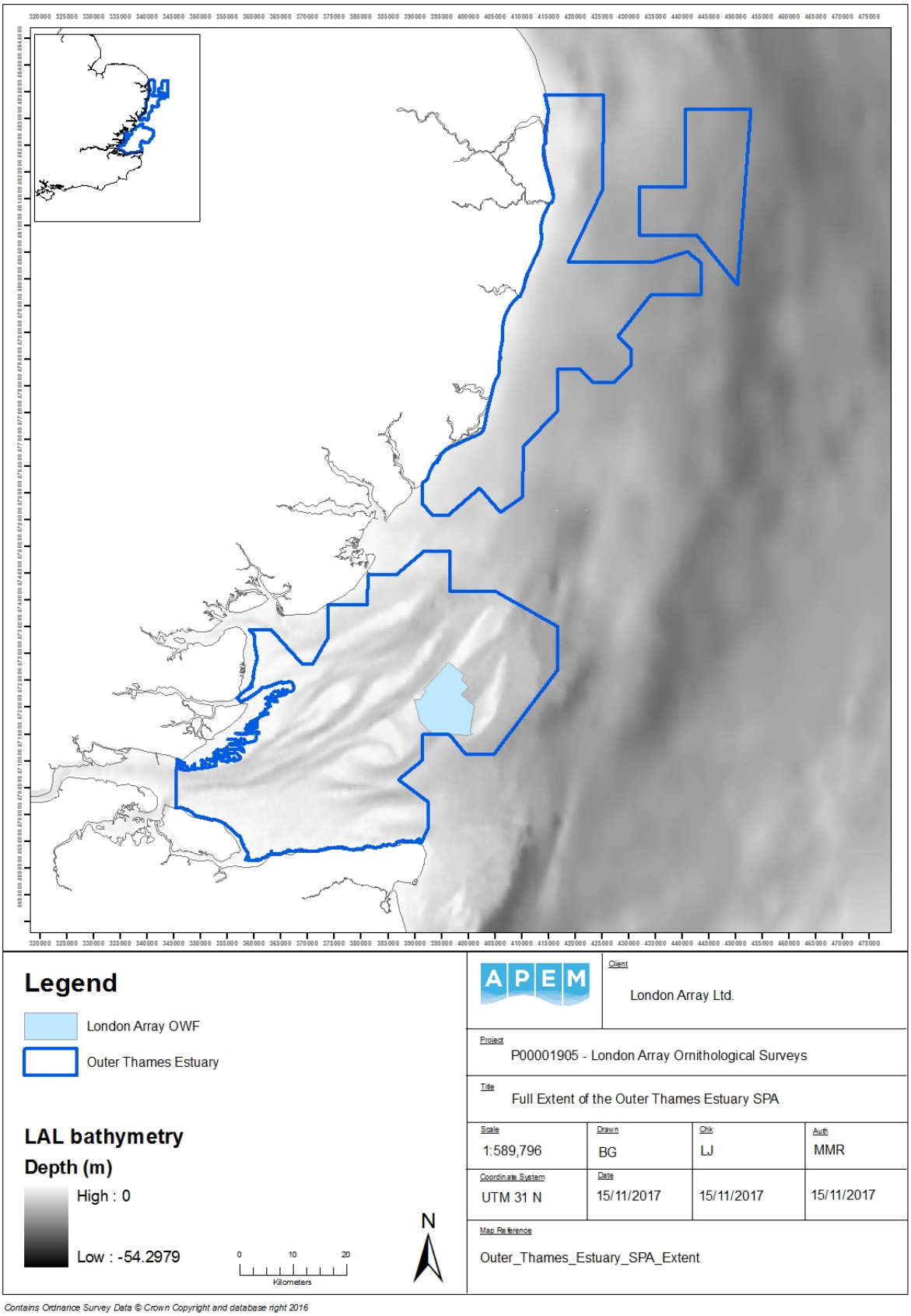


Figure 1 Full extent of the Outer Thames Estuary SPA.

2.2.1 Monitoring requirements

Annex 2 of Marine Licence (L/2011/00152/34) indicates that the objectives of the ornithological monitoring are to:

1. *Determine whether there is change in bird use and passage, measured by species (with particular reference to red-throated diver), abundance and behaviour, of the wind farm site, 1 km and 2-4 km buffer zones and the reference site.*

2. *Determine whether there is a barrier effect to movement of birds through the wind farm site and the 1 km and 2-4 km buffer zones.*

3. *Continue to determine the distribution of wildfowl and divers in the Greater Thames estuary, covering the London Array windfarm site, 1 km and 2-4 km buffer zones and the reference site.*

4. *If objectives 1 or 2 reveal significant change of use of the wind farm site and 1 km and 2-4 km buffer zones by populations of conservation concern, at heights that could incur collision, a programme of collision monitoring will be implemented.*

As part of the monitoring requirements, annual reports were submitted following the completion of each year of surveys: pre-construction: 2010-2011, during construction: 2011-2012, 2012-2013, and post-construction: 2013-2014, 2014-2015, and 2015-2016 (APEM, 2011a; 2012; 2013a; 2014; 2015a; 2017). An addendum to the first year of post-construction surveys was provided to summarise the density profile of divers, predominantly red-throated divers, in relation to varying buffer distances from the LAW. This was an initial, interim analysis to determine whether any displacement effects were identifiable (APEM, 2015b). Further to this analysis APEM undertook a more complex, detailed analysis on behalf of NE to determine if any displacement effects were identifiable for divers and auks (APEM, 2016).

As part of demonstrating that the ornithology monitoring requirements of the Marine Licence (including the achievement of the objectives in Annex 2) have been fully discharged, the FMR will test the key predictions made in the Environmental Statement (ES) (London Array Limited, 2005) concerning key ornithological interests of relevance to the consented scheme.

The approach to the analyses was constrained by the monitoring survey design and available data. As agreed through the ORP process, monitoring surveys were focused on obtaining data on red-throated diver distribution and abundance. Consequently, the timing of the surveys focused on the periods when divers are present in peak numbers in the Thames (i.e. winter: November to February) and the methods were focused on detecting changes related to displacement effects. These characteristics imposed some constraints on the analyses that were undertaken on species other than divers, particularly those that are present during non-winter months, and for potential impacts such as barrier effects and collision risk.

The scope and approach to analysis in this FMR, as agreed with NE and the MMO, is to provide a final update to the previous complex analysis undertaken for the first year of post-construction surveys by including the further two years of post-construction surveys to determine whether there are any identifiable effects of displacement to divers and auks due to the construction and associated activities of the LAW. In addition, in order to discharge the Marine Licence requirements, where possible analyses were completed for barrier effect and collision risk using the data available, noting the constraints on these analyses resulting

from the agreed decisions made that the monitoring program should focus on measuring any potential effect of displacement of divers and the consequent seasonality of surveys.

2.3 Potential wind farm effects and the identification of key species

2.3.1 Overview

The evaluation and assessment of the LAW, as set out in the ES (London Array Limited, 2005), identified three types of effect, detailed below, as those with the greatest potential to affect marine birds. Based on the evidence from surveys of bird populations in the area of the proposed wind farm, the ES identified the 'key species' to be assessed against each type of potential effect. Set out below is a summary of that identification of key species.

2.3.2 Barrier effect

Barrier effects on divers and other seabirds are generally poorly understood, especially outside of the migration period. Furthermore, it can be difficult to separate the possible consequences of a barrier effect on bird distributions from what could be the more frequently described displacement of birds (Drewitt & Langston 2006). For the purposes of this assessment it has thus had to be assumed that study species could potentially be affected by LAW acting as a barrier to daily movements (London Array Limited, 2005). A likely significant effect of the LAW acting as a barrier to divers was predicted in the ES (London Array Limited, 2005), stating this would result in either reduced utilisation of an ecological resource (through birds no longer being able to reach it through the barrier) or significantly increased energy expenditure by the birds in flying around the barrier. The assessment in the ES concluded that given the large extent of the proposed London Array site and the very important numbers of divers in particular present in the area, there is the potential for both of these points to give rise to a potentially significant effect, adding further to the likely significant effect on these species (London Array Limited, 2005).

Annex 2 of the Marine Licence identifies barrier effect as an issue to be addressed in the monitoring programme but does not highlight any particular key species or species groups:

- *Determine whether there is a barrier effect to movement of birds through the wind farm site and the 1 km and 2-4 km buffer zones.*

On the basis of the evaluation and assessment in the ES, the key identified species of concern for barrier effect as a result of the LAW are:

- Red throated diver / black-throated diver

2.3.3 Collision risk

Bird populations could be impacted through increased mortality as a result of bird collisions with wind turbines. Collision risk modelling was undertaken to determine whether there may be any significant effect of collision for the key species at the LAW. Table 1 summarises the overall collision risks predicted in the ES that would be likely to result from the LAW for the key species of concern. It is important to note however that on the basis of the low numbers of these species observed during the baseline surveys and the lack of any features that would be likely to concentrate large numbers of birds through the wind farm site, it was concluded in the ES that the magnitude of any effects on these birds would not be likely to be sufficient to result in any likely significant effect (London Array Limited, 2005).

Table 1 Summary of collision risks from the London Array Offshore Wind Farm (London Array Limited, 2005).

Species	Sensitivity of local population at risk	Magnitude of effect	Significance	Significant impact?
Red-throated diver	Very high	Low/medium	Medium/very high	Yes*
Black-throated diver	Very high	Low/medium	Medium/very high	Yes*
Herring gull	Medium	Medium	Medium	Possible
Lesser black-backed gull	Medium	Medium	Medium	Possible
Great black-backed gull	Medium	Medium	Medium	Possible
Gannet	Medium	Medium	Medium	Possible
Other seabirds	Medium	Medium	Low/very low	N/A**

*The impact on divers is considered significant when assessing collision risk in isolation. However when considered in connection with displacement it is expected that high levels of displacement would indicate avoidance rates of 99.9% or higher at which point the magnitude of collision impacts on diver becomes negligible, resulting in a low significance of the impact.
** Detailed collision risk modelling was not undertaken. It was however possible on the basis of the low numbers observed during the baseline surveys and the lack of any features that would be likely to concentrate large numbers of birds through the wind farm site, to conclude that the magnitude of any effects on these birds would not be likely to be sufficient to result in any likely significant effect.

Annex 2 of the Marine Licence identifies collision risk as a potential issue to be included in the monitoring programme but does not name any key species or species groups, referring to 'populations of conservation concern' instead:

- *If objectives 1 or 2 reveal significant change of use of the wind farm site and 1 km and 2-4 km buffer zones by populations of conservation concern, at heights that could incur collision, a programme of collision monitoring will be implemented.*

On the basis of the evaluation and assessment in the ES, the key identified species of concern for collision mortality impact are:

- Red-throated / black-throated diver
- Large gull species (herring gull, lesser black-backed gull, great black-backed gull)
- Small gulls
- Gannet

2.3.4 Displacement effects

The wind farm could potentially affect the local bird populations by disturbing them and displacing them from an area around the turbines. Such disturbing activities are likely to be greatest during construction but may continue through the operational phase as well (London Array Limited, 2005).

Annex 2 of the Marine Licence highlights two key species groups to be considered when assessing displacement impacts of the LAW:

- *Determine whether there is change in bird use and passage, measured by species (with particular reference to Red-Throated Diver), abundance and behaviour, of the windfarm site, 1 km and 2-4 km buffer zones and the reference site.*
- *Continue to determine the distribution of wildfowl and divers in the Greater Thames estuary, covering the London Array windfarm site, 1 km and 2-4 km buffer zones and the reference site.*

NE requested that auk displacement also be assessed as these birds were also present in numbers sufficient to warrant such an analysis (APEM, 2016).

On the basis of the evaluation and assessment in the ES and the additional post-consent studies, the key identified species of concern for displacement are:

- Divers
- Wildfowl
- Auks

Table 2 summarises the predictions of the ES in relation to displacement for the key species of concern.

Table 2 Summary of displacement impact assessment from the London Array Offshore Wind Farm (London Array Limited, 2005).

Species	Peak no. in WF + 1 km	Sensitivity of local population	Magnitude of effect	Significance	Significant impact?
Red-throated diver	6,700	Very high	Medium/high	Very high	Yes*
Black-throated diver	50	Very high	Medium/high	Very high	Yes*
Common scoter	73	Medium	Low	Low	No**
Guillemot	2,400	Medium	Low	Low	No**
Razorbill	250	Medium	Low	Low	No**

* While birds may be displaced this does not imply a population impact of similar magnitude as the likelihood is that these birds will not be limited by the availability of winter resources. This would reduce the potential for a significant impact of the London Array wind farm through habitat loss caused by displacement.
** The ES, published in 2005, noted that information based on wind farm disturbance to birds has been the subject of several studies on land, and that the maximum distance to which birds have been displaced is 800 m, though in many cases no effect was found (SGS Environment 1996; Gill *et al.,* 1996; Percival, 2000).

3. Survey Methods

3.1 Overview

The proposed site of the LAW (for the baseline EIA) and the site pre-, during-, and post-construction (for the monitoring period) has been surveyed by three methods, with decisions taken on changing the method used being driven by advances in survey techniques. The three methods used have been:

- Boat-based observers (undertaken by RPS; the method was used to collect baseline data to inform the EIA);
- Aerial visual (undertaken by aircraft based observers from the Wildfowl and Wetlands Trust (WWT) and the National Environmental Research Institute (NERI); the method was used to collect baseline date to inform the EIA); and
- Aerial digital (undertaken by aircraft fitted with cameras operated by APEM; the method was used to collect data post-consent based on the requirements of the Marine Licence monitoring program).

The following section identifies when the surveys of each type took place; the areas surveyed and the design of sampling within those areas; and the analysis of the bird occurrence information obtained. Table 3 provides a summary of this information.

Table 3 Timeline of surveys and events of the London Array Offshore Wind Farm (LAW)

Nomenclature in FMR	Survey Type / Event Description	Date(s)
Baseline EIA	Pre-consent boat-based surveys	2002-2004
	Pre-consent aerial visual surveys	2003-2006
	Planning consent process	2005-2007[1]
	Offshore works granted consent for the LAW comprising of Phase 1 (630 MW) and Phase 2 (370 MW)	2006
Pilot Study	Report to inform method and design of the monitoring period	2009-2010
Monitoring Period	Pre-construction aerial digital surveys	2010-2011
	During construction aerial digital surveys	2011-2012
		2012-2013
	LAW fully commissioned	2013
	Post-construction aerial digital surveys	2013-2014[2]
		2014-2015
		2015-2016

[1] Planning permission for onshore application was August 2007
[2] Plans for Phase 2 (370 MW) were terminated in 2014

3.2 Survey timings, design, and locations

Information is provided below for all surveys undertaken of the LAW from baseline EIA to post-construction. However it is important to note that due to differences in the survey methods used, and in the temporal and spatial overlap, it was not possible to incorporate the baseline EIA information in the analysis of barrier effect, collision risk, and displacement in this report. This is because in order for the results to be comparable a calibration exercise would need to be undertaken to determine if there are any platform effects in the numbers recorded.

3.2.1 Boat-based and aerial visual surveys undertaken to characterise the EIA baseline

Baseline EIA boat-based surveys were conducted between 2002 and 2004, providing baseline data for the impact assessment. Table 4 lists the boat-based survey dates.

Table 4 Information on survey dates for baseline EIA boat-based surveys.

Survey	Date
October 2002	01/10/02
	03/10/02
November 2002	01/11/02
	03/11/02
	30/11/02
December 2002	28/12/02
February 2003	05/02/03
	06/02/03
March 2003	16/03/03
	17/03/03
October 2003	27/10/03
	28/10/03
November 2003	19/11/03
	20/11/03
December 2003	09/12/03
	10/12/03
January 2004	20/01/04
	21/01/04
February 2004	16/02/04
	17/02/04
March 2004	08/03/04
	09/03/04
October 2004	17/10/04
	18/10/04
November 2004	08/11/04
	09/11/04
December 2004	08/12/04
	09/12/04

Baseline EIA aerial visual surveys of the LAW were conducted between 2003 and 2006, providing baseline data for the impact assessment. Table 5 lists the aerial visual survey dates.

Table 5 Information on survey dates for baseline EIA aerial visual surveys

Survey	Date
January 2003	18/01/03
February 2003	15/02/03
November 2003	27/11/03
December 2003	17/12/03
February 2004	15/02/04
	16/02/04
October 2004	30/10/04
November 2004	25/11/04
December 2004	04/12/04
February 2005	14/01/05
	15/01/05
March 2005	07/03/05
	13/03/05
	15/03/05
November 2005	16/11/05
December 2005	06/12/05
	11/12/05
January 2006	13/01/06
March 2006	02/03/06

Baseline EIA boat-based and aerial visual surveys conducted between 2002 and 2006 followed a line transect method with bird observations recorded in distance bands to allow abundance and density estimates to be calculated (Camphuysen *et al*., 2004). During aerial visual surveys birds were identified to at least group level, enumerated, and their spatial position approximated by comparing the time of recording to the position of the aircraft at the nearest GPS log point. During boat-based surveys birds were frequently identified to species. Figure 2 shows the wind farm area and buffer zone surveyed during the 2002 – 2006 aerial and boat-based surveys.

The aerial visual approach depends on conventional distance sampling (CDS) from aircraft. The aerial CDS approach involves flying transects within the area of interest, with trained observers identifying bird species and estimating abundance across four pre-defined 'distance' bands. These extend laterally from either side of the aircraft so that one observer covers port and one starboard. Distance bands range from 44-1000 m to the aircraft, and as transects are separated by 2 km approximately 95.6% of the area is assessed. The 4.4% of the area not covered is not visible to the observers as it is underneath the aircraft, from the flight line out to 44 m. CDS uses several parameters including the size of the region, the number of flocks (detections), the effort (length of transect searched), search region half-width (i.e. 1 km) and the expected flock size to form a framework for a detection function model. When fitted to those parameters, the expected flock size in the region is estimated from a regression of probability of detection taking into account the difficulty of seeing either small flocks or single birds.

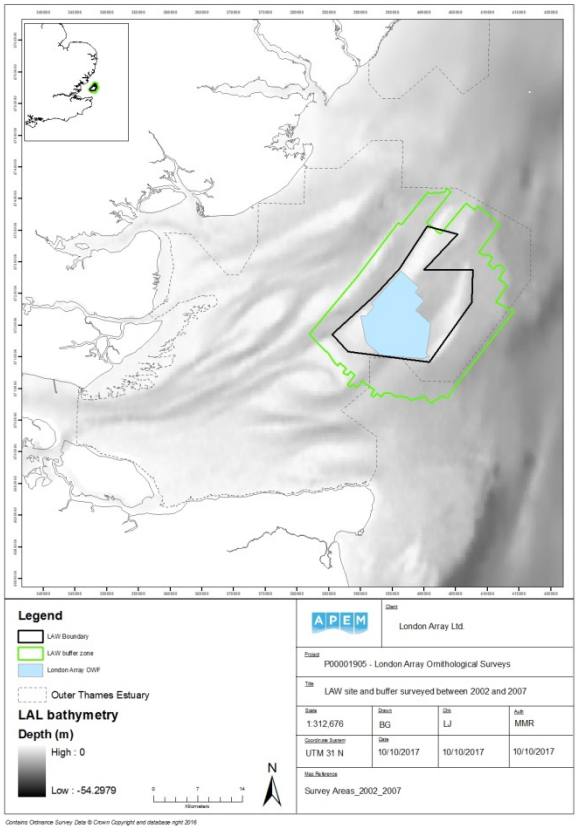


Figure 2 London Array offshore wind farm site (black outline was the planned wind farm extent, blue is the extent of Phase 1 as constructed) and buffer zone surveyed during the aerial and boat-based surveys (green outline) conducted between 2002 and 2007.

3.2.2 Aerial digital monitoring survey timings

During the 2009 / 10 winter pre-construction period, a pilot study was carried out comprising four digital aerial surveys flown in December 2009, January, February and April 2010. The pilot study is described in Section 3.2.2.1.

Pre-, during- and post-construction surveys were conducted during the 2010 / 11 to 2015 / 16 winters. In each winter four monthly surveys were conducted from November to February.

Details of the digital aerial survey timings and zones surveyed (the locations of these zones are described in the next section) for each construction phase are presented in Table 6.

Table 6 Information on survey dates and zones surveyed during pre-, during- and post-construction surveys.

Construction period	Survey	Date	Zones Surveyed						
			1	2	3	4	5	6	7
Pre-construction (pilot study)	December 2009	21/12/2009			✓				
		23/12/2009		✓					
	January 2010	24/01/2010	✓						
		26/01/2010		✓					

Construction period	Survey	Date	Zones Surveyed						
			1	2	3	4	5	6	7
		27/01/2010			✓				
	February 2010	10/02/2010		✓					
		12/02/2010	✓						
	April 2010	06/04/2010 – 08/04/2010	✓						
		09/04/2010		✓					
Pre-construction baseline surveys	November 2010	23/11/2010	✓						
		24/11/2010		✓	✓	✓			
		25/11/2010					✓	✓	✓
	December 2010	08/12/2010			✓		✓	✓	✓
		09/12/2010	✓	✓					
	January 2011	10/01/2011	✓		✓				
		11/01/2011							✓
		17/01/2011					✓		
		18/01/2011		✓				✓	
	February 2011	14/02/2011	✓						
		15/02/2011		✓	✓				
		16/02/2011					✓	✓	✓
First Year Construction Surveys	November 2011	02/11/2011 – 03/11/2011		✓					
		03/11/2011			✓				✓
		04/11/2011	✓						
		10/11/2011						✓	
		17/11/2011					✓		
	December 2011	01/12/2011			✓		✓	✓	✓
		02/12/2011	✓						
		03/12/2011		✓					
	January 2012	13/01/2012					✓	✓	
		16/01/2012		✓					✓
		17/01/2012	✓						
		19/01/2012			✓				
	February 2012	07/02/2012		✓	✓				
		08/02/2012	✓						
		09/02/2012					✓	✓	✓
Second Year Construction Surveys	November 2012	13/11/2012					✓		
		14/11/2012			✓				
		18/11/2012	✓	✓				✓	✓
	December 2012	04/12/2012			✓		✓		✓

Construction period	Survey	Date	Zones Surveyed						
			1	2	3	4	5	6	7
		05/12/2012		✓				✓	
		06/12/2012	✓						
	January 2013	02/01/2013		✓			✓		
		03/01/2013						✓	
		04/01/2013			✓				✓
		08/01/2013	✓						
	February 2013	02/02/2013	✓		✓		✓		✓
		03/02/2013		✓				✓	
First Year Post-construction Surveys	November 2013	09/11/2013		✓					
		10/11/2013	✓						
	December 2013	09/12/2013		✓					
		11/12/2013	✓						
	February 2014	10/01/2014	✓						
		11/01/2014		✓					
		02/02/2014		✓					
		03/02/2014	✓						
Second Year Post-construction Surveys	November 2014	24/11/2014		✓					
		24/11/2014 – 25/11/2014	✓						
	December 2014	13/12/2014		✓					
		19/12/2014	✓						
	January 2015	02/01/2015	✓						
		07/01/2015		✓					
	February 2015	02/02/2015		✓					
		03/02/2015	✓						
Third Year Post-construction Surveys	November 2015	12/11/2015	✓						
		13/11/2015		✓					
	December 2015	02/12/2015 and 04/12/2015		✓					
		03/12/2015	✓						
	January 2016	06/01/2016 and 08/01/2016	✓						
		18/01/2016 – 19/01/2016		✓					
	February 2016	03/02/2016		✓					
		03/02/2016 – 04/02/2016	✓						

3.2.2.1 The pilot study (2009-2010)

A pilot study was undertaken during the 2009 / 2010 winter, in consultation with the ORP, to explore and develop a methodology to be delivered in the post-consent monitoring period (APEM, 2010). It was agreed during the ORP discussions that displacement impact on red-throated diver was the key issue to be monitored and this decision informed the choice of technique, survey design, and timing and extent of the subsequent post-consent surveys. The pilot study was carried out to provide confidence in the aerial digital methodology, to allow comparisons to be made with the aerial visual surveys previously conducted; and to determine a suitable survey design for the pre-, during- and post-construction monitoring.

The initial pilot study aerial digital survey in November 2009 used a grid size of 750 m and images were collected at 3 cm resolution from one of three zones. This survey was undertaken to provide an initial assessment of the coarseness (spacing) of grid required to achieve a pre-defined level of confidence or coefficient of variation (CV) of < 0.16. A doubling or halving of the numbers recorded by two surveys each with a CV of 0.16 or less can be detected with statistical certainty ($P < 0.05$). The pilot study suggested that collecting images using a 750 m grid was likely to generate sufficiently precise mean population estimates of red-throated diver in the outer Thames Estuary region to detect a halving or doubling of populations between surveys. In fact, it was considered that the number of images could be reduced whilst retaining an acceptable level of precision of 0.14 around the mean estimate based on total birds recorded. The agreed reduction in image number led to an increase in grid coarseness from 750 m to 1000 m. This grid spacing was adopted for the remaining pilot study surveys (December 2009 to February 2010). For the April 2010 survey, however, the grid was reduced to 670 m as low numbers of birds were expected in the area at that time of the year.

3.2.2.2 The pre-, during-, and post-construction programme of aerial digital surveys

For the pre-, during- and post-construction surveys a survey design based on a 500 m by 500 m grid of images taken at 3 cm Ground Sampling Resolution (GSD) was chosen. An example of the 500 m grid image nodes captured within Zone 1 can be seen in Figure 3. The total area of images collected in each survey as a proportion of the survey area (the 'coverage') has ranged from approximately 10% to 18% through the period 2010 / 11 to 2015 / 16 due to different camera system arrangements.

3.2.3 Locations surveyed by the pilot study and the pre-, during- and post-construction programme of aerial digital surveys

The survey areas have changed between the pilot study and subsequent surveys. The 2009 / 2010 'pilot study' boundaries consisted of a 'London Array OWF boundary' and 'Control Zone' (Figure 4). In 2010 / 11, the survey areas differed to those surveyed in the 'pilot study' and included seven Zones (Figure 5). Aerial surveys of Zone 4 ceased after November 2010 due to an overlapping danger zone making flying dangerous. Thereafter Zones 1 to 3 and Zone 5 to 7 inclusive were surveyed until February 2013 (Figure 5). Aerial surveys of Zones 3, 5, 6 and 7 ceased after February 2013. From November 2013 until February 2016 (post-construction) it was decided to only survey Zones 1 and 2 (Figure 6). Zone 1 contains the London Array OWF boundary, and Zone 2 is considered the Reference Site. The decision was made to only survey Zones 1 and 2 post-construction to create a spatially consistent data set comprising of the two zones that had been surveyed consistently from the first pre-construction aerial digital surveys delivered during the 2009 / 2010 winter to the last post-construction surveys flown during the 2015 / 2016 winter.

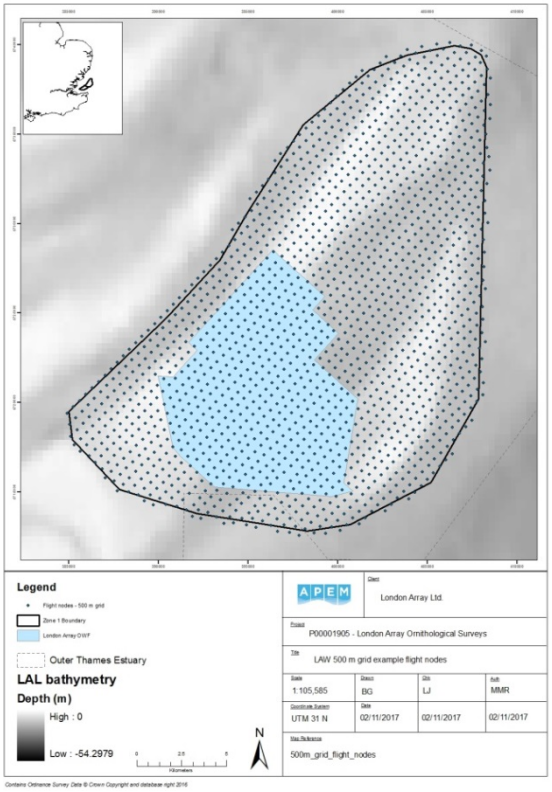


Figure 3 **Example of 500 m grid survey image nodes in Zone 1 used since the 2010-2011 surveys.**

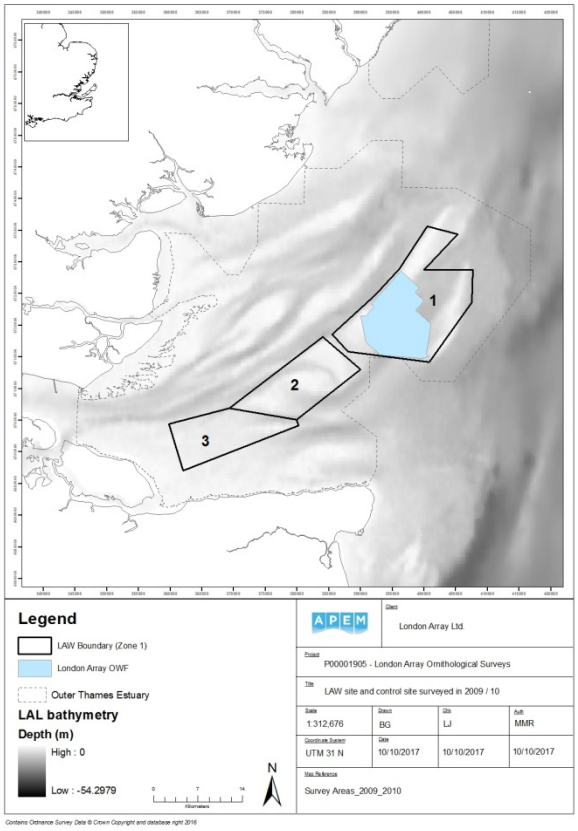


Figure 4 **London Array offshore wind farm site (Zone 1) and control zone (Zones 2 and 3) surveyed during the 'pilot study' conducted in 2009 / 10.**

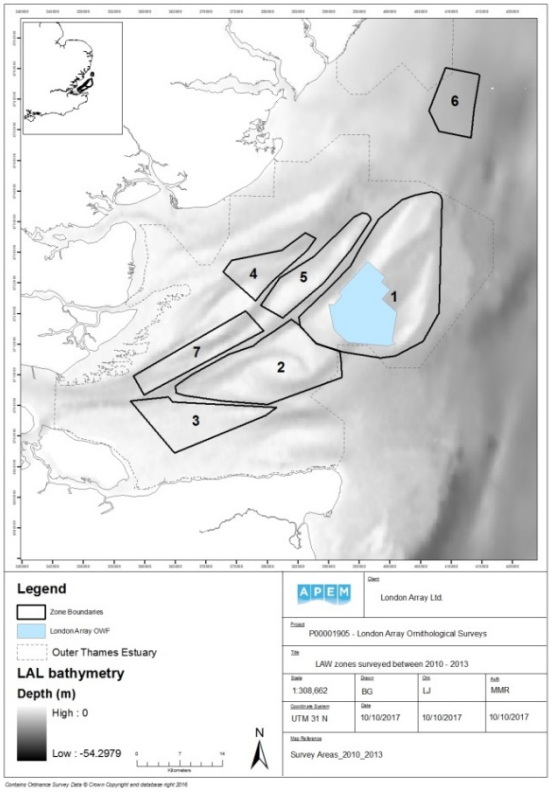


Figure 5 Zones 1-7 surveyed during the period November 2010 – February 2013. Zone 4 was only flown in November 2010 due to overlapping danger areas (D138, 138A and 138B).

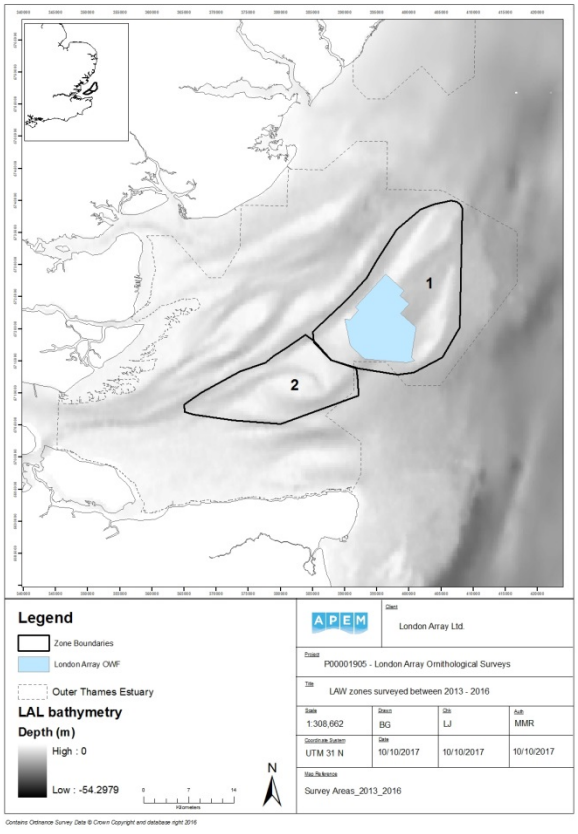


Figure 6 Post-construction survey areas of Zone 1 and Zone 2

4. Survey Results

This section provides a summary of the survey results. Appendix 1 describes the analysis undertaken for the processing of the raw survey data. Methods of analysis for investigating barrier effect, collision risk, and displacement are described in Sections 5, 6, and 7.

4.1 Overview

The following tables present peak counts, abundance estimates, precision and confidence limits for each species recorded during the pre-consent (baseline) and the pre-, during- and post-construction surveys of the LAW.

Raw counts of all species recorded per month for each year of surveys are detailed in the survey reports (APEM, 2010; 2011a; 2012; 2013a; 2014; 2015a; 2017). Please note that due to minor refinement of the data set (e.g. as our knowledge and experience of image processing and bird identification has improved it has been possible to apply some of those improvements retrospectively through the data QA process) a small number of the values will not match the data presented in the annual reports. A summary of the data refinements are provided in Appendix 2, Table 1 for clarity. The extent of the changes are minor and do not have any significant effect on the outcome of the analyses for this report nor do they alter the conclusions of the relevant annual reports.

4.2 EIA boat-based survey abundance estimates

Table 7 and Table 8 present the results collated from the baseline EIA boat-based surveys for red-throated divers conducted between 2002 and 2004.

Table 7 Percival and distance analysis peak abundance estimates and density values of red-throated divers for each winter from baseline EIA boat-based surveys. CL: 95% Confidence Limits.

Date	Percival Analysis		Distance Analysis					
	Estimated total	Density (birds per km^2)	Estimated total			Density (birds per km^2)		
	Wind Farm	Wind Farm	Wind Farm	-CL	+CL	Wind Farm	-CL	+CL
Nov-02	-	-	2,179	830	5,722	3.79	1.44	9.95
Feb-03	2,470	4.3	-	-	-	-	-	-
Feb-04	11,117	19.33	4,334	1,953	9,616	7.54	3.4	16.72
Dec-04	2,716	4.72	1,846	840	4,056	3.21	1.46	7.05

Table 8 Peak total population estimates and densities comprising distance estimates plus scaled up 'in flight' counts of red-throated divers for each winter from baseline EIA boat-based surveys.

Date	Distance Analysis					
	Estimated total			Density (birds per km^2)		
	Wind Farm	Birds in Flight	Total	Wind Farm	Birds in Flight	Total
Nov-02	2,179	598	2,777	3.79	1.04	4.83
Feb-03	-	-	-	-	-	-
Feb-04	4,334	7077	11,411	7.54	12.31	19.85
Dec-04	1,846	1353	3,199	3.21	2.35	5.56

4.3 EIA aerial visual survey abundance estimates

Table 9 presents the results collated from the baseline EIA aerial visual surveys for red-throated divers conducted between 2003 and 2006.

Table 9 Peak distance analysis estimates and density values of red-throated divers for each winter from the baseline EIA aerial visual surveys.

Date	Distance Analysis					
	Estimated total			Density (birds per km^2)		
	Wind Farm	-CL	+CL	Wind Farm	-CL	+CL
Jan-03	2,596	2,093	3,219	4.51	3.64	5.6
Feb-04	3,821	3,127	4,668	6.64	5.44	8.12
Mar-05	1,541	1,138	2,086	2.68	1.98	3.63
Jan-06	1,759	1,280	2,419	3.06	2.23	4.21

4.4 Post-consent (2009-2016) aerial digital survey report summary

There has been a long series of reports have been issued to describe the ornithological monitoring following the consent of the LAW. The following reports have been provided by APEM:

- The Pilot Study: Aerial Survey Methods, Data Collection and Statistical Analysis (APEM, 2010);
- Red-throated Divers & Offshore Windfarms in the Outer Thames: Historic Data Review (APEM, 2011b);
- Six Ornithology Aerial Survey Reports: 2010/2011, 2011/2012, 2012/2013, 2013/2014, 2014/2015, 2015/2016 (APEM 2011a, 2012, 2013a, 2014, 2015a, 2017); and
- London Array Additional Analysis (APEM, 2015b).

The pilot study aimed to demonstrate the appropriateness of the aerial digital survey method for offshore surveys, and to provide data describing the distribution and association of birds within and around the proposed wind farm site with particular focus on red-throated diver (APEM, 2010). The report described the methodology for monitoring the pre-construction distribution of birds, with particular focus on red-throated diver. The report was not a baseline report and did not present abundance or distribution of birds by species. A comparison of aerial digital and aerial visual methods was undertaken because at that time the aerial digital method was a relatively novel technique in comparison to boat-based or aerial visual techniques. The report concluded that 3 cm digital still resolution was the most suitable of the then possible approaches. The exact survey design was determined after further analysis and with discussions with the ORP. The report stated that the grid size would be in the region of 750 m. The final survey design, as agreed with the ORP, was based on a 3 cm resolution 500 m grid.

The historic data review was commissioned to evaluate the historical boat and aerial bird survey data relating to red-throated divers for five offshore wind farm areas: Greater Gabbard, Gunfleet Sands, Kentish Flats, Thanet, and London Array (APEM, 2011b). Additionally, it compared historical estimates with new data collected during the pilot study (2009-2010) by aerial digital methods. The data covered aerial and boat-based surveys spanning 2001 until 2010. The timings of the surveys were inconsistent in that aerial or boat-based data existed for one wind farm in one month but not in another. For data analysis, only data collected between the months of October and March were included, since outside of this period red-throated divers are predominantly on or travelling to or from their breeding territories and not found offshore in the southern North Sea. The report concluded that abundance estimates from boat surveys varied according to month, winter and wind farm area, and that probably as a result of this variation abundance estimates from aerial surveys did not show consistent patterns with boat survey data. An index of change in red-throated diver numbers over time in the Outer Thames was produced based on distance estimates calibrated against aerial digital data. The calibrated trends suggested that in the London Array area, red-throated divers fluctuated each winter, with estimates for the latest year similar to those in the earliest year of the survey.

The six annual reports provided species-specific abundance estimates generated for each month of survey, and species-specific distribution maps (APEM, 2011a, 2012, 2013a, 2014, 2015a, 2017). The timing and weather conditions of each survey were provided. The Discussion sections in the reports focussed on the red-throated diver abundance and distribution changes over time. A separate section of ‘other species’ was also included. These reports spanned the pre-construction period 2010-2011 until the final, third year of post-construction monitoring in 2015-2016. It is the data contained in these reports which were considered to cover the monitoring period and that were reviewed by the MMO. All six of the annual reports have been formally signed off by the MMO.

An additional analysis report was commissioned to analyse the red-throated diver density profile following the first year of post-construction surveys (APEM, 2015b). The scope of the analysis was agreed with NE and RSPB as part of the ORP process. The report presented the density profile of divers in Zone 1 in concentric 500 m buffers surrounding the LAW footprint. A repeated measures ANOVA (analysis of variance) was used to investigate if there was any significant change between the densities of divers during the different construction periods. The repeated measures ANOVA showed a significant effect of construction, which suggested a significant decrease pre- and during construction, and a significant increase between during and post-construction. There was no significant difference between the pre- and post-construction diver densities. Whilst the distribution of divers was quite similar pre- and post-construction within 2 km of the LAW, the distribution of diver density increased within 4 km of the LAW.

In addition to the reports referenced above a further report was completed which was funded by NE with permission from London Array Ltd to complete complex statistical analysis of the displacement of divers and auks following the first year of post-construction surveys (APEM, 2016). A literature review was undertaken to determine the relevant environmental variables that were needed for modelling the distribution of divers and auks in the Outer Thames area. All available data were considered for inclusion including boat-based and aerial visual. However due to the lack of spatial and temporal overlap between different methods it was agreed to only use data derived from aerial digital surveys. Aerial digital data included surveys conducted of the LAW and its associated Zones as well as surveys of the Outer Thames Estuary SPA undertaken by APEM in 2013 (APEM, 2013b). The results were focussed on the pre-construction and during construction phases because these phases were fully completed. The post-construction phase had two remaining years to be completed at the time that the modelling was undertaken. The results indicated that both divers and auks showed a reduction in numbers during construction compared to pre-construction. The results suggested divers avoided to a degree, but not absolutely, the areas within approximately 9 km of the LAW whilst auks avoided to a degree, but not absolutely, the areas approximately 4 km from the LAW during construction. Initial results of the post-construction phase suggested that one year after construction numbers returned to pre-construction levels for auks and divers; however the distribution of auks, especially, was altered particularly for auks as there were still fewer auks proportionally in the wind farm and surrounding areas. It is important to note that the results of the analysis were preliminary pending the further two years of post-construction data. The results in this FMR for the displacement of divers and auks provide an update to the modelling that was undertaken for NE and it is based on the addition of the final two years of post-construction surveys.

4.5 Monitoring period (2010-2016) aerial digital results species overview

This section presents an overview of the results of the monitoring period (2010-2016). It is important to note that the monitoring period included only the winter period, November to February. This was in order to capture the key information regarding red-throated divers, the focus on this species being agreed through the ORP process. Surveys were not carried out and hence data do not exist for the remaining months of the relevant years.

The level of analysis applied to each species that was recorded during the monitoring programme was determined primarily from the relevant monitoring objectives in the requirements and conditions of the Marine Licence. The monitoring objectives determined the key species and these species were subject to a greater level of analysis than others. This process was informed by consultation with the MMO, Natural England and the RSPB and agreed through the ORP.

A summary of species occurrence and a comparison of bird densities across the development phases, set out within species groupings, are presented in this section. For the detailed analysis of the key species, refer to:

- Section 5: Assessment for Barrier Effect (divers);
- Section 6: Assessment for Collision Risk (gannet, small gulls, and large gulls); and
- Section 7: Assessment for Displacement (divers and auks).

In addition, cumulative density distribution maps for the key groups are presented in Appendix 3, monthly distribution maps for the key species and groups are presented in Appendix 4 and peak densities per year are presented in Appendix 5.

For each species recorded in the surveys, the mean density per development phase, separated by survey zone, is presented in Table 10.

Kruskal-Wallis tests were undertaken on the density estimates of key species in Zone 1 to investigate if there was any significant difference between different development phases. A Kruskal-Wallis test allows for differences between populations to be investigated without requiring normally distributed data. If the Kruskal-Wallis test showed a significant result, further analysis was undertaken using a Dunn Test for multiple comparisons (using the FSA package in R).

Species that were tested using the Kruskal-Wallis test included: gannet, great black-backed gull, herring gull, lesser black-backed gull, black-headed gull, common gull and kittiwake between each development phase in Zone 1 and Zone 2. The results are included within the relevant species or species group accounts below.

The associated raw counts, population estimates, confidence intervals, and precision can be found in the annual monitoring reports (APEM 2011a, 2012, 2013a, 2014, 2015a, 2017).

Table 10 **Mean density per species per Zone (1, 2, 3, 4, 5, 6 and 7) per development phase: pre-construction, during construction, and post-construction**

Species / group	Pre-construction							Construction						Post-construction	
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 1	Zone 2	Zone 3	Zone 5	Zone 6	Zone 7	Zone 1	Zone 2
Scaup	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00
Common scoter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.25	0.00	0.00	0.00	0.27	0.00	0.00
Seaduck species	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Red-throated diver	0.23	0.02	0.00	0.00	0.00	0.00	0.02	1.98	2.17	1.32	1.13	0.44	0.78	4.02	4.88
Black-throated diver	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.03	0.02	0.02	0.02	0.03	0.00
Great northern diver	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.09	0.01	0.00	0.03	0.00	0.03	0.00
Diver species	6.32	1.39	0.64	0.03	1.53	0.22	1.73	0.15	0.76	0.25	0.22	0.05	0.27	0.00	0.00
Fulmar	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.04	0.02	0.04	0.00	0.03	0.01	0.00	0.00
Shearwater species	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gannet	0.38	0.05	0.00	0.00	0.00	0.00	0.04	0.25	0.00	0.00	0.02	0.03	0.00	0.13	0.04
Cormorant	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.25	0.98	0.00	0.00	0.13	0.02	0.51
Shag	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cormorant shag	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.05	0.00	0.00	0.03	0.00	0.18
Great crested grebe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.04	0.00	0.00
Grebe species	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Pomarine skua	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Great skua	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Kittiwake	0.18	0.33	0.26	0.00	0.24	0.11	0.73	0.34	0.24	0.36	0.13	0.21	0.48	0.52	0.25
Black-headed gull	0.03	0.08	0.30	0.00	0.04	0.02	0.09	0.01	0.03	0.10	0.01	0.00	0.01	0.01	0.03
Common gull	0.02	0.16	2.00	0.00	0.27	0.18	1.03	0.04	0.10	0.22	0.04	0.03	0.14	0.10	0.14
Little gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.03	0.00	0.00	0.00
Small gull species	0.52	1.00	3.48	0.00	1.89	3.43	2.07	0.02	0.02	0.03	0.02	0.01	0.08	0.02	0.02
Lesser black-backed gull	0.05	0.02	0.05	0.00	0.00	0.03	0.23	0.04	0.03	0.13	0.01	0.02	0.10	0.06	0.04
Herring gull	0.03	0.04	0.50	0.00	0.29	0.17	0.38	0.08	0.65	1.28	0.22	0.03	0.63	0.08	0.37
Great black-backed gull	0.04	0.12	0.10	0.00	0.18	0.00	0.30	0.26	0.29	0.31	0.17	0.05	0.16	0.26	0.55
Black backed-gull species	0.04	0.00	0.02	0.00	0.14	0.00	0.09	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Large gull species	0.04	0.15	0.37	0.00	0.26	0.14	0.11	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01
Guillemot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.02	0.06	0.02	0.00	0.00
Razorbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Guillemot/Razorbill	0.08	0.05	0.00	0.00	0.02	0.02	0.05	0.81	0.61	0.36	0.48	1.14	0.46	0.89	1.28
Puffin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.02	0.01	0.00	0.03	0.00	0.00
Little auk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Auk species	0.51	0.22	0.07	0.03	0.27	0.73	0.07	0.01	0.02	0.00	0.00	0.00	0.04	0.00	0.00

4.5.1 Wildfowl

Wildfowl were recorded sporadically throughout the monitoring period; too few were recorded to warrant analysis. A qualitative summary is provided here.

Scaup were recorded in Zone 3 and 7 during construction (see Appendix 4, Figure 1: November 2012) with a peak density of 0.13 birds km^{-2} in Zone 3 (Appendix 5, Table 3).

Common scoter were recorded in Zone 1, 2, and 7 during construction and post-construction (see Appendix 4, Figure 1: November 2011, November 2012, January 2013, February 2013, and January 2015) with a peak density of 2.14 birds km^{-2} recorded in Zone 7 in November 2011 (Appendix 5, Table 7).

Unidentified seaduck species were recorded in Zone 1 in pre-construction (see Appendix 4, Figure 1: January 2011 and February 2011) with a peak density of 0.05 birds km^{-2} in January 2011 (Appendix 5, Table 1).

4.5.2 Divers

Divers were the most abundance species group recorded during the monitoring surveys. Detailed analyses have been undertaken with respect to the assessment of barrier effect (Section 5) and displacement (Section 7) monitoring objectives. Due to the earlier years containing limited information regarding species identification, divers as a species group were combined for these assessments. An overview of the survey results has been provided here. Refer to the Sections 5 and 7 for information on the detailed analyses.

Red-throated divers were recorded in Zones 1 and 2 pre-construction, Zones 1, 2, 3, 5, 6 and 7 during construction and in Zones 1 and 2 post-construction (see Appendix 4, Figure 2: February 2011, January 2012, February 2012, November 2012, December 2012, January 2013, February 2013, November 2013, December 2013, January 2014, February 2014, November 2014, December 2014, January 2015, February 2015, November 2015, December 2015, January 2016, and February 2016) with a peak density of 15.86 birds km^{-2} recorded in Zone 2 in February 2015 (Appendix 5, Table 2).

Black-throated divers were recorded in Zones 1, 2, 3, 5, 6, and 7 during construction and Zones 1 and 2 post-construction (see Appendix 4, Figure 2: November 2012, December 2012, January 2013, February 2013, December 2013, January 2014, and February 2014) with a peak density of 0.29 birds km^{-2} recorded in Zone 1 in December 2013 (Appendix 5, Table 1).

Great northern divers were recorded in Zones 1, 2, 3, and 6 during construction and in Zone 1 post-construction (see Appendix 4, Figure 2: February 2012, November 2012, December 2012, January 2013, February 2013, November 2013, December 2013, January 2014, February 2016) with a peak density of 0.64 birds km^{-2} recorded in Zone 2 in February 2012 (Appendix 5, Table 2).

Unidentified diver species were recorded in Zones 1, 2, 3, 4, 5, 6, and 7 in pre-construction and Zones 1, 2, 3, 5, 6 and 7 during-construction (see Appendix 4, Figure 2: November 2010, December 2010, January 2011, February 2011, November 2011, December 2011, January 2012, February 2012, November 2012, December 2012) with a peak density of 19.25 birds km^{-2} recorded in Zone 1 in February 2011 (Appendix 5, Table 1).

4.5.3 Fulmar

Fulmars were recorded in low numbers throughout the monitoring period; too few were recorded to warrant analysis. A qualitative summary is provided here.

Fulmars were recorded in Zones 1 and 3 pre-construction, Zones 1, 2, 3, 6, and 7 during construction, and Zone 1 post-construction (see Appendix 4, Figure 8: January 2011, November 2011, January 2012, February 2012, November 2013, December 2013, and January 2014) with a peak density of 0.23 birds km^{-2} recorded in Zone 3 in January 2012 (Appendix 5, Table 3).

A single individual was recorded in the LAW pre-construction (2010-2011), during the second year of construction (2012-2013), and post-construction (2013-2014). Three individuals were recorded in the LAW during the first year of construction (2011-2012). Relatively greater numbers of fulmars were recorded throughout all of the Zones (particularly Zones 1, 2, and 3) during the construction years (Appendix 3, Figure 3). Due to the small number of fulmars recorded, it is difficult to state with any certainty whether the slight increases recorded during construction would be caused by the development of the LAW or other environmental factors.

4.5.4 Shearwaters

Unidentified shearwater species were recorded sporadically throughout the monitoring period; too few were recorded to warrant analysis. They were recorded in Zone 1 in pre-construction, January 2011 with a density of 0.28 birds km^{-2} (Appendix 5, Table 1).

4.5.5 Gannet

Gannets were recorded in Zones 1, 2 and 7 in pre-construction, Zones 1, 2, 5 and 6 during construction, and Zones 1 and 2 post-construction (see Appendix 4, Figure 4: January 2010, January 2011, February 2011, December 2011, November 2012, January 2013, February 2013, November 2013, December 2013, February 2014, November 2014, December 2014, February 2015, November 2015, December 2015, December 2015, January 2016 and February 2016) with a peak density of 1.90 birds km^{-2} recorded in Zone 1 in February 2013 (Appendix 5, Table 1).

Overall, gannet mean density decreased in Zone 1 across development phases from 0.38 birds km^{-2} in pre-construction to 0.13 birds km^{-2} in post-construction (Table 10; Figure 7). Mean densities were relatively low in Zone 2 with no birds recorded during construction (Table 10; Figure 7).

The Kruskal-Wallis test showed density was not significantly different for gannet (H_2=3.15, P =0.20) in Zone 1 between each of the development phases. Density was not significantly different for gannet (H_2=2.01, P =0.37) in Zone 2 between each of the development phases.

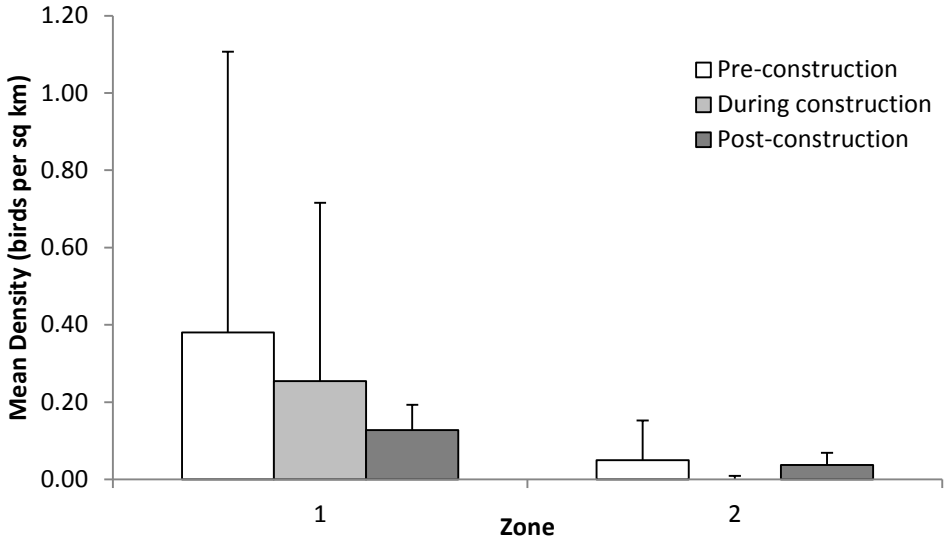


Figure 7 Mean densities per development phase of gannets recorded in Zone 1 and Zone 2

4.5.6 Cormorants and shags

Cormorants and shags were recorded in relatively low numbers, and exhibited a clustered distribution throughout the Zones surveyed. A qualitative summary has been provided here because too few were recorded to give meaningful results using non-parametric statistics.

Cormorants were recorded in Zones 1, 2, 3, and 7 during construction and Zones 1 and 2 post-construction (see Appendix 4, Figure 1: December 2011, January 2012, February 2012, December 2012, January 2013, February 2013, November 2013, January 2014, November 2014, January 2015, February 2015, November 2015, January 2016, and February 2016) with a peak density of 4.45 birds km^{-2} recorded in Zone 3 in January 2012 (Appendix 5, Table 3).

Shags were recorded in Zone 1 in pre-construction and during construction (see Appendix 4, Figure 1: November 2010, December 2010, and December 2012) with a peak density of 0.05 birds km^{-2} recorded in Zone 1 in November and December 2012 (Appendix 5, Table 1).

Cormorant / shag (i.e. unidentified individuals that were classified as either cormorant or shag) were recorded in Zone 1 pre-construction, Zones 1, 2, 3, and 7 during construction and Zone 2 post-construction (see Appendix 4, Figure 1: November 2010, January 2011, February 2011, November 2011, January 2012, February 2012, January 2013, and December 2013) with a peak density of 2.17 birds km^{-2} in Zone 2 in December 2013 (Appendix 5, Table 2).

Overall (when combining all individuals recorded as cormorants, shags, and cormorant / shags), two individuals were recorded within the LAW footprint during the pre-construction phase. In total, three individuals were recorded in Zone 1 pre-construction. During the first year of construction, in comparison to the pre-construction phase, relatively large clusters of were recorded throughout many of the Zones (in particular Zones 1, 2, 3, and 7) with a cluster recorded within the LAW footprint (four individuals in total). In the post-construction years, the number of individuals recorded in the LAW foot ranged from one to two per year. A greater number was recorded in Zone 1 in the second year of post-construction in comparison to the other two years of post-construction.

Due to the small numbers recorded it is difficult to state with any certainty whether the changes in numbers and distribution of cormorants and shags were in relation to the development activities of the LAW, or other environmental factors.

4.5.7 Grebes

Grebes were recorded in low numbers throughout the monitoring period; too few were recorded to warrant analysis. A qualitative summary is provided here.

Great crested grebes were recorded in Zones 1, 2, and 7 during construction (see Appendix 4, Figure 1: January 2012, February 2012, November 2012, January 2013, February 2013) with a peak density of 0.28 birds km^{-2} recorded in Zone 7 in January 2013 (Appendix 5, Table 7).

Unidentified grebe species were recorded in Zones 1, 2, and 7 in pre-, during, and post-construction (see Appendix 4, Figure 1: November 2010, December 2010, February 2011, December 2012, and February 2014) with a peak density of 0.08 birds km^{-2} recorded in Zone 1 in December 2010 (Appendix 5, Table 1).

A single grebe was recorded in the LAW pre-construction (2010-2011) and during construction (2011-2012), identified as unidentified grebe species and great crested grebe respectively. In the post-construction phase, no grebes were recorded in the LAW although two individuals were recorded within approximately 2 km from the wind farm boundary in February 2014 and January 2013 (Appendix 4: Figure 1). Overall, the mean density of grebes in Zone 1 was greater in the pre-construction than during, or post-construction. However due to the small numbers recorded, it is difficult to state with any certainty whether these slight differences can be attributed to the development of the LAW, or whether they are due to other environmental factors.

4.5.8 Waders

Waders were recorded sporadically throughout the monitoring period; too few were recorded to warrant analysis. Oystercatchers were recorded in Zone 3 during construction, January 2013 with a density of 0.05 birds km^{-2} (Appendix 5, Table 3).

4.5.9 Skuas

Skuas were recorded sporadically throughout the monitoring period; too few were recorded to warrant analysis.

Pomarine skuas were recorded in Zone 1 during- and post-construction (November 2012 and November 2013) with a density of 0.02 birds km^{-2} (Appendix 5, Table 1).

Great skuas were recorded in Zones 1 and 2 during- and post-construction (November 2011 and February 2013, November 2014, December 2014 and December 2015) with a peak density of 0.03 birds km^{-2} in Zone 2 in November 2014 and December 2015 (Appendix 5, Table 2).

4.5.10 Small gulls

Small gulls were an abundant species group during the monitoring surveys. Detailed analyses have been undertaken with respect to the assessment of collision risk (Section 6)

monitoring objective. An overview of the survey results has been provided here. Refer to the Section 6 for information on the detailed analysis.

Kittiwakes were recorded in Zones 1, 2, 3, 5, 6 and 7 during the majority of the pre-, during-, and post-construction monitoring surveys with exception to December 2009, January 2010, February 2010, April 2010, November 2010 and December 2010 (see Appendix 4, Figure 6), with a peak density of 2.90 birds km^{-2} recorded in Zone 7 in February 2011 (Appendix 5, Table 7).

Kittiwake mean density increased in Zone 1 across development phases from 0.18 birds km^{-2} in pre-construction to 0.52 birds km^{-2} in post-construction (Table 10; Figure 8). In Zone 2 mean kittiwake density was highest in pre-construction and remained almost constant between construction and post-construction (0.24 and 0.25 birds km^{-2} respectively) (Table 10; Figure 8).

The Kruskal-Wallis test showed density was not significantly different for kittiwake (H_2=5.26, *P*=0.07) in Zone 1 between each of the development phases. Density was not significantly different for kittiwake (H_2=0.86, *P*=0.65) in Zone 2 between each of the development phases.

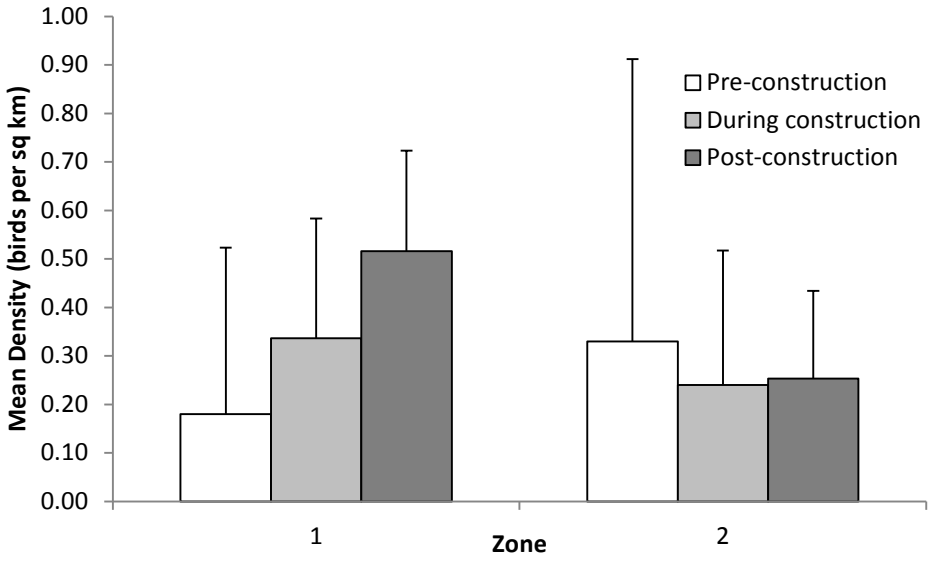


Figure 8 Mean densities per development phase of kittiwakes recorded in Zone 1 and Zone 2

Black-headed gulls were recorded in Zones 1, 2, 3, 5, 6 and 7 in pre-construction, Zones 1,2,3,5 and 7 during construction and Zones 1 and 2 during post-construction (see Appendix 4, Figure 6: January 2011, February 2011, December 2011, November 2012, December 2012, January 2013, February 2013, November 2013, November 2014 and February 2015) with a peak density of 0.87 birds km^{-2} recorded in Zone 3 in February 2011 (Appendix 5, Table 3).

In Zone 1 and Zone 2 black-headed gull mean densities were higher in pre-construction (0.03 and 0.08 birds km^{-2} respectively) (Table 10; Figure 9). Mean densities decreased in construction and increased slightly in post-construction in Zone 1 and Zone 2, however post-construction mean densities remained lower than those recorded pre-construction (0.01 and 0.03 birds km^{-2} respectively) (Table 10; Figure 9).

The Kruskal-Wallis test showed density was not significantly different for black-headed gull (H_2=0.48, *P* =0.79) in Zone 1 between each of the development phases. Density was not significantly different for black-headed gull (H_2=1.42, *P* =0.49) in Zone 2 between each of the development phases.

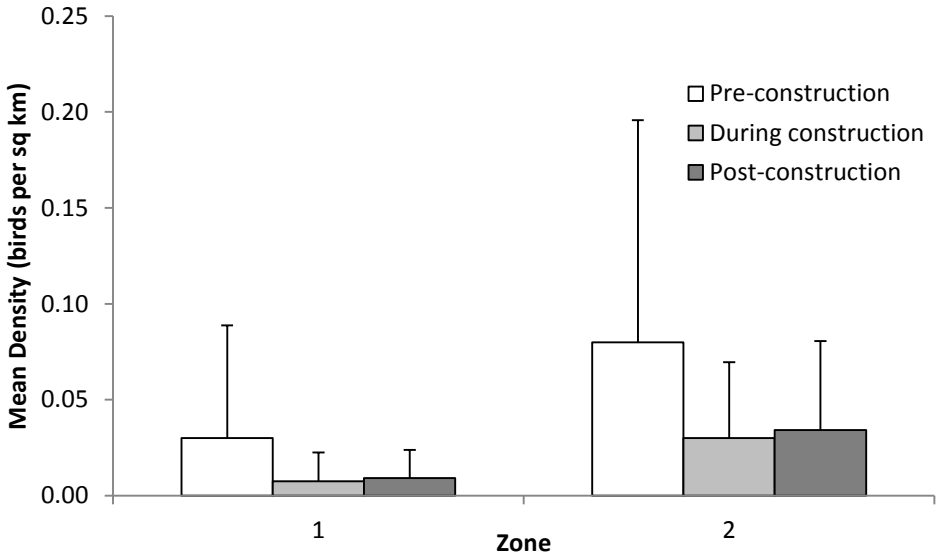


Figure 9 Mean densities per development phase of black-headed gulls recorded in Zone 1 and Zone 2

Common gulls were recorded in Zones 1, 2, 3, 5, 6 and 7 in pre-, and during construction, and Zones 1 and 2 post-construction (see Appendix 4, Figure 6: January 2010, November 2010, December 2010, January 2011, February 2011, December 2011, January 2012, February 2012, November 2012, December 2012, January 2013, February 2013, November 2013, December 2013, January 2014,February 2014, November 2014, December 2014, January 2015, February 2015, November 2015, December 2015, January 2016 and February 2016) with a peak density of 4.03 birds km-^{2} recorded in Zone 7 in February 2011 (Appendix 5, Table 7).

In Zone 1 common gull mean density increased across development phases from 0.02 birds km-^{2} in pre-construction to 0.10 birds km-^{2} in post-construction (Table 10; Figure 10). In Zone 2 mean density decreased during construction and increased post-construction, however post-construction mean density remained slightly lower than that recorded pre-construction (0.14 and 0.16 birds km-^{2} respectively) (Table 10; Figure 10).

The Kruskal-Wallis test showed that the density of common gull was significantly different in Zone 1 between development phases (H_2=9.00, *P*=0.01). A Dunn Test identified that the densities during versus post-construction (Z = -2.37, *P*=0.03) and pre- versus post-construction (Z = 2.49, *P*=0.04) were significantly different. This suggests that common gull density was similar pre- versus during construction, but had significantly greater density post-construction. Density was not significantly different for common gull (H_2=1.65, *P* =0.44) in Zone 2 between each of the development phases.

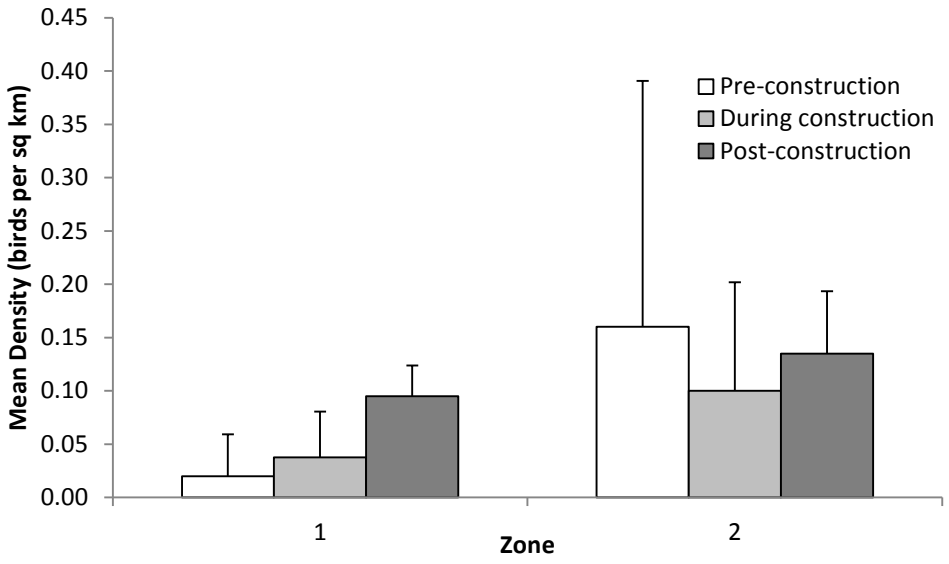


Figure 10 Mean densities per development phase of common gulls recorded in Zone 1 and Zone 2

Little gull was a sporadic species throughout the monitoring period; too few were recorded to warrant analysis. They were recorded in Zone 1, 2, and 6 during construction (see Appendix 4, Figure 6: November 2012 and December 2012) with a peak density of 0.21 birds km^{-2} recorded in Zone 6 in November 2012 (Appendix 5, Tables 1, 2 and 6).

Unidentified small gull species were recorded in Zones 1, 2, 3, 5, 6 and 7 during the majority of the pre-, during-, and post-construction monitoring surveys with exception to February 2012, November 2013, January 2014, November 2014, January 2015, and January 2016 (see Appendix 4, Figure 6), with a peak density of 22.8 birds km^{-2} recorded in Zone 3 in January 2011 (Appendix 5, Table 3).

Unidentified small gull species mean density was highest in pre-construction for Zone 1 and Zone 2 (0.52 and 1.00 birds km^{-2} respectively) (Table 10; Figure 11). In both Zone 1 and Zone 2 mean density decreased in construction to 0.02 birds km^{-2} and remained constant in post-construction (Table 10; Figure 11).

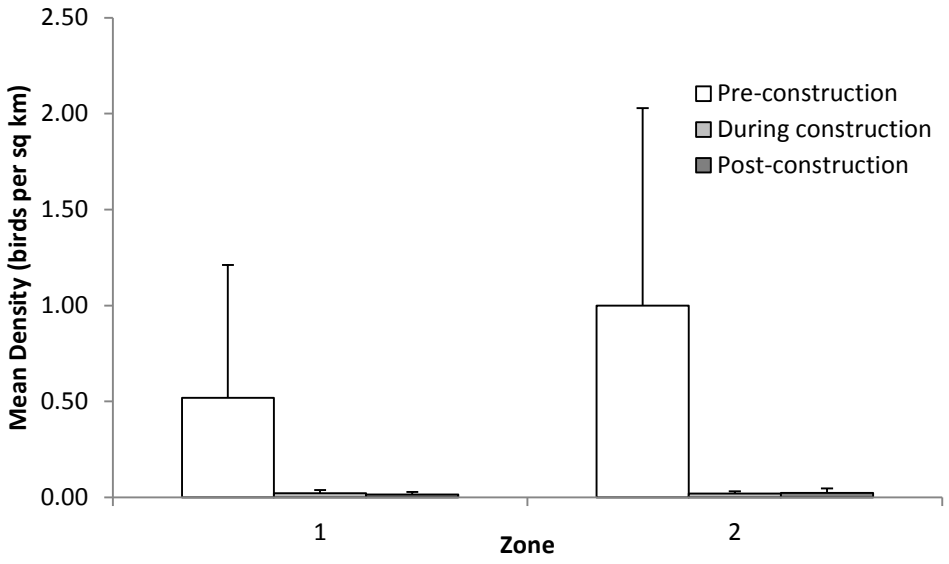


Figure 11 Mean densities per development phase of small gull species recorded in Zone 1 and Zone 2

4.5.11 Large gulls

Lesser black-backed gulls were recorded in Zones 1, 2, 3, 6 and 7 in pre- and during-construction and Zones 1 and 2 in post-construction. They were recorded in the majority of survey months except January 2011, January 2015, February 2015, and December 2015 (see Appendix 4, Figure 7). A peak density of 0.92 birds km^{-2} in Zone 7 was recorded in February 2011 (Appendix 5, Table 7).

In Zone 1 lesser black-backed gull mean density decreased during construction and was highest in post-construction (Figure 12). In Zone 2 mean density increased across development phases from 0.02 birds km^{-2} in pre-construction to 0.04 birds km^{-2} in post-construction (Table 10; Figure 12).

The Kruskal-Wallis test showed density was not significantly different for lesser black-backed gull (H_2=2.98, *P*=0.86) in Zone 1 between each of the development phases. Density was not significantly different for lesser black-backed gull (H_2=1.16, *P*=0.56) in Zone 2 between each of the development phases.

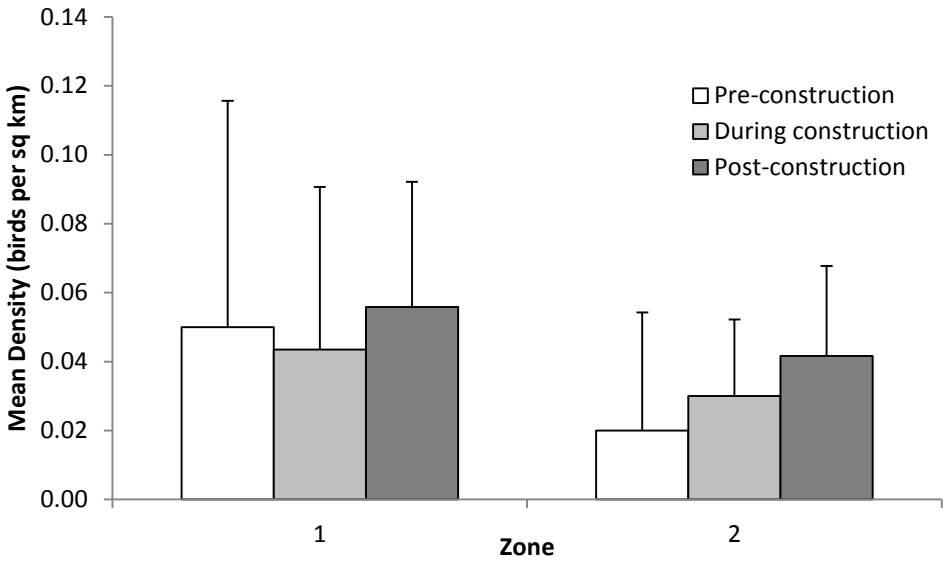


Figure 12 Mean densities per development phase of lesser black-backed gulls recorded in Zone 1 and Zone 2

Herring gulls were recorded in Zones 1, 2, 3, 5, 6, and 7 in pre- and during construction, and Zones 1 and 2 in post-construction. They were recorded in every survey month (see Appendix 4, Figure 7). A peak density of 3.73 birds km^{-2} in Zone 3 was recorded in January 2012 (Appendix 5, Table 3).

Herring gull mean density was lowest in pre-construction in both Zone 1 and Zone 2 (0.03 and 0.04 birds km-^{2} respectively). A small increase in mean density from 0.03 birds km-^{2} in pre-construction to 0.08 birds km-^{2} during construction occurred in Zone 1 and mean density remained constant in post-construction (Table 10; Figure 13). A large increase in mean density from 0.04 birds km-^{2} in pre-construction to 0.65 during construction occurred in Zone 2 followed by a decrease in post-construction to 0.37 birds km-^{2} (Table 10; Figure 13).

The Kruskal-Wallis test showed density was not significantly different for herring gull (H_2=5.12, *P* =0.08) in Zone 1 between each of the development phases. Density of herring gull was significantly different in Zone 2 between development phases (H_2=9.02, *P* =0.01). A Dunn Test identified that the density pre- versus during construction (Z = 3.00, *P*=0.01) was significantly different. This suggests that herring gull density was similar pre- versus post-construction, and had significantly greater density during construction. However the pre- versus post-construction densities were similar.

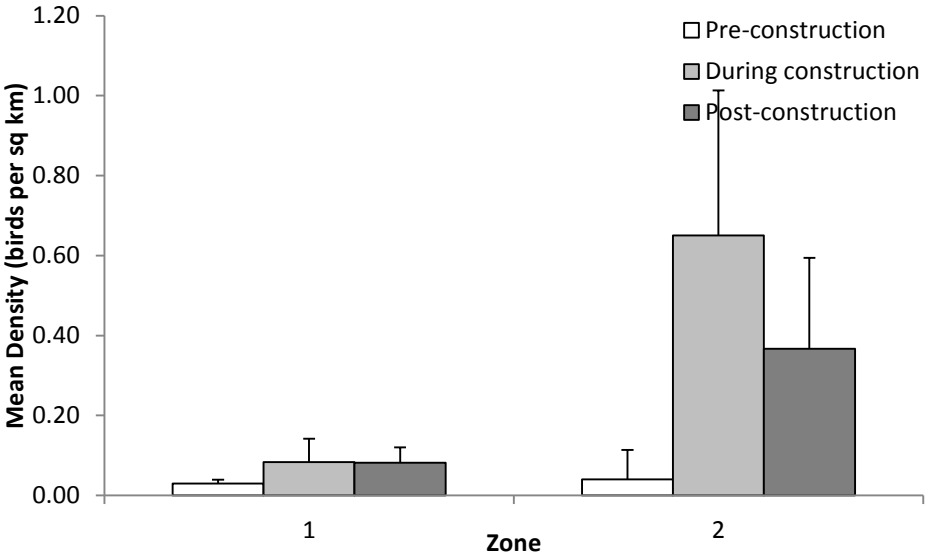


Figure 13 Mean densities per development phase of herring gulls recorded in Zone 1 and Zone 2

Great black-backed gulls were recorded in Zones 1, 2, 3, 5, and 7 in pre-construction, Zones 1, 2, 3, 5, 6 and 7 during construction and Zones 1 and 2 post-construction. They were recorded in every survey month (see Appendix 4, Figure 7). A peak density of 1.69 birds km^{-2} in Zone 2 was recorded in November 2013 (Appendix 5, Table 2).

Great black-backed gull mean density increased in Zone 1 from pre-construction to construction (0.04 to 0.26 birds km^{-2} respectively) (Table 10; Figure 14). Mean density remained constant between construction and post-construction in Zone 1 (Figure 14). Mean great black-backed gull density increased across development phases from 0.12 birds km^{-2} in pre-construction to 0.55 birds km^{-2} in post-construction (Table 10; Figure 14).

The Kruskal-Wallis test showed density was not significantly different for great black-backed gull (H_2=5.68, *P* =0.06) in Zone 1 between each of the development phases. Density was not significantly different for great black-backed gull (H_2=4.39, *P* =0.11) in Zone 2 between each of the development phases.

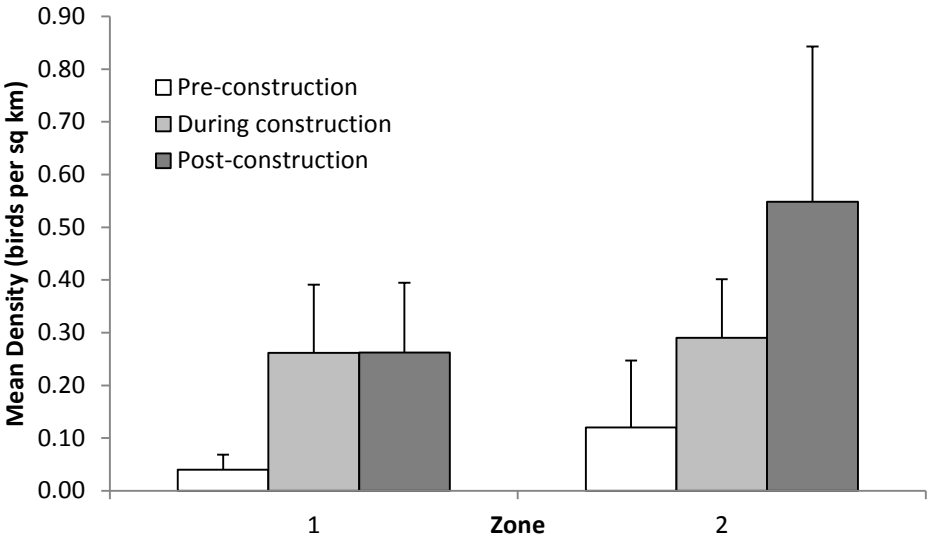


Figure 14 Mean densities per development phase of great black-backed gulls recorded in Zone 1 and Zone 2

Unidentified black-backed gull species were recorded in Zones 1, 3, 5, and 7 in pre-construction, Zones 1, 3 and 5 during construction (see Appendix 4, Figure 7: November 2010, January 2011, February 2011, November 2011, December 2011, and February 2012) with a peak density of 0.42 birds km^{-2} recorded in Zone 5 in January 2011 (Appendix 5, Table 5).

In Zone 1 black-backed gull species mean density was highest in pre-construction (0.04 birds km^{-2}). Mean density decreased during construction and no birds were recorded in post-construction (Table 10; Figure 15). No black-backed gull species were recorded in Zone 2 (Table 10; Figure 15).

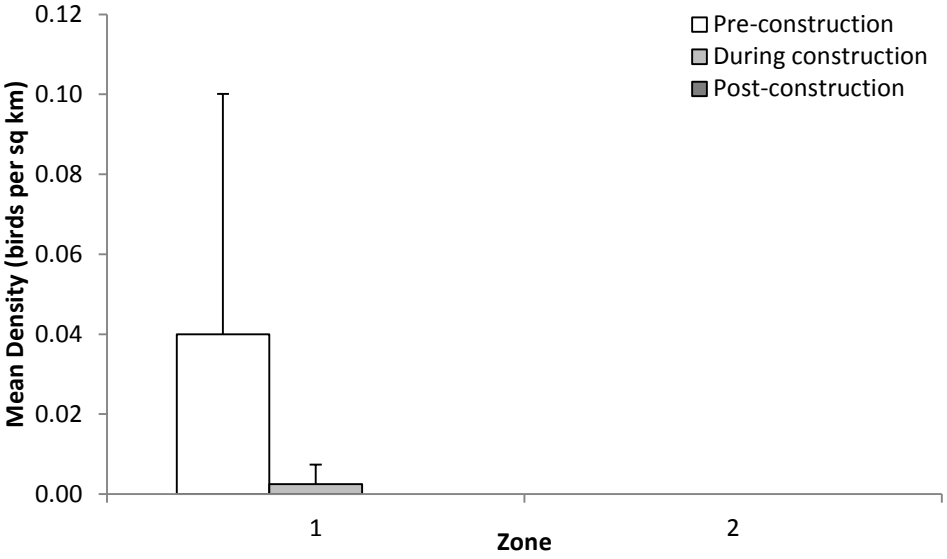


Figure 15 Mean densities per development phase of black-backed gull species recorded in Zone 1 and Zone 2

Unidentified large gull species were recorded in Zones 1, 2, 3, 5, 6, and 7 in pre-construction, Zones 1, 2, 3, 6 and 7 during construction and Zones 1 and 2 post-construction (see Appendix 4, Figure 7: November 2010, December 2010, January 2011, February 2011, November 2011, January 2012, February 2012, November 2012, December 2013, February 2014, December 2014, January 2016) with a peak density of 0.94 birds km^{-2} recorded in Zone 5 in February 2011 (Appendix 5, Table 5).

Unidentified large gull species mean density was highest in pre-construction in Zone 1 and Zone 2 (0.04 and 0.15 birds km-^{2} respectively) (Table 10; Figure 16). In Zone 1 mean density decreased in construction to 0.01 birds km-^{2} and remained constant in post-construction (Table X; Figure 16). In Zone 2 no unidentified large gulls were recorded in construction and mean density increased in post-construction to 0.01 birds km-^{2} however post-construction mean density remained lower than that recorded in pre-construction (Table 10; Figure 16).

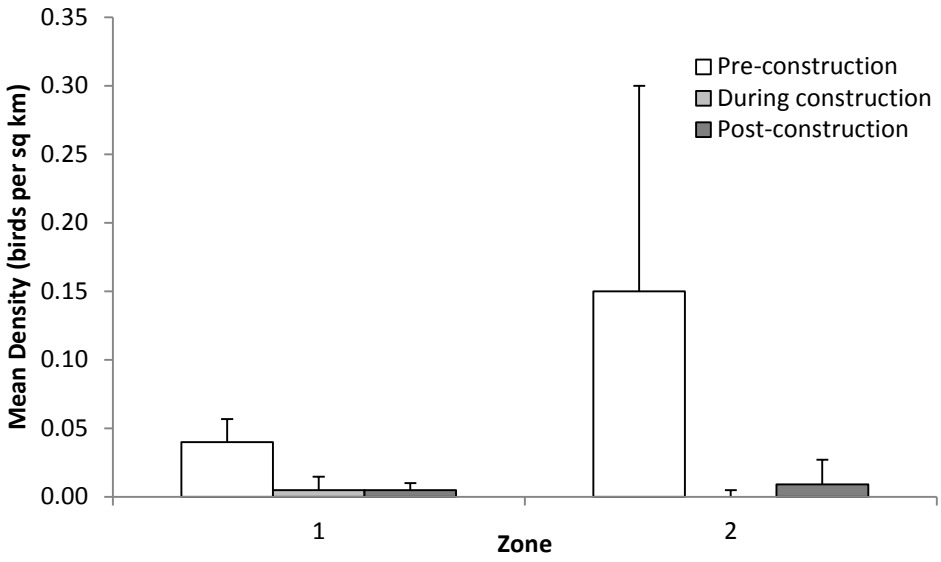


Figure 16 Mean densities per development phase of large gull species recorded in Zone 1 and Zone 2

4.5.12 Auks

Auks were the second most abundant species group recorded (after divers) during the monitoring surveys. Detailed analysis has been undertaken with respect to the assessment of displacement (Section 7) monitoring objective. Due to the earlier years containing limited information regarding species identification, auks as a species group were combined for further detailed analysis for this assessment. An overview of the survey results has been provided here. Refer to Section 7 for information on the detailed analysis.

Guillemots were recorded in Zones 1, 2, 5, 6, and 7 during construction (see Appendix 4, Figure 8: December 2011, January 2012, February 2012, and November 2012) with a peak density of 0.49 birds km^{-2} recorded in Zone 6 in November 2012 (Appendix 5, Table 6).

Razorbills were recorded in Zones 1, 2, and 3 during construction (see Appendix 4, Figure 8: December 2011, November 2012, December 2012) with a peak density of 0.22 birds km^{-2} recorded in Zone 1 in November 2012 (Appendix 5, Table 1).

Guillemot / razorbills (i.e. unidentified individuals that were classified as either guillemot or razorbill) were recorded in Zones 1, 2, 5, 6, and 7 in pre-construction, Zones 1, 2, 3, 5, 6 and 7 during-construction and Zones 1 and 2 post-construction (see Appendix 4, Figure 8: February 2011, November 2011, December 2011, January 2012, February 2012, November 2012, December 2012, January 2013, February 2013, November 2013, December 2013, January 2014, February 2014, November 2014, December 2014, January 2015, February 2015, November 2015, December 2015, January 2016, and February 2016), with a peak density of 5.58 birds km^{-2} recorded in Zone 2 in February 2014 (Appendix 5, Table 2).

Puffins were recorded in Zones 1, 2, 3, 5, and 7 during construction and Zone 1 post-construction (see Appendix 4, Figure 8: December 2011, January 2012, November 2012, December 2012, January 2013, February 2013, and February 2016) with a peak density of 0.19 birds km^{-2} recorded in Zone 7 in January 2012 (Appendix 5, Table 7).

Little auk were recorded in Zone 1, 2, and 5 during construction (see Appendix 4, Figure 8: January 2012, November 2012, December 2012, January 2013, February 2013,) with a peak density of 0.08 birds km^{-2} recorded in Zone 1 in November 2012 (Appendix 5, Table 1).

Unidentified auk species were recorded in Zone 1, 2, 3, 4, 5, 6, and 7 in pre-construction and Zones 1, 2, and 7 during construction (see Appendix 4, Figure 8: November 2010, December 2010, January 2011, February 2011, December 2011, January 2012, February 2012) with a peak density of 1.59 birds km^{-2} recorded in Zone 6 in November 2010 (Appendix 5, Table 6).

5. Assessment for Barrier Effect

5.1 Introduction

The ES predicted that in order for a barrier effect to be potentially significant it would need to result in either reduced utilisation of an ecological resource (through birds no longer being able to reach it through the barrier) or significantly increased energy expenditure by the birds having to fly around the barrier. Divers were assumed to be most at risk to any barrier effect given the large extent of the wind farm and the large number of divers present in the area. No barrier effect was anticipated for any other species.

Objective 2 of the Marine Licence is as follows:

- *Determine whether there is a barrier effect to the movement of birds through the wind farm site, 1 km and 2-4 km buffer zones.*

To meet Objective 2 of the Marine Licence analysis was undertaken to determine whether the LAW acts as a barrier to the movement of birds through the wind farm. In this case a barrier effect is taken to mean that a wind farm obstructs the movement of birds causing them to fly around it rather than through the turbines, or neither fly around nor through the wind farm i.e. creating inaccessible areas.

The approach to testing for a barrier effect is to hypothesise that if the LAW were to act as a barrier, then it could be expected that a smaller proportion of flying bird trajectories would be towards the wind farm than in other directions, and that as a result of any barrier effect lower densities of divers would be present near the wind farm than elsewhere in broadly similar habitats. This latter effect of detecting lower densities, but in this case of flying birds, can also be considered as displacement. Drewitt & Langston (2006) suggest that "the effect of birds altering their migration flyways or local flight paths to avoid a wind farm is also a form of displacement." The distribution of all divers (and auks) are analysed for potential displacement effects in Section 7. This displacement analysis could potentially also identify whether any areas have become inaccessible (i.e. are sited behind a barrier) following the construction activities of the LAW.

5.2 Methods

5.2.1 Data preparation

Barrier effect analysis was undertaken for all diver species recorded throughout the monitoring phase. Although a large proportion of the divers identified to species were red-throated divers, the analysis considered all divers as a single group. Raw count data were used to determine whether there was a barrier effect. These data from the digital aerial surveys collected during the construction and post-construction phases included identification to diver species or species group, diver behaviour and flight trajectory.

The densities of flying divers within Zone 1 were calculated separately for each construction phase for the wind farm, and its 1 km and 2 to 4 km buffer zones. The densities were calculated by dividing the number of birds recorded in each zone by the area of the images collected.

As the direction of flight of individual birds was only recorded from November 2011 onwards, no analysis of flight direction is possible during the pre-construction phase. For other

phases, the flight trajectory of the divers was recorded from digital still images by measuring the axis of bill to tail, within bespoke image analysis software, taking the bearing relative to the bird's head. This bearing is linked to the geo-referenced image and thus provides an accurate representation of bird orientation at the time of image capture.

The divers, during the pre-construction phase, for which it was not possible to estimate flight trajectory, are represented as a point on the figures. For the remaining divers for which it was possible to estimate flight trajectory the direction of movement during the construction and post-construction phases was plotted using arrows corresponding to their flight direction.

The most appropriate method to analyse barrier effect based on the data available was to first plot individual directions of flight, a descriptive method for analysing directional behaviour. As trajectory data are spread across the survey area, each individual bearing may not always indicate a trajectory relative to the wind farm when pooled. For instance, a bird bearing of 330° from the southeast and a bird bearing of 200° from the north may be flying towards the same location. Thus each individual bird's bearing was calculated in relation to the target location: the nearest turbine of the LAW. The relative bearing of each bird to the closest turbine was estimated by calculating the distance of each individual and the relative angle. The difference between a bird's bearing and a target's location was calculated to reveal the flight direction relative to the nearest point of the wind farm.

Directions were subdivided in to four quadrants: towards, away, and two for flying parallel in relation to the nearest turbine based on the relative angle. The divers were deemed to be flying towards the turbines if their bearing relative to the nearest turbine was between 135-225°, otherwise the divers were taken to be either flying away from or broadly parallel to the wind farm. Thus if the divers were equally likely to fly in all directions one would expect 25% of them to be flying towards the turbines (i.e. four quadrants of 90° making up the complete 360° possible in all directions which is 25%).

The high resolution digital aerial surveys were based on a grid design and the regular and even samples gathered across the survey area meant that it was possible to examine flight direction for sub-sets of samples. Bird records that fell within the wind farm (and associated buffers) could be selected in GIS, and their flight directions analysed separately.

5.2.2 Analysis

The diver trajectory data from each survey were analysed in two stages detailed below.

This analysis was not considered to be subject to bias by sampling flying birds at a non-random time in relation to tidal state. Technical Appendix 4 illustrates how flying birds were detected across a wide range of dates and times of the day and consequently across a range of tidal states.

Stage 1: Distribution of Birds

For this descriptive stage flying birds in the wind farm and associated buffers (1 km, 2 km, and 4 km), as well as in Zone 1 and Zone 2 were selected in ArcGIS. Data from all nine surveys of the post-construction phase were pooled for the key species group 'divers'. The distributions and directions of the flying birds have been mapped and their numbers tabulated according to each of the development phases. Flying individuals were coloured according to whether their relative direction was toward, away, or parallel to the nearest turbine for the post-construction period. Finally, the densities of the flying divers in each of the three development phases have been represented graphically.

Stage 2: Analysis of flight directions

The flight trajectory data were analysed to assess whether there was any evidence that the divers avoided the turbines. The number of flying divers recorded throughout each development phase was limited which poses an issue for statistical testing as to be valid statistical tests need minimum sample size thresholds to be met. Therefore, two approaches were used to test the relative direction of flying divers in relation to the nearest turbine of the LAW. Due to the small number of flying divers recorded in certain buffer regions it was necessary to sum data from several buffers to ensure that samples were large enough.

The null hypothesis that divers were likely to fly in all directions was tested using: a chi-squared (χ^2) test and a randomisation approach. The χ^2 test is suitable for count data which can be separated categorically. In this case the count data are based on the relative direction of flying divers in relation to the nearest turbine, and distance to the LAW using buffer regions. The randomisation approach is based on the number of flying divers per buffer and their relative direction. These data were resampled 999 times per buffer region providing a larger data set with the characteristics of the original data. This approach is especially useful for small data sets.

If the statistical testing provided a less than 5% probability ($P \leq 0.05$) then the null hypothesis is rejected. If the null hypothesis is rejected, divers are shown to have a significant flight direction in relation to the nearest turbine.

The technical details of the two approaches are provided in Appendix 4.

5.3 Results

Stage 1 Distribution of birds

Figures 15 to 17 present the distributions of flying divers recorded in Zones 1 and 2 for the pre-, during- and post-construction phases, respectively.

During the pre-construction and construction phases flying divers were present within the wind farm, 1 km and 2-4 km buffer zones, and Zones 1 and 2 (Figures 17 and 18). No divers were present within the LAW during the post-construction phase surveys (Figure 19). The highest densities of flying divers were observed in the north-eastern region of Zone 1 during all construction phases (Figures 17 to 19).

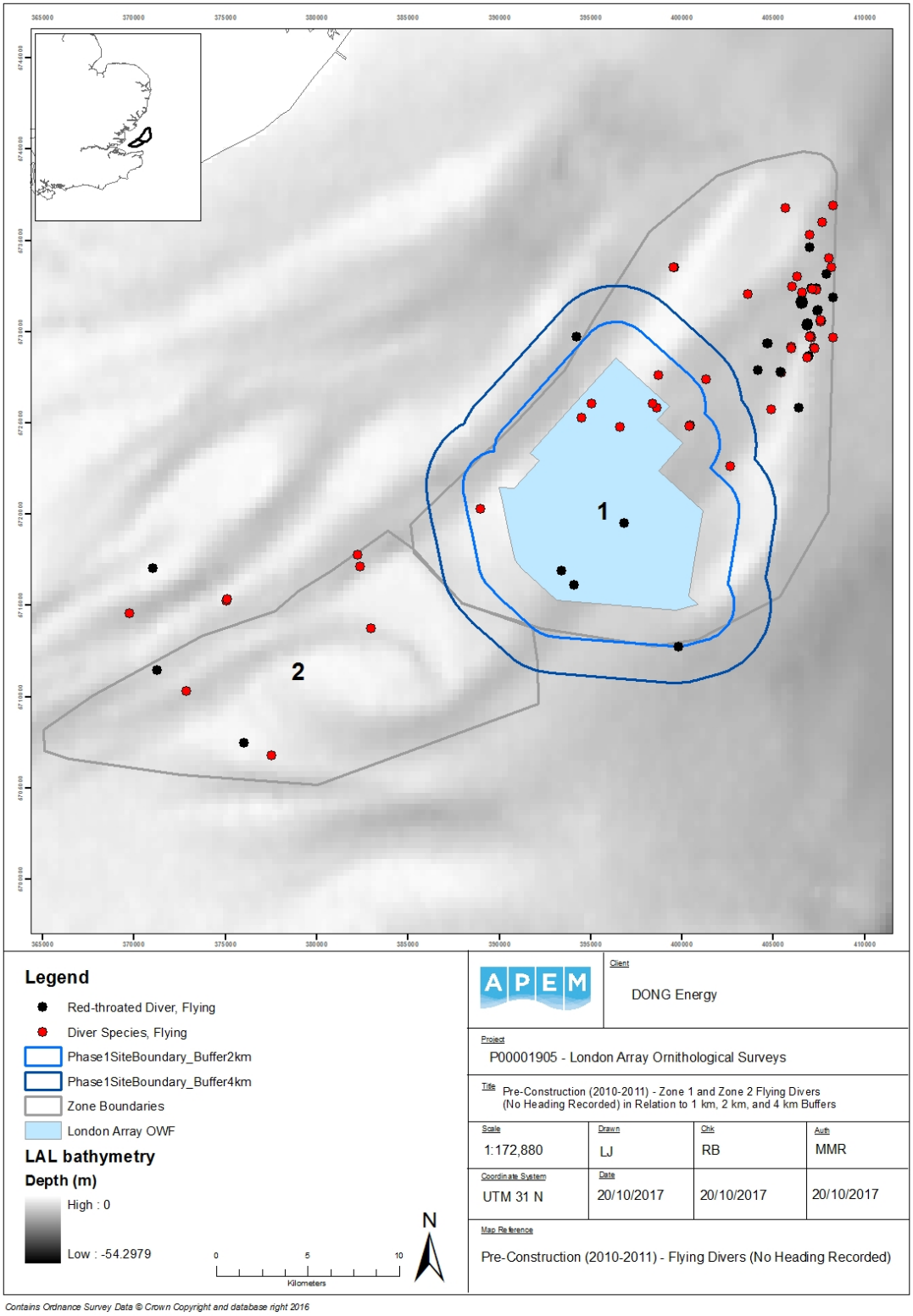


Figure 17 **Distribution of flying divers recorded during the pre-construction phase digital aerial surveys (November 2010 to February 2011)**

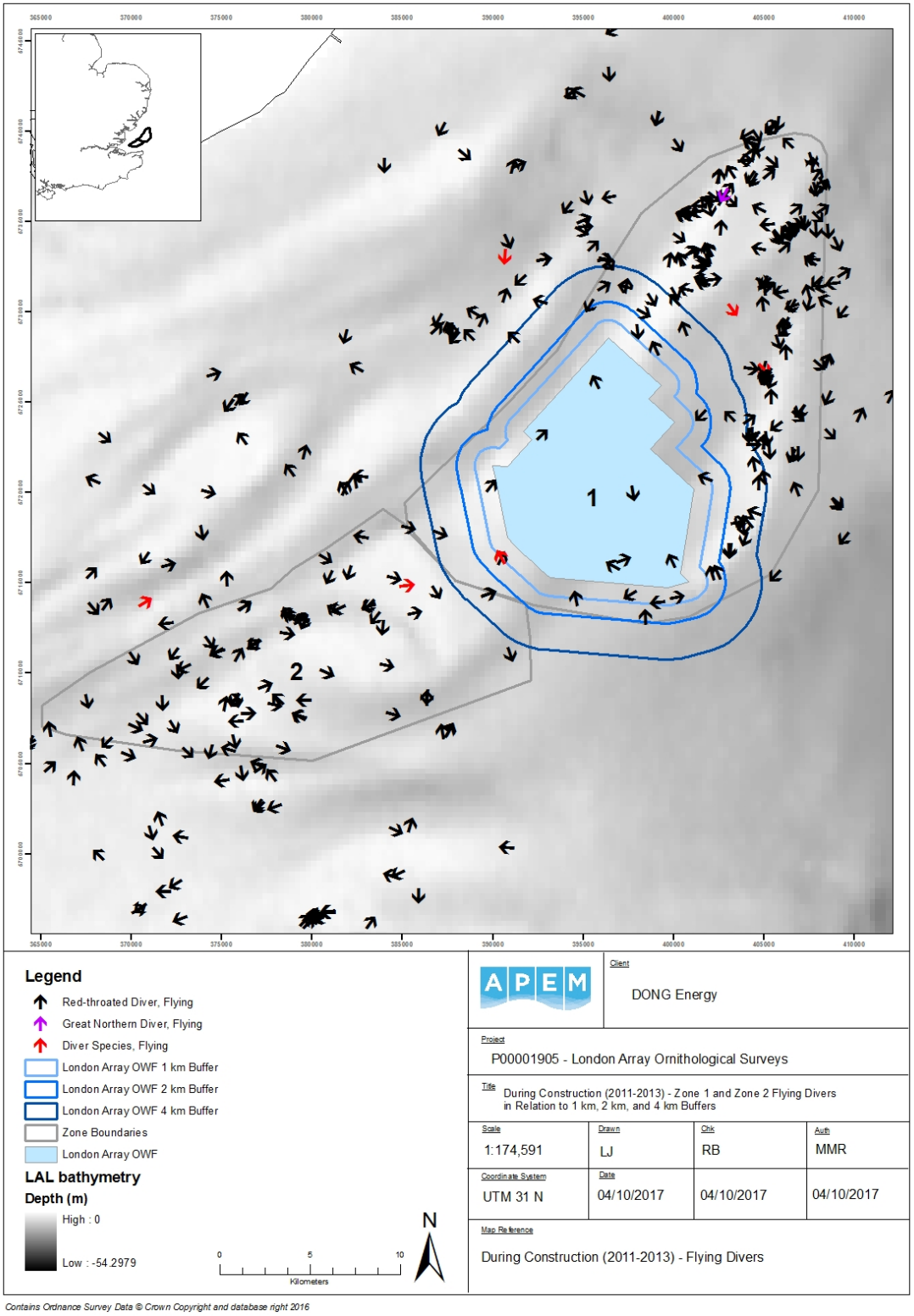


Figure 18 **Distribution of flying divers recorded during the construction phase digital aerial surveys (November 2011 to February 2013)**

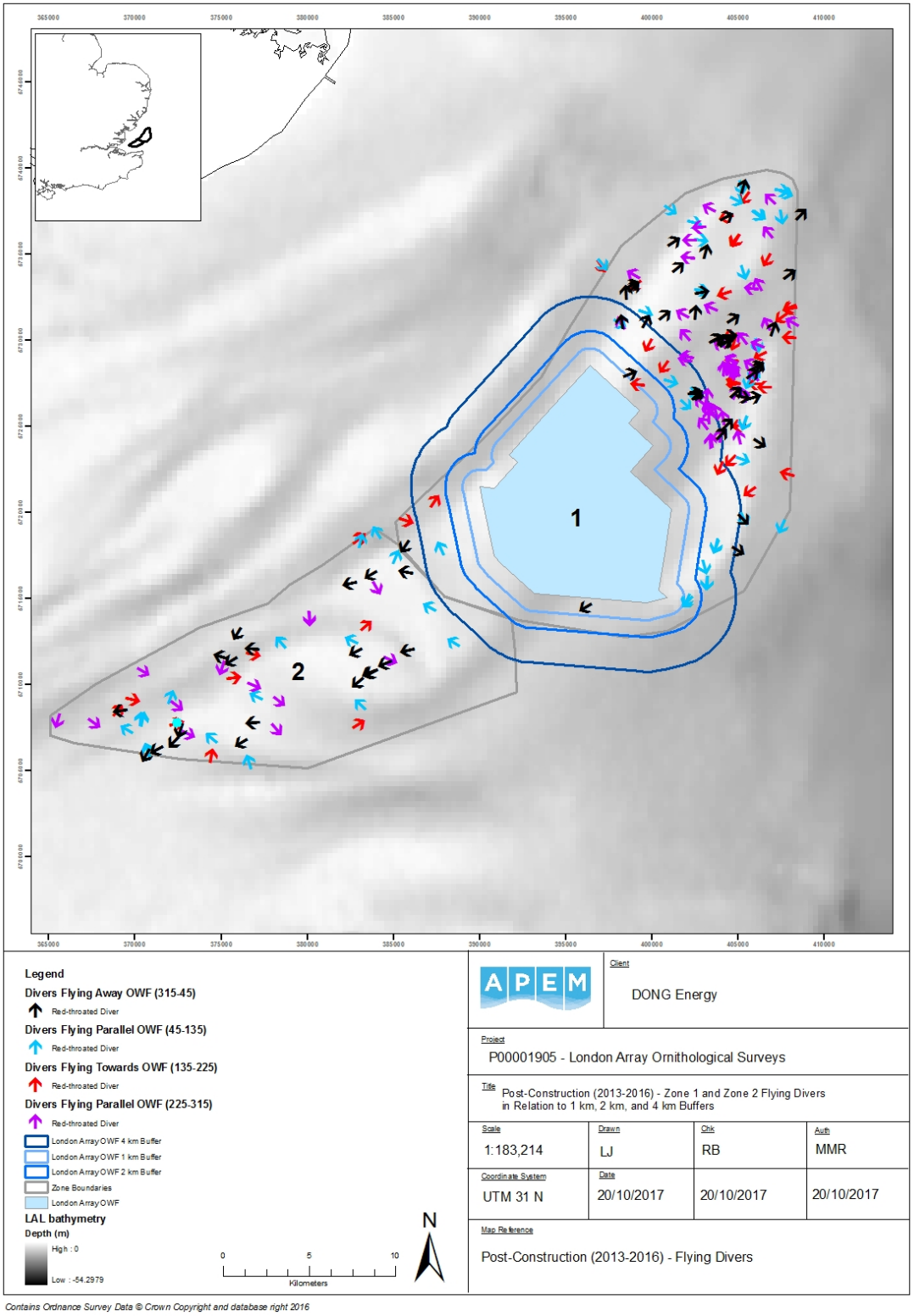


Figure 19 **Distribution of flying divers recorded during the post-construction phase digital aerial surveys (November 2013 to February 2016)**

The total number of flying divers recorded in the different buffer regions during each construction phase is summarised in Table 11.

Table 11 Counts of flying divers per construction phase and per buffer region (LAW = London Array Offshore Wind Farm).

Region	Pre-Construction[1]	During Construction[2]	Post-Construction[3]
LAW	8	6	0
LAW - 1 km	3	7	1
1 km - 2 km	1	7	4
2 km - 4 km	2	23	31
Zone 1 Total	100	186	150
Zone 2 Total	7	71	60

[1] 2010-2011 - One year of London Array surveys (Nov-Feb). The pre-construction year 2009/2010 was not included as during that year diver behaviour was not recorded.
[2] 2011-2013 - Two years of London Array surveys (Nov-Feb) and two Outer Thames surveys (Jan-Feb).
[3] 2013-2016 - Three years of London Array surveys (Nov-Feb).

The counts of flying individuals (Table 11) were weighted by the total surveyed coverage for each phase per buffer to make it possible to assess how the density of flying birds varied with distance to the wind farm. That assessment is presented in Figure 20.

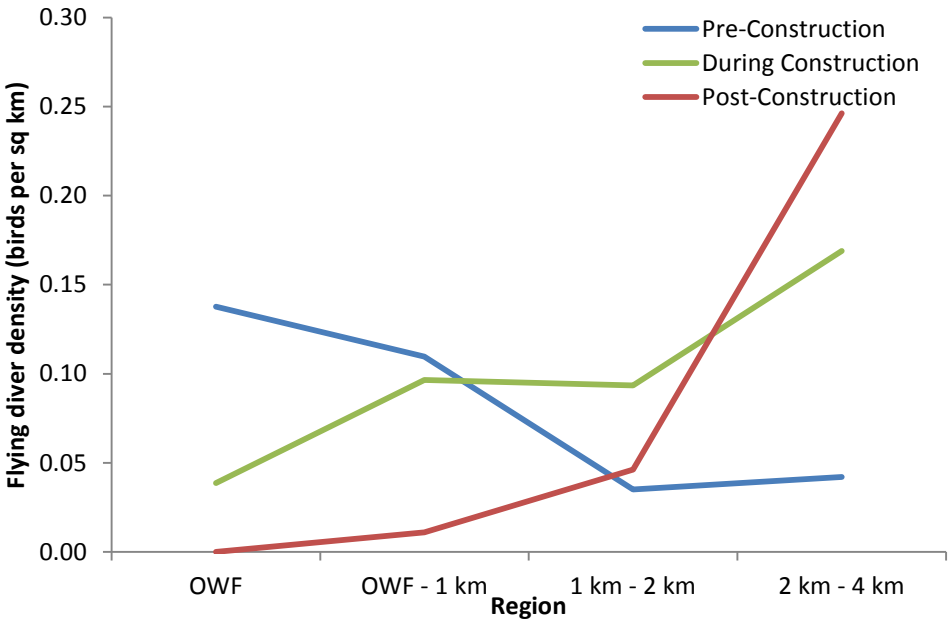


Figure 20 Differences in flying diver densities between the pre-, during-, and post-construction phases.

It can be observed from Figure 20 that in the pre-construction phase the density of flying divers is high within the proposed footprint of the wind farm and falls to lower levels with increasing distance from the proposed footprint of the wind farm. Opposite trends in flying diver densities are observed in the during- and post-construction phases with low (during-construction) and no (post-construction) flying divers within the footprint of the wind farm and rising densities of flying birds with increasing distance from the footprint of the wind farm.

Stage 2 Analysis of flight directions

Table 12 summarises the flight directions of the flying divers used for the χ^2 test. Due to the limited number of flying divers recorded in the wind farm and the 1 km buffer, it was necessary to combine the buffer regions to ensure that the assumptions of the chi-square statistic were met. Specifically that no more than 20% of the expected counts are less than five and that all individual expected counts are one or greater (Yates, Moore & McCabe, 1999).

Table 12 Counts of flying divers during the post-construction phase per buffer region. Directions are relative to the nearest turbine of the London Array Wind Farm.

Region	Flying towards wind farm (135-225°)	All other trajectories (225-135°)	Total
LAW – 4 km	5	31	36
> 4 km in Zone 1	24	90	114
Total	29	121	150

There would be evidence of a barrier effect if significantly less than the expected one in four divers was flying towards the wind farm (the 135-225° quadrant). There was no evidence that fewer (or more) divers were flying towards the wind farm compared to the other directions ($\chi^2_1 = 0.900$, n = 150, $P > 0.05$).

Table 13 presents the number of the 999 bootstrapped samples of diver flight directions that have 25% or less flying individuals flying towards the LAW. The five divers observed in flight within 2 km of the LAW, resampled to provide 999 bootstrapped samples, did not provide evidence that the divers tended to fly away from the wind farm ($P > 0.05$). Resampling of the 31 divers in flight between the 2 to 4 km buffer region of the LAW, produced 956 of 999 samples that had 25% or more of the divers flying away or parallel to the wind farm, thus the null hypothesis that the divers are as likely to fly towards the wind farm as in other directions can be rejected ($P < 0.05$).The 114 divers observed in Zone 1 in flight beyond 4 km of the LAW, resampled to provide 999 bootstrapped samples, did not provide evidence that the divers tended to fly away from the wind farm ($P > 0.05$).

Table 13 Raw counts and proportion of bootstrapped samples of flying divers present in each buffer region during the post-construction phase and the probability that such a proportion of bootstraps would occur by chance

Region	Raw counts		999 bootstraps		Probability value *$P < 0.05$
	Towards LAW (135-225°)	All other trajectories (225-135°)	≤ 25% Towards LAW (135-225°)	>25% Towards LAW (135-225°)	
LAW – 2 km	1	4	730	269	0.269
2 km – 4 km	4	27	956	43	0.043*
> 4 km in Zone 1	24	90	851	198	0.852

5.4 Discussion

Objective 2 of the Marine Licence is as follows:

- *Determine whether there is a barrier effect to the movement of birds through the wind farm site, 1 km and 2-4 km buffer zones.*

The effect of LAW acting as a barrier to divers was predicted in the ES to result in either a reduced utilisation of ecological resources (through birds no longer being able to reach them as a result of the "barrier") or a significantly increased energy expenditure by the birds as a result of having to fly around the barrier (London Array Limited, 2005).

To meet Objective 2 of the Marine Licence a two-stage data interpretation was undertaken to determine whether the LAW creates a barrier effect to the movement of diver species through the wind farm.

Stage 1 Distribution of birds

A greater number of flying divers were observed in the north-eastern region of Zone 1 during all construction phases (Figures 15-17) than in the pre-construction phase. This is unsurprising as the overall highest densities of divers; both sitting and flying, occurred in the northern area and eastern edge of Zone 1 (see Divers in Section 4.2). A combination of water depths of less than 20 m and the presence of sand banks makes this area a preferred habitat for divers (Skov & Prins, 2001).

Unlike during the pre-construction period, during the post-construction phase no flying divers were recorded within the LAW footprint. As there is some evidence that divers may be sensitive to shipping disturbance (Camphuysen *et al*., 2004; Schwemmer *et al*., 2011), it is possible that shipping may be disturbing the divers. However, any effect of disturbance could also be due to other operational activities inside the wind farm boundary or by the turbines themselves. It is also not possible to discount the changes in local environmental conditions or diver population size in some years (Maclean *et al*., 2013) could fully or partly explain the observed changes in observed diver numbers in the area.

Flying diver densities were found to have increased 1 to 4 km away from the LAW during the post-construction phase in comparison to the pre-construction phase (Figure 18). This would be consistent with divers displaced from the LAW footprint and near environs utilising adjacent airspace.

Interpretation of this information is not straightforward as there can be large variations in seabird numbers between years even in areas unaffected by developments (Maclean *et al*., 2013), and divers in particular have been known to vary considerably in numbers within the OTE SPA (Goodship *et al*., 2015). Such variation may be explained by a range of factors including environmental variables such as weather patterns (e.g. changing conditions on wintering or breeding grounds), tide, food availability, diurnal variation in diver movements affecting the number of individuals present at the time of each survey, possible (combined) effects following construction in the area or a combination of these factors (Goodship *et al*., 2015), as well as the overall population size of the species.

The observed changes in diver flight numbers suggest a possible barrier effect created by the LAW but this is unproven. The observed effects of no flying birds within the footprint post-construction and an increasing density of flying birds away from the wind farm are consistent with displacement (see Section 6) and do not necessarily infer a barrier effect.

Stage 2 Analysis of flight directions

Using the trajectories of flying birds recorded from the LAW to 4 km buffer, and greater than 4 km in Zone 1, a χ^2 test was carried out to determine whether there was any evidence that

divers were less likely to fly towards the LAW, if so suggesting that the birds may be avoiding the wind farm and thus that it could be acting as a barrier to their movements. This analysis indicates that there is no significant difference in the number of divers flying towards the LAW (Table 18) compared to that which would be expected by chance ($\chi^2_1 = 0.900$, n = 150, $P > 0.05$). On this basis there appears to be no effect of the wind farm on flight direction and thus there is no indication that the wind farm had become a barrier to movement and was forcing birds to deviate their flight paths. However the number of flying divers recorded was low, especially in the buffer regions nearest to the LAW.

To further investigate flight trajectories, additional analysis of flight directions was undertaken based on data bootstrapping. The results of this analysis showed that in the 2 to 4 km buffer region, significantly fewer divers than expected by chance were recorded flying toward the wind farm ($P > 0.05$). For the remaining buffer regions, LAW to 2 km and greater than 4 km, no significant difference was found between the number of divers flying towards the OWF and in other directions. Only five divers being recorded in flight from the LAW to 2 km buffer region makes the power of any test very weak and therefore little weight can be placed on its outcome for this region.

Unfortunately as the flight directions of divers before construction of the LAW are unknown; it is not possible to test whether diver behaviour (flight direction in relation to the wind farm) has changed with wind farm construction. The present tendency of divers to avoid flying towards the OWF may reflect a flight preference of the birds unrelated to the LAW. The large majority of the divers in the 2 to 4 km buffer being east of the LAW (Figure 3), it is possible that the divers prefer to avoid flying in a broadly east-west direction which would explain the apparent tendency of the birds to avoid flying towards the LAW for reasons unrelated to the wind farm. Why the birds would have such a preference is uncertain but it could relate to any predominant wind directions which would increase the energy requirements of birds flying into the wind. The average wind direction for the days surveyed during the post-construction period was south-westerly (SSW; 212°, n=9) based on Met Office data from an observation site at Shoeburyness on the coast. Assuming that the wind direction is similar offshore, and given that the majority of divers were recorded in the north east region of Zone 1, it is conceivable that the apparent avoidance of LAW by the divers is thus as a result of these birds avoiding to fly into the wind (and therefore the LAW). However, if this were so one would expect to observe a similar avoidance of south-westerly flight by divers in the more than 4 km buffer region but no such avoidance has been identified.

The flight trajectory and distribution of flying birds across the buffer regions observed during all surveys including the post-construction surveys is likely to reflect changing abundances and distributions of prey with tidal state (Kaiser *et al*., 2006; Skov & Prins, 2001) which could lead to a predominant direction of flight that although unrelated to the LAW suggests that the LAW provides a barrier to diver movements. This analysis designed to detect the possible presence of a barrier effect does not take habitat preferences and tidal states into account. However as flying divers were captured at different times and dates throughout the post-construction period (Appendix 4: Figure 1) and each survey takes several hours to deliver, it is most likely that the flying divers were captured at a range of different tidal states making the outcome of the analysis defensible.

Barrier effects are less likely to be an issue for migrating divers as the energetic costs associated with diverting around a wind farm are likely to be relatively small in the context of total distance travelled (Masden *et al*., 2009). Modelling the foraging flights of breeding seabirds has revealed that any prolonged flights brought about by the need to circumvent OWFs acting as barriers are likely to have less effect on breeding seabirds than low food abundance or adverse weather (Masden *et al*., 2010). Barrier effects could be of greater

importance to resident wintering divers as any barrier effect could stop them making most use of food resources that are on both sides of an obstruction for the duration of their time in the area, or making them have to fly around the obstruction on a regular basis to access these resources. When facing an obstruction, Masden *et al*. (2010) indicated that of the seabird species with contrasting morphologies, species with high wing-loading ratios, such as divers, would incur the greatest energetic costs associated with additional foraging distances. However, as the area covered by the OTE SPA consists of large areas of favourable habitat for divers the effect on energy expenditure would be expected to be negligible as rather than flying around any obstruction the divers may be able to utilise other feeding or roosting areas.

Overall, there is a suggestion that the LAW may be providing a barrier to movement; with very few divers being found very close to the LAW and evidence of the divers avoiding flying towards the LAW when within 4 km of it. The displacement modelling (see Section 7 Assessment for Displacement) showed that proportionally fewer divers were recorded post-construction in comparison to pre-construction up to 11 km of the LAW, although interpretation is complicated by the significantly higher densities of divers estimated to be present post-construction than during construction. The results of the modelling also suggested that divers were redistributed with significantly greater densities in the southern region of Zone 2 and a small pocket in the northern corner of Zone 1. However, as flying divers were recorded within the LAW footprint even during its construction, this suggests that it does not provide a complete barrier to diver movement although it is not known if those few flying divers were in a section of the part-constructed wind farm where turbines had not yet been erected.

It was not possible to determine whether the LAW was acting as a barrier to movement to other areas of habitat outside of the LAW due to the large extent of the OTE SPA. Thus, even if the LAW were to be acting as a barrier to flying divers in particular regions in the OTE SPA, it is difficult to see how what are likely to be only slightly longer flights than normal to avoid the LAW would notably affect them. Since the analysis was of diver flying directions relative to the nearest turbine, any loss of habitat for the divers would be specifically in relation to the proximity to the LAW. This form of barrier effect is better considered to be the result of a displacement effect.

5.5 Summary

No flying birds within the footprint and a trend for increasing densities of flying divers away from the LAW post-construction suggest a possible barrier effect. However it is difficult to discount that these observations are as a result of displacement.

The evidence that divers avoid flying towards the LAW when within 4 km of it provides stronger evidence of a possible barrier effect created by the LAW. Although displacement could explain the relatively small number of divers observed flying in the vicinity of the LAW, the few flying divers that there are do seem to avoid flying towards the LAW. For foraging flights of breeding seabirds modelling has revealed that any prolonged flights brought about by the need to circumvent OWFs acting as barriers have less effect on breeding seabirds than low food abundance or adverse weather (Masden *et al*., 2010). The area covered by the OTE SPA consists of large areas of favourable habitat for divers. If the LAW were to be acting as a localised barrier to wintering diver movement, the extra energy expenditure of the divers would be expected to be negligible as rather than flying around any obstruction the divers should be able to utilise other feeding or roosting areas.

As the flying directions were relative to the nearest turbine, any potential loss of habitat for the divers, which was not included in the barrier effect assessment, was specifically in relation to the LAW. This form of barrier effect i.e. potential loss of habitat relating to areas within the LAW is defined as displacement.

Since the analysis was of diver flying directions relative to the nearest turbine, any loss of habitat for the divers would be specifically in relation to the proximity to the LAW. This form of barrier effect is better considered to be the result of a displacement effect (refer to Section 7).

6. Assessment for Collision Risk

6.1 Introduction

Objective 4 of the Marine Licence relates to the potential of LAW to elevate the risk of bird collision mortality through changes in bird use of, and behaviour at, the wind farm site:

- *If objectives 1 or 2 reveal significant change of use of the wind farm site and 1 km and 2-4 km buffer zones by populations of conservation concern, at heights that could incur collision, a programme of collision monitoring will be implemented.*

The purpose of the analysis set out in this section is to determine whether there has been a change in use of the wind farm by flying birds - that behaviour placing them at risk of collision. It will also test whether the predictions made in the ES in relation to the number of birds at potential collision risk are consistent with the as-built situation.

Objective 4 focuses attention on bird "populations of conservation concern". The ES identified the species of concern with respect to potential collision mortality as:

- Red-throated / black-throated diver
- Large gull species (herring gull, lesser black-backed gull, great black-backed gull)
- Small gulls
- Gannet

The ES assessed the likelihood of a significant impact arising from collision mortality and identified a likely significant effect for divers. As divers were anticipated to be displaced by the wind farm it can be expected that the risk of collision can be reduced to non-significant levels. Section 7.3 describes the outcome of diver displacement at LAW.

The ES also assessed the likelihood of a significant impact arising from collision mortality to large gulls, small gulls and gannets. The potential impact was identified as possibly significant for large gulls and gannets and not significant for small gulls. These species are included in the analysis for any change in use of the site by flying birds.

6.2 Methods

The datasets used in the analysis are those obtained from the aerial digital surveys conducted in the periods of pre-construction (2010-2011) and post-construction (2013-2016). These two datasets are compared to determine whether there has been any change in the bird usage of, and behaviour at, the wind farm site.

As we do not have flight height information for the birds, this assessment is based on the assumption that collision risk for a species is directly proportional to the number of individuals present in the LAW footprint and environs. The assessment is predicated on the premise that there would be more collisions if more birds are present. This assumption would be at best simplistic and at worst wrong if the birds changed their flying behaviour (height and speed) as a consequence of turbines being present.

Pre-construction data from 2009 to 2010 (the pilot study period) were not included in the dataset of flying bird densities because bird behaviour was not recorded during the pilot study.

The post-consent monitoring surveys were specifically aimed at recording red-throated diver information. This means that the aerial surveys were confined to the winter season (November to February inclusive). As such, data do not exist for any analysis that would cover the remainder of the year, including the breeding season.

The flying bird data used in the analysis consist of raw counts contained within ArcGIS files obtained from the monitoring period of pre-construction (2010-2011) and post-construction aerial digital surveys (2013-2016). Flying bird density data are also provided for Zone 1 and Zone 2 for the purposes of context.

The datasets contained unidentified species, placed into species group categories (e.g. large gull species). If unidentified species were 5% or greater across the year of the total of each group recorded, an apportionment exercise was undertaken to divide these individuals into the relevant positively identified species that were recorded within the same month. In months where no positively identified individuals were recorded, an apportioning exercise of the unidentified individuals was not undertaken. Although it would have been possible to apportion these individuals using species' ratios from other months that could have lead to big errors in the numbers of each species present as the proportion of species present can vary a great deal between months. In the post-construction period the number of unidentified individuals did not meet the 5% threshold and as such no apportionment was undertaken.

The density of flying individuals within LAW was calculated for each species for each survey month based on the number of individuals in flight and the area surveyed. The peak density estimates per development phase of each key species were identified and qualitatively compared between pre-construction and post-construction.

The following approach is used to assess whether the predicted numbers of collisions in the ES for the proposed LAW are realistic. The expected number of collisions in the LAW is extrapolated from the estimated number of collisions in the ES. For each species, the change in the number of collisions in the LAW from that predicted in the ES will be proportional to changes in the density of the species in the wind farm footprint, the number of turbines in the footprint, the rotor swept zone of each turbine, and species' specific parameters such as its flight speed and flight height. Although this project does not have flight height information for the surveyed birds it is reasonable to assume that the birds' flight heights will not have changed from those used in the ES. The same assumption is made about the species' flight speeds.

Based on these assumptions the change in the estimated number of collisions for each species in the LAW from that predicted in the ES will be directly proportional to the change in the species' densities used for the ES and those recorded post-construction, and the ratio of the total rotor swept zones used in the built wind farm to that estimated in the ES. Applying that ratio of 0.6458 (Table 14) to the ES collision estimates corrects them to allow for the smaller than planned number of turbines in the built wind farm. Applying this ratio will always lower the expected number of collisions. Then, these new expected numbers of collisions are finalised for the built wind farm by multiplying them by the change in each species' density used in the ES and observed in the built LAL.

Table 14 Turbine parameters used to generate the ratio between the total turbine rotor swept zones used for the ES collision calculations and as exists in the LAW.

Parameters	Method	ES	LAW	Ratio LAW:ES
Turbine diameter (2r)		150 m	150 m	
Number of turbines		271	175	
Turbine model		3.6 MW Siemens	3.6 MW Siemens	
Total rotor swept area (m^2)	No turbines$\times\pi r^2$, where r = turbine radius	$=271\times\pi\times(150/2)^2$ m^2 $=4{,}788{,}965.30$ m^2 $=4.789$ km^2	$=175\times\pi\times(150/2)^2$ m^2 $=3{,}092{,}505.27$ m^2 $=3.093$ km^2	0.6458

6.3 Results

The peak flying densities of each key species recorded in flight in the LAW footprint are presented in Table 15. No other species of diver, small or large gulls were identified in flight during the two phases.

Table 15 Peak flying bird densities within the wind farm footprint pre- and post-construction of LAW. Numbers in bold represent the peak value recorded during the pre- and post-construction periods. Numbers in italics contain apportioned individuals.

Species	Peak Flying Density (bird per sq. km)		Difference (bird per sq. km)
	Pre-Construction	Post-Construction	
Red-throated diver	***0.33***	0.00	-0.33
Gannet	0.07	**0.13**	+0.07
Lesser black-backed gull	0.00	**0.13**	+0.13
Herring gull	0.00	**0.07**	+0.07
Great black-backed gull	0.00	**0.40**	+0.40
Kittiwake	*0.57*	**0.72**	+0.16
Common gull	*0.08*	**0.33**	+0.25
Black-headed gull	*0.08*	**0.13**	+0.05

There was a reduction in the density of flying divers in the footprint recorded post-construction compared to pre-construction. No flying divers were recorded in the LAW footprint during the post-construction phase. There were increases in the densities of flying gannets, and all large and small gull species recorded during the post-construction phase in the footprint.

The changes in density have to be considered in the context of the relatively small bird counts that these densities represent. Some of the changes are so small that they could just represent chance events. These changes in density in the LAW footprint between the pre- and post-construction phases equate to the following numbers of birds:

- Red-throated diver five versus zero

- Gannet one versus two;
- Lesser black-backed gull zero versus two;
- Herring gull zero versus one;
- Great black-backed gull zero versus six;
- Kittiwake seven versus eleven;
- Common gulls one versus five; and
- Black-headed gull one versus two.

Figure 21 demonstrates the percentage difference in peak flying density between the pre-construction and post-construction phases for each of the key species recorded within the LAW footprint, Zone 1 and Zone 2.

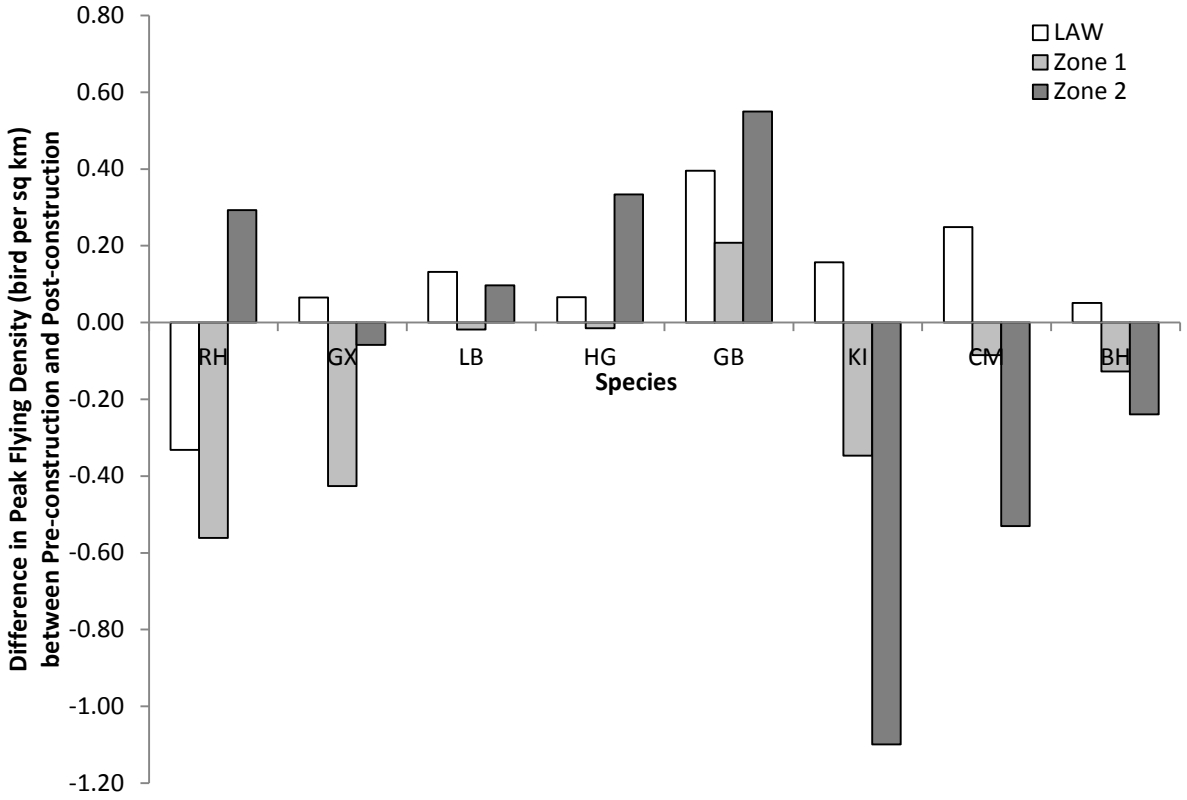


Figure 21 Difference in peak density of flying birds between the pre- and post-construction phases within the LAW footprint, Zone 1, and Zone 2 for each of the key species.

Figure Notes: Species key - red throated diver (RH), gannet (GX), lesser black-backed gull (LB), herring gull (HG), great black-backed gull (GB), kittiwake (KI), common gull (CM), and black-headed gull (BH). A value greater than zero indicates an increase in density post-construction.

No red-throated divers were recorded in flight during the post-construction phase in the LAW footprint. Whereas flying red-throated diver densities reduced in Zone 1 post-construction they increased in Zone 2.

Gannet, kittiwake, common gull, and black-headed gull flying densities were lower post-construction than pre-construction in Zones 1 and 2, but their flying densities in the LAW footprint were higher post-construction than pre-construction. It is important to note that the changes in the LAW relate to very few individuals e.g. from one to two gannets.

Great black-backed gull flying density increased in Zones 1 and 2 and the LAW footprint post-construction. Lesser black-backed gull and herring gull flying densities increased post-construction in the LAW footprint and Zone 2 but decreased in Zone 1.

Table 16 Mean flying bird densities used in the ES to estimate collisions and within the LAW footprint post-construction. No small gull densities are provided in the ES.

Species	Mean Flying Density (birds km^{-2})		Proportion of birds flying in LAW footprint compared to ES
	ES (based on 303.7 km^2 – old LAL + 1 km buffer)	LAW Post-Construction (100.8 km^2)	
Red-throated diver	0.16	0.00	0.00
Gannet	0.07	0.02	0.23
Lesser black-backed gull	0.67	0.02	0.03
Herring gull	0.55	0.05	0.10
Great black-backed gull	0.09	0.10	1.06
Kittiwake	n / a	0.32	n / a
Common gull	n / a	0.12	n / a
Black-headed gull	n / a	0.01	n / a

Table 17 Predicted change in the numbers of collisions in built LAW from the numbers predicted in ES. No change is presented for small gulls as they were not included in the ES.

Species	Predicted Collisions in ES A	Ratio turbines LAW:ES B	Proportion of birds flying in LAW footprint compared to ES C	Predicted Collisions in LAW (A × B × C)
Red-throated diver	20	0.6458	0.00	0
Gannet	100	0.6458	0.23	15
Lesser black-backed gull	12	0.6458	0.03	< 1
Herring gull	115	0.6458	0.10	7
Great black-backed gull	110	0.6458	1.06	76
Kittiwake	n / a	n / a	n / a	n / a
Common gull	n / a	n / a	n / a	n / a
Black-headed gull	n / a	n / a	n / a	n / a

The numbers of collisions estimated to occur in the LAW were lower than those predicted in the ES for red-throated diver, gannet, lesser black-backed gull, herring gull, and great black-backed gull (Tables 16 and 17). Kittiwake, common gull and black-headed gull were not assessed for collision risk in the ES. However it is important to note that the collisions in the ES are assumed to be per annum. The figures presented for the post-construction period are mean monthly densities based on data collected November to February. It is not possible to convert these mean monthly densities to an estimated per annum figure as sea bird densities change from month to month. Therefore caution is required when interpreting these differences. However it is expected that if anything these results will over-estimate the relative number of collisions that could occur in the LAW. This is due to the fact that as densities of many species of seabird in The Thames tend to be highest during the winter months of November to February, except lesser black-backed gulls, a mean seabird density

based on these months is very likely to be higher than one based on all months of the year as recorded in the ES.

6.4 Discussion

The results of this analysis of collision risk based on the peak densities of various species recorded during the pre- and post-construction phases of LAW indicate that the collision risk for red-throated divers is likely to be minimal as the flying diver density in the footprint, where the divers could encounter turbines, dropped to zero. This is likely to be due to the species showing significant avoidance (e.g. Garthe & Hüppop, 2004) and displacement (Section 7 of this report) in response to manmade structures.

The densities of the other key species increased within the LAW footprint post-construction. This potentially presents an increase in the risk of collision mortality but the numbers of birds concerned are very low. The increase in collision mortality, however small, may be fully or partly counteracted by the built wind farm comprising fewer turbines than used as a basis for the ES predictions (see below).

Gannets, large gulls, and small gulls are known to be attracted to vessels and their density and abundance are known to vary based on the availability of local food resources (Mitchell *et al*., 2004). Built wind farms tend to weakly attract great black-backed, herring, lesser black-backed, common and black-headed gulls, have little effect on black-legged kittiwake abundance, and be strongly or almost completely avoided by red- and black-throated divers (Dierschke *et al*., 2016). With several factors that could be attracting or repelling the birds to be considered as well as the presence of the LAW, it is impossible to determine with any certainty what has led to the observed increase in the numbers of these species.

The numbers of collisions estimated to occur in the LAW were lower than those predicted in the ES for red-throated diver, gannet, lesser black-backed, herring gull, and great black-backed gull (Tables 16 and 17). A similar analysis was not possible for the smaller gulls as no densities were provided for them in the ES. It is important to note that the collision estimates in the ES were assumed to be per annum, whereas the densities presented for the post-construction period were monthly. Due to species behaviour varying throughout each season, it was not possible to convert the monthly densities collected from November to February into per annum figures. If the ES density figures are based on mean monthly seabird densities for the whole year it is important to note that as the LAW densities are based on the mean of November to February densities, except lesser black-backed gulls, when seabird densities on The Thames tend to be at their highest of the year, the analysis presented here will if anything have over-estimated the collisions that could occur within the LAW. However, no red-throated diver collisions were estimated to occur in the LAW. This is lower than that predicted in the ES for the species that the Marine Licence focuses on most.

6.5 Summary

Red-throated divers were not recorded in flight during the post-construction phase of the LAW and therefore the species is not expected to collide with the turbines. For gannet, lesser black-backed, herring gull, and great black-backed gull the estimated number of collisions is lower than that predicted in the ES primarily due to the reduced number of turbines installed at LAW compared to the number used in the ES predictions. The lower flying bird densities measured in the post-construction surveys compared to that included in the ES predictions also contributes to lower collisions estimates for all but great black-backed gull.

7. Assessment for Displacement

7.1 Introduction

The key species of concern for assessing the potential for displacement effects arising from the construction of the LAW were identified as divers during the ORP process. The survey design and seasonality was developed specifically for quantifying any potential change in diver abundance and distribution. It was agreed with the MMO and NE during the ORP process that auks would also be assessed for displacement using the same analytical techniques as divers. Wildfowl species (a key species group of concern for displacement identified in the ES) were detected in such low numbers (Tables 10 to 16) that they were not included in this analysis for potential displacement effects.

The ES assumed that high levels of displacement will occur for divers. However, for species present in the area outside the breeding season such as red-throated divers and auks, while birds may be displaced, the impact on the population may not be of similar magnitude, as population constraints generally relate to the conditions of the breeding area, and non-breeding birds may not be limited by the availability of winter resources.

Annex 2 of the Marine Licence contains two points relevant to the assessment of displacement:

- *Determine whether there is change in bird use and passage, measured by species (with particular reference to Red-Throated Diver), abundance and behaviour, of the windfarm site, 1km and 2-4 km buffer zones and the reference site.*
- *Continue to determine the distribution of wildfowl and divers in the Greater Thames estuary, covering the London Array windfarm site, 1km and 2-4 km buffer zones and the reference site.*

The aim of the displacement analysis of divers and auks is to quantify the likely magnitude of displacement at different distances (buffers) from the LAW.

7.2 Methods overview

APEM was commissioned by NE in 2016 with permission from London Array Ltd to undertake spatial modelling of diver and auk density based on relevant environmental variables following the first year of post-construction surveys. The purpose of the modelling was to identify any potential displacement impacts and to set up a suitable model framework for any subsequent analysis of the data collected at the LAW. The modelling presented in this report includes data following the final two years of post-construction surveys.

As part of the NE funded report ‘a review of the environmental variables (including anthropogenic activities) which might influence the distribution of red-throated divers (and other species)’ was conducted. These were considered as factors to be accounted for in the analysis. APEM (2016) provides details of environmental data used in the analysis, selected on the basis of the literature review conducted by APEM, and availability of the selected environmental variables. The same environmental variables have been included in the analysis presented in this report.

7.2.1 Modelling approach overview

In order to compare the effects of the LAW construction or operation on the abundance and distribution of divers and auks, it was necessary to utilise only the data that was available in a consistent manner in each of the three construction phases, namely, pre-construction, during-construction and post-construction. This meant that only the areas within the London Array Zones 1 and 2 could be compared.

The following comparisons were undertaken between each of the development phases:

- Pre-construction versus during-construction
- During-construction versus post-construction
- Pre-construction versus post-construction

The bird data available for modelling comprised aerial digital data collected during ornithological monitoring surveys between 2009 and 2016, however earlier years (e.g. the pilot study of 2009-2010) contained limited information on species identification (identification was to species group level only). Other available datasets were considered and investigated (APEM, 2016) but a number of factors precluded their use. The bird data from the aerial visual surveys and the boat surveys differs in a number of ways from the digital aerial stills data and there was insufficient overlap between the different survey platforms to be able to investigate if there were any significant differences in the numbers of birds recorded. This meant therefore that the modelling work proceeded using the digital aerial stills data from 2010 to 2016 only.

The data were analysed using a statistical package in R called MRSea (Marine Renewables Strategic Environmental Assessment). This statistical package was specifically developed to quantify any change in the density and / or distribution of animals in and around marine renewables development sites. This modelling technique is suitable for seabird and marine mammal distributions that are potentially very complex and uneven in the marine environment (Mackenzie *et al*., 2013). This method is currently the recommended guidance for analyses of this type (Mackenzie *et al*., 2013).

The methodological information presented in the following sections has been simplified to aid understanding to readers with no statistical knowledge. However due to the nature of the approach used and the specific terminology required for describing statistical methods, the information provided assumes some understanding of modelling techniques. Additional detail for the modelling approach is provided in Appendix 6.

7.2.2 Modelling approach in-detail

APEM collated diver and auk abundance data from the final two years of post-construction surveys and appended them to the previous dataset for the modelling undertaken on behalf of NE (APEM, 2016). Shipping data were also obtained and collated accordingly. APEM provided these data to The Centre for Research into Ecological and Environmental Modelling (CREEM), the developers of the MRSea statistical package in R, to undertake the modelling of divers and auks to investigate displacement effects.

The MRSea package uses ‘Complex Region Spatial Smoother’ spatial modelling techniques with a ‘Spatially Adaptive Local Smoothing Algorithm’ (CReSS-SALSA) to estimate bird (or mammal) distribution in a GAM (Generalised Additive Model) framework (Scott-Hayward *et al*., 2013). GAMs are used to account for the non-linear relationship between variables. Generalised Estimating Equations (GEEs) are additionally used in the ‘CReSS-SALSA’ modelling framework to provide coefficients and estimates of precision. GEEs are

specifically designed to estimate and incorporate autocorrelation, which is a violation of spatial distribution modelling. Autocorrelation in data collected from offshore survey methods is likely due to data having a time-series element. Autocorrelation is the similarity between observations as a function of the time lag between them. For offshore survey methods, observations are more likely to be similar especially for data collected along the track lines. The 'CReSS-SALSA' method generates predictions of bird numbers across the study area (Scott-Hayward *et al*., 2013). The relevant environmental information was selected using a 10-fold cross-validation technique to inform the models for divers and auks based on all environmental data included in the dataset (see APEM, 2016 for further details about the relevant environmental data and a literature review). Cross-validation is a technique used to protect against overfitting in a predictive model. Overfitting is the production of a model that corresponds too closely to a particular set of data and may therefore fail to predict other observations reliably. In cross-validation, a fixed number of partitions (folds) of the data are created e.g. in a dataset of 100 observations, data can be partitioned into four separate folds of 25; the analysis is run for each fold; and then the average overall error is estimated.

The modelling approach of this report differed slightly to the modelling undertaken previously as described in APEM (2016). The different approach included the use of cross-validation to select covariates instead of probability which was previously used. In addition, amendments to the MRSea package have been undertaken since the previous modelling was completed [Scott-Hayward *pers. comm*.].

This analysis does not take into account that there can be major differences in diver or auk densities between years; therefore a lower density in a year does not necessarily mean that a local event in that year is the cause of that lower density.

7.2.3 Prediction grid

The relevant environmental information based on the 10 fold cross-validation technique was used to generate the best model for divers and auks to predict the bird density and distribution across all development phases in Zone 1 and Zone 2. All of the data from the relevant zones were used to inform the models. Bird density predictions were completed on Zone 1 and Zone 2 because these data spanned all development phases: pre-, during-, and post-construction.

The prediction grid was constructed by clipping a grid of 1 km² grid cells to the shapefile of Zones 1 and 2. This resulted in a final grid of 700 cells. Each grid cell was associated with each of the environmental variables listed in APEM (2016): Table 3.

7.2.4 Spatially explicit inference

Spatially explicit inference is the process of predicting density estimates based on the best model fit. A parametric 'bootstrap' which was based on the robust standard errors was used to incorporate the autocorrelation. 'Bootstrapping' is a statistical term used to describe the technique of resampling from the dataset. For example, all observations are in a bag, one observation is drawn from the bag at random and recorded, the observation is put back into the bag (termed resampling with replacement), and this process is repeated for as many observations as originally recorded. This example would provide one iteration of resampled data. The analysis to be completed is then run on these resampled data. This can create thousands of predicted datasets which is used to generate the errors associated with a mean. This technique is considered a robust method for determining the 95 percentile intervals for predictions. In the case of the modelling presented here, 1000 iterations were

used to determine upper and lower 95-percentile intervals for the predictions of divers and auks.

Following the prediction of diver or auk densities, spatially explicit maps of differences were used for assessment of changes in animal numbers between each of the development phases. The null hypothesis was that there was no difference between development phases in each grid cell. Grid cells with significant differences (where the probability was less than 0.05 i.e. 95%) were highlighted on the maps using 'o' for significantly negative, and '+' for significantly positive. Significantly negative indicates a significant decrease in the density of divers or auks, and likewise significantly positive indicates a significant increase in the density of divers or auks (Figures 27, 28, 29, 38, 39, 40).

7.3 Results: Divers

Not all divers were identified to species level, especially in the earlier years of surveys. As red-throated divers are the predominant species in the Outer Thames Estuary, it was assumed that unidentified divers were red-throated diver and the modelling was carried out on the total of red-throated divers and unidentified divers.

The final diver model (the model that has the greatest explanatory power) is provided below. The final model covariates are provided in Table 18.

Additive predictor = construction phase(df=2) + s(chlorophyll, df=3) + s(sea surface temp, df=5) + s(thermal front probability, df=3) + s(x, y, df=9) + s(x, y):construction phase

Model dispersion parameter for the final diver model was 23.05. Model dispersion greater than 1 suggests that there is over dispersion and a large amount of noise (high variance in the count data) present in the underlying data. This supports the decision to fit an overdispersed model. Model diagnostics are shown in Appendix 7.

Table 18 Final diver model covariates.

Covariate	Df	*P*-value
Construction Phase	2	<0.0001
s(Chlorophyll)	3	0.017
s(sea surface temperature)	5	<0.0001
s(thermal front probability)	3	<0.0001
s(x, y)	9	<0.0001
s(x,y):construction phase	18	<0.0001

Table notes: The 's' before a covariate in brackets indicates that a smoothed term has been applied because the relationship with density is non-linear. 'Df' is Degrees of Freedom, and '*P*-value' is the probability value where less than 0.05 indicates a significant relationship with density.

Observed values across the years within each of the development phases were plotted to give a visual indication of any change. This provided an average value across the surveys within Zone 1 and Zone 2 within the years classified to each construction phase. Figures 22 to 24 provide the observed density of divers with associated lower and upper confidence intervals.

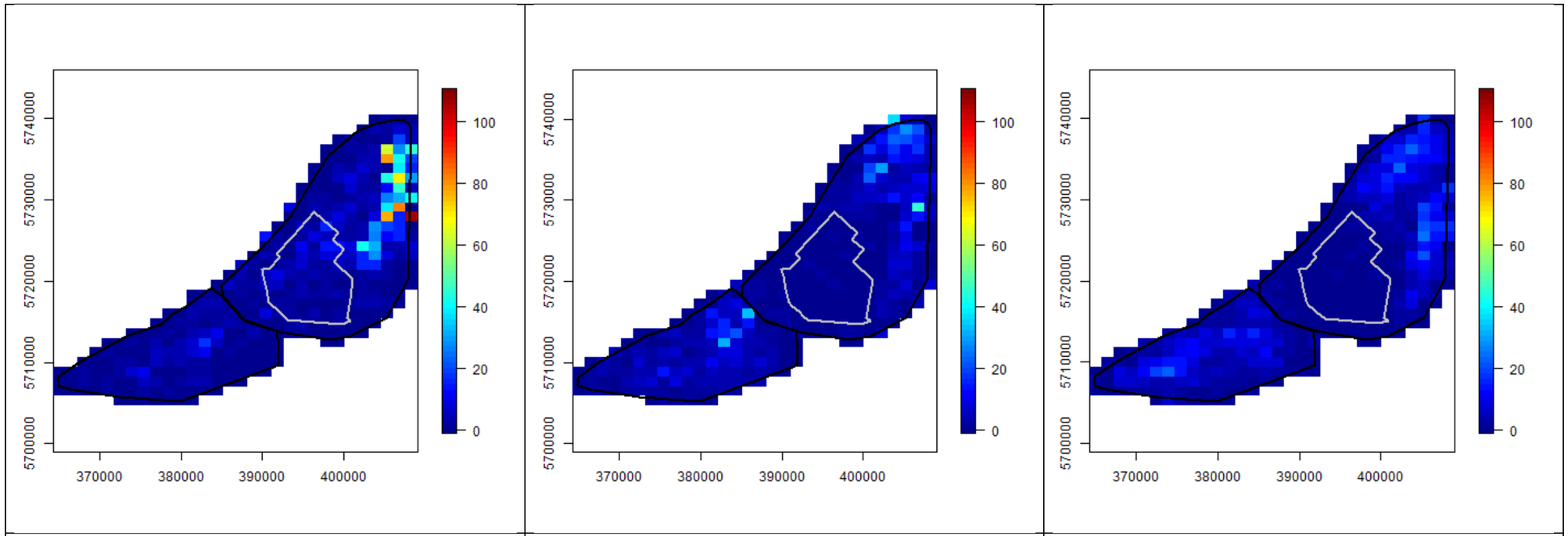


Figure 22 Pre-construction, during construction, and post-construction mean observed diver density (birds per sq km)

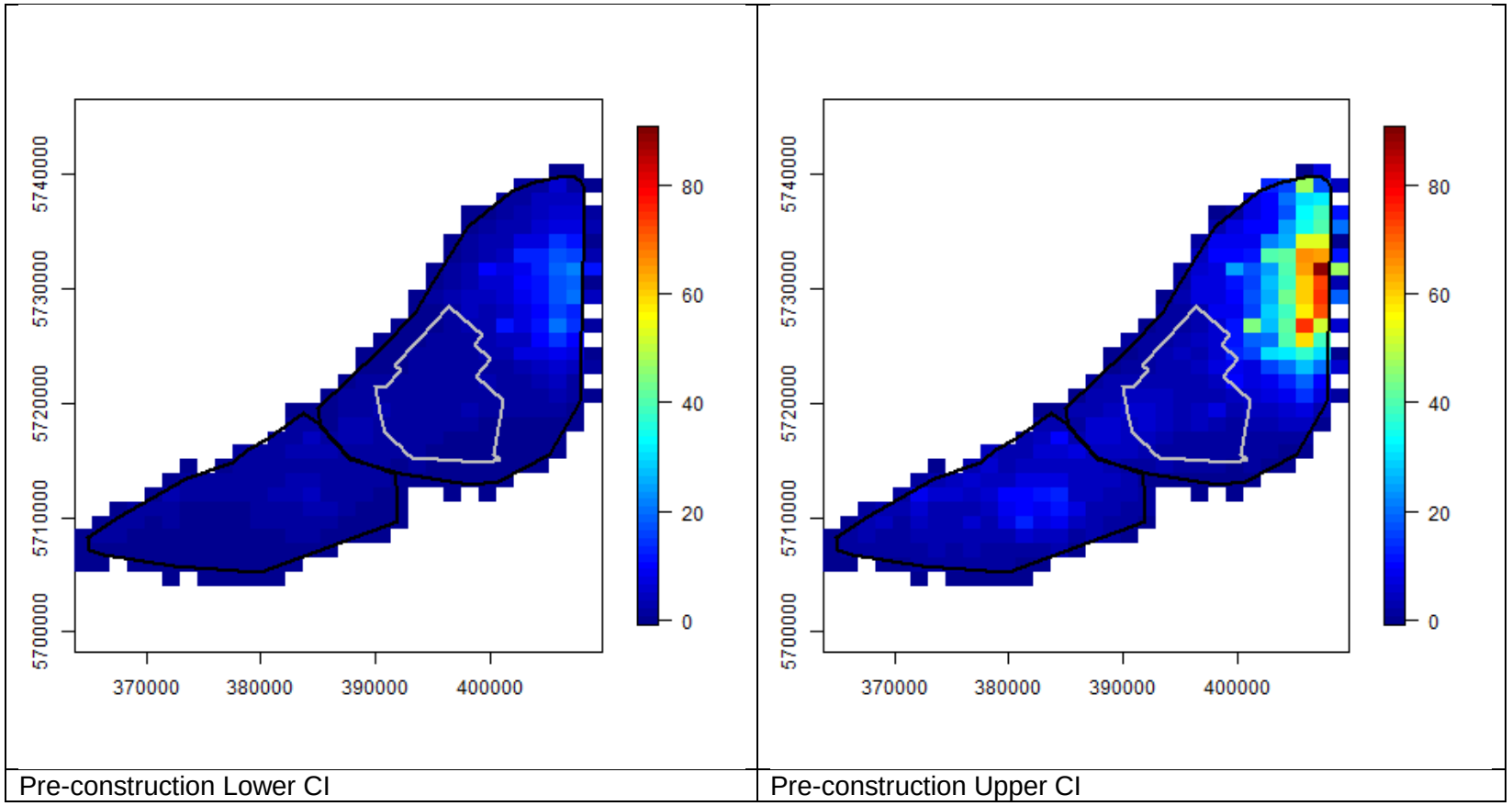
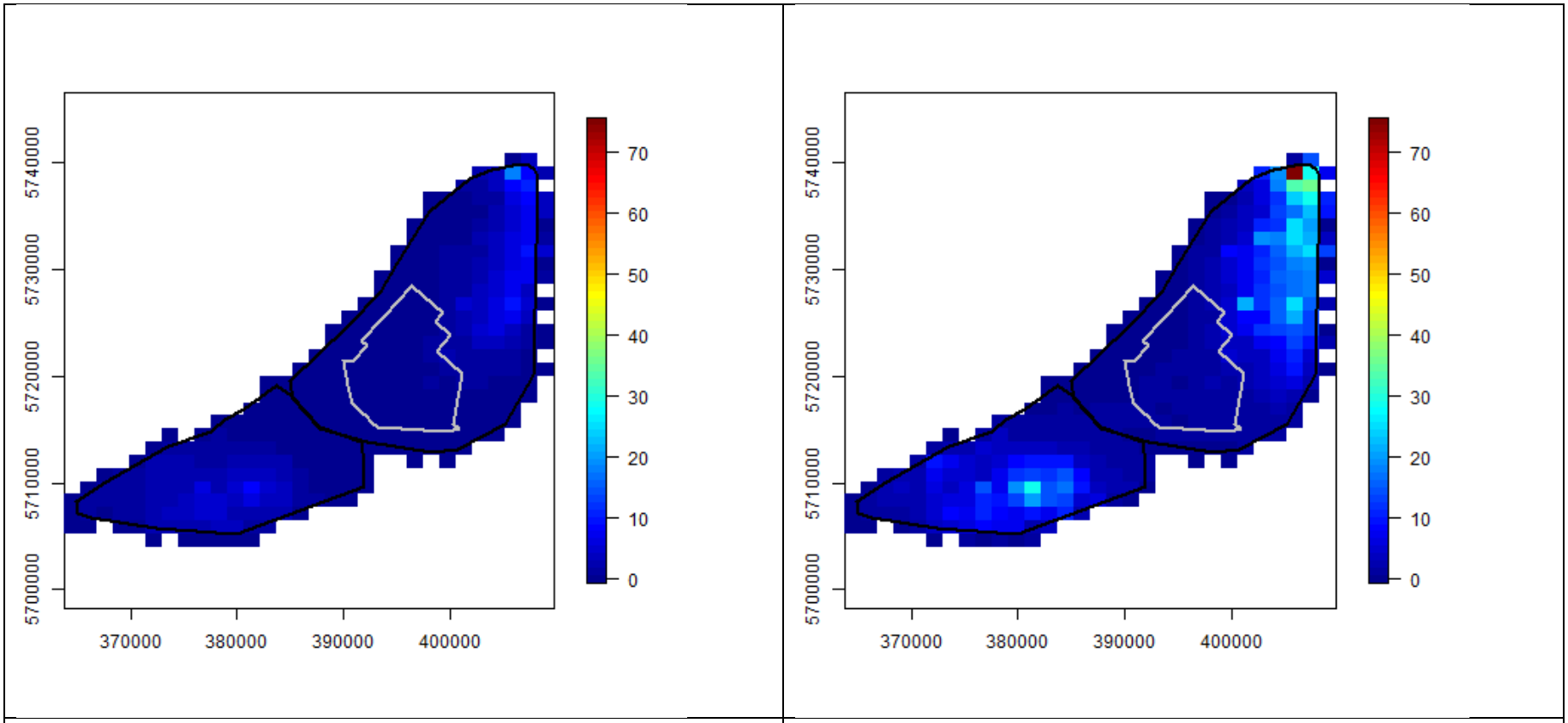


Figure 23 Pre-construction diver density (birds per sq km) lower and upper confidence limits



During Construction Lower CI	During Construction Upper CI

Figure 24 During construction diver density (birds per sq km) lower and upper confidence limits

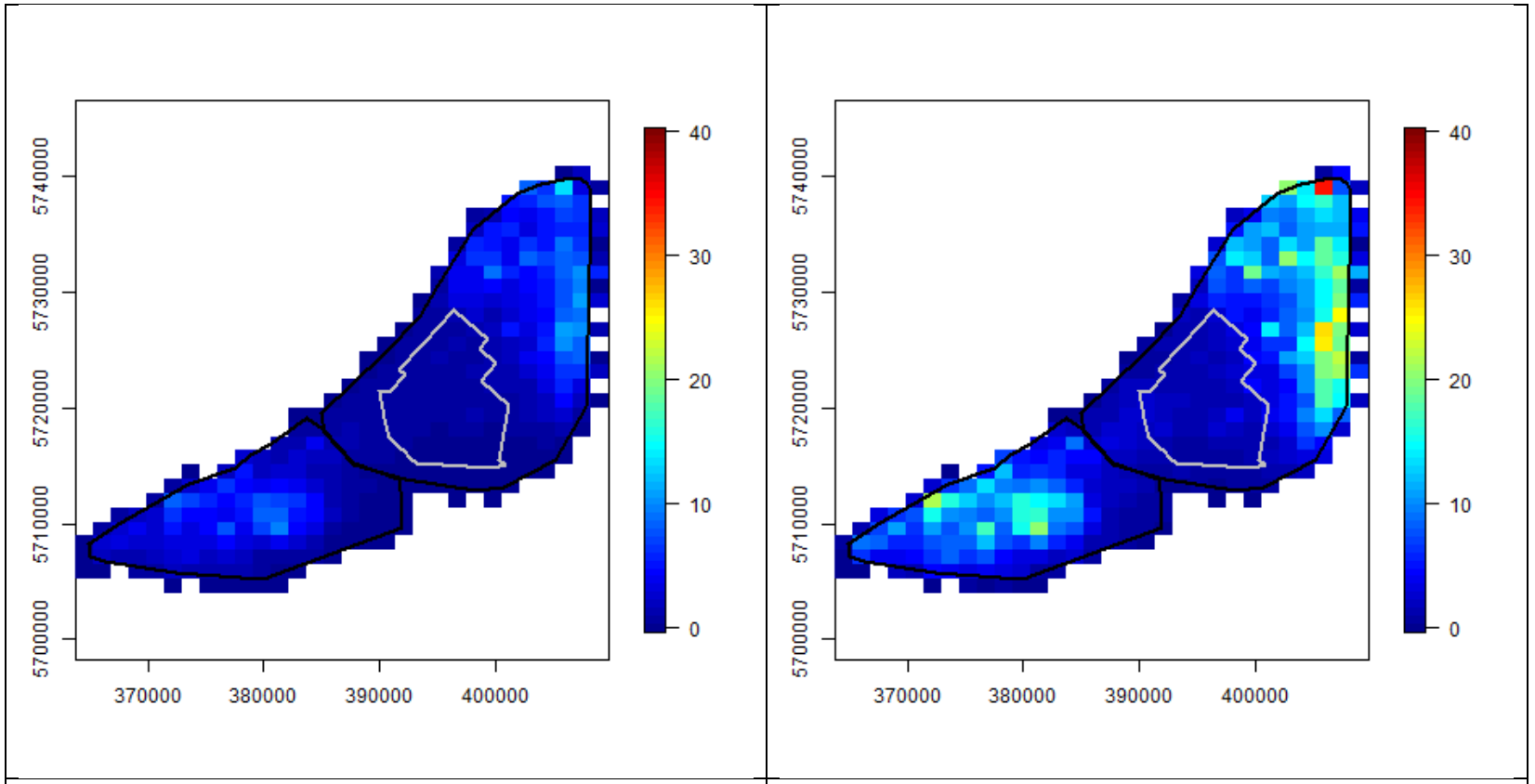


Figure 25 Post-construction diver density (birds per sq km) lower and upper confidence limits

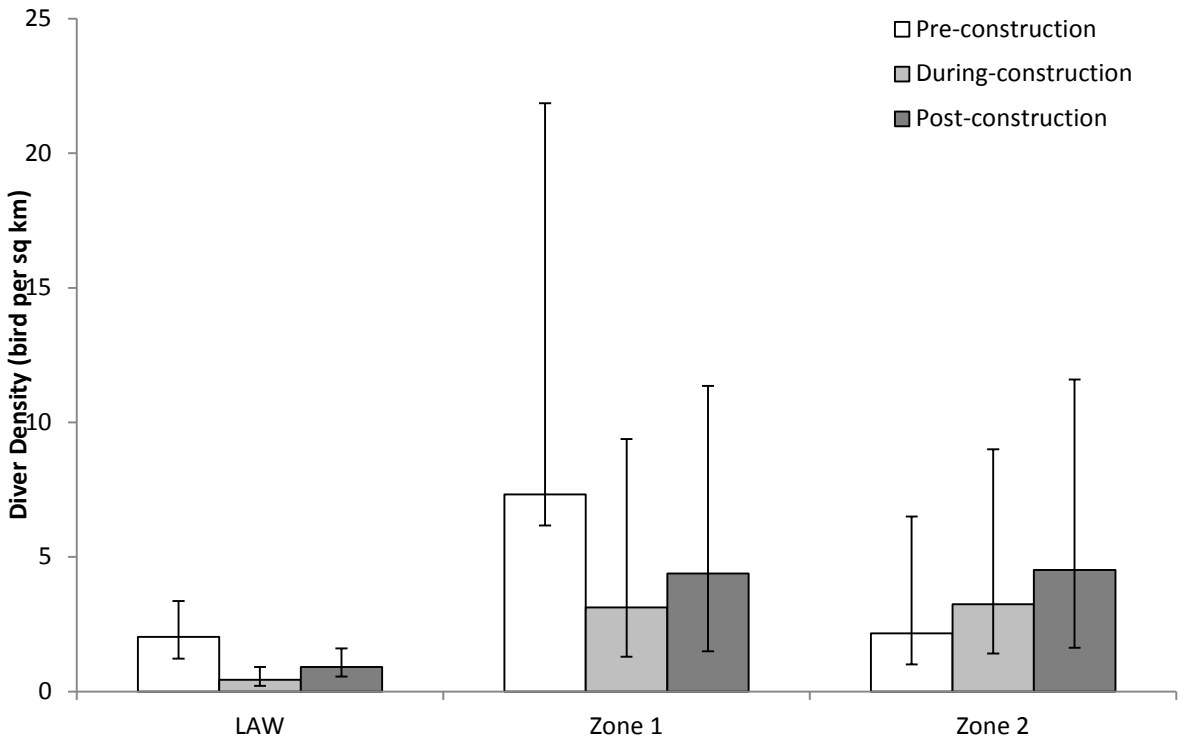


Figure 26 Mean diver density (± 95% confidence intervals generated during the modelling process) within the London Array Wind Farm (LAW), Zone 1, and Zone 2 per development phase

Figure 26 presents the average densities of divers and associated confidence intervals (based on those generated during the modelling) across each construction phase within Zone 1 and Zone 2, and the LAW. Pre-construction densities were greater in the LAW and Zone 1, with decreases in the during-construction phase. Densities increased slightly for the post-construction phase, but remained lower than those recorded in the pre-construction phase. For Zone 2 the density of divers was estimated to be lower in the pre-construction phase with increases during and post-construction.

There was a significant decrease in diver numbers across most of Zone 1, and significant increase in the southern area of Zone 2 between the pre-construction and during-construction phases (Figure 27). The greatest decline was seen in the areas of highest density in Zone 1 along the eastern boundary. This reduction is not localised to the LAW footprint area and therefore is unlikely to have been caused by the ongoing construction of the LAW.

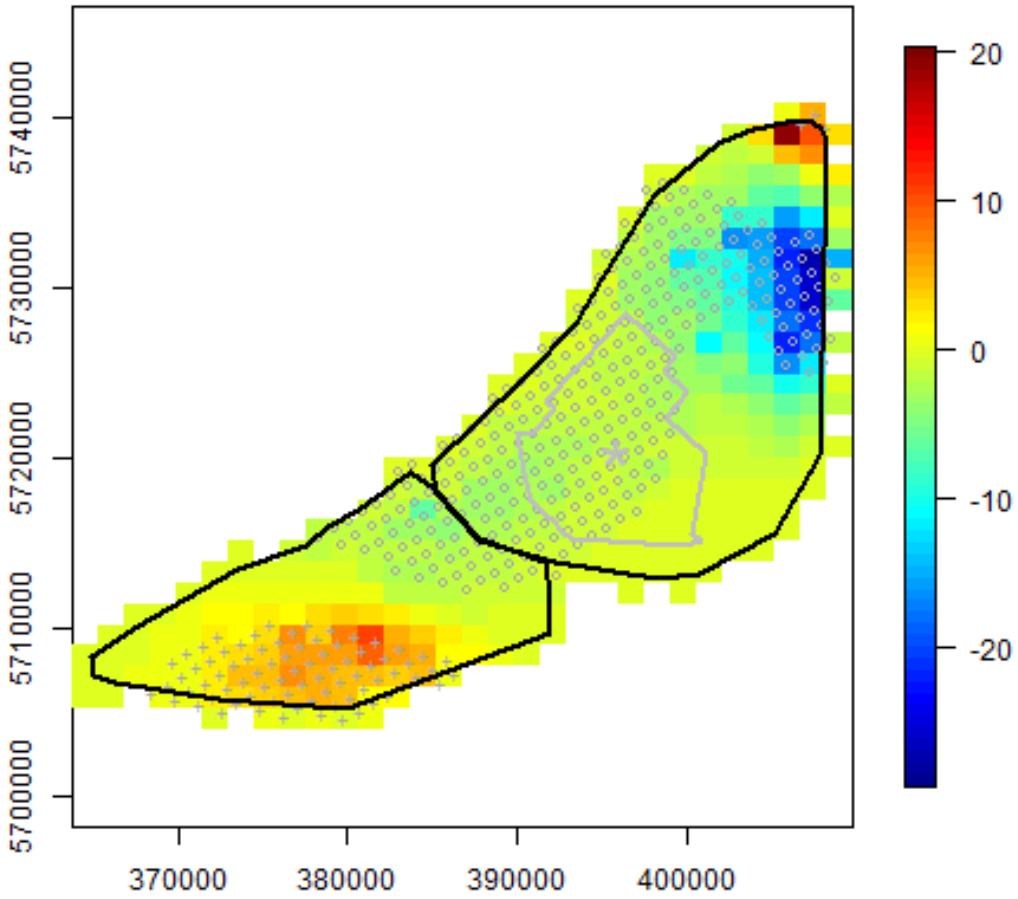


Figure 27 Predicted differences in average diver numbers per 1 km x 1 km square comparing pre- and during construction. Statistically significant increases are indicated using '+', and statistically significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '*'.

There appears to have been a redistribution of divers across Zone 1 and Zone 2 between the pre-construction and post-construction phases (Figure 28). Numbers remained to be significantly lower in the north east corner post-construction than they were in the pre-construction reference period (Figure 26). There was a significant increase in diver numbers to the north of the LAW in Zone 1 and in the south west corner of Zone 2.

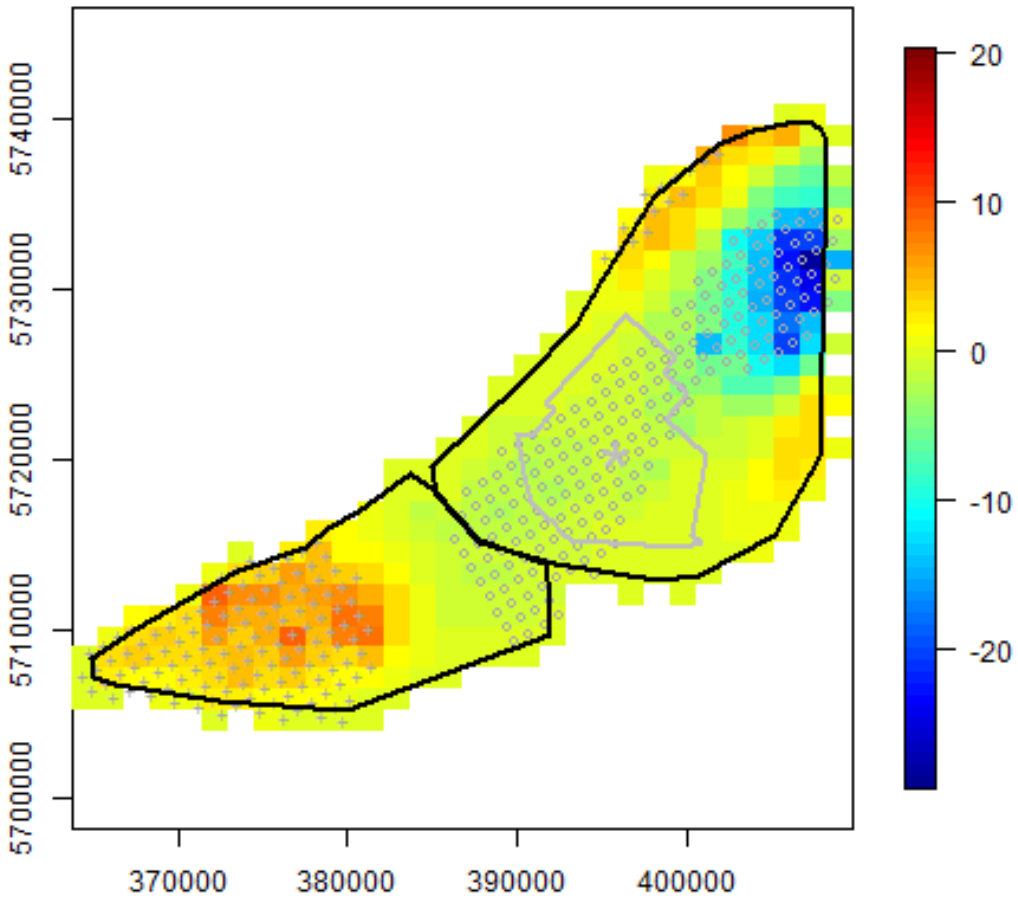


Figure 28 Predicted differences in average diver numbers per 1 km x 1 km square comparing pre- and post-construction. Statistically significant increases are indicated using '+', and statistically significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '∗'.

There was a significant increase in diver numbers post-construction compared to the construction period within both Zones 1 and 2 (Figure 29). Diver density across both of the sites has increased along the northern boundary, although there is a greater increase in density to the northern region and a small pocket in the south of Zone 1, and the northern region of Zone 2 respectively. Significant decreases in diver density are evident in the north eastern corner of Zone 1 and the southern region of Zone 2.

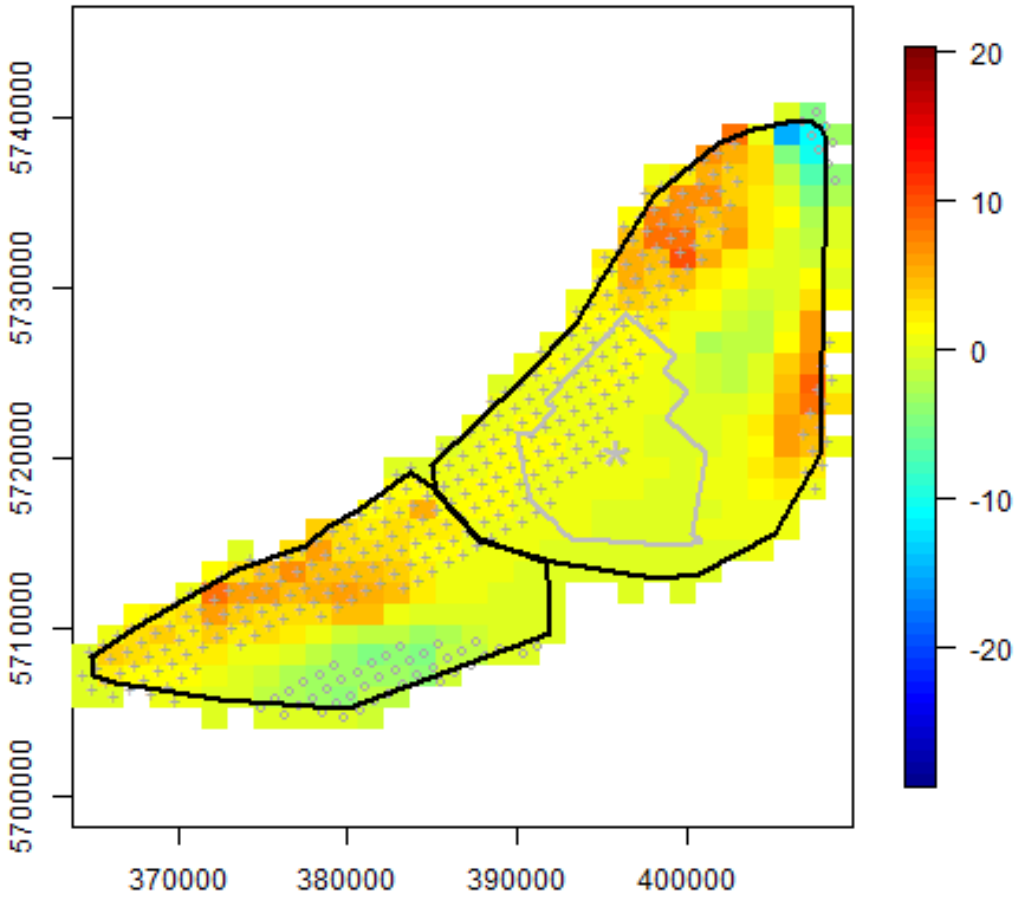


Figure 29 Predicted differences in average diver numbers per 1 km x 1 km square comparing during and post-construction. Statistically significant increases are indicated using '+', and statistically significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '*'.

To investigate whether there was an effect of the wind farm on diver density, average diver densities as predicted from the model were summarized for the wind farm, and for 1 km buffers extending around the wind farm up to 15 km distance in ArcGIS (Figure 30). The density of divers was calculated for each buffer and compared to that of the wind farm footprint. Confidence intervals calculated as part of the modelling process for each predicted value have been provided to demonstrate the variance in the modelled estimates. The summary of the results of the modelling in this method have not been subjected to further statistical analysis.

The density of divers varied with distance to the LAW (Figure 30). There was a decrease in density close to the wind farm during-construction years when compared to the pre-construction reference period. During-construction years, the density of divers decreased compared to the pre-construction reference period up to 12 km from the wind farm. Post-construction, diver density is more similar to that of the pre-construction reference period and is slightly greater from 12 km of the wind farm footprint. This does not account for any changes in abundance that could have occurred between the periods. It is worth noting that the greatest density of divers during the pre-construction phase is estimated approximately 9 km from the LAW. This means that whilst densities were lower during and post-construction compared to pre-construction within 12 km, the greatest relative change occurs at the 9 km distance.

To look at how the distribution of divers between construction periods has changed, the proportion of diver density at each distance from the wind farm was calculated (Figure 31).

Figure 31 shows that whilst there appears to be a redistribution of divers across the site between the years in each construction period, these differences are unlikely to be significant. There are fewer divers predicted to be present within 11 km of the wind farm during-construction, with an increase in the proportion of divers present outside of this distance. Post-construction, an increase in the proportion of divers is seen from approximately 11 km away from the wind farm, when compared to the pre-construction reference period, with a decrease inside of this distance. A greater increase is seen when comparing the during-construction figures within 10.5 km of the wind farm to those of the post-construction period. These changes are highlighted when looking at the percentage change between these proportions in Figure 32. However, as previously stated, the density of divers pre-construction varied throughout the buffer distances with the greatest peak occurring at 9 km from the LAW.

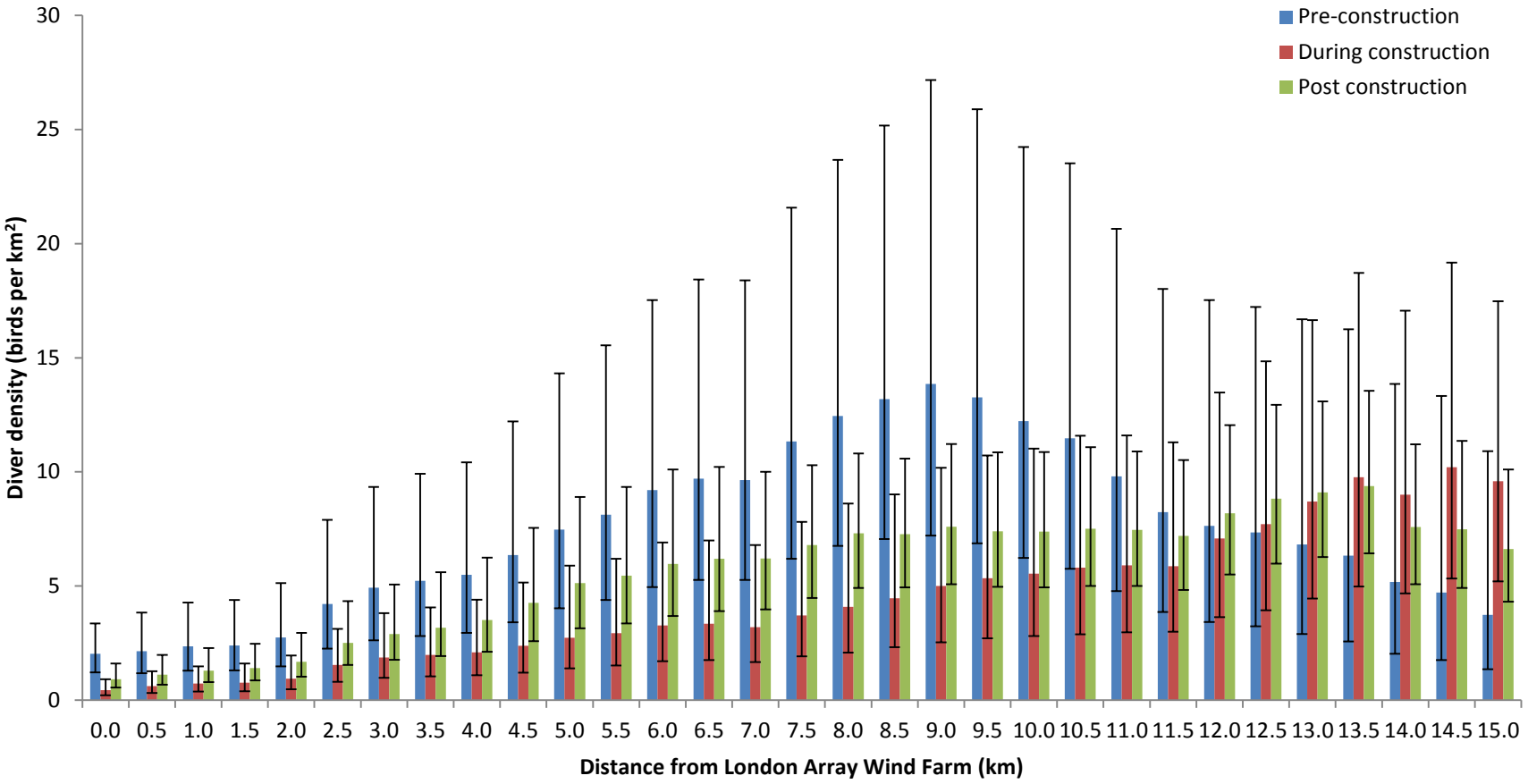


Figure 30 **Diver density (± 95% confidence intervals generated during the modelling process) at different distances from the London Array Wind Farm**

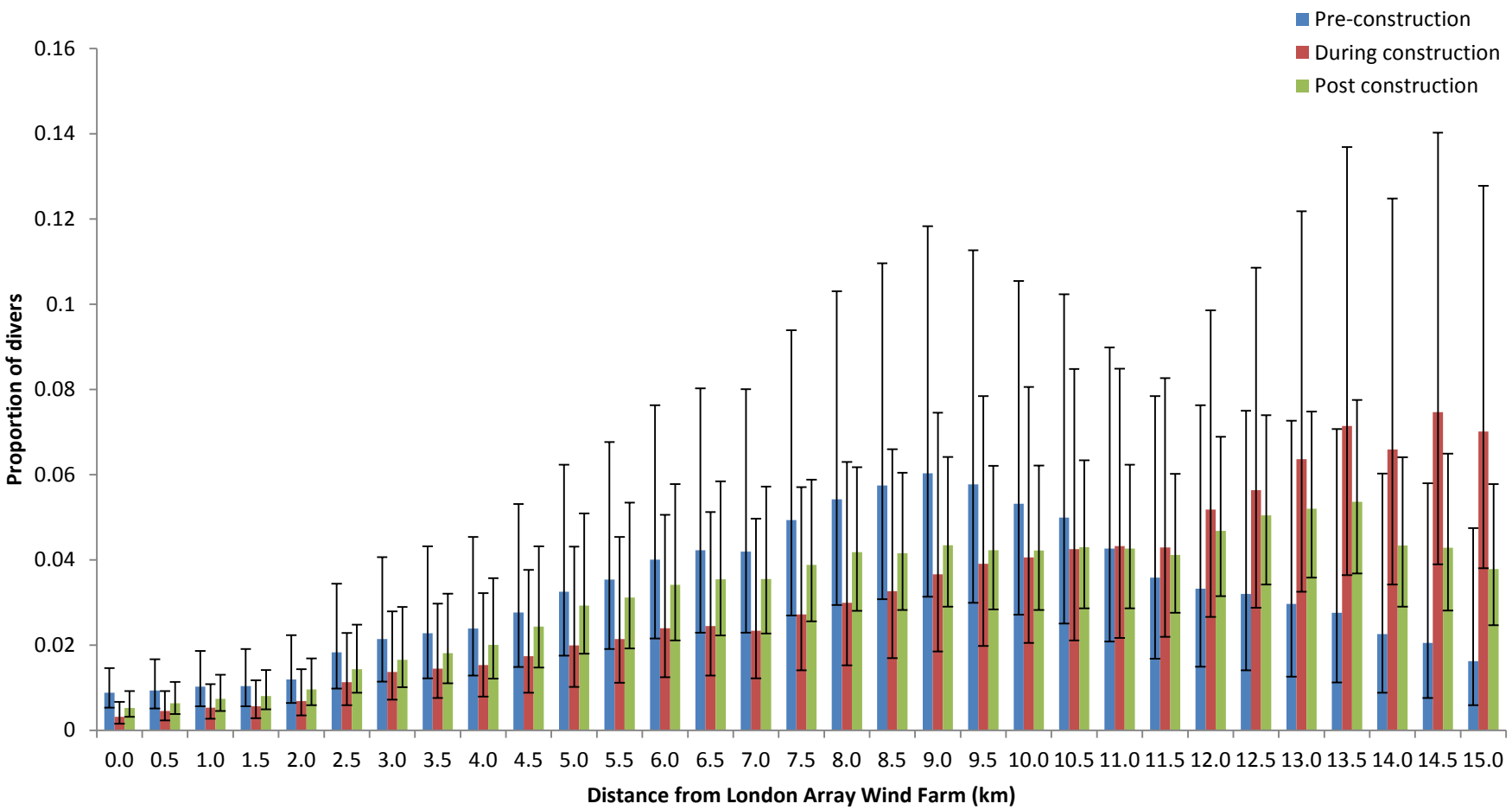


Figure 31 **Proportion of divers (± 95% confidence intervals generated during the modelling process) by distance to the London Array Wind Farm**

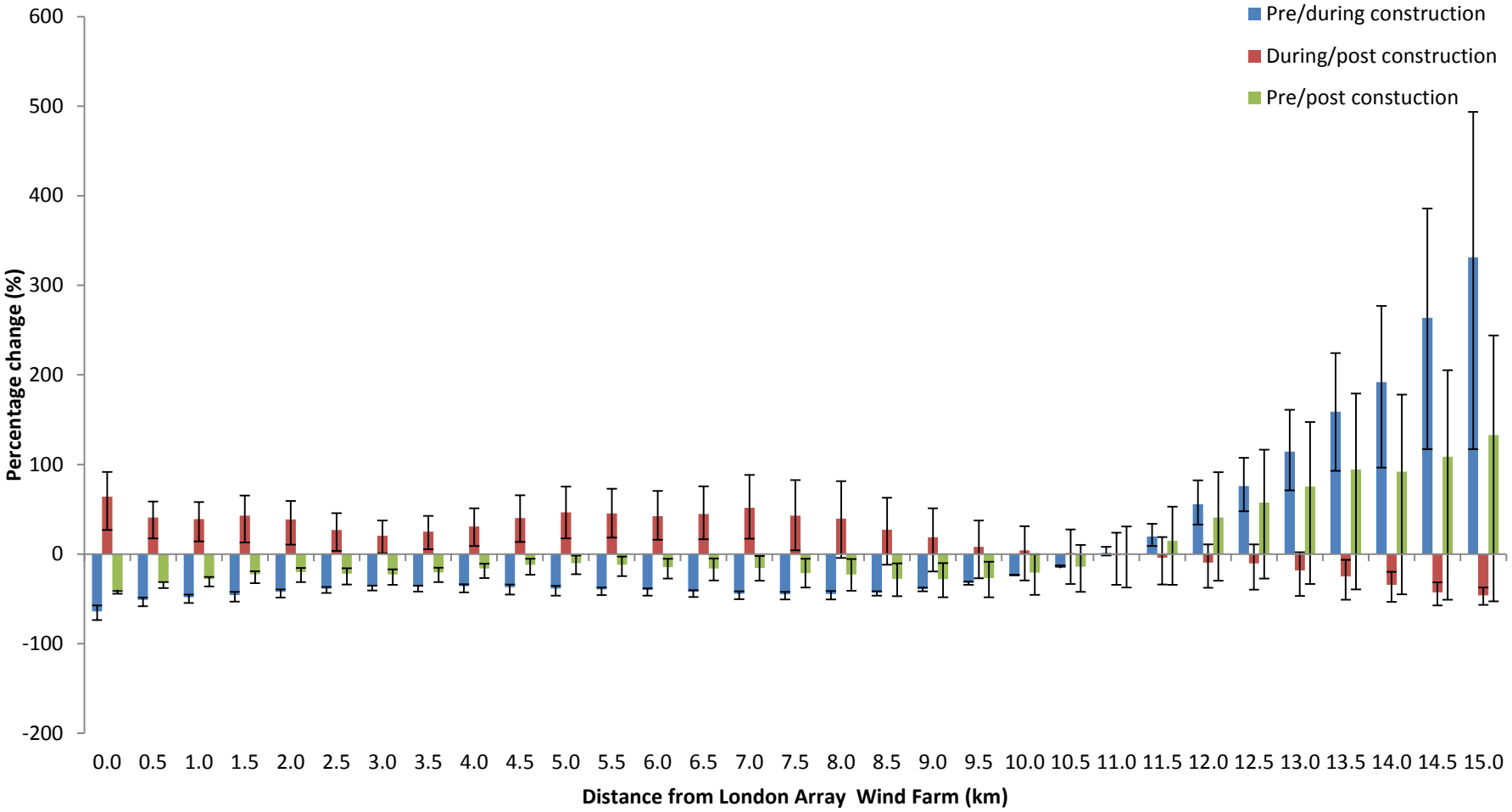


Figure 32 **Percentage change in proportion (± 95% confidence intervals generated during the modelling process) of divers between construction periods**

7.4 Results: Auks

Figures 33 to 35 provide the observed density of auks with associated lower and upper confidence intervals.

Final auk model (the model with the greatest explanatory power) is provided below. The final model covariates are provided in Table 19.

Additive predictor = construction phase (df=2) + s(sea surface temp, df=5) + s(bathymetry, df=4) + s(tidal force, df=3) + s(x, y, df=6) + s(x, y):construction phase

Model dispersion parameter for the final auk model was 16.86. Model dispersion greater than 1 suggests that there is over dispersion and a large amount of noise (high variance in the count data) present in the underlying data. This supports the decision to fit an overdispersed model. Model diagnostics are shown in Appendix 7.

Table 19 Final auk model covariates.

Covariate	Df	*P*-value
Construction Phase	2	0.0010
s(sea surface temperature)	5	<0.0001
s(tidal force)	3	0.0022
s(x, y)	6	0.0207
s(x,y):construction phase	12	<0.0001

Table notes: The 's' before a covariate in brackets indicates that a smoothed term has been applied because the relationship with density is non-linear. 'Df' is Degrees of Freedom, and '*P*-value' is the probability value where less than 0.05 indicates a significant relationship with density

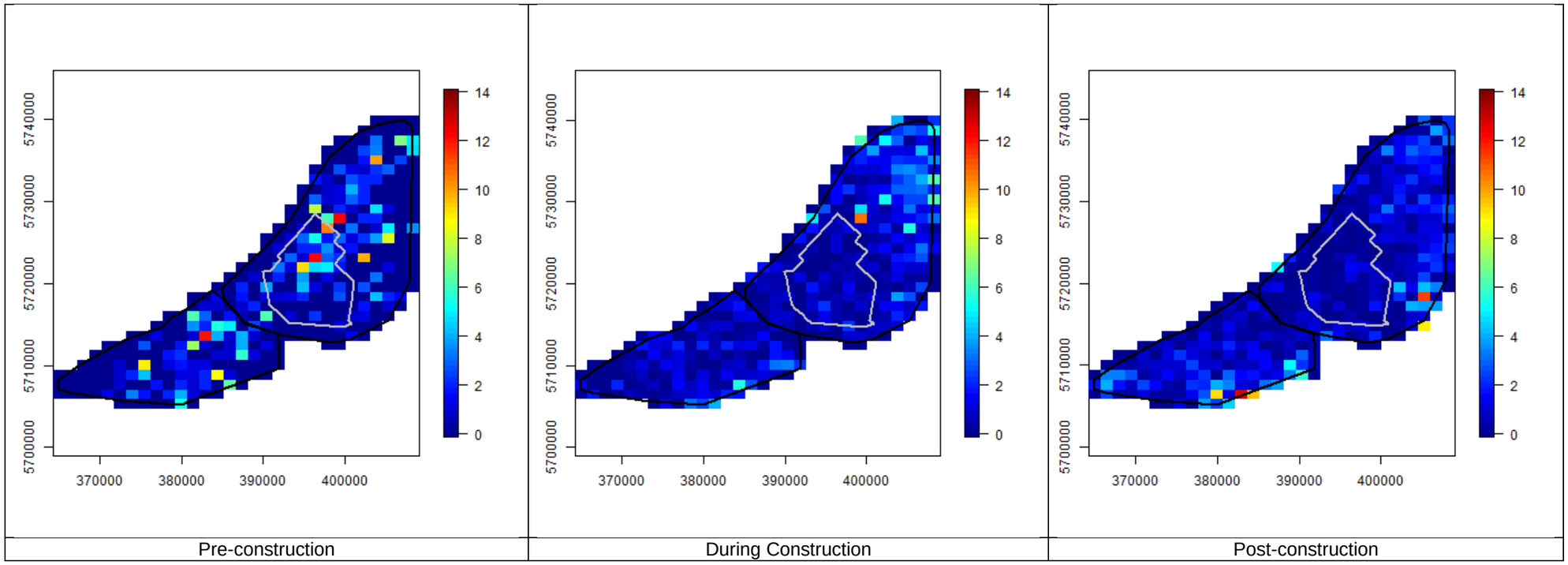
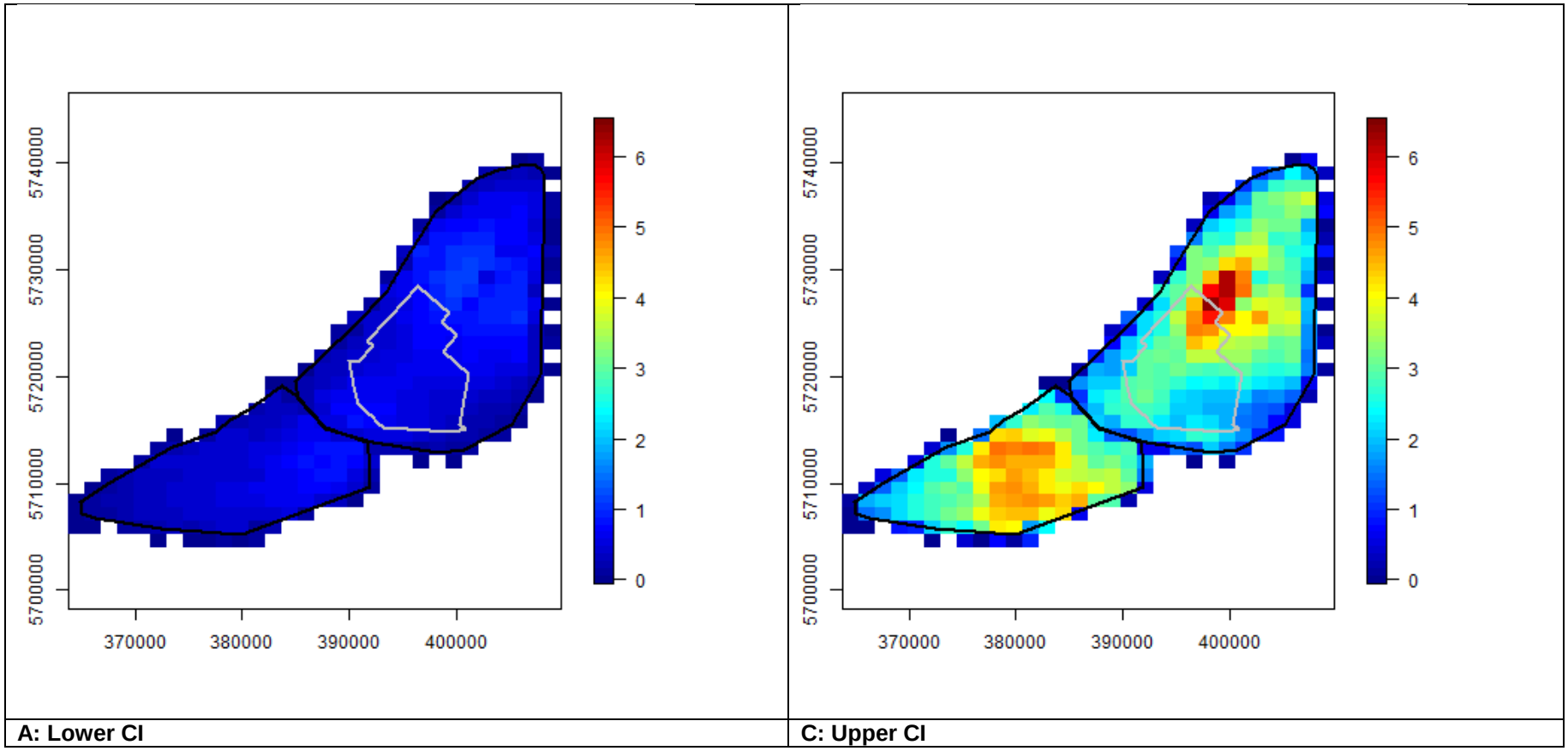


Figure 33 **Pre-construction, during construction, and post-construction mean observed auk density (birds per sq km)**



A: Lower CI	C: Upper CI

Figure 34 Pre-construction auk density (birds per sq km) lower and upper confidence limits

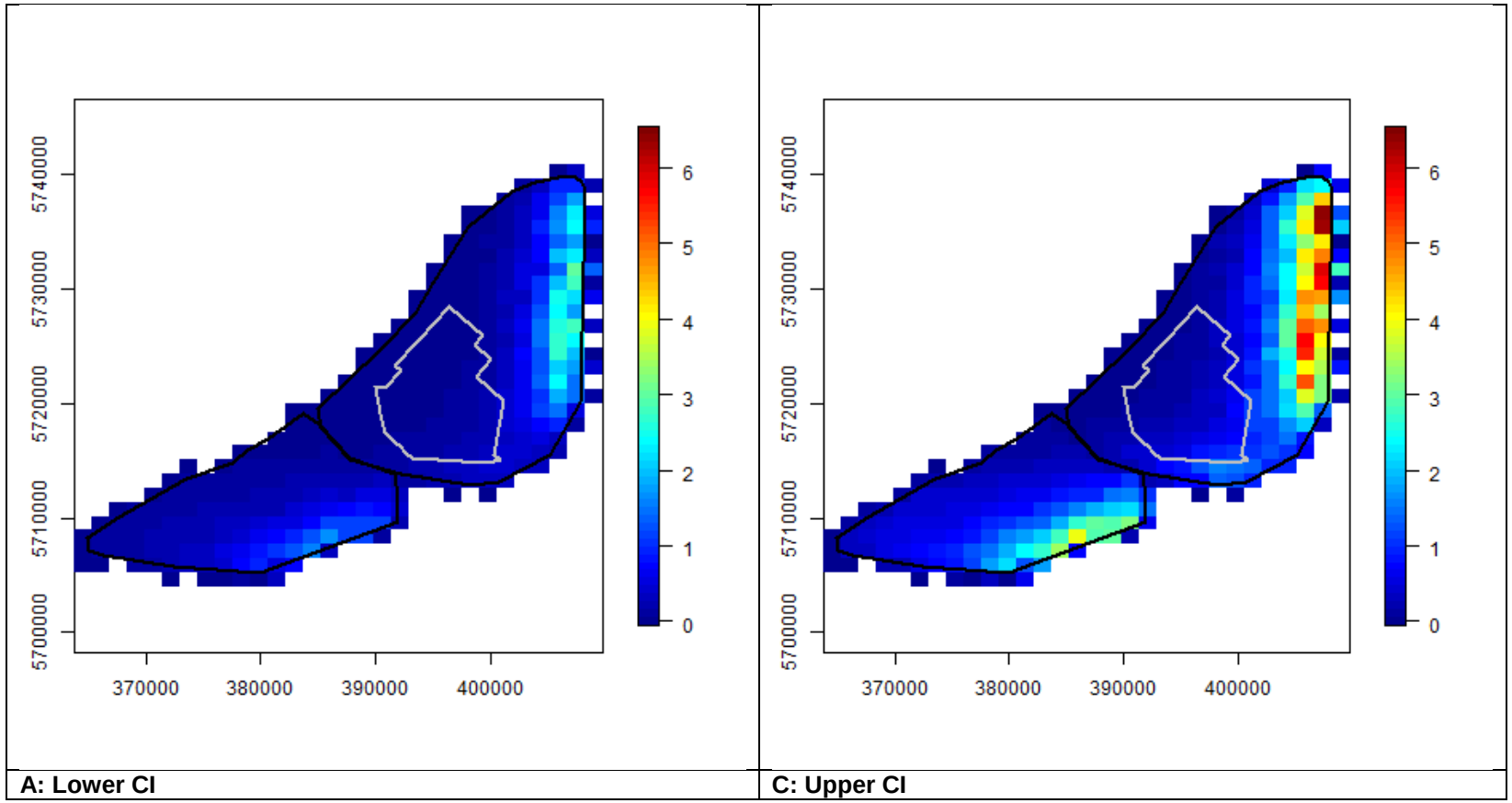


Figure 35 **During construction auk density (birds per sq km) lower and upper confidence limits**

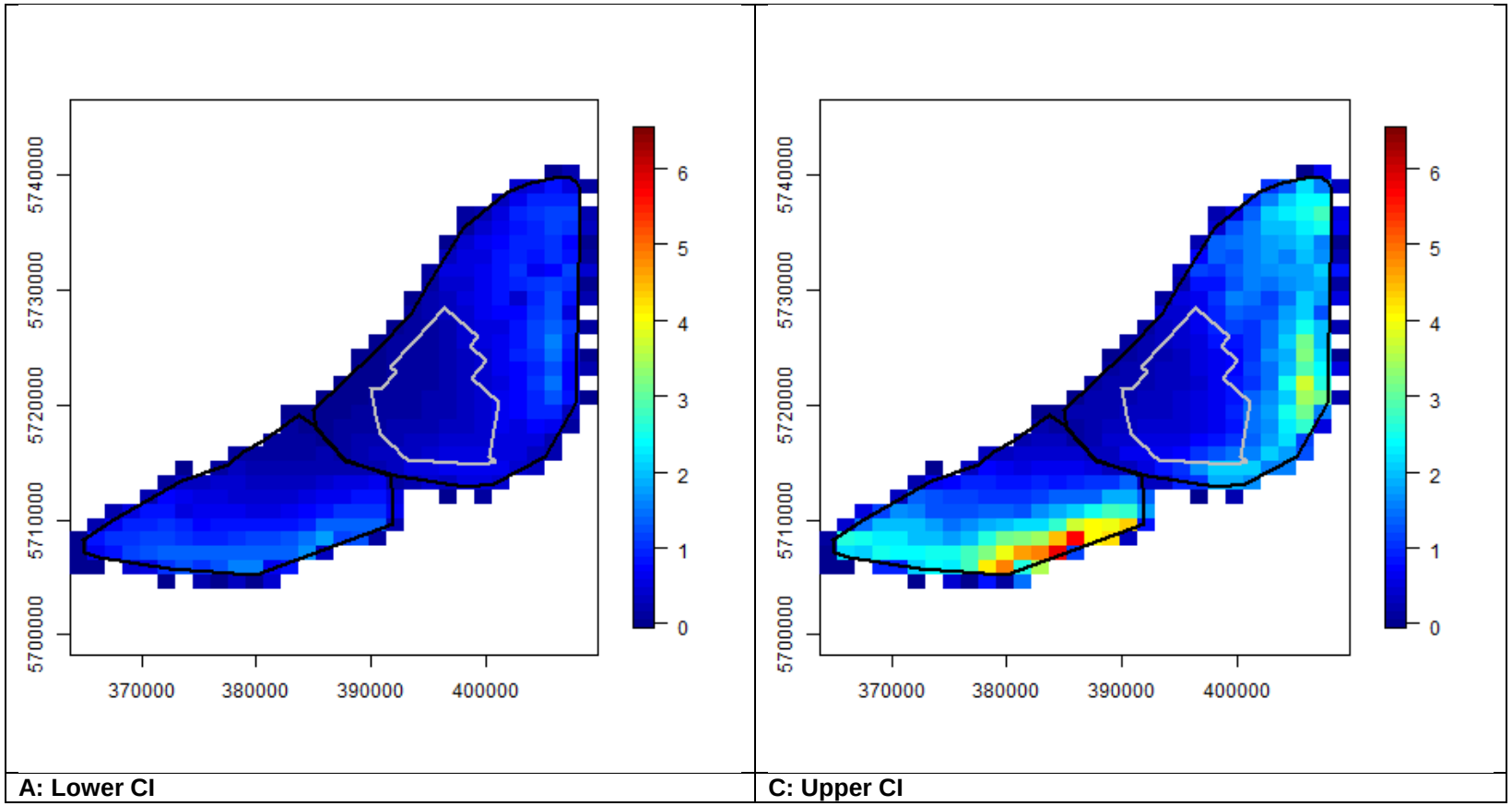


Figure 36 **Post-construction auk density (birds per sq km) lower and upper confidence limits**

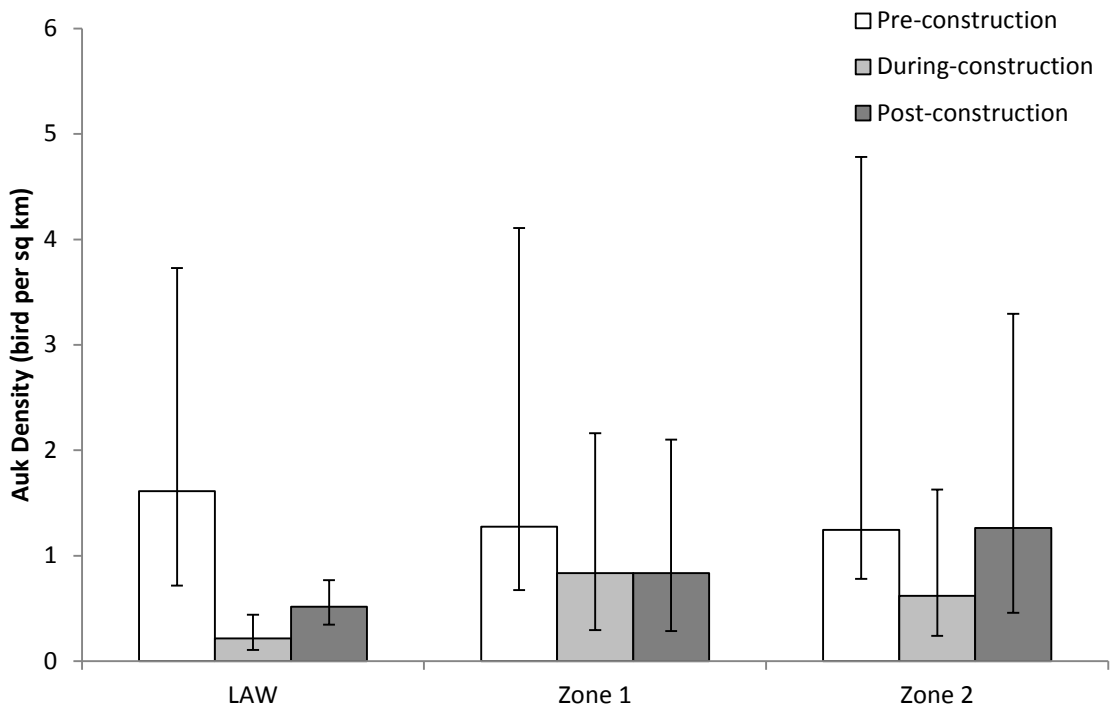


Figure 37 Mean auk density (± 95% confidence intervals generated during the modelling process) within the London Array Wind Farm (LAW), Zone 1, and Zone 2 per development phase

Figure 37 presents the average densities of auks and associated confidence intervals (based on those generated from the models) across each construction phase within Zone 1 and Zone 2, and the LAW. Pre-construction densities were greater in all cases, with decreases in the during-construction phase. Densities increased slightly for the post-construction phase in Zone 2, but remained lower than recorded in the pre-construction phase in the LAW and Zone 1.

There was a significant decrease in auk numbers across most of Zones 1 and 2 before construction and during-construction (Figure 38). There was a significant decline in the density of auks predicted in and around the LAW with a significant increase in auk density predicted along the eastern boundary of Zone 1.

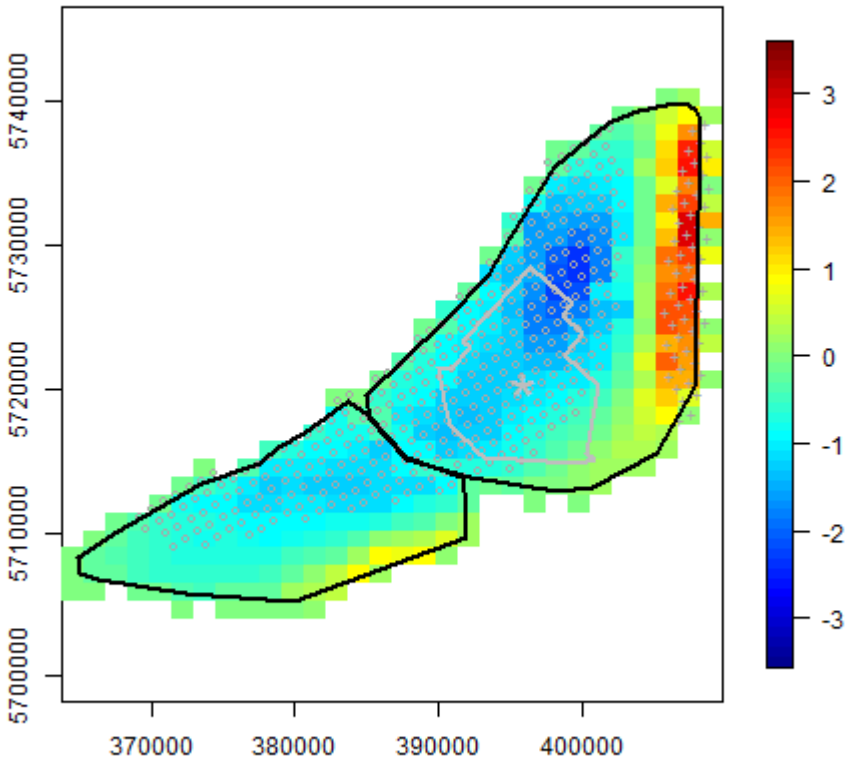


Figure 38 Predicted differences in average auk numbers per 1 km x 1 km square comparing pre- and during construction. Statistically significant increases are indicated using '+', and significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '∗'.

There appeared to be a redistribution of auks across the site between the pre-construction and post-construction phases (Figure 39). Numbers remained significantly lower in and around the LAW during the post-construction years than they were in the pre-construction reference period. There was a significant increase in auk density in the south eastern corner of Zone 1.

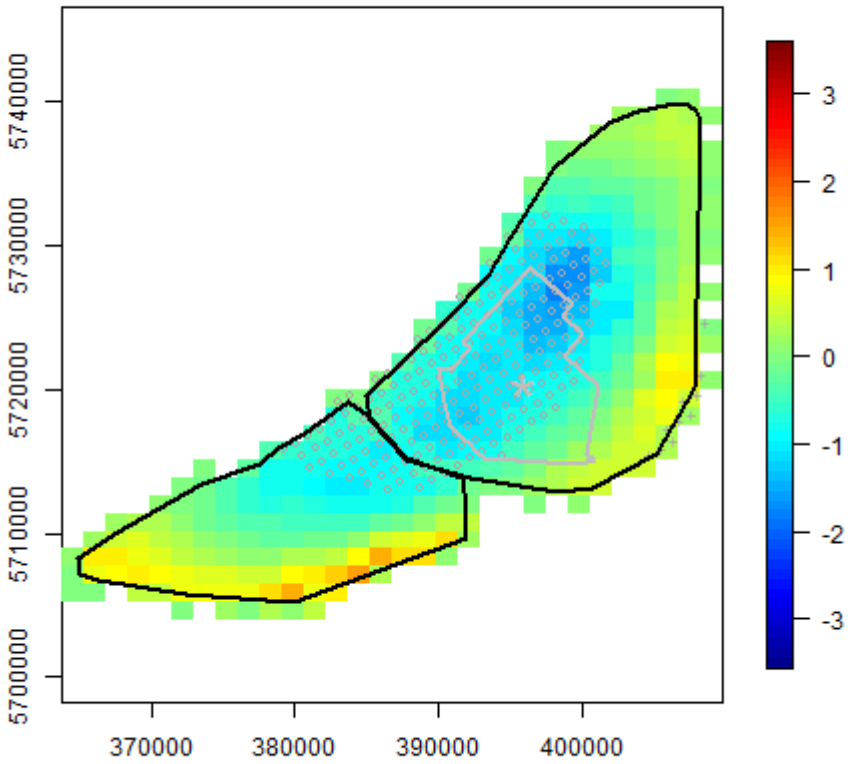


Figure 39 Predicted differences in average auk numbers per 1 km x 1 km square comparing pre- and post-construction. Statistically significant increases are indicated using '+', and significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '∗'.

There was a significant increase in auk density post-construction when compared to the construction period years across Zone 1 and Zone 2 (Figure 40). There were widespread increases across the site, although significant decreases were shown along the eastern boundary of Zone 1.

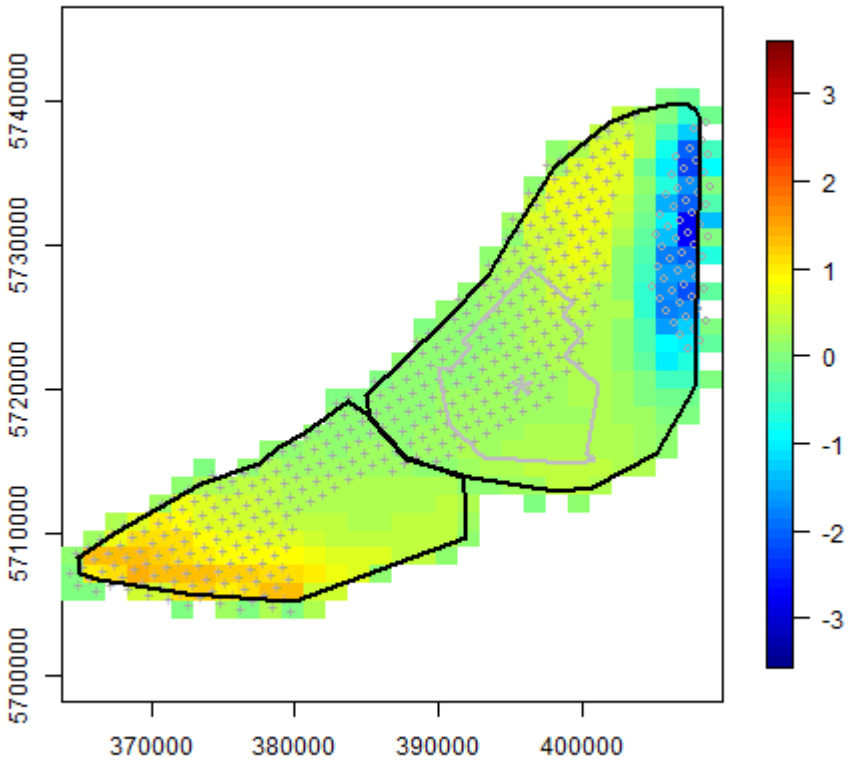


Figure 40 Predicted differences in average auk numbers per 1 km x 1 km square comparing during and post-construction. Statistically significant increases are indicated using '+', and significant decreases are indicated using 'o'. The centre of the London Array Wind Farm is indicated using '∗'.

To investigate if there was an effect of the wind farm on auk density, average auk density was summarised for the wind farm, and for 1 km buffers extending around the wind farm up to 15km distance (Figure 41). The density of auks was calculated for each buffer and compared. The summary of the results of the modelling in this method have not been subjected to further statistical analysis.

The density of auks varied with distance to the LAW (Figure 41). There was a decrease in density close to the wind farm in both during and post-construction periods. Post-construction years, the density matches that of the pre-construction reference period at approximately 11 km from the wind farm. However this does not account for changes in abundance between the development phases.

To look at how the distribution of auks between construction periods has changed, the proportion of auk density at each distance from the wind farm was calculated (Figure 42). Figure 42 indicates there was a redistribution of auks across the site between the development phases. Unlike divers, auk density in the pre-construction period appeared

similar across all the buffer distances. There were fewer auks predicted within 5.5 km of the wind farm during-construction, with an increase in auk density outside of this distance. Post-construction years, a decrease in the proportion of auks is seen up to 5 km from the wind farm, when compared to the pre-construction reference period, with an increase outside of this distance (Figure 42). These changes are highlighted when looking at the percentage change between these proportions in Figure 43.

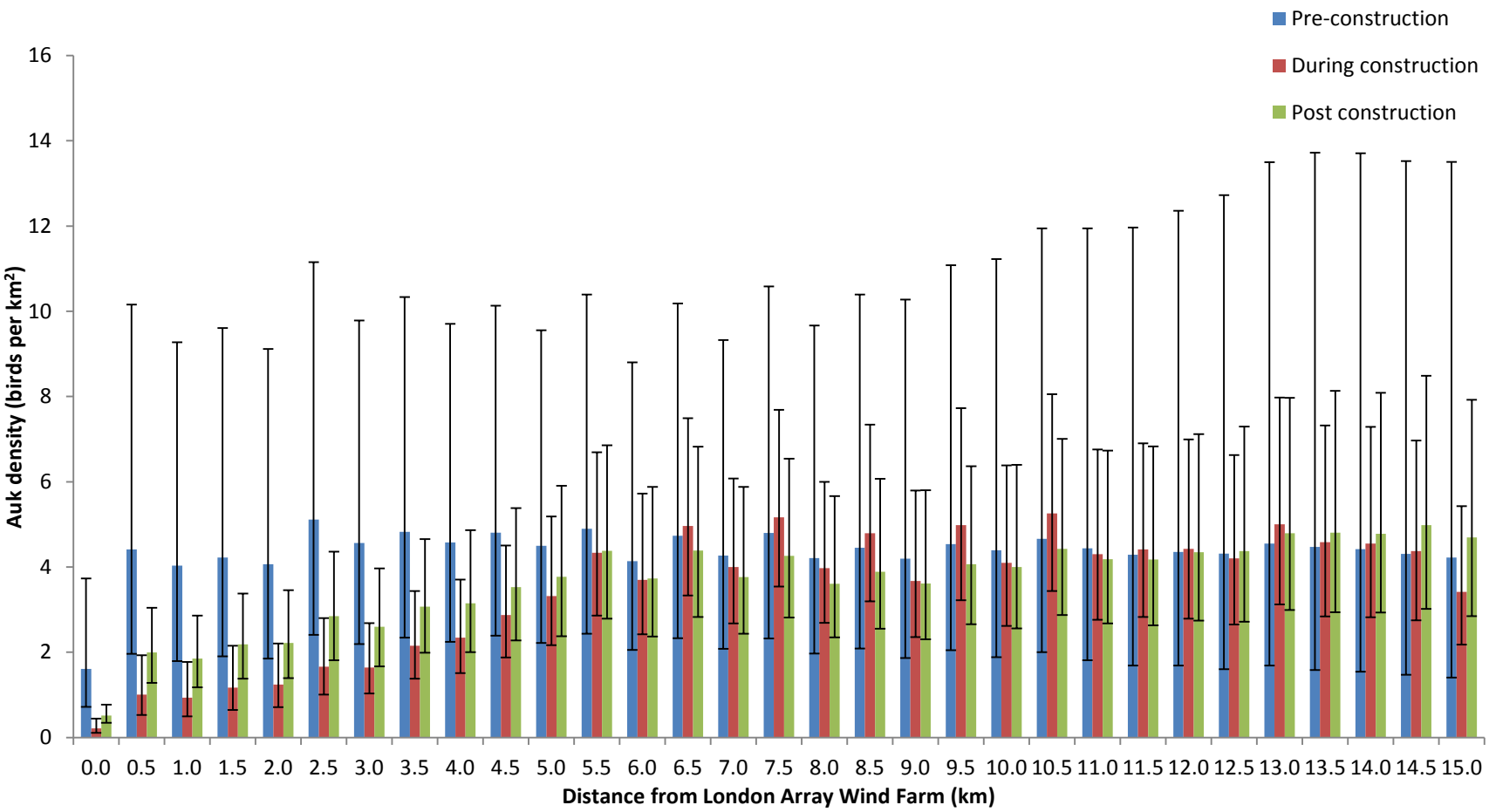


Figure 41 Auk density (± 95% confidence intervals generated during the modelling process) at different distances from the London Array Wind Farm

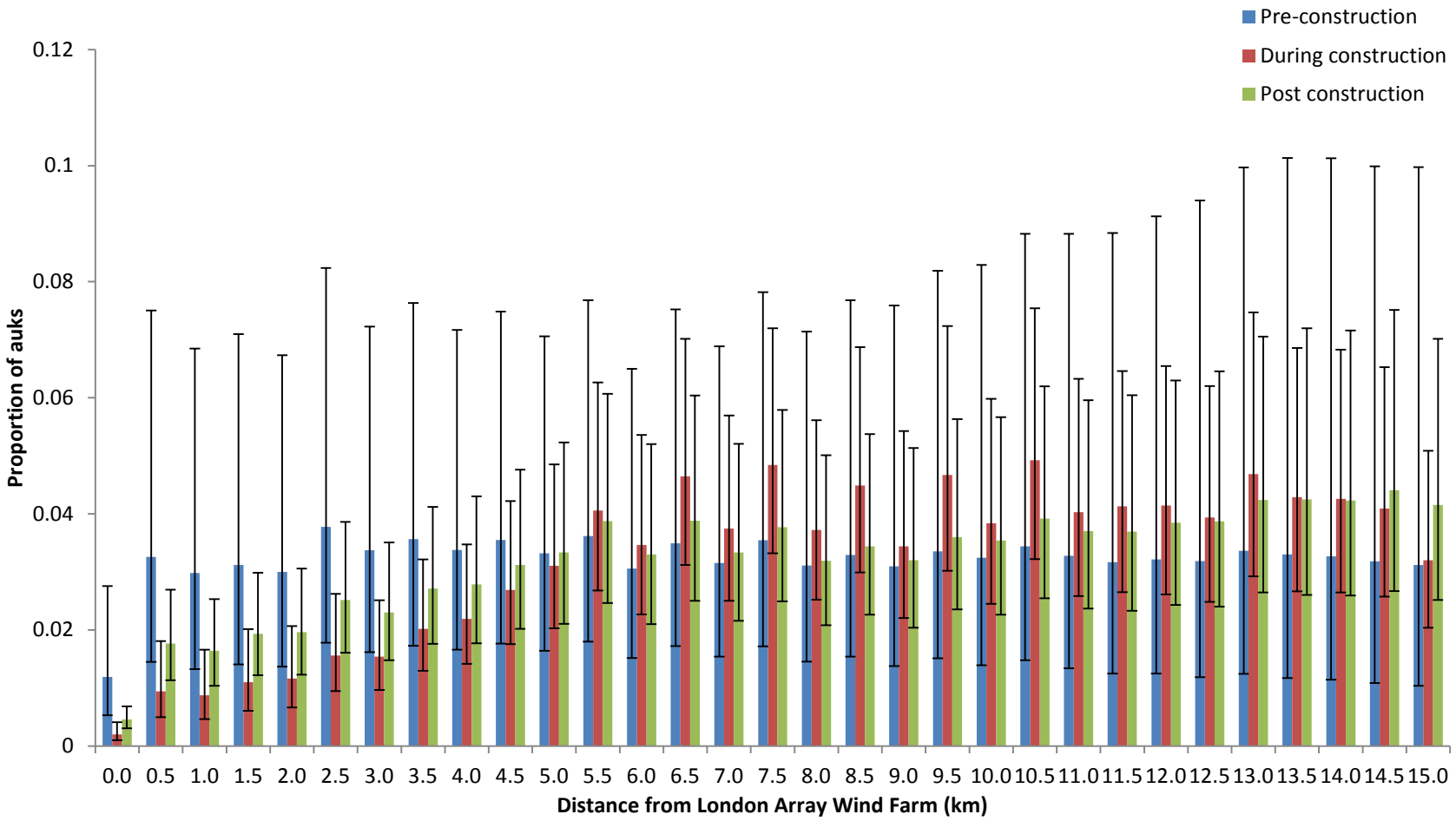


Figure 42 **Proportion of auks (± 95% confidence intervals generated during the modelling process) by distance to the London Array Wind Farm**

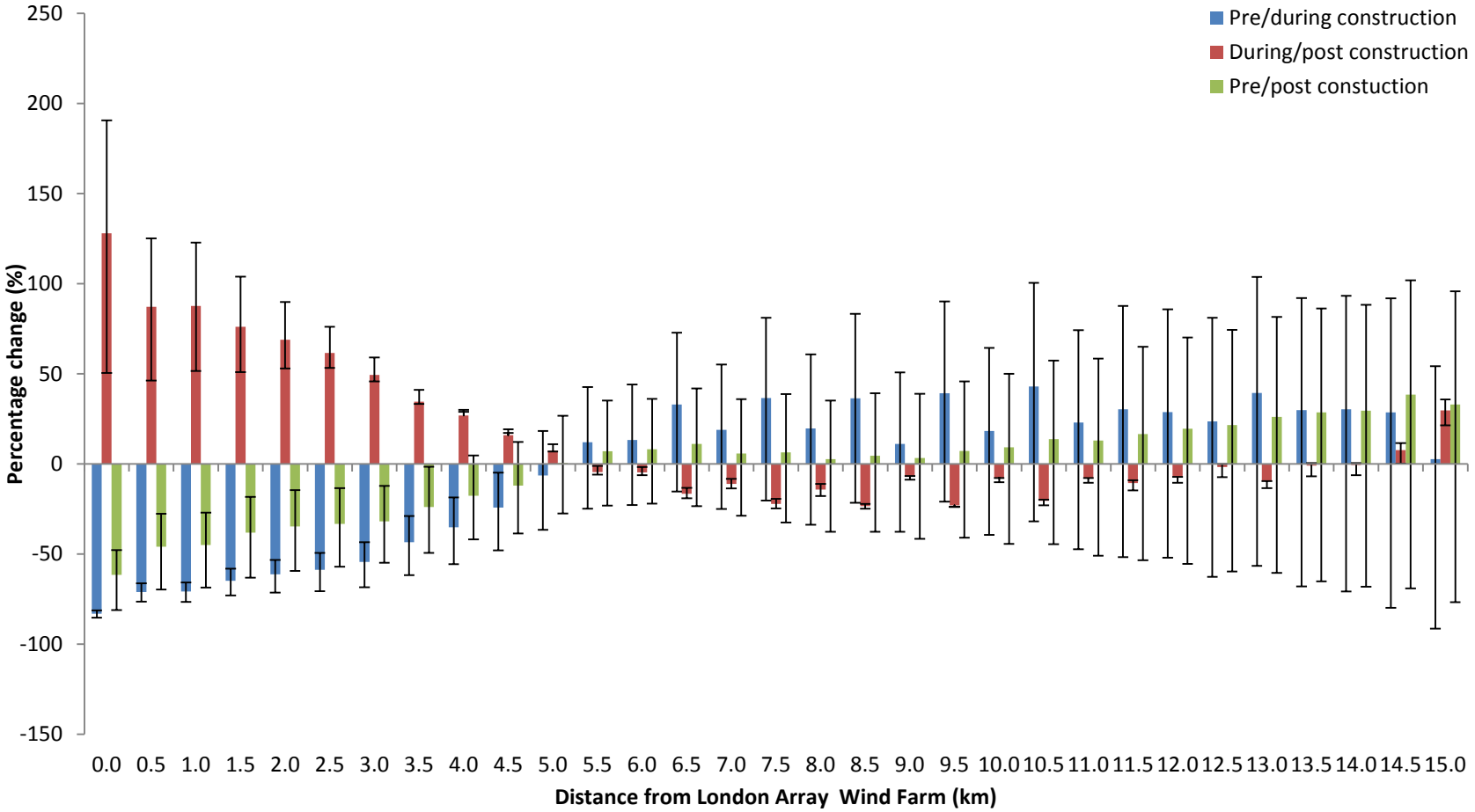


Figure 43 **Percentage change in proportion (± 95% confidence intervals generated during the modelling process) of auks between construction periods**

7.5 Discussion

Initial 'CReSS-SALSA' models were constructed for divers and auks with a large number of continuous variables. The model simplification process determined that construction phase, chlorophyll-*a*, sea surface temperature, thermal front probability were retained for divers. For auks, construction phase, sea surface temperature, and tidal force were retained. This suggests that the construction phase had a significant effect on the density and distribution for both divers and auks due to the construction activities at the LAW because the construction phase covariate was retained in the final model. The significant relationships with environmental variables for both divers and auks are perhaps indicative of habitat preferences.

The proportion of auk and diver abundance was calculated by estimating the difference in the predicted modelled abundance within specific buffer regions between pairwise comparisons of pre-construction, during, and post-construction. The proportion of birds at different distances from the wind farm is likely to provide a better indication, than a comparison of abundance, of any effect that construction may have on the distribution of the birds as it accounts for changes in overall abundance between years. Whereas this is likely to provide a better indication of any effect that construction may have on the distribution of the birds, this analysis will only be valid for the density of birds present in each year. The results are not conclusive across all bird densities as the selection of habitat made by divers or auks will vary with habitat quality but this quality of habitat for foraging birds will vary with the number of birds in it (Fretwell & Lucas 1970, Fretwell 1972). Therefore in years of low bird densities the birds may select habitat with sufficient prey and also where real or perceived disturbance is low. Offshore wind farms or the boat traffic associated with the wind farms could be examples of such disturbance. However in years of high bird density, when competition for food between birds is greater, prey availability may become the key determinant of bird distribution and individual birds may become more tolerant of any real or perceived disturbance. Thus, any differences recorded in the observed proportions of birds with distance to the wind farm footprint should be taken to apply to the density of birds in that particular year, and any generalisation of the results should only be made with great caution. It is also important to note that summarising the abundance per buffer for the pairwise comparisons of each development phase results in averaged abundances irrespective of positive or negative abundances in a particular direction. Therefore the best interpretation of the displacement effects should be taken from the maps (Figures 25, 26, and 27 for divers, and Figures 36, 37 and 38 for auks).

The results indicated that diver and auk density significantly decreased in the LAW footprint and surrounding area during the construction phase of the wind farm in comparison to the pre-construction phase. During the post-construction phase, the proportional decrease in diver and auk density was less than those recorded pre-construction. However, the density in the wind farm and surrounding area significantly increased in comparison to the during construction phase.

7.5.1 Discussion: Divers

The proportion of divers displaced from the LAW footprint was estimated to be approximately 78% and 55% for during and post-construction respectively.

The comparison of diver distribution pre- versus during construction indicated that significant increases in density were estimated mainly in the southern region of Zone 2, but also a small pocket in the northern corner of Zone 1. Significant decreases were estimated across Zone 1 and extended into the eastern boundary of Zone 2. During versus post-construction

comparison indicated that significant increases in density were estimated mostly along the northern boundary of Zone 1 and Zone 2. A small pocket of increased density was also estimated in the southern corner of Zone 1. Areas of significant decrease in diver density were evident in the north eastern corner of Zone 1 and the south western corner of Zone 2. The pre- versus post-construction comparison indicated that significant decreases were estimated in a band across the middle of Zone 1 and extending into the eastern boundary of Zone 2. Significant increases in diver density were estimated in the western half of Zone 2.

Based on the summarised density information, a proportion of the divers appeared to avoid areas up to approximately 11 km from the wind farm. It is also important to note that whilst the density of divers during and post-construction was lower in comparison to pre-construction up to 11 km, the greatest density of divers pre-construction occurred at the 9 km distance from the LAW. This may be indicative that other factors, apart from the construction activities at the LAW, are compounding displacement effects of divers in the Zone. This distance demonstrates the greatest relative change which is outside of the LAW footprint (Figure 29). The pattern recorded in pre-construction i.e. diver density increasing with distance from the LAW up to 9 km and then gradually decreasing was similar, although amplified, to the pattern of diver density during and post-construction i.e. a gradual increase in density from the LAW with increasing distance. This pattern in density suggests that preferred habitat for divers occurred outside of the LAW footprint during pre-construction. The change in peak density between the development phases was estimated by calculating the difference in the peaks of the diver density pre- (9 km), during (14.5 km), and post-construction (13.5 km). Whilst the pattern was similar during and post-construction in comparison to pre-construction, increasing density from the LAW, the peak in density shifted approximately 5.5 km and 4.5 km away from the LAW respectively. This suggests that divers redistributed to areas away from the LAW with the overall density remaining lower than previously estimated for pre-construction, but were not completely displaced at any distance. These results have not been subjected to any statistical analysis and therefore may not indicate significant changes.

Overall the results indicate that greater numbers of divers were recorded in the pre-construction period with divers redistributing to other areas of Zone 2 and to a lesser extent, Zone 1 during the construction phase. Post-construction the number of divers significantly increased across Zone 1 and Zone 2, but not to the same level as the densities recorded pre-construction in Zone 1.

The results following the analysis of the first year of post-construction surveys indicated that divers appeared to avoid areas within 9 km of the LAW during the construction period with diver numbers appearing similar to those recorded pre-construction (APEM, 2016). The results of this analysis of the final two years of post-construction has indicated that diver density post-construction was lower than that estimated for pre-construction. This suggests that higher densities were recorded in the first year of post-construction, with lower densities recorded in the last two years of post-construction. These apparent year-to-year fluctuations in diver density may be in response to local food and habitat availability and are perhaps indicative of fluctuations in diver numbers across the OTE SPA as a whole (O'Brien *et al*., 2008; Goodship *et al*., 2016). However due to the slight amendments to the modelling method, the previous analysis (APEM, 2016) cannot be directly comparable to the one presented in this report.

The ES suggested that disturbing activities were likely to be greatest during construction and may continue through the operational phase. A detailed disturbance impact assessment was undertaken using existing bird data taken from aerial surveys in the Thames estuary which resulted in a predicted significant impact on red-throated diver and black-throated diver and no significant impact on all other species. It was noted however, that red-throated

diver generally have a surplus of survival (non-breeding) habitat and population constraints would therefore relate to the conditions in the breeding area. This could therefore reduce the potential for a significant impact of the LAW through habitat loss caused by displacement. The observed redistribution of divers into Zone 1 and Zone 2 during construction supports this statement in that divers appear to utilise surrounding areas of suitable habitat. In addition, the observed significant post-construction increase of divers in the LAW disproves the ES prediction that there would be a significant impact.

7.5.2 Discussion: Auks

The proportion of auks displaced from the LAW footprint was estimated to be approximately 87% and 68% for during and post-construction respectively.

The comparison of auk distribution pre- versus during construction indicated that significant increases in density were estimated along the eastern boundary of Zone 1. Significant decreases were estimated for areas surrounding the LAW within Zone 1, as well as areas extending into Zone 2. The during versus post-construction comparison indicated that significant increases in density were estimated in a similar extent to the regions of significant decrease pre- versus during, but extending slightly into the southern region of Zone 2. Significant decreases in density were estimated along the eastern boundary of Zone 1. The pre- versus post-construction comparison indicated that significant decreases were estimated across the northern half of the LAW and surrounding areas extending into the eastern boundary of Zone 2. Significant increases in diver density were estimated along the eastern boundary of Zone 1.

Based on the summarised density information, a proportion of the auks appeared to avoid areas up to approximately 5 km from the wind farm. The proportional decline in auk density was greater than that of divers near the wind farm.

Overall the results indicate that greater numbers of auks were recorded in the pre-construction period with auks redistributing to the eastern boundary of Zone 1 during the construction phase. Post-construction, the number of auks significantly increased across Zone 1 and Zone 2, but not to the same level as the densities recorded pre-construction in Zone 1. Significant decreases in auk density were recorded along the eastern boundary of Zone 1 during versus post-construction.

Following the modelling of the first year of post-construction surveys, proportionally fewer auks were recorded in the wind farm and surrounding areas up to approximately 7 km (APEM, 2016). The results following the further two years of post-construction indicate that proportionally fewer auks were recorded within 5 km of the wind farm which may suggest that auks are gradually returning to the area. However due to the slight amendments to the modelling method, the previous analysis (APEM, 2016) cannot be directly comparable to the one presented in this report.

7.6 Summary

Based on the modelling presented in this report, a decreasing proportion of divers were displaced at distances estimated up to approximately 11 km from the LAW, but that complete displacement was not detected at any distance. Table 20 summarises displacement distances estimated for divers and auks at other offshore wind farms, the distances for divers ranged from 1 to 6 km (Welcker & Nehls, 2016).

The density profile of divers increased gradually throughout the 15 km buffer regions with a peak at 9 km pre-construction. This density profile pattern was similar during and post-construction but with the peak in density shifting 5.5 km and 4.5 km away from the LAW respectively. Year-to-year fluctuations in diver numbers and distribution should be an important consideration when interpreting these results. In addition, the greatest decline in diver density occurred outside of the LAW footprint pre- versus during construction, along the eastern boundary of Zone 1. This may be indicative that other factors, apart from the construction activities at the LAW, are compounding any displacement effects in divers in the region. Therefore the displacement distance estimated for divers is between 4.5 km and 11 km. Overall, the displacement effects of divers appeared to be less than expected but occurred over a larger distance.

Based on the modelling presented in this report, a decreasing proportion of auks were displaced at distances estimated up to approximately 5 km from the LAW but, as for divers, complete displacement was not detected at any distance. Table 20 summarises displacement distances estimated for divers and auks at other offshore wind farms, the distances for auks ranged from 2 to 4 km (Welcker & Nehls, 2016).

Table 20 Displacement effects for divers and auks from other offshore wind farms taken from Welcker & Nehls (2016): '-' and '0' indicates statistically significant negative effect on abundance and no effect detected respectively. Symbols in parentheses indicate no significant effect, but response suggested by authors.

Source	Offshore Wind Farm	Diver Displacement Distance (km)	Auk Displacement Distance (km)
Petersen *et al*. 2006 & Petersen & Fox 2007	Horns Rev I / Nysted	2	2
Leopold *et al*. (2011, 2013)	Egmond aan Zee / Princess Amalia	-	-
Percival 2013	Thanet	0	(-)
Walls *et al*. 2013	Robin Rigg	(-)	(-)
Vanermen *et al*. 2013	Thorntonbank	N/A	0
Percival 2014	Kentish Flats	1 *	0
Petersen *et al*. 2014	Horns Rev II	5-6 **	N/A
Webb *et al*. 2015	Lincs	2-6	4
Vanermen *et al*. 2015	Bligh Bank	-	3
Welcker & Nehls 2016	Alpha Ventus	1.5	2.5

* No statistical effect outside the wind farm - 1 km suggested by author

** Authors suggested up to 13 km but summarised that 5-6 km was more sensible

8. Conclusions

Each of the marine licence conditions have been analysed in the preceding sections and the results are summarised below under each of the relevant conditions.

Determine whether there is change in bird use and passage, measured by species (with particular reference to Red-Throated Diver), abundance and behaviour, of the windfarm site, 1 km and 2-4 km buffer zones and the reference site.

The results indicate that divers and auks were not completely displaced during or post-construction. During construction it appears that there was a redistribution of divers and auks into Zone 1 and Zone 2 with significant increases in density estimated for divers in the southern region of Zone 2, and along the eastern boundary of Zone 1 for auks. Post-construction diver and auk densities significantly increased from the construction phase in the LAW and surrounding area, although the densities were still proportionally lower than those recorded pre-construction. These significant post-construction increases in the LAW may be an indication that divers and auks are gradually returning to the area.

During the construction phase the proportion of divers present appeared to be reduced up to approximately 11 km from the LAW. However the diver density profile pre-construction, with the greatest diver density occurring at 9 km from the LAW suggests that factors other than the construction activities of the LAW influenced the distribution of divers. The locations of the peak diver densities pre-, during- and post-construction moved 5.5 km and 4.5 km away from the LAW, respectively. This may be indicative that other factors, apart from the construction activities at the LAW, are compounding any displacement effects in divers in the region. Therefore the displacement distance for divers is estimated to be between 4.5 km and 11 km. Overall, the displacement effects of divers appeared to be less than expected but occurred over a larger distance.

During the construction phase the proportion of auks present appeared to be reduced up to approximately 5 km from the LAW.

Objective 2: Determine whether there is a barrier effect to the movement of birds through the wind farm site, 1 km and 2-4 km buffer zones.

Flying divers were located mainly in the north-east region of Zone 1 during all construction phases, and no flying individuals were recorded within the wind farm footprint during the post-construction surveys. However, birds were recorded within the LAW footprint during construction and within 1 km of the LAW across all construction phases. A first test did not detect any difference in the number of divers flying towards the wind farm compared to all other directions, between the LAW to 4 km and greater than 4 km in Zone 1 (P >0.05), however due to the small sample size this test lacked in power. A more powerful test based on resampling detected that fewer divers tended to fly toward the wind farm in the 2 to 4 km buffer region, than in other directions (P < 0.05). This suggests that the wind farm may be acting as a barrier to flying divers up to 4 km from the LAW. The analysis specifically calculated the direction of flying individuals in relation to the nearest turbine and as such barrier effect was determined for habitat within the LAW. This type of barrier effect is defined as displacement. The monitoring survey programme did not cover areas of the OTE SPA and as such could not be assessed for barrier effect.

Although displacement could explain the relatively small number of divers observed flying in the vicinity of the LAW, the few flying divers that there are do seem to avoid flying towards

the LAW. The divers avoiding flights into the predominant south-westerly wind, however, could give the misleading impression that the LAW is acting as a barrier.

Modelling has revealed that any prolonged flights brought about by the need to circumvent OWFs acting as barriers have less effect on breeding seabirds than low food abundance or adverse weather (Masden *et al*., 2010). Thus, even if the LAW were to be acting as a barrier to flying divers in the LAW or other areas of the OTE SPA, it is difficult to see how the requirement for what are likely to be only slightly longer flights than normal by the Thames' wintering divers to avoid the LAW would notably affect them.

Objective 3: If objectives 1 or 2 reveal significant change of use of the wind farm site and 1 km and 2-4 km buffer zones by populations of conservation concern, at heights that could incur collision, a programme of collision monitoring will be implemented.

The absence of flying red-throated divers in the footprint post-construction means that the collision risk is reduced for this species. This displacement of red-throated diver and hence reduction in collision risk is consistent with the predictions of the ES.

Even though the analysis presented in this report is likely to overestimate the number of collisions in the LAW, seven or less herring and lesser black-backed gulls were estimated to collide with the wind farm which is less than the figures predicted by the ES. Gannet and great black-backed gull collisions were also overestimated in the ES.

These results do not support the need for a programme of collision monitoring.

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Appendix 3 Tranquillity Map

N

Legend

- Site Boundary
- Proposed Cable Corridor
- East Anglia TWO Wind Turbine
- Indicative Accommodation Platform
- Indicative Offshore Substation Platform (OSS)
- Indicative Operational Meteorological Mast (OMM)
- 10km Radii
- 50km SLVIA Study Area
- County Boundary
- Suffolk Coast & Heaths AONB

Tranquillity
- Most tranquil
- Least tranquil

NORFOLK COUNTY

SUFFOLK COUNTY

ESSEX COUNTY

GREAT YARMOUTH

LOWESTOFT

SOUTHWOLD

ALDEBURGH

SAXMUNDHAM

HALESWORTH

390000 395000 400000 405000 410000 415000 420000 425000 430000 435000 440000 445000 450000 455000

5835000 5830000 5825000 5820000 5815000 5810000 5805000 5800000 5795000 5790000 5785000 5780000 5775000 5770000 5765000 5760000 5755000 5750000 5745000

SCOTTISHPOWER RENEWABLES

Rev	Date	By	Comment	Checked:	SM
1	06/08/2020	JM	First issue	Approved:	

1:125,000
Scale @ A1

0 0.5 1 2 3 4 5 Km

East Anglia TWO
Tranquillity Map

Drg No	EA2-XXX-XXXXXXXXX
Rev	1
Date	29/09/20
Figure	1

Datum: WGS84
Projection: UTM Z31N

Appendix 4 Intrusion Map

N

Legend

- Site Boundary
- Proposed Cable Corridor
- East Anglia TWO Wind Turbine
- Indicative Accommodation Platform
- Indicative Offshore Substation Platform (OSS)
- Indicative Operational Meteorological Mast (OMM)
- 10km Radii
- 50km SLVIA Study Area
- County Boundary
- Suffolk Coast & Heaths AONB

Intrusion Map: England 2007

- Undisturbed areas
- Areas disturbed by noise & visual disturbance*
- Urban areas

NORFOLK COUNTY

SUFFOLK COUNTY

ESSEX COUNTY

GREAT YARMOUTH

LOWESTOFT

SOUTHWOLD

ALDEBURGH

SCOTTISHPOWER RENEWABLES

Rev	Date	By	Comment	Checked:	SM
1	06/08/2020	JM	First issue	Approved:	

1:125,000
Scale @ A1

0 0.5 1 2 3 4 5 Km

East Anglia TWO
Intrusion Map

Drg No	EA2-XXX-XXXXXXXXX
Rev	1
Date	29/09/20
Figure	2

Datum: WGS84
Projection: UTM Z31N