NORTH FALLS

Offshore Wind Farm

Report to Inform Appropriate Assessment

Part 3 Marine Mammals (Annex II Species)

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Contents

3 Marine Mammals (Annex II Species) 20

3.1 Introduction 20

3.1.1 Background 20

3.1.2 Purpose of this document 20

3.2 Approach to Assessment 20

3.2.1 Consultation 20

3.2.2 Worst case scenario 28

3.2.3 Embedded mitigation 37

3.3 Screening conclusions 39

3.3.1 Definition of adverse effect on integrity 41

3.4 Southern North Sea SAC 42

3.4.1 Site overview 42

3.4.2 Conservation objectives 44

3.4.3 Shadow appropriate assessment 46

3.5 Humber Estuary SAC and Ramsar 119

3.5.1 Site overview 119

3.5.2 Conservation objectives 122

3.5.3 Shadow appropriate assessment 123

3.6 The Wash and North Norfolk Coast SAC 161

3.6.1 Site overview 161

3.6.2 Conservation objectives 163

3.6.3 Shadow appropriate assessment 164

3.7 Other European sites 202

3.7.1 Conservation objectives 202

3.7.2 Vlaamse Banken SAC 205

3.7.3 SBZ 1 / ZPS 1 SPA 212
3.7.4 Vlakte van de Raan SCI 213
3.7.5 Baie de Canche et couloir des trois estuaries SAC 214
3.7.6 Bancs des Flandres SAC 215
3.7.7 Dunes De La Plaine Maritime Flamande SAC 216
3.7.8 Estuaire De La Canche, Dunes Picardes Plaquées Sur L'ancienne Falaise, Forêt d'Hardelot Et Falaise D'equihen SAC 217
3.7.9 Estuaires et littoral picards (baies de Somme et d'Authie) SAC 218
3.7.10 Recifs Gris-Nez Blanc-Nez SAC 219
3.7.11 Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC 220
3.7.12 Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC 221
3.7.13 Borkum Riffgrund SCI 222
3.7.14 Nationalpark Niedersachsisches Wattenmeer SAC 223
3.7.15 Doggersbank SAC 224
3.7.16 Duinen Ameland SAC 224
3.7.17 Duinen en Lage Land Texel SAC 225
3.7.18 Duinen Goeree & Kwade Hoek SAC 225
3.7.19 Duinen Terschelling SAC 226
3.7.20 Duinen Vlieland SAC 226
3.7.21 Grevelingen SAC 227
3.7.22 Klaverbank SAC 228
3.7.23 Noordzeekustzone SAC 228
3.7.24 Oosterschelde SPA and SAC 229
3.7.25 Vlakte van de Raan SAC 230
3.7.26 Voordelta SAC and SPA 231
3.7.27 Waddenzee SAC 231
3.7.28 Westerschelde and Saeftinghe SAC 232

4 References..... 234

Tables

Table 3.1 Consultation Responses Relevant to Marine Mammal Sections of the RIAA 21

Table 3.2 Realistic worst case scenarios for the likely significant effects scoped in for the marine mammal assessments 30

Table 3.3 Embedded mitigation 37

Table 3.4 Additional mitigation 38

Table 3.5 Summary of marine mammal SACs and features screened in 40

Table 3.6 Maximum harbour porpoise summer, winter and annual density estimates for North Falls 44

Table 3.7 Likely Significant Effects of North Falls in Relation to the Conservation Objectives of the SNS SAC for Harbour Porpoise 46

Table 3.8 Hammer energy, ramp-up and piling duration for monopiles 48

Table 3.9 Hammer energy, ramp-up and piling duration for pin piles 49

Table 3.10 The predicted impact ranges for PTS, at the worst case modelling location for harbour porpoise, for the starting and maximum hammer energies of both monopiles and pin piles 49

Table 3.11 Assessment of the potential for instantaneous PTS due to a single strike of the maximum hammer energy for a monopile and jacket pin pile 50

Table 3.12 The predicted impact ranges for PTS for harbour porpoise, at the worst case modelling location, for the cumulative exposure of both monopiles and pin piles 50

Table 3.13 Assessment of the potential for PTS due to the cumulative exposure of sequential monopiles or jacket pin piles in a 24 hour period for harbour porpoise ... 51

Table 3.14 The predicted impact ranges for PTS for harbour porpoise at the North and South modelling locations, for the cumulative exposure of multiple monopiles and pin pile installations at the same time 52

Table 3.15 Assessment of the potential for PTS due to the cumulative exposure of simultaneous monopiles or jacket pin piles at the same time 52

Table 3.16 Assessment of the potential for disturbance to harbour porpoise based on the EDR approach for monopiles and jacket pin piles, and for both a single and two simultaneous piling events..... 53

Table 3.17 Number of harbour porpoise (and % of reference population) that could be disturbed during piling at North Falls based on the dose-response approach 55

Table 3.18 Maximum potential overlap with SNS SAC summer and winter areas.... 59

Table 3.19 Estimated seasonal average for SNS SAC winter area based on 26km EDR for North Falls 62

Table 3.20 Assessment of the potential for disturbance due to ADD activation for both monopile and jacket pin piles..... 64

Table 3.21 The predicted impact ranges for cumulative PTS for other construction activities in harbour porpoise 65

Table 3.22 Assessment of the potential for PTS due to other construction activities, including cable laying, suction dredging, cable trenching, and rock placement, for one activity taking place at any one time 65

Table 3.23 Assessment of the potential for disturbance due to other construction activities, including cable laying, suction dredging, cable trenching, and rock placement..... 67

Table 3.24 Maximum potential overlap with SNS SAC Summer and Winter Areas based on the potential disturbance range of 4km for North Falls..... 67

Table 3.25 Estimated seasonal average for SNS SAC Winter Area based on disturbance range of 4km for North Falls..... 68

Table 3.26 The predicted impact ranges for cumulative PTS for vessels in all marine mammal species..... 69

Table 3.27 Assessment of the potential for PTS due to medium and large vessels . 70

Table 3.28 Assessment of the potential for PTS due to medium and large vessels during O&M 78

Table 3.29 Quantitative assessment for in-combination disturbance for harbour porpoise due to piling at other OWFs [number of individuals at risk of disturbance is based on project specific reporting, and rounded up to nearest whole number]..... 85

Table 3.30 Results of the iPCoD modelling for the cumulative assessment, giving the mean population size of the harbour porpoise population (wider reference population) for years up to 2053 for both impacted and un-impacted populations in addition to the median ratio between their population sizes..... 86

Table 3.31 Estimated maximum, minimum, and average overlaps with the SNS SAC Winter Area from single piling at other OWFs on the same day as single piling at North Falls 92

Table 3.32 Estimated maximum, minimum, and average overlaps with the SNS SAC Winter Area from multiple location piling at other OWFs on the same day as piling at North Falls 93

Table 3.33 Estimated seasonal averages for the SNS SAC Winter Area from single piling at other OWFs which could be piling on the same day as single piling at North Falls..... 95

Table 3.34 Quantitative assessment for in-combination disturbance for harbour porpoise due to construction activities (including vessels) at other OWFs 98

Table 3.35 Quantitative assessment for in-combination disturbance of harbour porpoise due to construction activities (including vessels) at other OWFs 100

Table 3.36 Estimated seasonal averages with the SNS SAC winter area from other construction activity (including vessels) on the same day as single piling at North Falls..... 100

Table 3.37 Quantitative assessment for in-combination disturbance of marine mammals due to up to two geophysical surveys at OWFs 103

Table 3.38 Estimated overlaps with the SNS SAC winter area from one geophysical survey at OWFs on the same day as single piling at North Falls..... 104

Table 3.39 Estimated seasonal averages with the SNS SAC winter area from geophysical surveys on the same day as single piling at North Falls 104

Table 3.40 Quantitative assessment for in-combination disturbance of harbour porpoise due to aggregate and dredging projects 106

Table 3.41 Quantitative assessment for in-combination disturbance of harbour porpoise due to up to two oil and gas seismic surveys..... 107

Table 3.42 Estimated overlaps with the SNS SAC winter area from one seismic survey at OWFs on the same day as single piling at North Falls 107

Table 3.43 Estimated seasonal averages with the SNS SAC summer and winter areas from seismic surveys on the same day as single piling at North Falls 108

Table 3.44 Quantitative assessment for in-combination disturbance of marine mammals due to cable and pipeline projects 109

Table 3.45 Estimated overlaps with the SNS SAC winter area from sub-sea cable and pipeline projects on the same day as single piling at North Falls 110

Table 3.46 Estimated seasonal averages with the SNS SAC winter area from subsea cable and pipeline projects on the same day as single piling at North Falls 110

Table 3.47 Quantitative assessment for in-combination disturbance of harbour porpoise due to UXO clearance 112

Table 3.48 Estimated overlaps with the SNS SAC winter area from UXO clearance on the same day as single piling at North Falls 113

Table 3.49 Estimated seasonal averages with the SNS SAC summer and winter areas from UXO clearance on the same day as single piling at North Falls 113

Table 3.50 Quantitative assessment for all noisy activities with the potential for in-combination disturbance effects for harbour porpoise 115

Table 3.51 Grey seal counts and population estimates 122

Table 3.52 Likely Significant Effects of North Falls in relation to the conservation objectives of the Humber Estuary SAC for grey seal 123

Table 3.53 The predicted impact ranges for PTS for grey seals, at the worst case modelling location (East), for the starting and maximum hammer energies of both monopiles and pin piles 125

Table 3.54 Assessment of the potential for instantaneous PTS due to a single strike of the maximum hammer energy for a monopile and jacket pin pile for grey seal .. 126

Table 3.55 The predicted impact ranges for PTS in grey seals, at the worst case modelling location (East location), for the cumulative exposure of both monopiles and pin piles 126

Table 3.56 Assessment of the potential for PTS due to the cumulative exposure of sequential monopiles or jacket pin piles in a 24 hour period for grey seal 127

Table 3.57 The predicted impact ranges for PTS grey seals at the East and South modelling locations, for the cumulative exposure of multiple monopiles and pin pile installations at the same time 127

Table 3.58 Assessment of the potential for PTS due to the cumulative exposure of simultaneous monopiles or jacket pin piles at the same time 128

Table 3.59 Assessment of the potential for disturbance to grey seal based on a disturbance range of 25km for both monopiles and jacket pin piles 129

Table 3.60 Number of grey seal (and % of reference population) that could be disturbed during piling at North Falls based on the dose-response approach 129

Table 3.61 Assessment of the potential for disturbance due to ADD activation for both monopile and jacket pin piles..... 130

Table 3.62 The predicted impact ranges for cumulative PTS for other construction activities on grey seal 131

Table 3.63 Assessment of the potential for PTS due to other construction activities, including cable laying, suction dredging, cable trenching, and rock placement, for one activity taking place at any one time 131

Table 3.64 Assessment of the potential for disturbance due to one or up to four construction activities taking place, including cable laying, suction dredging, cable trenching, and rock placement..... 132

Table 3.65 Assessment of the potential for PTS to grey seal from one or up to 35 construction vessels 134

Table 3.66 Assessment of the potential for PTS to grey seal from O&M vessels ... 142

Table 3.67 Quantitative assessment for in-combination disturbance for grey seal from piling at other OWFs..... 148

Table 3.68 Results of the iPCoD modelling for the in-combination assessment, giving the mean population size of the grey seal Humber Estuary SAC population for years up to 2053 for both impacted and un-impacted populations in addition to the median ratio between their population sizes. 149

Table 3.69 Quantitative assessment for in-combination disturbance for grey seal due to construction activities (including vessels) at other OWFs 151

Table 3.70 Quantitative assessment for in-combination disturbance of marine mammals due to up to two geophysical surveys at OWFs 153

Table 3.71 Quantitative assessment for in-combination disturbance of marine mammals due to aggregate and dredging projects..... 153

Table 3.72 Quantitative assessment for in-combination disturbance of marine mammals due to up to two oil and gas seismic surveys 155

Table 3.73 Quantitative assessment for in-combination disturbance of grey seals due to cable and pipeline projects 155

Table 3.74 Quantitative assessment for in-combination disturbance of grey seals due to UXO clearance 157

Table 3.75 Quantitative assessment for all noisy activities with the potential for in-combination disturbance effects for grey seals..... 157

Table 3.76 Harbour seal counts and population estimates..... 163

Table 3.77 Likely Significant effects of North Falls in relation to the conservation objectives of TW & NNC SAC for harbour seal..... 164

Table 3.78 The predicted impact ranges for PTS for harbour seals, at the worst case modelling location (East), for the starting and maximum hammer energies of both monopiles and pin piles 167

Table 3.79 Assessment of the potential for instantaneous PTS due to a single strike of the maximum hammer energy for a monopile and jacket pin pile for harbour seal 167

Table 3.80 The predicted impact ranges for PTS in harbour seals, at the worst case modelling location (East location), for the cumulative exposure of both monopiles and pin piles 168

Table 3.81 Assessment of the potential for PTS due to the cumulative exposure of sequential monopiles or jacket pin piles in a 24 hour period for harbour seal..... 168

Table 3.82 The predicted impact ranges for PTS harbour seals at the East and South modelling locations, for the cumulative exposure of multiple monopiles and pin pile installations at the same time 169

Table 3.83 Assessment of the potential for PTS due to the cumulative exposure of simultaneous monopiles or jacket pin piles at the same time 169

Table 3.84 Assessment of the potential for disturbance to harbour seal based on a disturbance range of 25km for both monopiles and jacket pin piles 170

Table 3.85 Number of harbour seal (and % of reference population) that could be disturbed during piling at North Falls based on the dose-response approach 171

Table 3.86 Assessment of the potential for disturbance due to ADD activation for both monopile and jacket pin piles..... 172

Table 3.87 The predicted impact ranges for cumulative PTS for other construction activities in harbour seal 173

Table 3.88 Assessment of the potential for PTS due to other construction activities, including cable laying, suction dredging, cable trenching, and rock placement, for one activity taking place at any one time 173

Table 3.89 Assessment of the potential for disturbance due to one or up to four construction activities taking place at the same time, including cable laying, suction dredging, cable trenching, and rock placement 174

Table 3.90 Assessment of the potential for PTS to harbour seal from one or up to 35 construction vessels 175

Table 3.91 Assessment of the potential for PTS to harbour seal from one or up to 35 construction vessels 184

Table 3.92 Quantitative assessment for in-combination disturbance for harbour seal from piling at other OWFs..... 190

Table 3.93 Results of the iPCoD modelling for the in-combination assessment, giving the mean population size of the harbour seal TW & NNC SAC population for years up to 2053 for both impacted and un-impacted populations in addition to the median ratio between their population sizes. 191

Table 3.94 Quantitative assessment for in-combination disturbance for harbour seal due to construction activities (including vessels) at other OWFs 193

Table 3.95 Quantitative assessment for in-combination disturbance of harbour seals due to up to two geophysical surveys at OWFs 195

Table 3.96 Quantitative assessment for cumulative disturbance of harbour seal due to aggregate and dredging projects 195

Table 3.97 Quantitative assessment for in-combination disturbance of harbour seal due to up to two oil and gas seismic surveys 196

Table 3.98 Quantitative assessment for in-combination disturbance of harbour seal due to cable and pipeline projects 197

Table 3.99 Quantitative assessment for in-combination disturbance of harbour seal due to UXO clearance 198

Table 3.100 Quantitative assessment for all noisy activities with the potential for in-combination disturbance effects for harbour seal 199

Table 3.101 Alignment of UK Conservation Objectives and EU Designated Sites' Conservation Objectives 203

Table 3.102 Summary of potential construction effects for qualifying features of the Vlaamse Banken SAC (x = no potential for adverse effect on site integrity; ✓= potential for adverse effect on site integrity) 212

Plates

Plate 3.1 Simulated worst-case harbour porpoise population sizes for both the un-impacted and the impacted populations for the in-combination assessment 86

Plate 3.2 Simulated worst-case grey seal Humber Estuary SAC population sizes for both the un-impacted and the impacted populations for the in-combination assessment 149

Plate 3.3 Simulated worst-case harbour seal The Wash and North Norfolk Coast SAC population sizes for both the un-impacted and the impacted populations for the in-combination assessment 191

Plate 3.4 Tracking data for grey and harbour seals (coloured by individual (grey seals = 114; harbour seals = 239)) (Carter *et al*., 2020) 207

Plate 3.5 Tracking data for grey seal and harbour seals, colour-coded by habitat preference region (data shown have been cleaned to remove erroneous location estimates, trips between regions and locations during the corresponding species' breeding season) (Carter *et al*., 2022)..... 208

Plate 3.6 Harbour seal telemetry tracks from Baie du Mont Saint-Michel (BSM) (6 individuals tracked in 2006 and 2007, in purple), Baie des Veys (BDV) (12 individuals tracked in 2007 and 2008, in blue) and Baie de Somme (BDS) (10 individuals tracked in 2010, in orange) (Vincent *et al*., 2017)..... 208

Plate 3.7 Grey seal telemetry tracks from Molene archipelago (MOL) (15 individuals from 1999 to 2003, in light blue, and 19 individuals from 2010 to 2013, in dark blue) and Baie de Somme (BDS) (11 individuals tracked in 2012, in green) (Vincent *et al*., 2017) 209

Plate 3.8 Grey seal haul out sites (source: Poncet *et al.,* 2019) 216

Figures

Figure 3.1 Overlap of maximum potential disturbance ranges for monopiles at North Falls within the SNS SAC 56

Figure 3.2 Overlap of maximum potential disturbance ranges for pin piles at North Falls within the SNS SAC 57

Figure 3.3 Maximum area of disturbance within the SNS SAC from one monopile at each of the in-combination OWFs 88

Figure 3.4 Maximum area of disturbance within the SNS SAC from one pin pile at North Falls and one monopile at each in-combination OWF..... 89

Figure 3.5 Maximum area of disturbance within the SNS SAC from two monopiles at each of the in-combination OWFs 90

Figure 3.6 Maximum area of disturbance within the SNS SAC from two pin piles at North Falls, and two monopiles at each in-combination OWF 91

Figure 3.7 Grey seal at-sea mean densities for those individuals associated with the Humber Estuary SAC 121

Figure 3.8 Grey seal at-sea mean densities for those individuals associated with the Humber Estuary SAC with North Falls and other OWFs 146

Figure 3.9 Harbour seal at-sea mean densities for those individuals associated with The Wash and North Norfolk Coast SAC 162

Figure 3.10 Harbour seal at-sea mean densities for those individuals associated The Wash and North Norfolk Coast SAC for North Falls and other OWFs 188

Appendices

Appendix 3.1 Unexploded Ordnance Clearance Information and Assessment

Glossary of Acronyms

ADD	Acoustic Deterrent Device
AIS	Automatic Identification System
AOE	Alde-Ore Estuary
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
AU	Assessment Uni
AU	Assessment Unit
B&NNC	Berwickshire and North Northumberland Coast
BAP	Biodiversity Action Plan
BDS	Baie de Somme
BDV	Baie des Veys
BEIS	Business Energy and Industrial Strategy
BSM	Baie du Mont Saint-Michel
CEA	Cumulative Effects Assessment
CL	Confidence Limit
CPOD	Cetacean Porpoise Detector
cSAC	Candidate Special Area of Conservation
CSIP	Cetacean Strandings Investigation Programme
CTV	Crew Transfer Vessel
CV	Coefficient of Variation
dB	Decibels
DCO	Development Consent Order
DEFRA	Department for Environment, Food and Rural Affairs
DEP	Dudgeon Extension Project
DESNZ	Department for Energy Security and Net Zero
EC	European Commission
EDR	Effective Deterrent Range
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
EMODnet	European Marine Observation and Data Network
EMP	Ecological Management Plan
EPS	European Protected Species
ES	Environmental Statement
ETG	Expert Topic Group
EU	European Union
EUNIS	The European Nature Information System
FCS	Favourable Conservation Status
GBS	Gravity Base Structures
GGOW	Greater Gabbard Offshore Wind Farm
GPS	Global Positioning System

ha	Hectare
HAT	High Astronomical Tide
HDPE	High Density Polyethylene
HRA	Habitats Regulations Assessment
HVAC	High Voltage Alternating Current
IAMMWG	The Inter-Agency Marine Mammal Working Group
INSPIRE	Impulsive Noise Propagation and Impact Estimator
iPCoD	Interim Population Consequences of Disturbance Mode
JNCC	Joint Nature Conservation Committee
kJ	Kilo Joules
km	Kilometre
LSE	Likely Significant Effect
m	Metre
Mm^3	Million meters cubed
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MNR	Marine Noise Registry
MU	Management Unit
NE	North East
NFOW	North Falls Offshore Wind Farm Limited
nm	Nautical Mile
NPS	National Policy Statement
NS	North Sea
O&G	Oil and gas
O&M	Operation and Maintenance
OCP	Offshore Converter Platform
OSP	Offshore Substation Platform
OSPAR	Oslo and Paris Convention - Convention for the Protection of the Marine Environment of the North-East Atlantic
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
PEMP	Project Environmental Management Plan
PLONOR	Pose Little or No Risk to the Environment
pSAC	Potential Special Area of Conservation
pSPA	Potential Special Protection Area
PTS	Permanent Threshold Shift
RIAA	Report to Inform Appropriate Assessment
RoC	Review of Consents
SAC	Special Area of Conservation
SBP	Sub-Bottom Profiler
SBZ 1 / ZPS 1	Speciale beschermingszone 1

SCANS	Small Cetaceans in the European Atlantic and North Sea
SCI	Sites of Community Importance
SCOS	Special Committee on Seals
SE	South East
SEL	Sound Exposure Level
SEL_{cum}	Cumulative Sound Exposure Level
SEP	Sheringham Shoal Extension Project
SIP	Site Integrity Plan
SMASS	Scottish Marine Animal Stranding Scheme
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Body
SNS	Southern North Sea
SoS	Secretary of State
SOV	Service Operation Vessels
SPA	Special Protection Area
SPL_{peak}	Sound Pressure Level
SSC	Suspended Sediment Concentration
SSSI	Site of Special Scientific Interest
TTS	Temporary Threshold Shift
UK	United Kingdom
USBL	Ultra-Short Base Line
UXO	Unexploded Ordnance
VMP	Vessel Management Plan
WCS	Worst-case scenario
WTG	Wind Turbine Generator
ZoI	Zone of Influence

Glossary of Terminology

Array area	The offshore wind farm area, within which the wind turbine generators, array cables, platform interconnector cable, offshore substation platform(s) and/or offshore converter platform will be located.
Array cables	Cables which link the wind turbine generators with each other, the offshore substation platform(s) and/or the offshore converter platform.
Landfall	The location where the offshore export cables come ashore at Kirby Brook.
Offshore cable corridor	The corridor of seabed from the array area to the landfall within which the offshore export cables will be located.
Offshore converter platform	Should an offshore connection to a third party HVDC cable be selected, an offshore converter platform would be required. This is a fixed structure located within the array area, containing HVAC and HVDC electrical equipment to aggregate the power from the wind turbine generators, increase the voltage to a more suitable level for export and convert the HVAC power generated by the wind turbine generators into HVDC power for export to shore via a third party HVDC interconnector ncable.
Offshore export cables	The cables which bring electricity from the offshore substation platform(s) to the landfall, as well as auxiliary cables.
Offshore project area	The overall area of the array area and the offshore cable corridor.
Offshore substation platform(s)	Fixed structure(s) located within the array area, containing HVAC electrical equipment to aggregate the power from the wind turbine generators and increase the voltage to a more suitable level for export to shore via offshore export cables.
Onshore project area	The boundary within which all onshore infrastructure required for the Project will be located (i.e. landfall; onshore cable route, accesses, construction compounds; onshore substation and cables to the National Grid substation)
PEIR offshore project area	The boundary encompassing the offshore cable corridor and array areas, as considered within the PEIR.
Platform interconnector cable	Cable connecting the offshore substation platforms (OSP); or the OSP and offshore converter platform (OCP)
Safety zones	A marine zone outlined for the purposes of safety around a possibly hazardous installation or works / construction area
Scour protection	Protective materials to avoid sediment being eroded away from the base of the wind turbine generator foundations and offshore substation platform (OSP) or / and offshore converter platform (OCP) foundations as a result of the flow of water.
Wind turbine generator (WTG)	Power generating device that is driven by the kinetic energy of the wind

3 Marine Mammals (Annex II Species)

3.1 Introduction

3.1.1 Background

1. North Falls Offshore Wind Farm (hereafter 'North Falls' or 'the Project') is an extension to the existing Greater Gabbard Offshore Wind Farm (GGOW), in the southern North Sea. When operational, North Falls would have the potential to generate renewable power for approximately 400,000 United Kingdom (UK) homes from up to 57 wind turbines.
2. The offshore project area lies in the Southern North Sea, approximately 40km from the coast of East Anglia and the onshore project area is located in the Tendring Peninsula of Essex. The offshore project area is relevant to this Part of the RIAA and includes:
    - The offshore wind farm area (the 'array area') - within which the WTGs, offshore substation platform(s) (OSPs), offshore converter platform (OCPs, if required), platform interconnector cable and array cables will be located; and
    - Offshore cable corridor - the corridor of seabed from the array area to the landfall within which the offshore export cables will be located.
3. Effects associated with the onshore project area are assessed in Part 5 Onshore European and Ramsar Sites.
4. The Applicant is North Falls Offshore Wind Ltd (NFOW), a joint venture between SSE Renewables Offshore Windfarm Holdings Limited (SSER) and RWE Renewables UK Swindon Limited (RWE) both of which are highly experienced developers.

3.1.2 Purpose of this document

5. The purpose of the Report to Inform Appropriate Assessment (RIAA) is to provide the information necessary for the competent authority to carry out the Appropriate Assessment of the North Falls Offshore Wind Farm (OWF) (hereafter 'North Falls' or 'the Project').
6. This Part of the RIAA provides the shadow Appropriate Assessment for offshore European Sites designated for Annex II marine mammal species screened in based on the Habitats Regulations Assessment (HRA) Screening Report (RIAA Appendix 1.1 (Document Reference: 7.1.1.1) and summarised in Section 3.3.

3.2 Approach to Assessment

3.2.1 Consultation

7. The key elements of consultation to date have included scoping, Section 42 consultation on the draft RIAA submitted with the Preliminary Environmental Information Report (PEIR) and the ongoing technical consultation via the marine mammal Expert Topic Group (ETG). The feedback received has been considered

in preparing this RIAA. Table 3.1 provides a summary of how the consultation responses received to date have influenced the approach that has been taken.

Table 3.1 Consultation Responses Relevant to Marine Mammal Sections of the RIAA

Consultee	Date/ Document	Comment	Applicant Responses
Planning Inspectorate	Scoping opinion - 26/08/2021	Para 244 Figure 2.1 Designated sites and study area. The aspect chapter does not reference any designated sites other than the Southern North Sea SAC (designated for harbour porpoise), despite several other European designated sites and Marine Protected Areas being present within the vicinity of the Proposed Development (as shown in Figure 2.1). Therefore, the extent to which these offshore designated sites and their qualifying / protected features have been considered within the marine mammal assessment is not clear. No reference is made to a defined study area and / or methodology that will be used to establish the baseline and assess impacts, nor is any criteria presented to identify how significance of effect will be determined. The ES should be clear on how the assessment has been undertaken, taking into relevant guidance and using an aspect specific methodology where this is relevant.	Sites screened into the assessment are listed in Table 3.5. The study area and methodology to establish features / sites to be considered are listed below in paragraph 21.
Planning Inspectorate	Scoping opinion - 26/08/2021	Section 2.7.3.1 Para 390 Approach to assessment – underwater noise modelling. The Scoping Report states that underwater noise modelling will be undertaken to inform the marine mammal assessment; however, limited information is provided regarding the proposed assessment methodology. It's unclear, for example, which receptors underwater noise modelling will be applied to / undertaken for. The Environmental Statement (ES) should fully describe the methodology applied, including Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS) and disturbance ranges used, as well as the potential for the disturbance impact footprints to overlap with the boundary of offshore designated sites, including the Southern North Sea SAC. If noise modelling indicates an overlap	An assessment of potential disturbance effects to the Southern North Sea (SNS) Special Area of Conservation (SAC) has been provided within Section 3.4 of this RIAA. Given that impact from Unexploded Ordnance (UXO) clearance will be from North Falls as well as from other projects, UXO clearance has been assessed from other projects within the in-combination assessment (Sections 3.4.3.4, 3.5.3.4, 3.6.3.4). An indicative project alone assessment for UXO has been provided within RIAA Appendix 3.1 (Document Reference: 7.1.3.1).

Consultee	Date/ Document	Comment	Applicant Responses
		of the disturbance footprint with an offshore designated site, the area and duration of such disturbance will need to be assessed against the conservation objectives of the designated site. The Inspectorate understands that the number, type and size of UXO devices is not known. However, the ES should assess the likely impacts from UXO (including the potential for auditory injury from underwater noise from UXO clearance, as well as other construction activities) and explain the assumptions applied to the assessment as necessary. The ES should also clarify whether UXO are envisaged during the operations and maintenance phased of the Proposed Development.	
Natural England	HRA Screening 29/10/21	Natural England does not consider that "changes to prey availability and any disturbance to foraging at sea" can be screened out during the decommissioning phase. There is currently little information on the activities that will be taken as part of decommissioning and no information provided to demonstrate that this will not affect the prey and/or foraging of marine mammals.	Decommissioning effects are included for each European site with reference to the construction effects (see Sections 3.4.3.3, 3.5.3.3 and 3.6.3.3)
Natural England	HRA Screening 29/10/21	As this is a standalone report, we advise that a summary of the presence of Annex II marine mammal species in the project area would be beneficial, to demonstrate why certain species have been considered and not others.	This has been added to the HRA Screening report, provided in Appendix 1.1 (Document Reference: 7.1.1.1)
Natural England	HRA Screening 29/10/21	We advise that the report should include information to demonstrate the appropriateness of the MUs screened in for seals e.g., maps of telemetry showing connectivity to the MUs outside of those that the project is located within.	Information on the populations and Management Unit (MU) used is provided in the Site Overview Section for each European site (Sections 3.4.1, 3.5.1, 3.6.1,and relevant subsections of Section 3.7)
Natural England	HRA Screening 29/10/21	We advise that the report should include a figure showing the extent of the MUs being used for screening. In addition, references should be added to demonstrate where the MUs have come from	
Natural England	HRA Screening 29/10/21	We advise that the Wadden Sea population is not included in the reference population. Although we acknowledge the connectivity between the populations, the Wadden Sea population should be considered as part of the	The Wadden Sea population has been removed from the assessments and Carter *et al.,* (2022) used to establish connectivity to SACs and the populations used for each assessment.

Consultee	Date/ Document	Comment	Applicant Responses
		transboundary assessment, rather than in the core assessment.	
Natural England	HRA Screening 29/10/21	We note that, here, the report states that the extent of the reference population for seals are certain MUs. However, this does not appear to be the same as the screening extent in Table 6.2, which is referred to as OSPAR (Convention for the Protection of the Marine Environment of the North-East Atlantic) Region II. Greater clarity is needed	Information on the populations and MU used is provided in the Site Overview section for each European site (Sections 3.4.1, 3.5.1, 3.6.1,and relevant subsections of Section 3.7)
Natural England	HRA Screening 29/10/21	Given that the report is proposing to include the north-east England MU in their reference population for grey seals, we question why you not screened in Berwickshire and North Northumberland Coast (B&NNC) SAC for grey seal. By including the north-east MU in the reference population, the report is acknowledging that there is connectivity between the project and the MU population, in that seals in the project area could originate from either the south-east or north-east MU as these two populations act as a single large population. However, grey seals in the north-east MU are almost certainly connected to the B&NNC SAC as it is the only SAC in the MU and supports the vast majority of August hauled-out seals (Special Committee on Seals (SCOS), 2020). Furthermore, we consider that there is potential for connectivity between the B&NNC SAC and the project site based on Vincent et al., (2017) and more broadly the known wide-ranging foraging habitats of grey seal in the North Sea. We therefore advise that the grey feature of the B&NNC SAC is screened in to the HRA.	The Carter *et al*., (2022) report shows no presence of grey seal associated with the Berwickshire and North Northumberland Coast (B&NNC) SAC within the North Falls project areas (Figure 7.3, Appendix 1.1 (Document Reference: 7.1.1.1)), with the closest presence of any grey seal from that SAC being 40km from the closest point of the array area which is further than any potential impact range assessed.
Natural England	HRA Screening 29/10/21	We advise that the Humber Estuary is also a Ramsar site and, as per UK policy, should be assessed in the same way as the SAC.	Noted, this is covered in Sections 3.5.1 and 3.5.2.
Natural England	HRA Screening 29/10/21	The report states that the typical foraging ranges for grey seal is 100km, and for harbour seal 80km.	Telemetry data has been reviewed to determine potential for connectivity between offshore project area and designated sites.
Natural England	HRA Screening 29/10/21	Although we acknowledge that non-UK sites are outside of Natural England's remit, we note that there are several non-UK sites designated for harbour porpoise that are within	Non UK sites are covered in Section 3.7.

Consultee	Date/ Document	Comment	Applicant Responses
		the North Sea MU but have been screened out.	
Natural England	HRA Screening Update 2/12/22	Natural England agrees with the summary of potential effects, and we note that the Applicant considered our previous advice to screen in "changes to prey availability and any disturbance to foraging at sea" during decommissioning.	Noted.
Natural England	HRA Screening Update 2/12/22	In-combination assessment should take in to consideration geophysical surveys and any potential oil and gas (O&G) surveys.	Geophysical surveys have been assessed within the in-combination assessment (Sections 3.4.3.4, 3.5.3.4, 3.6.3.4).
Natural England	HRA Screening Update 2/12/22	The foraging distance of grey seals should be revised following new information from Carter *et al*., (2022) which suggest that grey seal undertake foraging trips up to 448km. This information should also be used to revise the connectivity between the project area and protected sites.	Carter *et al*., (2022) has been used to update the assessments (see Sections 3.5 and 3.6).
Natural England	HRA Screening Update 2/12/22	More up to date maps are available from Carter *et al.,* 2020 should be used to depict global position system (GPS) tracking data for seals. We consider the approach of using telemetry data to determine connectivity is favourable compared to using a single foraging range, which is oversimplistic and does not reflect the variation in movements intra- and inter-sites. Telemetry data can also be used to determine connectivity to transboundary sites.	
Natural England	HRA Screening Update 2/12/22	We note the use of Greater North Sea OSPAR region II as a MU for grey seals. This region can be useful for screening in transboundary sites. We, however, advise the use of OSPAR AUs as presented in SCOS reports (please see SCOS 2021, Figure 4 and Figure 8). All AUs which have connectivity to the project should be considered as well as telemetry data and known foraging ranges (See Best Practice Phase III document). Thus, for grey seals, South East (SE) England and North East (NE) England AUs (or Seal MU as per SCOS 2021) should be considered.	This has been revised in the HRA Screening report, provided in Appendix 1.1 (Document Reference: 7.1.1.1).
Natural England	HRA Screening Update 2/12/22	The foraging distance of harbour seals should be revised following new information from Carter *et al* 2022 which suggest that they	Carter *et al* (2022) has been used to update the assessments (see Section 3.6).

Consultee	Date/ Document	Comment	Applicant Responses
		undertake foraging trips up to 273km. This information should also be used to revise the connectivity between the project area and protected sites.	
Natural England	HRA Screening Update 2/12/22	We note the use of Greater North Sea OSPAR region II as a MU for harbour seal. This region can be useful for screening in transboundary sites. We, however, advise the use of OSPAR AU as presented in SCOS reports (please see SCOS 2021, Figure 4 and Figure 8). All AUs which have connectivity to the project should be considered as well as telemetry data and known foraging ranges (See Best Practice Phase III document). Thus, we advise the use of Seal MUs from SCO 2021 whereby SE England Seal MU for harbour seals should be considered.	This has been revised in the HRA Screening report, provided in Appendix 1.1 (Document Reference: 7.1.1.1).
Natural England	HRA Screening Update 2/12/22	B&NNC SAC for grey seal should be added to the list of screened in sites as per our previous advice due to the connectivity between the B&NNC SAC and the project site based on Vincent *et al*., (2017) and more broadly the known wide-ranging foraging habitat of grey seal in the North Sea.	The Carter *et al*., (2022) report shows no presence of grey seal associated with the B&NNC SAC within the North Falls project areas (Figure 7.3, Appendix 1.1, Document Reference: 7.1.1.1), with the closest presence of any grey seal from that SAC being 40km from the closest point of the array area, which is further than any potential impact range assessed. In addition, the north-east England MU is no longer included within the assessed population of grey seal.
Natural England	HRA Screening Update 2/12/22	Natural England advises North Falls to revise this table [Table 7.2] in the light of new information on foraging distances of seals as per Carter *et al* 2022. B&NNC SAC for grey seal should be scoped in. We also suggest putting the UK sites at the top of the table, not at the end.	
The Wildlife Trusts (TWT)	HRA Screening 29/10/21	The HRA should consider "changes to prey availability and associated habitats, and any disturbance to foraging at sea" to marine mammal features. TWT are not comfortable with "barrier effects due to the physical presence of offshore infrastructure" being screened out at this stage.	Changes to prey availability are assessed for all European sites for construction, operation and decommissioning. Barrier effects due to underwater noise are assessed in Sections 3.4.3.1.4 and 3.4.3.2.4. Physical barrier effects are not included. This is agreed with Natural England.
The Wildlife Trusts (TWT)	HRA Screening 29/10/21	The meaning of this sentence needs to be made clearer in order to ensure consistency with the other receptors. Is this a list of marine mammal sites where LSE could not be ruled out?	This has been amended in the HRA Screening report. In addition, a summary of the sites screened-in, where Likely Significant Effect (LSE) could not be ruled out is provided in Section 3.3.

Consultee	Date/ Document	Comment	Applicant Responses
Natural England	Draft RIAA – 01/08/2023 Table 6.2 and 6.3, para 286	As in the PEIR, there is a discrepancy in the indicated soft start duration. Natural England recommends that soft start and ramp up are clearly defined and the same terms/durations are used across the documents. It would be beneficial to state which best practice documents and procedures will be implemented to reduce the collision risk	Soft start and ramp up durations have been reviewed and consistent approach used throughout.
Natural England	Draft RIAA – 01/08/2023 Table 6.4	Natural England does not support use of scale charges for UXO clearance. Also, we recommend that use of Passive Acoustic Monitoring (PAM) is considered for marine mammal monitoring alongside Marine Mammal Observers (MMO).	PAM has been listed as a potential mitigation measure for UXO clearance, and scare charges have been removed as an option, see Section 3.2.3.1.
Natural England	Draft RIAA – 01/08/2023 Table 6.4	A Vessel Management Plan should be included in the list of documents relevant for mitigation.	Vessel management measures are included within the Outline Project Environmental Management Plan (OPEMP) (Document Reference: 7.6).
Natural England	Draft RIAA – 01/08/2023 Para 256	It is stated here that the most precautionary approach will be applied for the assessment using average winter density estimates for harbour porpoises (2.8 animals/km^2), yet in Table 6.10 the assessment has been made using annual density estimates. Natural England advises that the calculations are revised using the most precautionary density estimate as stated in the paragraph 256.	Precautionary (worst case) density estimates have been used throughout the assessments, including Table 3.11 (previously Table 6.10).
Natural England	Draft RIAA – 01/08/2023	Natural England recommends that calculations which indicate a decimal number of animals impacted should be rounded up as it is ecologically not possible to impact 0.6 of an animal. In this example, 2.6 harbour porpoises should be 3. This applies to other instances thus needs to be revised throughout the document.	Figures have been rounded up to the whole number throughout assessments, unless the number is less than one as rounding to one may arbitrarily inflate the level of risk to each marine mammal species.
Natural England	Draft RIAA – 01/08/2023 Para 303	We understand the rationale behind the assessment, but due to the large number of animals that could potentially be affected by the PTS from to the cumulative exposure to piling, we can only agree with the conclusion that there will be no adverse effect on the integrity of the SNS SAC if appropriate mitigation is implemented. We note that previous Sections have mentioned the SIP and MMMP but assume these have been omitted in the text here.	Text has been reviewed and amended to include appropriate potential mitigation measures and reference to the MMMP.

Consultee	Date/ Document	Comment	Applicant Responses
Natural England	Draft RIAA – 01/08/2023 Table 6.16	A scenario whereby one monopile and one jacket pin pile are piled per day should also be considered if consent for this is being sought. It should be acknowledged that in such scenario the 20% daily threshold would be exceeded. This scenario should be assessed throughout.	A worst case scenario of 3 monopiles or 6 pin piles per day has been included within the assessments. In addition, a scenario of one monopile and one pin pile on the same day has been included.
Natural England	Draft RIAA – 01/08/2023 Para 318	It should be acknowledged that the seasonal threshold of 10% will be exceeded for two piling events per day.	Exceedances of thresholds have been detailed throughout Section 3.4.
Natural England	Draft RIAA – 01/08/2023 Table 6.50	It is not clear why SNS SAC summer area has been mentioned in the table title, while the table itself only refers to winter area. Also, the paragraph below refers to the seasonal threshold of 10% for winter area as relevant to this project given the location in the SNS SAC.	Instances of mention of summer area have been reviewed to ensure it is used in the correct context throughout Section 3.4.
Natural England	Draft RIAA – 01/08/2023 6.4.3.1.1	We note that the Section on harbour seal assessment does not follow the same format as the assessments for harbour porpoise and grey seal. For clarity, we recommend that the results of the assessments are presented in tables as in previous chapters	Assessments for harbour seal have been presented in the same way as the other species throughout all assessments in Sections 3.6 and 3.7.
Natural England	Draft RIAA – 02/08/2023 Para 801	We advise that the potential for disturbance at seal haul out sites is revised when the information on ports and shipping routes becomes available. Currently, due to the lack of information on the ports that will be used, we cannot agree with the outcome of the assessment.	Assessments have been updated based on potential port locations.
Natural England	Draft RIAA – 02/08/2023 Table 6.34	In order to conduct a more accurate in -combination assessment (especially where local harbour porpoise densities are higher than those from Small Cetacean Abundance in the North Sea (SCANS) surveys, we advise that project specific densities, where available, should be used. For example, harbour porpoise densities obtained from the site survey for Hornsea Project Four are in the public domain	Assessments have been revised and any further available data has been included for in-combination assessments and have been added to the ES, see Appendix 12.6 (Document Reference: 3.3.11).
Natural England	Draft RIAA – 02/08/2023 Para 465	In order to correctly calculate if the seasonal threshold will be exceeded as a result of in-combination effects with other OWF, any piling activity at North Falls happening in the season, but outside of the 74 or 76 days of piling, should be taken into account.	The piling days included for in combination assessments have been reviewed and include the maximum amount of days the OWFs may be piling (as reported by each OWF), to ensure the threshold calculations are correct. Further details in Section 3.4.3.4.1, with

Consultee	Date/ Document	Comment	Applicant Responses
			Table 3.33 showing the amount of piling days included in the assessment.
Natural England	Draft RIAA – 02/08/2023 Para 489	We appreciate that it is currently difficult to estimate the number and location of geophysical surveys that could be undertaken, but considering the amount of activity anticipated in the North Sea, two surveys occurring at the same time as construction of North Falls appear to be too low to be regarded a WCS.	One geophysical survey taking place at the same time as activity at North Falls, in the winter season and winter area of the SNS SAC, is appropriate given that geophysical surveys are undertaken less frequently in the winter months. The Marine Noise Registry (MNR) data for previous years has been analysed to determine the average number at any one time within this area, the results suggested an average of less than one geophysical survey at any one time within a year. Note that up to two geophysical surveys have been included for the wider MU assessments, and within the CEA.
Natural England	Draft RIAA – 02/08/2023 Table 6.36	The maximum overlap with the seasonal area should be included in this table in order to present the WCS.	Maximum overlaps with seasonal area have been presented in tables to show the worst case, see Section 3.4.
Natural England	Draft RIAA – 02/08/2023 Table 6.38, 6. 41 and 6.42	The use of generic North Sea MU density should be avoided. As further information becomes available, we would expect that more local and more precautionary densities will be applied for the in-combination assessment for disturbance.	Project specific densities have been used for the CEA where available, see Appendix 12.6 (Document Reference: 3.3.11).
Natural England	Draft RIAA – 02/08/2023 Table 2.5	Natural England agrees with the listed additional mitigation. However, we do not support use of 'scare' charges as a mitigation tool for UXO clearance. Also, it would be beneficial to include the VMP in the list as a way of reducing vessel disturbance and collision risk.	Scare charges have been removed as a potential mitigation measure within all assessments. A Vessel Management Plan (VMP) has been added to the list of additional mitigation measures, as seen in Table 3.4.

3.2.2 Worst case scenario

8. The final design of North Falls will be confirmed through detailed engineering design studies that will be undertaken post-consent. In order to provide a precautionary but robust shadow appropriate assessment at this stage of the development process, realistic worst case scenarios (WCS) have been defined for each of the LSE screened in to the RIAA for the marine mammal assessment.

Table 3.2 outlines the parameters of relevance to marine mammals associated with the range of WTGs[1].

[1] Further information on the scaling up from existing noise data is provided in ES Volume 3.3, Appendix 12.2 (Document Reference: 3.3.7).

Table 3.2 Realistic worst case scenarios for the likely significant effects scoped in for the marine mammal assessments

LSE	Parameter	Notes
Construction		
Impact 1: Underwater noise during piling, including: • Permanent auditory injury; and • Disturbance.	Spatial worst case scenario: • 57 WTGs on monopile foundations; • Two OSPs/OCP on monopile foundations; • Maximum pile diameter for WTG and OSP/OCP monopiles: 17m; • 6,000 kJ hammer energy, 7.5 hours piling duration per monopile including a 10 minute soft start at 15% hammer energy, and 120 minute (2 hour) ramp up to full energy (where full energy is required); • Maximum number of monopiles to be installed per 24 hour period: three; • Total WTG active piling duration: 427.5 hours (equivalent to 17.8 days); • Total OSP/OCP active piling duration: 15 hours (less than one day); • Duration of foundation installation: 12 months; • Simultaneous piling: only two piles will be piled simultaneously within the North Falls array area. Temporal worst case scenario: • 57 WTGs on pin piled jacket foundations, four legs and two piles per leg (eight piles per jacket; 456 total); • Two OSPs/OCP with six legs and two piles per leg (24 total piles); • Maximum pile diameter for WTG pin piles: 6m; • Maximum pile diameter for OSPs/OCP pin piles: 3.5m; • WTGs: 4,400 kJ hammer energy, 4.5 hours piling duration including a 10 minute soft start at 15% hammer energy, and 80 minute ramp up to full energy (where required); • OSP/OCPs: 3,000 kJ hammer energy; • Maximum number of pin piles to be installed per 24 hour period: six; • Total WTG active piling duration: 2,052 hours (equivalent to 85.5 days); • Total OSP/OCP active piling duration: 108 hours (equivalent to 4.5 days); • Duration of foundation installation: 12 months;	The spatial worst case scenario is based on the largest hammer energy which is required for monopile foundations. The temporal worst case scenario is based on the greatest number of piles which is the pin piled jacket foundations[3]. Full hammer energy is unlikely to be required on all piles but is assessed for all piles as a worst case scenario. Drive-drill-drive is an option for installation, however, 100% pile driving is the worst case and has been assessed. Alternative foundation types (including suction bucket monopiles, and gravity based for both monopiles and pin piles) are an option, but do not represent the worst case for underwater noise. Activation of ADD is indicative only and the details will be confirmed during the post-consent phase, through the finalisation of the Marine Mammal Mitigation Protocol (MMMP).

[3] Assessments for pin piles for the OSP/OCP are based on the parameters for pin piles for the WTG as a worst-case

LSE	Parameter	Notes
	• Simultaneous piling: only two piles will be piled simultaneously within the North Falls array area; • Additional disturbance from Acoustic Deterrent Devices (ADD): ○ Indicative activation time of 37 minutes[2].	
Impact 2: Underwater noise during other construction activities, including: • Permanent auditory injury; and • Disturbance.	Seabed clearance methods: Pre-lay grapnel run, boulder clearance, sand wave levelling (pre-sweeping), dredging	Appendix 12.3 (Document Reference: 3.3.8) provides underwater noise modelling for suction dredging to represent the worst case scenario of these activities.
	Cable installation methods: It is anticipated that the offshore cables will be installed via either ploughing, jetting, trenching, or a combination of these techniques. Surface laid cable protection could be required in areas where cables cannot be buried (e.g. at cable crossings and hard ground conditions. Array cables total length: 170km Platform interconnector cable total length: 20km Offshore export cable total length 125.4km (based on 2 cables) Indicative duration of offshore construction: approximately two years (including commissioning)	Appendix 12.3 (Document Reference: 3.3.8) provides underwater noise modelling for cable laying, trenching and rock placement to represent the worst case scenario for these activities.
Impact 3: Underwater noise due to construction vessels, including: • Permanent auditory injury; and • Disturbance.	Vessel movements: • Maximum indicative peak number of construction vessels on site at any one time: up to 35 vessels • Construction vessel two-way trips to port (movements): 2,532 over two year offshore construction period (average of 1,266 movements per year; 3.5 movements per day) Construction port: To be determined, could be any North Sea port (UK and/or EU).	The maximum numbers of vessels and associated vessel movements represents the maximum potential for disturbance. Appendix 12.3 (Document Reference: 3.3.8) provides underwater noise modelling for noise from large and medium sized vessels

[2] Calculated based on the maximum PTS distances for UXO clearance and piling.

LSE	Parameter	Notes
Impact 4: Barrier effects due to underwater noise during construction	Maximum impact range from all three underwater noise assessments (worst case parameters described above).	The maximum spatial area of potential impact, and duration of impacts, are considered to cause the worst case barrier impact.
Impact 5: Collision risk due to construction vessels	Vessel movements: • Maximum indicative peak number of construction vessels on site at any one time: up to 35 vessels • Construction vessel trips to port (movements): 2,532 over two year offshore construction period (average of 1,266 movements per year; 3.5 movements per day) Construction port: To be determined, could be any North Sea port (UK and/or EU).	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk.
Impact 6: Disturbance at seal haul-out sites	Vessel movements: • As above. Location of works: • Minimum distance of array area to coastline: 40km • Landfall: Kirby Brook, Tendring Peninsula of Essex. • Construction port: To be determined, could be any North Sea port (UK and/or EU). Indicative duration of offshore construction: approximately two years (including commissioning)	Number of vessel movements and proximity to seal haul out sites defines the worst case scenario.
Impact 7: Changes to water quality	• Suspended sediments arising from: • Seabed preparation for foundation installation = 1.14Mm^3 • Array cable installation = 28.96Mm^3 • Export cable installation = 1.7Mm^3	The worst case scenario for marine mammals is based on the conclusions of the assessments presented in Chapter 9 Marine Water and Sediment Quality (Document Reference: 3.1.11).
Impact 8: Changes to prey resources	Prey impacts from temporary habitat loss/ disturbance: 9.19km^2 (worst case scenario total disturbance footprint in the array area = 5.88km^2 + offshore export cables total disturbance footprint = 3.31km^2).	The worst case scenario for maximum area of temporary habitat loss / disturbance of seabed from offshore cable installation, seabed preparation, jack-up vessels and anchoring). See Chapters 10 and 11 in the North Falls ES (Document References: 3.1.12 and 3.1.13) for further detail. Worst case scenario for marine mammals is based on the conclusions of the assessments presented in Chapter 10 Benthic Ecology and Chapter 11 Fish and Shellfish Ecology (ES Document References: 3.1.12 and 3.1.13).
	Prey impacts from underwater noise parameters as outlined for Impacts 1 to 3, above and Appendix 12.3 Underwater Noise Modelling Report (Volume 3.3 of ES, Document Reference: 3.3.8)	
	Prey impacts resulting from changes to water quality as described for Impact 7, above	

LSE	Parameter	Notes
Operation		
Impact 1: Underwater noise from operational wind turbines, including: • Permanent auditory injury; and • Disturbance.	Indicative operational life of North Falls: 30 years Number of WTGs: • 57 x smallest WTGs (rotor diameter 236m), or • 34 x largest WTGs (rotor diameter 337m) Minimum turbine spacing: • Smallest WTGs = 944m (crosswind) and 1,180m (downwind), or • Largest WTGs = 1,348m (crosswind) and 1,685m (downwind)..	Worst case assessment is based on the underwater noise modelling results presented Appendix 12.3 Underwater Noise Modelling Report (Volume 3.3 of the ES, Document Reference: 3.3.8).
Impact 2: Underwater noise from O&M activities, including: • Permanent auditory injury; and • Disturbance.	Unplanned repairs and reburial of cables may be required during O&M, the following estimates are included: • Reburial of c.2.75% of array cable length is estimated over the life of the project (24m disturbance width) = 112,200m^2 • Reburial of c.2.75% of platform interconnector cable is estimated over the life of the project (24m disturbance width) = 13,200m^2 • Reburial of c4% of export cable is estimated over the life of the project (24m disturbance width) = 120,384m^2 • Five array/interconnector cable repairs are estimated over the Project life. • Four offshore export cable repairs are estimated over the Project life. Anchored vessels placed during the no. of cable repairs include above. Maintenance of offshore infrastructure would be required during O&M. An estimated 177 major component replacement activities may be required per year, using jack up vessels and/or anchoring.	Underwater noise modelling for other activities presented Appendix 12.3 Underwater Noise Modelling Report (Volume 3.3 of ES, Document Reference: 3.3.8).
Impact 3: Underwater noise due to O&M vessels	Indicative peak number of vessels on site at any one time: 22 • Two jack-up vessels • Two Service Operation Vessels (SOVs) • Six small O&M vessels (e.g. crew transfer vessels (CTVs) • Two lift vessels • Two cable maintenance vessels • Eight auxiliary vessels (e.g. survey vessels, diver platform vessels, tugs, cargo vessels, scour replacement vessels)	Worst case is based on the maximum number of vessel movements.
	Indicative O&M vessel movements per year: 1,095 round (two-way) trips of small vessels, and 127 (two-way) round trips of large vessels (1,222 two-way round trips in total):	

LSE	Parameter	Notes
	• Seven (two-way) round trips per year of jack-up vessels • 52 SOV (two-way) round trips per year • 1,095 small O&M vessel (two-way) round trips per year • Seven (two-way) round trips per year of lift vessels • One cable maintenance vessel (two-way) round trip per year • 60 (two-way) round trips per year of auxiliary vessels, dependent on size of vessel	
Impact 4: Barrier effects due to underwater noise during operation	Maximum impact range from O&M phase underwater noise impacts 1 to 3 (as above).	The maximum spatial area of potential impact, and duration of impacts, are considered to cause the worst case barrier effect.
Impact 5: Increased collision risk due to O&M vessels	Indicative O&M vessel movements per year: as above.	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk.
Impact 6: Disturbance at seal haul-out sites	Vessel movements: • As above. Location of works: • Minimum distance of array area to coastline: 40km • O&M base location: potentially Harwich or Felixstowe	Operation and maintenance activities could happen at any time of year.
Impact 7: Changes to water quality	Suspended sediments arising from: • Reburial of c.2.75% of array cable length (170km) is estimated over the life of the project (24m disturbance width and average 1.2m depth) = 134,640m^3 • Reburial of c.2.75% of platform interconnector cable (20km) is estimated over the life of the project (24m disturbance width and average 1.2m depth) = 15,840m^3 • Reburial of c. 4% of offshore export cable (125.4km) is estimated over the life of the project (24m disturbance width and average 1.2m depth) = 144,460.8m^3 • Five array/platform interconnector cable repairs are estimated over the project life. 600m section removed x 24m disturbance width x average 1.2m depth = 86,400m^3 • Four export cable repairs are estimated over the project life. 600m section removed x 24m disturbance width x average 1.2m depth = 69,120m^3.	The worst case scenario for marine mammals is based on the conclusions of the assessments presented in Chapter 9 Marine Water and Sediment Quality.
Impact 8: Changes to prey resources	Prey impacts from habitat loss within the offshore project area = 5.5km^2 (5.37km^2 in the array area and 0.08km^2 in the offshore cable corridor)	The worst case scenario for maximum area of temporary habitat loss / disturbance of seabed from offshore cable installation, seabed preparation, jack-up vessels and anchoring). See
	Prey impacts from underwater noise parameters as outlined for Impacts 1 to 3, above and ES Volume 3.3, Appendix 12.3 Underwater Noise Modelling Report (Document Reference: 3.3.8).	

LSE	Parameter	Notes
	Prey impacts resulting from changes to water quality as described for Impact 7, above.	Chapters 10 and 11 for further detail (Document References: 3.1.12 and 3.1.13). Worst case scenario for marine mammals is based on the conclusions of the assessments presented in Chapter 10 Benthic Ecology and Chapter 11 Fish and Shellfish Ecology (Document References: 3.1.12 and 3.1.13).
Decommissioning		

Impact 1: Underwater noise from decommissioning activities
 	
Impact 2 & 4: Underwater noise and increased collision risk due to decommissioning vessels
 	
Impact 3: Barrier effects from underwater noise during decommissioning
 	
Impact 5: Disturbance at seal haul-out sites
 	
Impact 6: Changes to water quality
 	
Impact 7: Changes to prey resources
	Foundations
	Cutting of piles below the seabed surface:
	• 480 pin piles of 6m diameter
	  ○ 57 wind turbines x 8 piles
	  ○ 2 OSPs/OCP x 12 piles
	Or
	• 59 monopiles of 17m diameter (57 wind turbines + 2 OSPs/OCP)
	Or
	Removal of largest foundations (gravity based systems; GBS):
	• 57 WTGs x 65m diameter
	• 2 OSP/OCPs x 65m diameter
	
	<u>Export cables</u>
	Up to 125.4km of offshore export cable (removal to be determined in consultation with key stakeholders as part of the decommissioning plan)
	<u>Array cables</u>
	Up to 190km of array/platform interconnector cable (removal to be determined in consultation with key stakeholders as part of the decommissioning plan)
	
	<u>Platform interconnector cables:</u>
	Up to 20km of platform interconnector cable (removal to be determined in consultation with key stakeholders as part of the decommissioning plan)
		No decision has yet been made regarding the final decommissioning arrangements for the offshore project infrastructure. It is also recognised that legislation and industry good practice change over time. However, the following infrastructure is likely to be removed, reused or recycled where practicable:
		• Turbines including monopile, steel jacket and GBS foundations;
		• OSP/OCPs including topsides and steel jacket foundations; and
		• Offshore cables may be removed or left in situ depending on available information at the time of decommissioning.
		The following infrastructure is likely to be decommissioned in situ depending on available information at the time of decommissioning, however where it represents the worst case scenario (e.g. for disturbance, removal is assessed):
		• Scour protection;
		• Offshore cables may be removed or left in situ; and
		• Crossings and cable protection.
		The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of

LSE	Parameter	Notes
		decommissioning and will be agreed with the regulator. Decommissioning arrangements will be detailed in a Decommissioning Plan, which will be prepared in accordance with the Energy Act 2004.

3.2.3 Embedded mitigation

9. This section outlines the embedded mitigation relevant to the marine mammal assessments, which has been incorporated into the design of North Falls (Table 3.3).

Table 3.3 Embedded mitigation

Parameter	Mitigation measures embedded into North Falls design
Underwater Noise	
Soft-start and ramp-up for piling activities	Each piling event would commence with a soft-start at a lower hammer energy followed by a gradual ramp-up to the maximum hammer energy required (the maximum hammer energy is only likely to be required at a few of the piling installation locations).
Water Quality	
Pollution prevention	As outlined in Chapter 9 Marine Sediment and Water Quality (Document Reference: 3.1.11), the Applicant is committed to the use of good practice techniques and due diligence regarding the potential for pollution throughout all construction, operation and maintenance, and decommissioning activities. The outline PEMP, submitted alongside the DCO application, sets out the details of the measures that will be taken in relation to accidental pollution events. The final PEMP would be agreed with the MMO prior to construction.

3.2.3.1 Additional mitigation and management

10. Mitigation will be required for the following activities, and will use the relevant JNCC guidelines as standard (the relevant guidelines are noted below);

    - UXO clearance
        - Following the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC, 2010a)
        - Natural England Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards (Phase III and IV) (Parker *et al*. 2022a and Parker *et al*. 2022b)
    - Piling
        - Following the Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010b)

11. While the JNCC guidelines will be used as a standard, they may be adapted to ensure that the predicted instantaneous and cumulative PTS ranges are mitigated against, for all marine mammal species. It is expected that ADDs will be used as part of the mitigation for both UXO clearance and piling. Mitigation and monitoring protocols will be developed for each of the above listed activities.

12. Management measures may also be required in the form of a Site Integrity Plan (SIP) for the management of underwater noise disturbance within the SNS SAC.

13. Mitigation, management and monitoring will be secured through the following management plans (Table 3.4). A draft MMMP (Document Reference: 7.7) and outline SNS SAC SIP (Document Reference: 7.8) are submitted with the DCO application.

Table 3.4 Additional mitigation

Parameter	Additional mitigation measures
MMMP for piling activities in accordance with the draft MMMP (Document Reference: 7.7)	
MMMP for Piling Activities	The MMMP for piling will be developed in the pre-construction period and be based upon best available information, methodologies, industry good practice, latest scientific understanding, current guidance and detailed project design. The MMMP for piling will be developed in consultation with the relevant SNCBs and the MMO, detailing the proposed mitigation to reduce the risk of any physical or permanent auditory injury (PTS) to marine mammals during all piling operations.
MMMP for UXO Clearance [requirement to be confirmed through separate Marine Licencing process, during which final MMMP will be provided in accordance with the Outline MMMP (Document Reference:7.7)]	
MMMP for UXO	A detailed MMMP will be prepared for UXO clearance during the separate Marine Licencing process. The MMMP for UXO clearance will ensure there is adequate mitigation to minimise the risk of any physical or permanent auditory injury to marine mammals as a result of UXO clearance. The MMMP for UXO clearance will be developed in the pre-construction period, when there is more detailed information on the UXO clearance which could be required and the most suitable mitigation, based upon best available information and methodologies at that time, in consultation with the MMO and relevant SNCBs. The MMMP for UXO clearance will include details of all the required mitigation to minimise the potential risk of physical and auditory injury (PTS) as a result of underwater noise during UXO clearance, for example, this would consider the options, suitability and effectiveness of mitigation such as, but not limited to: • Low-order disposal technique, such as deflagration; • The use of bubble curtains for any high-order detonations (taking into consideration the environmental limitations); • All detonations to take place in daylight and, when practicable, in favourable conditions with good visibility (sea state 3 or less); • Establishment of a monitoring area with minimum of 1km radius. • The observation of the monitoring area will be by dedicated and trained marine mammal observers during daylight hours and suitable visibility; • The potential use of Passive Acoustic Monitoring; • The activation of ADDs; • The controlled explosions of the UXO will be undertaken by specialist contractors, using the minimum amount of explosive required in order to achieve safe disposal of the UXO; and • Other UXO clearance techniques, such as the use of multiple detonations, if UXO are located in close proximity; avoidance of UXO; or relocation of UXO.
Site Integrity Plan in accordance with the Outline SNS SAC SIP (Document Reference: 7.8)	
SNS SAC SIP	In addition to the MMMPs for piling and UXO clearance, a SNS SAC SIP will be developed. The SIP will set out the approach to deliver any project mitigation or management measures to reduce the potential for any significant disturbance of harbour porpoise in relation to the SNS SAC conservation objectives. The SIP will be an adaptive management tool, which can be used to ensure that the most adequate, effective and appropriate measures, if required, are put in place to reduce the significant disturbance of harbour porpoise in the SNS SAC. The SIP will be developed in the pre-construction period and will be based upon best available information and methodologies at that time, in consultation with the relevant SNCBs and MMO. Potential measures considered within the SIP are: • Seasonal restrictions • Noise reduction • Different foundation types and installation methods
Vessel Management Plan (VMP)	
VMP	A VMP is included within the Outline Project Environmental Management Plan (PEMP), submitted alongside the DCO application. The VMP details measures to reduce disturbance and collision risk to marine mammals. Vessel movements, where

Parameter	Additional mitigation measures
	possible, will follow set vessel routes and hence areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. All vessel movements will be kept to the minimum number that is required. Additionally, vessel operators will use good practice to reduce any risk of collisions with marine mammals.

14. A summary report will be provided following all activities as outlined above, to provide detail on the activities and mitigation undertaken. The summary reports will also provide detail on any marine mammal presence during each of the relevant activities.

3.3 Screening conclusions

15. For marine mammals, the approach to the RIAA primarily focuses on the potential for connectivity between individual marine mammals from designated populations and the North Falls offshore project area (i.e. demonstration of a clear source-pathway-receptor relationship). This is based on the distance of the offshore project area from a European site, the range of each effect and the potential for animals from a European site to be within range of that effect.

16. The RIAA therefore considers European sites which meet the following criteria:

- The distance between the zone of influence (ZoI) of the North Falls offshore project area and a European site with marine mammals as a qualifying feature is within the range for which there could be an interaction. For example, the pathway is not too long for significant noise propagation and therefore the site is within the area of effect for underwater noise effects.
- The distance between the North Falls offshore project area and resources on which the qualifying marine mammal feature depends, such as key habitats or areas of prey species is within the potential area of effect. There is the potential for an indirect effect acting through prey or access to habitat.
- The likelihood that a foraging area or a migratory route occurs within any area of effect of the North Falls offshore project area. This applies to mobile qualifying features when outside of a European site.

17. The approach to screening for seal species was undertaken based on the identified connectivity with SACs through tagging studies, and those SACs that are within the Management Units (MUs) with identified connectivity for seal species.

18. Table 3.5 shows the European sites and qualifying features that have been screened in for LSE.

19. All other European sites designated for Annex I marine mammal species are screened out on the basis of no potential for LSE. For further information on the rationale, see Appendix 1.1 (Document Reference: 7.1.1.1).

20. The LSE on marine mammals are:

- Auditory injury and disturbance effects from piling, other construction activities, vessels, operational turbines, O&M activities and decommissioning activities;
- Any barrier effects from underwater noise;

- Any increased collision risk with vessels;
- Disturbance at seal haul-out sites;
- Disturbance of foraging at sea;
- Changes to water quality;
- Changes to prey resources; and
- In-combination effects.

Table 3.5 Summary of marine mammal SACs and features screened in

Site	Qualifying feature screened in
Southern North Sea (SNS) SAC	Harbour porpoise *Phocoena phocoena*
Humber Estuary SAC and Ramsar	Grey seal *Halichoerus grypus*
The Wash and North Norfolk Coast SAC	Harbour seal *Phoca vitulina*
Vlaamse Banken SAC	Harbour porpoise Harbour seal Grey seal
Speciale beschermingszone 1 (SBZ 1 / ZPS 1) SPA	Harbour seal
Vlakte van de Raan SCI	Harbour porpoise Harbour seal Grey seal
Baie de Canche et couloir des trois estuaries SAC	Grey seal Harbour seal
Bancs des Flandres SAC	Harbour porpoise Harbour seal Grey seal
Dunes De La Plaine Maritime Flamande SAC	Harbour seal
Estuaire De La Canche, Dunes Picardes Plaquees Sur L'ancienne Falaise, Foret D'hardelot Et Falaise D'equihen SAC	Harbour seal
Estuaires et littoral picards (baies de Somme et d'Authie) SAC	Grey seal Harbour seal
Recifs Gris-Nez Blanc-Nez SAC	Harbour porpoise Harbour seal Grey seal
Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC	Harbour porpoise Harbour seal Grey seal
Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC	Harbour porpoise Harbour seal Grey seal
Borkum-Riffgrund SCI	Grey seal
Nationalpark Niedersachsisches Wattenmeer SAC	Grey seal
Doggersbank SAC	Grey seal
Duinen Ameland SAC	Grey seal

Site	Qualifying feature screened in
Duinen en Lage Land Texel SAC	Grey seal
Duinen Goeree & Kwade Hoek SAC	Grey seal Harbour seal
Duinen Terschelling SAC	Grey seal
Duinen Vlieland SAC	Grey seal
Grevelingen SAC	Grey seal Harbour seal
Klaverbank SAC	Grey seal
Noordzeekustzone SAC	Grey seal Harbour seal
Oosterschelde SPA and SAC	Grey seal Harbour seal
Vlakte van de Raan SAC	Harbour porpoise Harbour seal Grey seal
Voordelta SAC and SPA	Harbour porpoise Harbour seal Grey seal
Waddenzee SAC	Grey seal Harbour seal
Westerschelde and Saeftinghe SAC	Harbour porpoise Harbour seal Grey seal

21. For each European site screened into the Appropriate Assessment the following has been provided:

    - A summary of the ecology of the marine mammal species relevant for each designated site assessment;
    - An assessment of the effects on the integrity of the European site during the construction, operation, maintenance and decommissioning phases of North Falls; and
    - An assessment of the potential for in-combination effects for North Falls alongside other relevant developments and projects.

3.3.1 Definition of adverse effect on integrity

22. The potential for adverse effects on the integrity for each designated site for marine mammals for construction, operation, maintenance and decommissioning at North Falls has been assessed where LSE have been identified in the HRA Screening.

23. Assessments of the potential for adverse effects on integrity, at the population level, have been based on the JNCC *et al., (2010)* draft guidance for effects on

EPS, and the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) agreement.

24. The JNCC *et al., (2010)* draft guidance provides some indication on how many animals may be removed from a population without causing detrimental effects to the population at FCS. The *JNCC et al., (2010)* draft guidance also provides limited consideration of temporary effects, with guidance reflecting consideration of permanent displacement.

25. JNCC *et al., (2010)* draft guidance considered 4% as the maximum potential growth rate in harbour porpoise, and the 'default' rate for cetaceans. Therefore, beyond natural mortality, up to 4% of the population could theoretically be permanently removed before population growth could be halted. In assigning 5% to a temporary effect, consideration is given to uncertainty of the individual consequences of temporary disturbance.

26. Permanent effects with a greater than 1% of the reference population being affected within a single year are considered to result in a significant effect. This is based on ASCOBANS and Defra advice (Defra, 2003; ASCOBANS, 2015) relating to impacts from fisheries by-catch (i.e. a permanent effect) on harbour porpoise. A threshold of 1.7% of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to ASCOBANS, with an intermediate precautionary objective of reducing the impact to less than 1% of the population (Defra, 2003; ASCOBANS, 2015).

27. As a precautionary approach, and as there is no current guidance on what determines a significant temporary or permanent effect, the above information on the potential for population level effects has been used to inform the approach to defining potential for adverse effect for harbour porpoise, grey seal and harbour seal populations. The approach to define the potential for adverse effect on the integrity of the site, based on the likely significant effect to the overall populations, is therefore as follows;

    - For temporary effects, there would be potential for an adverse effect on the integrity of the site, if there is an effect to 5% or more of the population; and
    - For permanent effects, there would be potential for an adverse effect on the integrity of the site, if there is an effect to 1% of more of the population.
    - The exception to this approach is the use of the Effective Deterrent Range (EDR) spatial approach for disturbance impacts upon harbour porpoise within the SNS SAC (see Section 3.4.3.1.1), following the guidelines provided in Sinclair *et al*., (2023).

3.4 Southern North Sea SAC

3.4.1 Site overview

28. The SNS SAC has been recognised as an area with persistent high densities of harbour porpoise (JNCC, 2017; JNCC and Natural England, 2019) and is the largest designated site for harbour porpoise in UK and European waters at the time of designation.

29. The SNS SAC covers an area of 36,951km^2, with both winter and summer habitats of importance to harbour porpoise (JNCC, 2017). Approximately

27,028km^2 of the site is important in the summer period (183 days from April to September inclusive) and 12,696km^2 of the site is important in the winter period (182 days from October to March inclusive) (JNCC *et al.*, 2020). The majority of the site is less than 40m in depth, reaching up to 75m in the northernmost areas.

30. The North Falls array area is fully within the winter area of the SNS SAC, and the offshore cable corridor is partly within the winter area of the SAC.

3.4.1.1 Qualifying Feature

3.4.1.1.1 Harbour porpoise

31. Within the SNS SAC area, harbour porpoise is the most common marine mammal species (Gilles *et al.*, 2023). Heinänen and Skov (2015) identified that within the North Sea, water depth and hydrodynamic variables are the most important factors in harbour porpoise densities in species areas, in both winter and summer seasons. The seabed sediments also play an important role in determining areas of high harbour porpoise density, as well as the number of vessels present in the area.

32. Distribution and abundance maps have been developed by Waggitt *et al.*, (2019) for harbour porpoise and show a clear pattern of high density in the SNS, and the coasts of south-east England, for both January and July (Waggitt *et al.*, 2019). Examination of this data, including all 10km grids that overlap with North Falls, including offshore cable corridor areas, indicates an average annual density estimate of:

- 0.368 individuals per km^2 for the North Falls array area; and
- 0.393 individuals per km^2 for the North Falls offshore cable corridor.

33. The North Falls offshore project area is in the SCANS-IV (Small Cetaceans in the European Atlantic and North Sea) survey block NS-B (Gilles *et al.*, 2023) where:

- Abundance estimate = 7,982 harbour porpoise (95% Confidence Limit (CL) = 4,865 – 13,033); and
- Density estimate = 0.3096 harbour porpoise/km^2 (Coefficient of Variation (CV) = 0.239).

34. The SCANS-IV (Gilles *et al.*, 2023) provided density and abundance estimates for the five Assessment Units (AUs) for harbour porpoise: NS; West Scotland and Ireland (partial coverage only); Irish and Celtic Seas (partial coverage only); Belt Sea and the Iberian Peninsula. AUs are as defined in IMR/NAMMCO (2019). The North Falls offshore project area is located in the NS AU.

35. The reference population for harbour porpoise used in the assessments is the North Sea AU, which is based on the latest SCANS-IV estimated abundance of 338,918 harbour porpoise (CV = 0.17; 95%; CI = 243,063 – 476,203) (Gilles *et al.*, 2023).

36. The SNS SAC Site Selection Report (JNCC, 2017) identifies that the SNS SAC site supports approximately 18,500 individuals (95% CI = 11,864 - 28,889) for at least part of the year (JNCC, 2017). However, JNCC and Natural England (2019) state that because this estimate is from a one-month survey in a single year (the SCANS-II survey in July 2005) it cannot be considered as an estimated population for the site. It is therefore not appropriate to use site population estimates in any assessments of effects of plans or projects on the site (i.e. HRA),

as they need to take into consideration population estimates at the MU level (i.e. the North Sea AU), to account for daily and seasonal movements of the animals (JNCC and Natural England, 2019).

37. Data from the North Falls site specific surveys have also been used to generate abundance and density estimates for the array area with a 4km buffer (for further details see ES Appendix 12.2 Marine Mammal Baseline (Document Reference: 3.3.7). The average of the winter months, summer months, and annual density has then been calculated based on the maximum calculated for each month. Table 3.6 shows the densities for harbour porpoise, based on all individuals that have the potential to be harbour porpoise.

Table 3.6 Maximum harbour porpoise summer, winter and annual density estimates for North Falls

Season	Maximum density estimate (corrected) for whole survey area (animals/km^2)
Average winter	3.217
Average summer	1.665
Average annual	2.441

38. The site-specific surveys indicate a seasonal pattern in the abundance of harbour porpoise, with higher numbers present in the winter months. There is no evident pattern of harbour porpoise distribution within the survey area, with no indication of a particular area of importance.

39. It is not currently known at what time of year any activities associated with North Falls will take place, and therefore, as a precautionary approach, the worst case average winter density estimate of harbour porpoise from the site specific surveys (3.217 harbour porpoise/km^2) have been used in the impact assessments.

3.4.2 Conservation objectives

40. The Conservation Objectives for the SNS SAC are designed to help ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Habitats Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely.

41. The Conservation Objectives (JNCC and Natural England, 2019) for the SNS SAC are:

"To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS for Harbour Porpoise in UK waters.

In the context of natural change, this will be achieved by ensuring that:

- *Harbour porpoise is a viable component of the site;*
- *There is no significant disturbance of the species; and*
- *The condition of supporting habitats and processes, and the availability of prey is maintained*".

42. These Conservation Objectives are:

"a set of specified objectives that must be met to ensure that the site contributes in the best possible way to achieving FCS of the designated site feature(s) at the national and biogeographic level" (JNCC and Natural England, 2019).

3.4.2.1 *Conservation Objective 1: The Species is a Viable Component of the Site*

43. This Conservation Objective is designed to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the SAC. Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoise using the SAC. Unacceptable levels can be defined as those having an impact on the FCS of the population of the species in their natural range.

44. Harbour porpoise are considered to be a viable component of the SAC if they are able to live successfully within it. The SNS SAC has been selected primarily based on the long term, relatively higher densities of porpoise in contrast to other areas of the North Sea. The implication is that the SAC provides relatively good foraging habitat and may also be used for breeding and calving. However, because the number of harbour porpoise using the site naturally varies there is no exact value for the number of animals expected within the site (JNCC and Natural England, 2019).

45. The Conservation Objectives (JNCC and Natural England, 2019) state that, with regard to assessing impacts, 'the reference population for assessments against this objective is the MU population in which the SAC is situated'.

46. Harbour porpoise are listed as European Protected Species (EPS) under Annex IV of the Habitats Directive, and are therefore protected from the deliberate killing (or injury), capture and disturbance throughout their range. Under the Habitats Regulations, it is an offence if harbour porpoise are deliberately disturbed in such a way as to:

    - Impair their ability to survive, to breed or reproduce, or to rear or nurture their young; or
    - To affect significantly the local distribution or abundance of that species.

47. The term deliberate is defined as any action that is shown to be "by a person who knows, in the light of the relevant legislation that applies to the species involved, and the general information delivered to the public, that his action will most likely lead to an offence against a species, but intends this offence or, if not, consciously accepts the foreseeable results of his action".

48. In addition, Article 12(4) of the Habitats Directive is concerned with incidental capture and killing. It states that Member States "*shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned*".

3.4.2.2 *Conservation Objective 2: There is no significant disturbance of the species*

49. The disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise, including activities such as seismic surveys, pile driving and sonar.

50. Disturbance is considered to be significant if it leads to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. The current SNCBs guidance for the assessment of significant noise disturbance on harbour porpoise in the SNS SAC (JNCC *et al*., 2020) is that:

"*Noise disturbance within an SAC from a plan/project individually or in-combination is considered to be significant if it excludes harbour porpoise from more than:*

- *20% of the relevant area of the site in any given day, or*
- *An average of 10% of the relevant area of the site over a season*."

3.4.2.3 *Conservation Objective 3: The condition of supporting habitats and processes, and the availability of their prey is maintained.*

51. Supporting habitats, in this context, means the characteristics of the seabed and water column. Supporting processes encompass the movements and physical properties of the habitat. The maintenance of these supporting habitats and processes contributes to ensuring prey is maintained within the site and is available to harbour porpoise using the SAC. Harbour porpoise are strongly reliant on the availability of prey species year round due to their high energy demands, and their distribution and condition may strongly reflect the availability and energy density of prey.

52. This Conservation Objective is designed to ensure that harbour porpoise are able to access food resources year round, and that activities occurring in the SNS SAC will not affect this.

3.4.3 Shadow appropriate assessment

53. The North Falls array area is located within the SNS SAC and therefore there is potential for LSE on its designated feature, harbour porpoise, during construction, O&M or decommissioning of North Falls. This resulted in the SNS SAC being screened into the assessment through the Habitats Regulations Assessment Screening Report (Appendix 1.1, Document Reference: 7.1.1.1).

54. For the purposes of the assessments, the likely significant effects considered in relation to the SNS SAC Conservation Objectives are outlined in Table 3.7.

Table 3.7 Likely Significant Effects of North Falls in Relation to the Conservation Objectives of the SNS SAC for Harbour Porpoise

Conservation Objective for harbour porpoise	Likely Significant Effect
1. Harbour porpoise is a viable component of the site	Permanent auditory injury from underwater noise will be mitigated but in line with current advice this is screened in.
	Significant disturbance and displacement as a result of increased underwater noise levels.
	Potential increased collision risk with vessels.

Conservation Objective for harbour porpoise	Likely Significant Effect
2. There is no significant disturbance of the species	Significant disturbance and displacement as a result of increased underwater noise levels.
3. The condition of supporting habitats and processes, and the availability of prey is maintained	Changes in water quality and prey availability.

55. Assessment of the likely significant effects on the SNS SAC for harbour porpoise, is based on the current SNCB advice (JNCC *et al.,* 2020) that noise disturbance within an SAC from a plan/project, individually or in-combination, is considered to be significant if it excludes harbour porpoises from more than:
    - 20% of the relevant area of the site in any given day, or
    - an average of 10% of the relevant area of the site over a season.
56. The likely significant effect should be considered in the context of the seasonal components of the SAC area, rather than the SAC area as a whole.
57. The assessments are based on the current recommended EDRs for assessing the disturbance of harbour porpoise in the SAC from different noise generating activities (JNCC *et al*., 2020).

3.4.3.1 Effects during construction

58. The effects of North Falls that are assessed to determine any potential for an adverse effect on the integrity of the SNS SAC in relation to the Conservation Objectives for harbour porpoise during construction are:
    - Auditory injury and disturbance or behavioural impacts resulting from underwater noise during piling;
    - Disturbance impacts resulting from underwater noise during other construction activities, including seabed preparations, rock placement and cable installation;
    - Effects resulting from construction vessels:
        - Underwater noise and disturbance from construction vessels; and
        - Vessel interaction (collision risk);
    - Barrier effects as a result of underwater noise;
    - Changes to prey availability and supporting habitats; and
    - Changes to water quality.

3.4.3.1.1 Impact 1: Effects of underwater noise during piling

59. A range of foundation options are being considered for North Falls. Of these being considered, monopiles and jackets (pin piles) may require piling. As a worst-case scenario for underwater noise, it has been assumed that all foundations could be piled.
60. Impact piling is a source of high-level underwater noise. Underwater noise can cause both physiological (e.g. lethal, physical injury and auditory injury) and behavioural (e.g. disturbance and masking of communication) impacts on marine mammals.

Impact 1a: Permanent Auditory Injury (PTS)

61. Underwater noise modelling was carried out by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during noisy activities and determine the potential impacts on marine mammals using the INSPIRE v5.1 (Impulsive Noise Propagation and Impact Estimator) subsea noise propagation model (ES Appendix 12.3, Document Reference: 3.3.8).

62. The underwater noise modelling was based on the following worst-case scenarios for monopiles and pin piles;

    - Monopile with a maximum diameter of up to 17m, a maximum hammer energy of up to 6,000kJ, and a maximum starting hammer energy of 900kJ.
    - Pin pile with a maximum diameter of up to 6m, a maximum hammer energy of up to 4,400kJ, and a maximum starting hammer energy of 660kJ.

63. To determine the potential for permanent auditory injury (PTS) the soft-start, hammer energy profile, total active piling duration, and strike rate are taken into account. For monopiles, the soft-start takes place over the first 130 minutes of piling, which includes low-energy blows (at the starting hammer energy of 900kJ) for 10 minutes, followed by a gradual increase (ramp-up) to the maximum hammer energy required to safely install the pile over the next two hours. For pin piles, the soft-start takes place over the first 90 minutes of piling, which includes low-energy blows (at the starting hammer energy of 660kJ) for 10 minutes, followed by a gradual increase (ramp-up) to the maximum hammer energy required to safely install the pile over the next 80 minutes.

64. As a worst-case scenario, it is assumed that all piles installed will require 100% of the maximum hammer energy, however, maximum hammer energy is only likely to be required at a few of the piling installation locations, and for shorter periods of time.

65. The low-energy blows, ramp-up, and piling duration used to assess cumulative sound exposure level (SEL_{cum}) for both monopiles and pin piles are summarised in Table 3.8 and Table 3.9.

Table 3.8 Hammer energy, ramp-up and piling duration for monopiles

Hammer energy / piling parameters	900kJ	1,800kJ	2,700kJ	3,700kJ	4,800kJ	6,000kJ	Total for pile
Hammer energy profile for monopiles							
Number of hammer strikes	100	600	600	600	600	10,880	13,380 strikes, 7.5 hours per pile [Or 40,140 strikes over a total duration of 22.5 hours for three piles]
Duration of piling at each stage	10 minutes	30 minutes	30 minutes	30 minutes	30 minutes	320 minutes	
Strike rate	10 strikes / minute	20 strikes / minute				Approx. 34 strikes / minute	

Table 3.9 Hammer energy, ramp-up and piling duration for pin piles

Hammer energy / piling parameters	660kJ	1,320kJ	1,980kJ	2,640kJ	3,520kJ	4,400kJ	Total for pile
Hammer energy profile for pin piles							
Number of hammer strikes	100	400	400	400	400	6,120	7,820 strikes over a total duration of 4.5 hours [Or 46,920 strikes over a total duration of 27 hours for six pin piles in a 24 hour period]
Duration of piling at each stage	10 minutes	20 minutes	20 minutes	20 minutes	20 minutes	180 minutes	
Strike rate	10 strikes / minute	20 strikes / minute				Approx. 34 strikes / minute	

66. The assessments are based on the latest Southall *et al.,* (2019) thresholds and criteria for marine mammals. The thresholds indicate the onset of PTS, the point at which there is an increase in risk of permanent hearing damage in an underwater receptor (although not all individuals within the maximum PTS range will have permanent hearing damage, this is assumed as a worst-case scenario).

67. The maximum impact ranges (and areas) are used to inform the assessments. The assessment below shows the winter densities only for brevity; ES Volume 3.3 Appendix 12.4 (Document Reference: 3.3.9) includes the assessment using both the annual and the summer seasonal density for harbour porpoise.

PTS from a single strike

68. The underwater noise modelling results for the predicted impact ranges and areas for PTS from a single strike of the starting and maximum hammer energy for the worst case location are shown in Table 3.10.

Table 3.10 The predicted impact ranges for PTS, at the worst case modelling location for harbour porpoise, for the starting and maximum hammer energies of both monopiles and pin piles

Marine mammal species	Potential impact ranges (and areas) for PTS	
Starting hammer energy	Monopile (900kJ)	Jacket pin pile (660kJ)
	310m (0.29km^2)	240m (0.17km^2)
Maximum hammer energy	Monopile (6,000kJ)	Jacket pin pile (4,400kJ)
	680m (1.40km^2)	630m (1.2km^2)

69. The worst-case for a single hammer strike is for full hammer energy, and therefore this has been used to inform the following assessments. An assessment of the potential impact from a single strike at the starting hammer energy has been provided in Appendix 12.4 (Document Reference: 3.3.9).

70. An assessment of the maximum number of individuals that could be at risk of instantaneous PTS, due to a single strike at the maximum hammer energy, for both monopiles and jacket pin piles, is presented in Table 3.11.

Table 3.11 Assessment of the potential for instantaneous PTS due to a single strike of the maximum hammer energy for a monopile and jacket pin pile

Marine mammal species	Assessment of effect
PTS due to a single strike of a monopile at maximum hammer energy (Sound pressure level (SPL_{peak}))	
Harbour porpoise	5 harbour porpoise (0.001% of the NS MU reference population, based on the HiDef winter density estimate).
PTS due to a single strike of a jacket pin pile at maximum hammer energy (SPL_{peak})	
Harbour porpoise	4 harbour porpoise (0.001% of the NS MU reference population, based on the HiDef winter density estimate).

71. The maximum potential number of harbour porpoise that could be at possible risk of PTS due to a single strike at the maximum hammer energy, for monopiles, without any mitigation is 5 individuals (0.001% of the NS MU reference population). The maximum potential number of harbour porpoise that could be at possible risk of PTS from due to a single strike at the maximum hammer energy, for jacket pin piles, without any mitigation is 4 individuals (0.001% of the NS MU reference population).

PTS from cumulative exposure

72. The SEL_{cum} is a measure of the total received noise over the whole piling operation. The SEL_{cum} range indicates the distance from the piling location that if the receptor were to start fleeing in a straight line from the noise source starting at a range closer than the modelled range it would receive a noise exposure in excess of the criteria threshold, and if the receptor were to start fleeing from a range further than the modelled range it would receive a noise exposure below the criteria threshold.

73. Table 3.12 presents the underwater noise modelling results for the predicted impact ranges and areas for PTS due to the cumulative exposure of monopiles and jacket pin piles at the worst case location.

74. It is important to note that assessment for PTS from cumulative exposure is highly precautionary. There is a lot of variation in the potential impact ranges for SEL_{cum} at each location and between locations (ES Appendix 12.3, Document Reference: 3.3.8). For example, for harbour porpoise, the PTS impact range for three sequential monopile installations is 3.3km at the East location, and 2.2km at the West location, and therefore while the assessment is based on the worst-case ranges at the East location, many of the piling locations would have lower impact ranges. In addition, as noted above, the maximum hammer energy is only likely to be required at a few of the piling installation locations and for shorter periods of time.

Table 3.12 The predicted impact ranges for PTS for harbour porpoise, at the worst case modelling location, for the cumulative exposure of both monopiles and pin piles

Marine mammal species	Potential impact ranges (and areas) for PTS due to cumulative exposure	
	Monopile (6,000kJ)	Jacket pin pile (4,400kJ)
Single pile installation in a 24 hour period	**One monopile**	**One jacket pin pile**
Harbour porpoise	3.3km (22km^2)	3.3km (22km^2)

Marine mammal species	Potential impact ranges (and areas) for PTS due to cumulative exposure	
	Monopile (6,000kJ)	Jacket pin pile (4,400kJ)
Multiple sequential pile installations in a 24 hour period	**Three sequential monopiles**	**Six sequential jacket pin piles**
Harbour porpoise	3.3km (22km^2)	3.4km (23km^2)

75. Assessments for the modelling of a single pile in 24 hours are provided in Appendix 12.6 (Document Reference: 3.3.11), and the assessments for three sequential monopiles or six sequential pin piles in a 24 hour period are provided below, as the worst case. An assessment against all marine mammal densities is provided in Appendix 12.4 (Document Reference: 3.3.9), including the annual and summer seasonal density for harbour porpoise.

76. An assessment of the maximum number of harbour porpoise that could be at risk of cumulative PTS, for both sequential monopiles and jacket pin piles, is presented in Table 3.13, based on the effect areas as presented in Table 3.12.

77. In the worst case, 71 individuals (0.02% of the NS MU reference population) could be at risk of cumulative PTS due to the cumulative exposure of three sequential monopiles. Up to 74 individuals (0.02% of the NS MU reference population) could be at risk due to six sequential jacket pin piles in a 24 hour period.

Table 3.13 Assessment of the potential for PTS due to the cumulative exposure of sequential monopiles or jacket pin piles in a 24 hour period for harbour porpoise

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of three sequential monopiles in a 24 hour period (SEL_{cum})	71 harbour porpoise (0.02% of the NS MU reference population, based on the HiDef winter density estimate).
PTS due to the cumulative exposure of six sequential jacket pin piles in a 24 hour period (SEL_{cum})	74 harbour porpoise (0.02% of the NS MU reference population, based on the HiDef winter density estimate).

PTS from cumulative exposure from multiple piling locations

78. The simultaneous piling scenario assumes that animals are within potential impact ranges for a much longer period (i.e. they would be travelling from one pile location to another which piling is ongoing), and therefore cumulative impact ranges are much larger than for the cumulative exposure ranges of one pile at a time. See ES Appendix 12.3 (Document Reference: 3.3.8) and Appendix 12.4 (Document Reference: 3.3.9) for further information.

79. The potential impact ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect only.

80. Where the potential impact areas are not large enough to interact with each other (i.e. they do not meet), the results for the respective locations and scenarios are used (the results of the modelling for the South and East locations are used to

inform the assessment, to align with the modelling locations used for the simultaneous modelling).

81. Table 3.14 presents the underwater noise modelling results for the predicted impact ranges and areas for PTS due to the cumulative exposure of simultaneous monopiles and jacket pin piles at the East and South modelling locations. These locations were chosen as the have the potential for the largest 'spread' in terms of underwater noise propagation (as they are the two furthest apart locations). The modelling includes three monopiles being installed sequentially at each location at the same time, and six jacket pin piles being installed sequentially at each location at the same time.

82. For harbour porpoise, the cumulative PTS is significantly higher for simultaneous piling than it is for a single piling location at any one time.

Table 3.14 The predicted impact ranges for PTS for harbour porpoise at the North and South modelling locations, for the cumulative exposure of multiple monopiles and pin pile installations at the same time

Marine species	Potential impact areas for PTS due to cumulative exposure of simultaneous pile installations	
	Monopile (6,000kJ)	Jacket pin pile (4,400kJ)
Multiple sequential pile installations in a 24 hour period (for the East or South modelling locations)	Three sequential monopiles	Six sequential jacket pin piles
Harbour porpoise	East = 22km^2 South = 16km^2	East = 23km^2 South = 17km^2
Multiple simultaneous pile installations in a 24 hour period (at the East and South modelling locations simultaneously)	Multiple simultaneous monopiles (three sequential monopiles at each location, at the same time)	Multiple simultaneous jacket pin piles (six sequential jacket pin piles at each location, at the same time)
Harbour porpoise	210km^2	230km^2

83. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for simultaneous monopiles and jacket pin piles is presented in Table 3.15, based on the effect areas as presented in Table 3.14.

Table 3.15 Assessment of the potential for PTS due to the cumulative exposure of simultaneous monopiles or jacket pin piles at the same time

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of simultaneous monopile installations (SEL_{cum})	676 harbour porpoise (0.20% of the NS MU reference population, based on the HiDef winter density estimate).
PTS due to the cumulative exposure of simultaneous jacket pin pile installations (SEL_{cum})	740 harbour porpoise (0.22% of the NS MU reference population, based on the HiDef winter density estimate).

Summary for Impact 1a

84. The potential for PTS onset due to either a single strike (Table 3.11), from the cumulative exposure of sequential piling at one location (Table 3.13), or from the

cumulative exposure of sequential piling at multiple locations (Table 3.15), would impact less than 1% of the harbour porpoise NS MU population in all cases.

85. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise for PTS on harbour porpoise from pile installation.

Impact 1b: Disturbance effects due to piling

86. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al.,* 2007).

Assessment against the North Sea population

87. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of marine mammals, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.

88. The current advice from the SNCBs is that an EDR of 26km around piling locations for monopiles (without noise abatement), and 15km for pin piles (with and without noise abatement) is used to determine the area that harbour porpoise may be disturbed from in relevant SACs (JNCC *et al*., 2020). The North Falls array area is located wholly within the SNS SAC, and therefore this approach has been followed for this assessment. Not all harbour porpoise within these potential disturbance areas based on EDRs will be disturbed, however as a worst case scenario 100% disturbance of harbour porpoise in the areas has been assumed.

89. The estimated number of harbour porpoise and percentage of the North Sea MU reference population that could be disturbed as a result of underwater noise during piling at North Falls is presented in Table 3.16.

90. For a single piling event the worst case would be 2.02% of the NS MU reference population at risk of disturbance (Table 3.16). This would be from monopiles.

91. For two simultaneous piling events the worst case would be 4.03% of the NS MU reference population to be at risk of disturbance (Table 3.16). Again, this would be from monopiles. Note that this does not assume any overlap between disturbance areas from the piling events and is therefore precautionary.

Table 3.16 Assessment of the potential for disturbance to harbour porpoise based on the EDR approach for monopiles and jacket pin piles, and for both a single and two simultaneous piling events

EDR	Assessment of effect
For a single piling event	
26km for monopiles	6,832 harbour porpoise (2.02% of the NS MU reference population.
15km for jacket pin piles	2,274 harbour porpoise (0.7% of the NS MU reference population.

EDR	Assessment of effect
For two simultaneous piling events	
26km for monopiles, at two simultaneous locations	13,664 harbour porpoise (4.03% of the NS MU reference population.
15km for jacket pin piles, at two simultaneous locations	4,549 harbour porpoise (1.3% of the NS MU reference population.
26km for monopiles and 15km for jacket pin piles at two simultaneous locations	9,106 harbour porpoise (2.72% of the NS MU reference population).

92. In addition, not all individuals would be displaced over the entire potential disturbance range (26km) used within the assessments. For example, the study of harbour porpoise at Horns Rev (Brandt *et al*., 2011), indicated that at closer distances (2.5 to 4.8km) there was 100% avoidance, however, this proportion decreased significantly moving away from the pile driving activity and at distances of 10km to 18km avoidance was 32% to 49% and at 21km the abundance was reduced by just 2%.

Dose response curve assessment

93. Where sufficient scientific evidence exists, a species-specific dose-response assessment has been undertaken rather than the fixed behavioural EDR approach that is described above, as per current best practice guidance (Southall *et al*., 2021).

94. The application of a dose-response curve allows for an evidence-based estimate which accounts for the fact that the likelihood of an animal exhibiting a response to a stressor or stimulus will vary according to the dose of stressor or stimulus received (Dunlop *et al.,* 2017). Therefore, unlike the traditional threshold assessments commonly used, a dose-response analysis assumes that not all animals in an impacted area will respond (with behavioural disturbance response in this case). For the purposes of this assessment, the dose is the received single-strike SEL (SEL_{SS}). The use of SEL_{SS} in a dose-response analysis, where possible, is considered to be good practice in the latest guidance provided by Southall *et al.,* (2021).

95. To estimate the number of animals disturbed by piling, SEL_{SS} (sound exposure level single strike) contours at 5dB increments (generated by the noise modelling – see ES Appendix 12.3, Document Reference: 3.3.8) were overlain on the relevant species density surfaces to quantify the number of animals receiving each SEL_{SS}, and subsequently the number of animals likely to be disturbed based on the corresponding dose-response curve.

96. For harbour porpoise, the Waggitt *et al.,* (2019) density estimates were used. As August was the month with the greatest harbour porpoise densities within the offshore project area, density estimates from this month were used for the analysis as worst case.

97. The dose-response relationship used for harbour porpoise was developed by Graham *et al*., (2017) using data collected during Phase 1 of piling at the Beatrice OWF. Following the development of this dose-response relationship, further study revealed that the responses of harbour porpoises to piling noise diminishes

over the construction period (Graham *et al.*, 2019). Therefore, the use of the dose-response relationship related to an initial piling event for all piling events in this assessment can be considered conservative.

98. The estimated number of harbour porpoise and percentage of the North Sea MU reference population that could be disturbed as a result of underwater noise during piling at North Falls is presented in Table 3.17.

99. For a single piling event the worst case would be 0.32% of the NS MU reference population to be at risk of disturbance (Table 3.17), from monopiles.

Table 3.17 Number of harbour porpoise (and % of reference population) that could be disturbed during piling at North Falls based on the dose-response approach

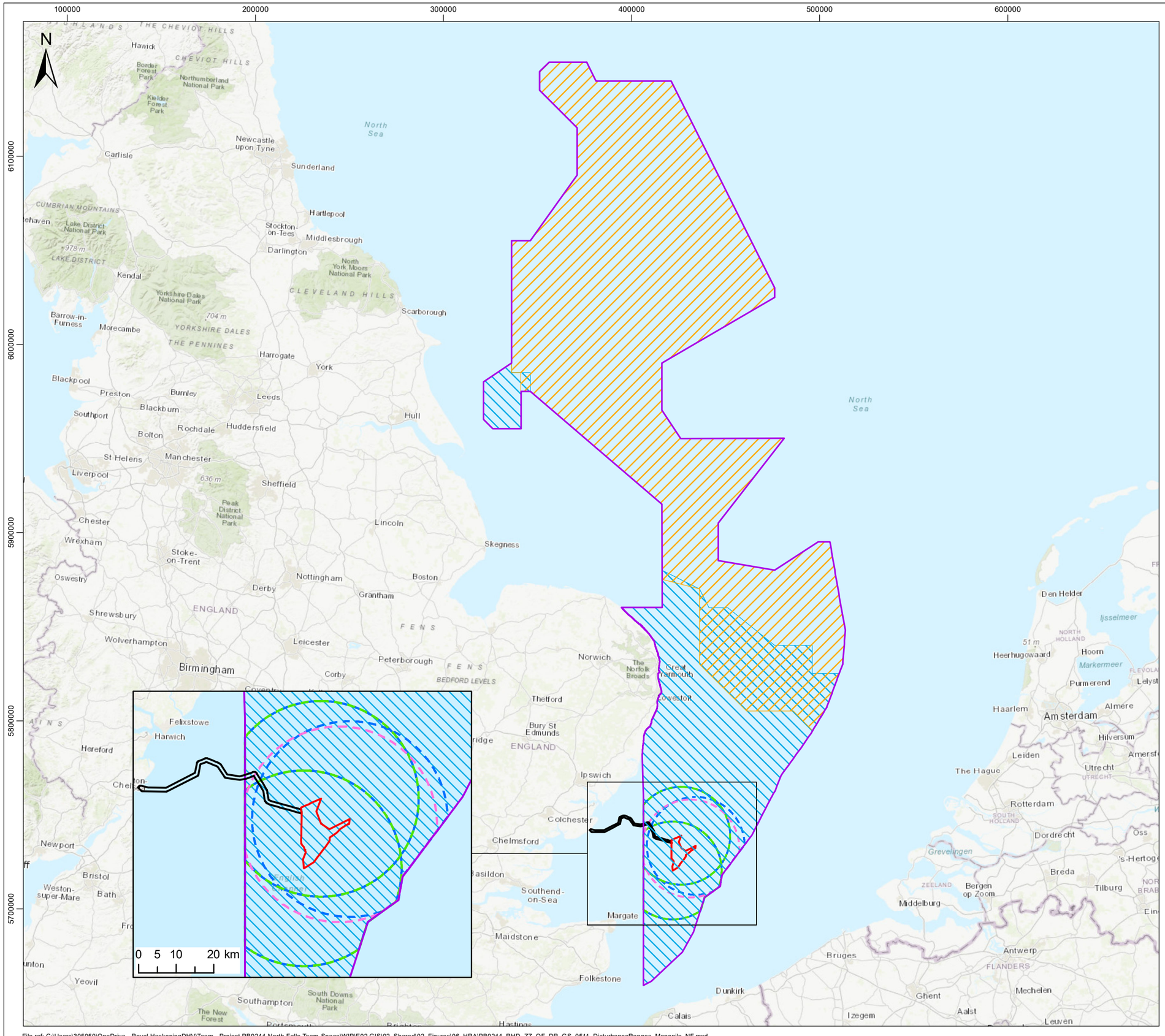
Piling scenario	Assessment of effect
Instantaneous behavioural disturbance due to a single, maximum energy monopile strike (SEL_{SS})	1,072 harbour porpoise (0.32% of the NS MU reference population)
Instantaneous behavioural disturbance due to a single, maximum energy pin pile strike (SEL_{SS})	1,023 harbour porpoise (0.30% of the NS MU reference population)

Spatial assessment

100. Figure 3.1 and Figure 3.2 show the potential SNS SAC overlaps for either a single monopile or pin pile in one day, or for two or three monopiles or two pin pile location in one day.

101. For pin pile foundations, either eight or twelve piles would be required for each foundation (for WTGs and OSP/OCPs respectively). This therefore means that multiple pin piles will be installed in effectively the same location for the same jacket foundation. Under the following assessments, one pin pile refers to one pin pile location (or one jacket location), which could include up to eight or twelve individual piles.

102. It should be noted that these assessments are based on the worst possible case piling locations, and do not take account of actual WTG locations, which may reduce the potential disturbance overlap areas. Therefore, this is considered to be a precautionary assessment, and the actual disturbance overlap areas would likely be less. The actual WTG locations would be used within the final SIP.



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Southern North Sea (SNS) Special Area of Conservation (SAC)

Harbour Porpoise Southern North Sea (SNS) SAC Seasonal Areas

- Summer
- Winter

Disturbance Ranges

- Maximum Area of Disturbance from One Monopile in Any One Day
- Maximum Area of Disturbance from Two Monopiles in Any One Day
- Maximum Area of Disturbance from Three Monopiles in Any One Day

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Overlap of Maximum Potential Disturbance Ranges for Monopiling at North Falls within the Southern North Sea SAC

Rev	Date	Remarks	Drwn	Chkd
01	28/02/2024	First issue	JH	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0511	3.1

Scale	Plot Size	Datum	Projection
1:2,000,000	A3	WGS84	UTM31N

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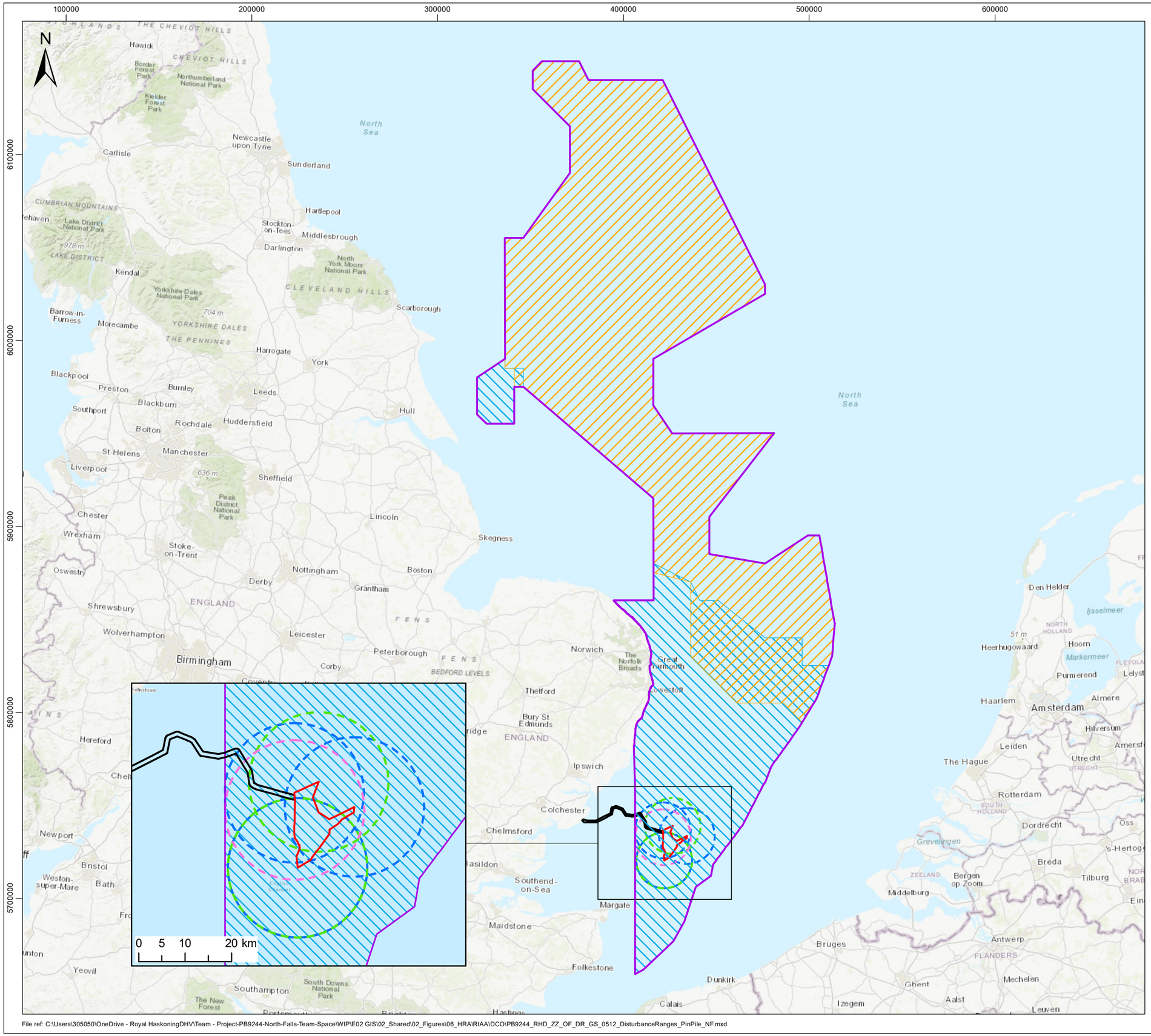
NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\PB9244_RHD_ZZ_OF_DR_GS_0511_DisturbanceRanges_Monopile_NF.mxd



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Southern North Sea (SNS) Special Area of Conservation (SAC)

Harbour Porpoise Southern North Sea (SNS) SAC Seasonal Areas

- Summer
- Winter

Disturbance Ranges

- Maximum Area of Disturbance from One Pin Pile in Any One Day
- Maximum Area of Disturbance from Two Pin Piles in Any One Day
- Maximum Area of Disturbance from Three Pin Piles in Any One Day

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Overlap of Maximum Potential Disturbance Ranges for Pin-Piling at North Falls within the Southern North Sea SAC

Rev	Date	Remarks	Drwn	Chkd
01	28/02/2024	First issue	JH	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0512	3.2

Scale	Plot Size	Datum	Projection
1:2,000,000	A3	WGS84	UTM31N

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NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0512_DisturbanceRanges_PinPile_NF.mxd

103. 3.18 provides the assessment against the spatial (20%) SNS SAC threshold for disturbance, for single and multiple location piling.

104. For a single piling event in any one day during the winter season, the spatial threshold (20%) would not be exceeded for either monopiles or jacket pin piles. For two or three piling locations in any one day, however, the threshold would be exceeded for either two or three monopile locations. Therefore, North Falls has committed to only piling one monopile per day during the winter season, unless NAS is used.

Table 3.18 Maximum potential overlap with SNS SAC summer and winter areas

EDR	Maximum area of overlap with SNS SAC summer area (% of SNS SAC summer area)	Maximum area of overlap with SNS SAC winter area (% of SNS SAC winter area)	Minimum area of overlap with SNS SAC winter area (% of SNS SAC winter area)	Potential adverse effect on site integrity
For a single piling location per day				
26km for monopiles	0km^2	2,055.5km^2 (16.19%)	1,789.2km^2 (14.09%)	No Temporary effect. Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling at North Falls based on a single pile per day.
15km for jacket pin piles	0km^2	706.9km^2 (5.57%)	706.6km^2 (5.57%)	
For two piling locations per day[4]				
26km for monopiles, at two locations in one day, with maximum potential separation	0km^2	2,688.6km^2 (21.18%)	1,833.2km^2 (14.44%)	Yes Temporary effect. Displacement of harbour porpoise would exceed 20% of the seasonal component of the SNS SAC area on any given day during piling at North Falls, based on two piling locations per day.
15km for pin piles, at two jacket locations in one day, with maximum potential separation	0km^2	1,236.5km^2 (9.74%)	740.3km^2 (5.83%)	No Temporary effect. Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling at North Falls based on two piling locations per day.
26km for a single monopile location and 15km for a single	0km^2	2,183.55km^2 (17.20%)	1,789.20km^2 (14.09%)	No Temporary effect.

[4]This assessment does take account of any potential overlap in disturbance areas

EDR	Maximum area of overlap with SNS SAC summer area (% of SNS SAC summer area)	Maximum area of overlap with SNS SAC winter area (% of SNS SAC winter area)	Minimum area of overlap with SNS SAC winter area (% of SNS SAC winter area)	Potential adverse effect on site integrity
jacket location in one day, with maximum potential separation[5].				Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling at North Falls based on two piling locations per day.
For three piling locations per day[4]				
26km for monopiles, at three locations in one day, with maximum potential separation	0km^2	2,886.4km^2 (22.73%)	1,876.5km^2 (14.78%)	Yes Temporary effect. Displacement of harbour porpoise would exceed 20% of the seasonal component of the SNS SAC area on any given day during piling at North Falls based on three piling locations per day.
15km for pin piles, at three jacket locations in one day, with maximum potential separation	0km^2	1,485.2km^2 (11.70%)	775.5km^2 (6.11%)	No Temporary effect. Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling at North Falls based on a single pile per day.

[5] This covers the potential for monopile installation for WTGs on the same day as OSP/OCP installation.

Seasonal average assessment

105. The foundation installation period (for both monopiles and jacket pin piles) is currently expected to take place over 12 months. This will include transit of the foundation components in batches to the array area and foundation installation, including any piling. As a worst-case, it has been assumed that there would be piling throughout the winter season (or 182 days), however, there may also be potential delays for weather or other technical issues.

106. The seasonal averages have been calculated by taking into account the average potential overlap with SNS SAC seasonal areas on any one day, and the estimated number of days within the season on which piling could occur. The seasonal averages have been based on the precautionary approach that all piling and related disturbance could occur in a single season, with the maximum potential activity being undertaken in the winter season.

107. As noted above, North Falls have made a commitment to only pile one monopile per day during the winter season, unless NAS is used. Therefore, the seasonal assessment is based on the following assumptions for each piling scenario (including one monopile per day, or one or more pin piles per day):

    - The number of monopile piling days would be at worst 59 if only one monopile location were to be piled on any one day (for 57 WTGs and two OSP/OCPs).
    - For a single jacket location, the number of pin pile piling days could be 182 days if one pile was installed per day (i.e. on all available winter days) [6], or 160 days if two piles were installed per day, or 80 days if three piles were installed per day (for 456 WTGs pin piles and 24 OSP/OCP pin piles).
    - For two jacket locations per day, the number of pin pile piling days could be 182 days if one pile was installed at each location per day (i.e. on all available winter days), or 80 days if two piles were installed at each location per day, or 40 days if three piles were installed at each location per day.
    - For three jacket locations per day, the number of pin pile piling days could be 160 days if one pile was installed at each location per day, or 54 days if two piles were installed at each location per day, or 27 days if three piles were installed at each location per day.
    - For one monopile and one jacket location per day, the number of piling days would be four for both locations, plus 53 days of a single monopile installation (to take account of 57 days of monopile installations at the same time as four days of OSP/OCP pin pile installations (with a total of 24 piles).

108. This assessment is considered to be precautionary at this stage of the Project. This assessment will be updated during the post-consent phase, through the SIP process, when there is further detail on the pile design and programme.

[6] As noted in paragraph 105, the total piling programme is expected to be 12 months, and therefore this is the estimated maximum number of days of piling within the winter season.

109. The assessment indicates less than 10% of the seasonal component of the SNS SAC over the duration of that season could be affected during piling at North Falls, based on any piling scenario (Table 3.19).

Table 3.19 Estimated seasonal average for SNS SAC winter area based on 26km EDR for North Falls

Piling options	Average area of overlap with SNS SAC winter area[7]	Number of disturbance days per season	Maximum seasonal average for SNS SAC winter area	Potential adverse effect on site integrity
For a single piling location per day				
26km for monopiles	1,922.4km^2	59 days	4.91%	No Temporary effect. Displacement of harbour porpoise would not exceed 10% of the seasonal component of the SNS SAC over the duration of that season during piling at North Falls, based on the worst-case scenario.
15km for a single jacket location	706.8km^2	182 days (for one pin pile installation per day)	5.57%	
		160 days (for three pin pile installations per day[8])	4.89%	
		80 days (for six pin pile installations per day)	2.45%	
For two piling locations per day				
15km for two jacket locations in one day	988.4km^2	182 days (for one pin pile installation per day)	7.79%	No Temporary effect. Displacement of harbour porpoise would not exceed 10% of the seasonal component of the SNS SAC over the duration of that season during piling at North Falls, based on the worst-case scenario.
		80 days (for three pin pile installations per day)	3.42%	
		40 days (for six pin pile installations per day)	1.71%	
26km for a single monopile location and 15km for a single jacket location in one day.	1,986.4km^2	Four days for both locations, plus 55 days of a single monopile installation	4.75%	
For three piling locations per day				
15km for pin piles	1,130.4km^2	160 days (for one pin pile installation per day)	7.83%	No Temporary effect.

[7] Taken from the maximum and minimum disturbance area overlaps provided in 3.18.
[8] Multiple pin pile locations per day undertaken at the same jacket foundation location is effectively the same piling location due to distance between legs.

Piling options	Average area of overlap with SNS SAC winter area[7]	Number of disturbance days per season	Maximum seasonal average for SNS SAC winter area	Potential adverse effect on site integrity
		54 days (for three pin pile installations per day)	2.64%	Displacement of harbour porpoise would not exceed 10% of the seasonal component of the SNS SAC over the duration of that season during piling at North Falls, based on the worst-case scenario.
		27 days (for six pin pile installations per day)	1.32%	

Summary for Impact 1b

110. Disturbance of harbour porpoise has the potential to exceed 20% of the spatial component of the SNS SAC winter area on any given day during piling at North Falls, based on the worst-case scenario of multiple monopile piling locations without NAS (Figure 3.2; 3.18). However, North Falls has committed to only piling one monopile (without NAS) per day during the winter season, to ensure the spatial (20%) SNS SAC threshold is not breached.

111. The assessment indicates less than 10% of the seasonal component of the SNS SAC over the duration of that season could be affected during piling at North Falls, based on the worst-case scenario (Table 3.19).

112. Mitigation and management measures are presented in the Outline SIP. NFOW will seek to agree these outline mitigation and management measures with Natural England and the MMO through the post-consent phase of the Project, once the final piling design and programme is available. The SIP ensures there is no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise due to disturbance from piling during construction.

113. Mitigation and management options included within the outline SIP, *inter alia,* are minimising piling in the winter months which would reduce disturbance within the winter area of the SAC, within which North Falls is located, and reducing noise levels at source. A revised assessment, taking account of finalised mitigation and management measures will be agreed as part of the SIP process post-consent.

Impact 1c: Disturbance effects due to ADD activation

114. The assessments of the potential disturbance during any ADD activation is indicative only, as the final requirements for mitigation in the MMMP will be determined prior to construction, in the post-consent phase.

115. Mitigation to reduce the risk of PTS could include activation of ADDs prior to the soft-start commencing. The period of time that an ADD is required to be activated for is dependent on the potential PTS ranges for each species, and their known swim speeds, as used within the underwater noise modelling.

116. Based on the swim speed of 1.5m/s for harbour porpoise (Otani *et al.,* 2000), and the maximum ranges of cumulative PTS onset for the installation of one pile (Table 3.12), the ADD would be required to be activated for a period of 37 minutes

prior to piling, for both monopiles and jacket pin piles. This would result in harbour porpoise fleeing to a range of 3.33km (further than the modelled cumulative PTS onset range of 3.3km for both monopiles and jacket pin piles). This is therefore the potential disturbance range (with an area of 34.84km^2) within which harbour porpoise may be disturbed. The assessment provided in Table 3.20 is based on the winter harbour porpoise density as a worst-case.

Table 3.20 Assessment of the potential for disturbance due to ADD activation for both monopile and jacket pin piles

Marine mammal species	Assessment of effect
Harbour porpoise	113 harbour porpoise (0.03% of the NS MU reference population), based on the HiDef winter density estimate).

117. The ADD activation would ensure marine mammals are beyond the maximum impact range for instantaneous PTS due to a single strike of the maximum hammer energy for both monopiles and jacket pin piles. ADD activation prior to the soft-start would also reduce the number of marine mammals at risk of PTS from cumulative exposure. This disturbance area would be within the disturbance area due to piling (as assessed above), and therefore would not be an additive effect to harbour porpoise.

118. The assessment for the potential for disturbance to harbour porpoise due to ADD activation shows that less than 1% of the NS MU population would be disturbed, and therefore shows that there is no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

3.4.3.1.2 Impact 2: Effects of underwater noise during other construction activities

119. Potential sources of underwater noise during construction activities, other than piling, include seabed preparation, dredging, rock placement, trenching and cable installation.

120. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd (ES Appendix 12.3, Document Reference: 3.3.8) to estimate the noise levels likely to arise during the other noisy activities and determine the likely significant effects on marine mammals. Key information on the methodology of underwater noise modelling, and the full results of the assessments for marine mammals, is provided in Appendix 12.4 (Document Reference: 3.3.9).

121. It should be noted that this is not an additive effect when considered with the potential for PTS or disturbance from piling, as the potential for PTS or disturbance from other construction activities have significantly lower effect areas when compared to piling, and therefore in the case of piling and other activities taking place at the same time, harbour porpoise effected from construction activities would be within the area for PTS or disturbance of piling itself.

Impact 2a: Permanent auditory injury (PTS) due to other construction activities

122. Table 3.21 presents the underwater noise modelling results for the predicted impact ranges and areas for PTS from the cumulative exposure of other construction activities. For SEL_{cum} calculations, the duration of the noise is also considered, with all sources operating for a worst case of 24-hours in a day.

123. The results of the underwater noise modelling does not define impact ranges of <100m, and therefore, where the impact ranges are less than that, the results show impact ranges of <100m (it is possible that the actual impact ranges are therefore considerably lower).

124. The results of the underwater noise modelling (Table 3.21) indicate that harbour porpoise would have to be <100m (precautionary maximum range) from the continuous noise source at the onset of the activity, to be exposed to noise levels that could induce PTS. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal.

125. There is the potential that more than one of these other construction activities could be underway within the array area, or within the offshore export cable, at the same time. As a worst case and unlikely scenario, an assessment for all four activities being undertaken simultaneously has also been undertaken.

Table 3.21 The predicted impact ranges for cumulative PTS for other construction activities in harbour porpoise

Other construction activity scenario	Potential impact ranges (and areas) for PTS Cable laying, suction dredging, cable trenching, and rock placement*
One other construction activity	<100m (0.031km^2)
All four construction activities taking place at the same time	0.126km^2

** effect areas are based on the area of a circle, with the impact range as the radius*

126. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in Table 3.22, based on the effect areas as presented in Table 3.21. An assessment against the harbour porpoise annual and summer density estimates is provided in Appendix 12.4 (Document Reference: 3.3.9).

Table 3.22 Assessment of the potential for PTS due to other construction activities, including cable laying, suction dredging, cable trenching, and rock placement, for one activity taking place at any one time

Other construction activity scenario	Assessment of effect
One construction activity	0.1 harbour porpoise (0.00003% of the NS MU reference population), based on the HiDef winter density estimate.
All four construction activities taking place at the same time	0.4 harbour porpoise (0.0001% of the NS MU reference population), based on the HiDef winter density estimate.

127. Given the small number of individuals affected (less than one individual, and less than 1% of the NS MU population), there would be no adverse effect of PTS in harbour porpoise from other construction activities either alone or taking place simultaneously on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

Impact 2b: Disturbance effects due to other construction activities

128. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

129. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance impact on marine mammals.

130. There is limited data on the potential for a behavioural response or disturbance from other construction activities (or other continuous noise sources).

131. Studies undertaken during the construction of two Scottish OWFs (Beatrice OWF and Moray East OWF) (Benhemma-Le Gall *et al*., 2021), found that the probability of harbour porpoise being present increased with distance from the vessels and construction activities, and decreased with increasing vessel presence and background noise. During the period of turbine installation at Beatrice OWF, a significant reduction in harbour porpoise presence was detected even while no piling was taking place. Various construction activities were undertaken during this turbine installation phase, including jacket installation, turbine and cable installations, with some activities occurring simultaneously, which led to high levels of vessel traffic within the OWF site.

132. A reduction in porpoise presence was detected at up to 12km from pile driving, and up to 4km from construction related vessels (Benhemma-Le Gall *et al*., 2021). With construction vessels at 2km from Cetacean Porpoise Detector (CPOD) locations, harbour porpoise activity decreased by up to 35.2%, with construction vessels at 3km from the CPODs, there was a decrease of up to 24%, and at 4km from construction vessels, there was an increase of 7.2%. Outside of the piling period, the study found that the presence of harbour porpoise decreased by 17% with SPLs of 57dB (above ambient noise). It was not possible to determine what activities were being undertaken by the construction vessels in order to determine what activity was causing this effect (Benhemma-Le Gall *et al.,* 2021).

133. While the study did not define which activities were taking place to cause the disturbance, it was while a number of construction vessels were on site (Benhemma-Le Gall *et al*., 2021). Therefore, this reported 4km reduction in harbour porpoise presence has been used as a potential disturbance range for other construction activities in this assessment.

134. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range (with an effect area of 50.3km^2) is presented in Table 3.23. As a worst case and unlikely scenario, an assessment for all four activities being undertaken simultaneously has also been undertaken. Based on a 4km potential disturbance range, and up to four other construction activities taking place at the same time, there is the potential for a simultaneous disturbance effect area of 201.06km^2. This is a precautionary approach as it is unlikely that all harbour

porpoise would react in the same manner and to the same distance in response to other construction activities taking place in the offshore project area.

135. If piling and other construction activities take place at the same time, the disturbance area for other construction activities would be within the disturbance area from piling (as assessed above), and therefore would not be an additive effect to harbour porpoise.

Table 3.23 Assessment of the potential for disturbance due to other construction activities, including cable laying, suction dredging, cable trenching, and rock placement

Other construction activity scenario	Assessment of effect
One construction activity	162 harbour porpoise (0.05% of the NS MU reference population), based on the HiDef winter density estimate.
All other construction activities taking place at the same time	647 harbour porpoise (0.19% of the NS MU reference population), based on the HiDef winter density estimate.

Spatial assessment

136. Disturbance of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC winter area on any given day during other construction activities for a single or for all other construction activities occurring at the same time at North Falls, based on the worst-case scenario (Table 3.24).

Table 3.24 Maximum potential overlap with SNS SAC Summer and Winter Areas based on the potential disturbance range of 4km for North Falls

Other construction activity scenario	**Maximum area of overlap with SNS SAC winter area (% of SNS SAC winter area)**	**Potential adverse effect on site integrity**
One construction activity	50.3km^2 (0.4%)	No Temporary effect. Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling at North Falls based on the worst-case scenario.
All other construction activities taking place at the same time	201.06km^2 (1.58%)	No Temporary effect. Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling at North Falls based on the worst-case scenario.

Seasonal average

137. The seasonal averages have been calculated by taking into account the maximum potential overlap with SNS SAC seasonal areas on any one day by the estimated maximum number of days within the season on which other

construction activities could occur. In this case, it is assumed that construction could occur throughout the whole winter season (182 days).

138. The assessment indicates less than 10% of the seasonal component of the SNS SAC over the duration of that season could be affected during other construction activities for a single or for all other construction activities occurring at the same time at North Falls, based on the worst-case scenario (Table 3.25).

Table 3.25 Estimated seasonal average for SNS SAC Winter Area based on disturbance range of 4km for North Falls

Other construction activity scenario	Number of disturbance days per season	Maximum seasonal average for SNS SAC winter area	Potential adverse effect on site integrity
One construction activity	182 days	0.4%	No Temporary effect. Displacement of harbour porpoise would not exceed 10% of the seasonal component of the SNS SAC over the duration of that season during piling at North Falls, based on the worst-case scenario.
All other construction activities taking place at the same time	182 days	1.58%	No Temporary effect. Displacement of harbour porpoise would not exceed 10% of the seasonal component of the SNS SAC over the duration of that season during piling at North Falls, based on the worst-case scenario.

Summary for Impact 2b

139. The potential for disturbance due to either a single construction activity or from multiple construction activities occurring at the same time (Table 3.23), would impact less than 1% of the harbour porpoise NS MU population in all cases.

140. Disturbance of harbour porpoise has no potential to exceed 20% of the seasonal component of the SNS SAC summer or winter area on any given day due to other construction activity at North Falls, based on the worst-case scenario (Table 3.24).

141. The assessment indicates less than 10% of the seasonal component of the SNS SAC over the duration of that season could be affected during other construction activity at North Falls, based on the worst-case scenario (Table 3.25).

142. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from disturbance on harbour porpoise from other construction activity.

3.4.3.1.3 Impact 3: Effects from underwater noise and disturbance associated with construction vessels

143. During the construction phase, there will be an increase in the number of vessels in the offshore project area; this is estimated to be up to a total of 35 vessels at

any one time (Table 3.2). The number, type and size of vessels will vary depending on the activities taking place at any one time.

144. With a peak of 35 vessels expected to be on site at any one time during the construction of North Falls, there will be approximately a 23% increase in the baseline daily vessel presence during the winter period, and approximately a 21% increase during the summer period.

145. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise due to vessel presence and determine the likely significant effects on marine mammals (ES Appendix 12.3, Document Reference: 3.3.8).

Impact 3a: Permanent auditory injury (PTS) due to construction vessels

146. Table 3.26 presents the underwater noise modelling results for the predicted impact ranges and areas for PTS from the cumulative exposure of vessels within the site. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.

147. As for other construction activities above, the results of the underwater noise modelling does not define impact ranges of <100m, and therefore, where the impact ranges are less than that, the results show impact ranges of <100m (it is possible that the actual impact ranges are therefore considerably lower).

148. The results of the underwater noise modelling (Table 3.26) indicate that any harbour porpoise would have to be <100m (precautionary maximum range) from the continuous noise source to be exposed to noise levels that could induce PTS. As a worst case and unlikely scenario, an assessment for all 35 vessels has also been undertaken.

149. It is highly unlikely that any individual would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.

Table 3.26 The predicted impact ranges for cumulative PTS for vessels in all marine mammal species

Vessel scenario	Potential impact ranges (and areas) for PTS Medium or large vessels*
One vessel	<100m (0.031km^2)
35 vessels	1.1km^2

150. An assessment of the maximum number of individuals that could be at risk of PTS, due to other vessel presence, is presented in Table 3.27, based on the effect areas as presented in Table 3.26.

Table 3.27 Assessment of the potential for PTS due to medium and large vessels

Vessel scenario	Assessment of effect
One vessel	0.1 harbour porpoise (0.00003% of the NS MU reference population), based on the HiDef winter density estimate.
35 vessels	4 harbour porpoise (0.001% of the NS MU reference population), based on the HiDef winter density estimate.

151. Given the small number of individuals affected (less than 1% of NS MU population; Table 3.27), there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from PTS in harbour porpoise from vessels.

Impact 3b: Disturbance effects due to construction vessels

152. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

153. There is the potential for sensitive species with high metabolic requirements, such as the harbour porpoise, to be more vulnerable to anthropogenic stressors such as vessel noise, forcing individuals to make trade-off decisions between using energy to leave the area or remaining in exposed areas (Benhemma-Le Gall *et al*., 2021). This additional energy use may have biological consequences in the short and long-term (Pirotta *et al*., 2014), and harbour porpoise have been shown to be displaced by vessel activity up to 7km away depending on vessel type (Wisniewska *et al.,* 2018). In a 2012 study, high-speed planing vessels (small boats, jet skis etc.) caused the most negative reactions in this species (Oakley *et al*., 2017).

154. During surveys, the average recorded number of vessels per day in the summer was 167 (predominantly cargo) and 151 vessels per day in winter in 2022; in winter in 2024 141 vessels were recorded per day (ES Volume 3.3, Appendix 15.1). During the construction phase there may be an increase in the number of vessels in the area, however, this is likely to be offset by construction vessels/activity displacing existing vessel traffic as commercial vessels tend to deviate to avoid construction/decommissioning areas. The number, type and size of vessels will vary depending on the activities taking place at any one time. Vessel movements to and from any port will be incorporated within existing vessel routes and therefore any increase in disturbance as a result of underwater noise from vessels during construction will be within the offshore project area only.

155. Brandt *et al.* (2018) found that at seven German OWFs, in the vicinity (up to 2km) of their construction sites, harbour porpoise detections declined several hours before the start of piling as a result of increased construction related activities and vessels. Similarly, studies in the Moray Firth during piling of the Beatrice OWF, indicate higher vessel activity within 1km was associated with an increased probability of response in harbour porpoise (Graham *et al.,* 2019).

156. Studies in the Moray Firth indicate that at a mean distance of 2km from construction vessels harbour porpoise occurrence decreased by up to 35.2% as

vessel intensity increased. Harbour porpoise responses decreased with increasing distance to construction related vessels, out to 4km where no response was observed (Benhemma-Le Gall *et al.,* 2021).

157. During the periods when piling is underway, vessel noise is unlikely to add an additional impact to those assessed for piling, as the vessels and vessel noise would be within the maximum impact areas assessed.

158. The distance at which animals may react to vessels is difficult to predict and behavioural responses can vary a great deal depending on location, type and size of vessel, vessel speed, noise levels and frequency, ambient noise levels and environmental conditions.

159. Modelling by Heinänen and Skov (2015) indicates that the number of ships represents a relatively important factor determining the density of harbour porpoise in the NS MU during both winter and summer, with markedly lower densities with increasing levels of traffic. A threshold level in terms of impact seems to be approximately 20,000 ships per year (approximately 80 vessels per day within a 5km^2 area).

160. Taking into account the maximum number of vessels that could be onsite during construction, the array area and the displacement of other vessels from the area, the number of vessels would not exceed the Heinänen and Skov (2015) threshold level of 80 vessels per day in a 5km^2 area for harbour porpoise. For example, 35 vessels within the offshore project area (223.4km^2) would equate to <0.16 vessels per km^2 (approximately 0.8 vessels per 5km^2). In addition, due to safety and logistical considerations during piling, it is likely that the number of vessels in a small area, for example, around a pile location during pile installation would be limited to a very low number of essential vessels only.

161. Whilst short to medium term behavioural responses have been recorded from vessel disturbance, there are no long-term or population level effects recorded to date. Therefore, it is considered that there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from disturbance from underwater noise associated with vessels.

162. No mitigation is required for underwater noise impacts due to the presence of vessels, however, vessel good practice measures would reduce the potential for effect. The measures include ensuring that vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any impacts, including increased disturbance in accordance with the VMP provided in the Outline PEMP (document reference 7.6).

3.4.3.1.4 Impact 4: Barrier effects from underwater noise during construction

163. Underwater noise during construction could have the potential to create a barrier effect, preventing movement or migration of harbour porpoise between important feeding and / or breeding areas, or potentially increasing swimming distances if individuals avoid the site and go around it. However, there are no known migration routes nearby.

164. The greatest potential barrier effect for marine mammals could be from underwater noise during piling. However, piling would not be constant during the piling phases and construction periods, as there will be gaps between the

installations of individual piles, and if installed in groups there could be time periods when piling is not taking place as piles are brought out to the site. There will also be potential delays for weather or other technical issues.

165. The maximum duration of any barrier effects would be for the maximum piling duration, based on worst case scenarios, including soft-start, ramp-up and ADD activation;

- Piling of up to 59 monopiles (including soft-start, ramp-up and 37 minute ADD activation) = up to 479 hours (up to 20 days); or
- Piling of up to 480 jacket pin piles (including soft-start, ramp-up and 37 minute ADD activation) = up to 2,456 hours (up to 102.4 days).

166. There is unlikely to be the potential for any barrier effects from underwater noise for other construction activities and vessels, as it is predicted that harbour porpoise will return once the activity has been completed, and therefore any effects from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of marine mammals.

167. There is unlikely to be any significant long-term impacts from any barrier effects, as any areas affected would be relatively small in comparison to the range of harbour porpoise and would not be continuous throughout the offshore construction period.

168. Any potential barrier effects as a result of underwater noise during construction have been assessed as having no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

3.4.3.1.5 Impact 5: Increased risk of collision with vessels during construction

169. Marine mammals are able to detect and avoid vessels. However, vessel strikes are known to occur, possibly due to distraction whilst foraging and socially interacting, or due to the marine mammals' inquisitive nature (Wilson *et al*., 2007). Therefore, increased vessel movements, especially those outside recognised vessel routes, can pose an increased risk of vessel collision to marine mammals.

170. Studies have shown that larger vessels are more likely to cause the most severe or lethal injuries, with vessels over 80m in length causing the most damage to marine mammals (Laist *et al*., 2001). Vessels travelling at high speeds are considered to be more likely to collide with marine mammals, and those travelling at speeds below 10 knots would rarely cause any serious injury (Laist *et al.,* 2001).

171. Harbour porpoises are small and highly mobile, and given their responses to vessel noise (e.g. Thomsen *et al.,* 2006; Polacheck and Thorpe, 1990), are expected to largely avoid vessel collisions. The Heinänen and Skov (2015) report indicates a negative relationship between the number of ships and the distribution of harbour porpoise in the North Sea, suggesting that the species could exhibit avoidance behaviour which reduces the risk of strikes.

172. Predictability of vessel movement by marine mammals is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek *et al*., 2001, Lusseau, 2003, 2006).

173. Collision risk is assessed in Chapter 12 of the ES (Section 12.65.1.5, Document Reference: 3.1.14) and the methodology has been applied to this assessment. To inform this assessment, the total number of harbour porpoise in UK waters has been compared against the total vessels present in UK waters, as well as the potential collision risk rate of each species based on Scottish Marine Animal Stranding Scheme (SMASS) and Cetacean Strandings Investigation Programme (CSIP) data. The total UK harbour porpoise population is taken from IAMMWG (2023). The total presence of vessels in UK waters is taken from the total vessel transits within the 2015 Automatic Information System (AIS) data, which is the latest publicly available.

174. To estimate the potential collision risk of vessels associated with North Falls during construction, the potential risk rate per vessel has been calculated, which is then used to calculate the total risk to the harbour porpoise population due to the presence of an additional 35 vessels at any one time during construction. The baseline conditions indicate an already relatively high level of shipping activity in and around the array area, with an average of 151 vessels per day in winter, and 167 in summer.

175. Between 2003 and 2020, SMASS and CSIP identified the cause of death for 1,165 of the 4,796 reported harbour porpoise strandings. Of these, 49 (4.2%) died from physical trauma of an unknown cause, and 19 (1.6%) died as a result of physical trauma following probable impact from a ship or boat (see Table 12-12-60 of Chapter 12 of the ES (Document Reference: 3.1.14)). This results in a collision risk rate of 0.058 (or the proportion of the total harbour porpoise population at risk of collision with vessels).

176. Based on the collision risk rate, it is estimated that up to 7 harbour porpoise (0.002% of the reference population) could be at risk of collision for each year of construction (see Table 12-12-62 of Chapter 12 of the ES, Document Reference: 3.1.14). This is a highly precautionary assumption, as it is unlikely that all harbour porpoise in the offshore project area would be at increased collision risk with vessels during construction, considering the low number of vessel movements compared to the existing number of vessel movements in the area, and that vessels within the offshore project area would be stationary for much of the time or very slow moving.

177. As less than 1% of the NS MU population would be at risk of collision, any increase in vessel collision risk during construction has been assessed as having no adverse effect on the integrity of the SNS SAC. In addition, vessel good practice measures would be in place.

178. Vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. Vessel operators will use good practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever practicable, as described in the VMP.

3.4.3.1.6 Impact 6: Effects of changes to prey availability and habitat quality

179. The effects on prey species during construction can result from physical disturbance and loss of seabed habitat; increased SSC and sediment re-deposition; and underwater noise. ES Chapter 11 Fish and Shellfish Ecology

(Document Reference: 3.1.13) provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms.

180. For harbour porpoise, the relevant prey species are schooling fish, such as herring, whiting and sprat. Harbour porpoise are highly influenced by the spatiotemporal distribution and availability of their prey (Santos & Pierce 2003, Santos *et al.,* 2004, Sveegaard *et al.,* 2012), as their small body size and lack of energy storage requires them to feed constantly and they must therefore be near abundant food sources (Read & Hohn 1995, Johnston *et al.,* 2005, Wisniewska *et al.,* 2016). However, it has been estimated that, depending on the conditions, harbour porpoise can rely on stored energy (primarily blubber) for three to five days, depending on body condition (Kastelein *et al.,* 1997).

181. During construction activities, the worst-case footprint for disturbance would be 5.5km^2. Predominantly medium and coarse-grained sediment type were found at North Falls (see Chapter 8 Marine Geology, Oceanography and Physical Processes, Document Reference: 3.1.10), typically remaining close to the seabed and settling quickly once disturbed. The worst-case level of sediment smothering and deposition would be approximately <1mm, short-lived (minutes) and localised. Increases in suspended sediment are therefore expected to cause localised and short-term increases in SSC only and not significantly affect fish species.

182. The data and analysis in ES Chapter 9 Marine Water and Sediment Quality (Document Reference: 3.1.11) indicates that levels of contaminants within the North Falls offshore site are low and do not contain elevated levels to cause concern.

183. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13), provides an assessment of the potential underwater noise impacts on fish and shellfish species and predicts that impacts would be of a temporary nature (see Chapter 11 (Document Reference: 3.1.13) for a detailed assessment of underwater noise impacts on fish species). Potential sources of underwater noise and vibration during construction include piling, increased vessel traffic, seabed preparation, rock placement and cable installation. Of these, piling is considered to produce the highest levels of underwater noise and therefore has the greatest potential to result in adverse impacts on fish.

184. Piling could have mortality/injury effects, but under a realistic fleeing animal assumption, ranges at which mortality/potential mortal injury and recoverable injury could occur would be reduced to less than 100m (see ES Chapter 11 (Document Reference: 3.1.13) Table 11.21 to 11.34). Therefore, any effect on prey populations would be highly localised.

185. The outputs of the underwater noise modelling for the spatial worst-case scenario indicate that TTS may occur at distances up to 15km and 16km assuming a fleeing animal (single pin pile and sequential pin pile installation), increasing to up to 33km and 42km when considering a stationary receptor (single monopile and sequential monopiles installation). Behavioural responses would be expected within these ranges and potentially in wider areas depending on the hearing ability of the species under consideration (see ES Chapter 11 (Document Reference: 3.1.13) Table 11.21 to 11.34). However, the potential for behavioural

response does not indicate that prey would actually leave the area (and in many cases this would not be possible within the duration of a piling event).

186. It is unlikely that there would be significant changes to prey over the entire area. It is more likely that effects would be restricted to an area around the working sites. There is unlikely to be any additional displacement of harbour porpoise as a result of any changes in prey availability during piling as harbour porpoise would also be disturbed from the area.

187. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13) provides an assessment of the potential changes of fishing activity by the presence of safety zones associated with the project during construction. The predicted impact would be of negligible impact given the short-term and temporary nature of the construction phase.

188. The footprint of the project is relatively small with regard to the entire area of the SNS SAC and so the effects of changes to prey, possibly arising during construction activities, would have no adverse effects on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise for North Falls.

3.4.3.1.7 Impact 7: Effects of changes to water quality

189. Potential changes in water quality during construction could occur through:

- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, array, and interconnector cables;
- Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and OSP/OCP;
- Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
- Deterioration in water quality associated with release of sediment bound contaminants.

190. North Falls are committed to the use of good practice techniques and due diligence regarding the potential for pollution throughout all construction activities. An outline PEMP has been submitted alongside the DCO application to outline these good practice measures. The final PEMP would be agreed with the MMO prior to construction and would include, for example, measures to control accidental release of drilling fluids whilst ensuring that any chemicals used are listed on the OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR) (OSPAR, 2021).

191. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly (Todd *et al*., 2014).

192. Increased turbidity is unlikely to have a direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely.

193. Therefore there would be no adverse effects on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise for North Falls from potential changes in water quality during construction.

3.4.3.2 Effects during O&M

194. The effects of North Falls that are assessed to determine any potential for an adverse effect on the integrity of the SNS SAC in relation to the Conservation Objectives for harbour porpoise during O&M are:

- Auditory injury and disturbance or behavioural impacts resulting from operational WTGs;
  - Permanent auditory injury (PTS).
  - Disturbance.
- Auditory injury and disturbance or behavioural impacts resulting from underwater noise during maintenance activities, including cable protection and cable reburial;
  - Permanent auditory injury (PTS).
  - Disturbance.
- Impacts resulting from the deployment of O&M vessels:
  - Underwater noise and disturbance from O&M vessels;
    - Permanent auditory injury (PTS).
    - Disturbance.
- Vessel interaction (collision risk).
- Barrier effects as a result of underwater noise;
- Changes to prey resource and habitat quality; and
- Changes to water quality.

3.4.3.2.1 Impact 1: Impacts from underwater noise associated with operational WTGs

195. The operational WTGs will work nearly continuously, except for occasional shutdowns for maintenance or severe weather. The North Falls indicative design life is 30 years. Therefore, there is concern that underwater noise from operational WTGs could contribute a consistent, long duration of sound to the marine environment. However, the underwater noise levels emitted during the operation of the turbines are low and not expected to cause physiological injury to marine mammals, but could cause behavioural reactions if the animals are in the immediate vicinity of the WTG (Tougaard *et al.,* 2009a; Sigray and Andersson, 2011).

196. There is the potential for proposed larger WTGs to have greater noise levels compared to smaller WTGs currently in operation (Stöber and Thomsen, 2021). However, the shift from using gear boxes to direct drive technology is expected to reduce the sound level by 10dB (Stöber and Thomsen, 2021).

197. As outlined in ES Appendix 12.3 (Document Reference: 3.3.8), noise measurements made at operational wind farms have demonstrated that the

operational noise produced was at such a low level that it was difficult to measure relative to background noise at distances of a few hundred metres.

198. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during the operational phase and determine the likely significant effects on marine mammals (ES Appendix 12.3, Document Reference: 3.3.8).

Impact 1a: Permanent auditory injury (PTS) due to operational wind turbine noise

199. The full underwater noise modelling results are provided in Appendix 12.4 (Document Reference: 3.3.9) for the potential for PTS from the cumulative exposure of operational WTGs. For SEL_{cum} calculations, the duration of the noise is also considered, with operating WTGs for a worst case of 24-hours in a day. For harbour porpoise, the potential PTS onset range due to operational WTG noise is predicted to be <100m.

200. The reported PTS onset range of less than 100m is likely an overestimation, as the underwater noise modelling does not define impact ranges of <100m. The TTS modelling results also show an effect range of <100m, indicating that the actual potential PTS ranges would be much lower than the reported 100m. Therefore, the potential for any PTS effect is expected to be present in localised areas only, and is not expected to cause a significant risk of PTS onset in the harbour porpoise population.

201. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from PTS in harbour porpoise from operational WTG noise.

Impact 1b: Disturbance effects due to operational wind turbine noise

202. Currently available data indicates that there is no lasting disturbance or exclusion of harbour porpoise around OWF sites during operation (Diederichs *et al*., 2008; Marine Scotland, 2012; Russell *et al.,* 2014; Scheidat *et al*., 2011; Tougaard *et al*., 2005, 2009a, 2009b). Data collected suggests that any behavioural responses for harbour porpoise may only occur up to a few hundred metres away (Tougaard *et al*., 2009b; McConnell *et al*., 2012).

203. Monitoring was carried out at the Horns Rev and Nysted OWFs in Denmark during their operation between 1999 and 2006 (Diederichs *et al*., 2008). Numbers of harbour porpoise within Horns Rev were slightly reduced compared to the wider area during the first two years of operation, however, it was not possible to conclude that the OWF was solely responsible for this change in abundance without analysing other dynamic environmental variables (Tougaard *et al*., 2009a). Later studies by Diederichs *et al*., (2008) recorded no noticeable effect on the abundances of harbour porpoise at varying wind velocities at both of the OWFs studied, following two years of operation.

204. Harbour porpoise have been shown to forage within operational OWFs (e.g. Lindeboom *et al*., 2011; Russell *et al*., 2014), indicating no restriction to movements in operational OWF sites.

205. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from the potential disturbance due to operational WTGs.

3.4.3.2.2 Impact 2: Impacts from underwater noise associated with O&M activities

206. The requirements for any potential O&M work, such as additional rock placement or cable re-burial, are currently unknown, however the work required, and associated effects to marine mammals would be less than those during construction.

207. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities at the onset of the activity. Therefore, it is highly unlikely for there to be any PTS due to these activities.

208. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. As there is expected to be less noisy activities during the operation phase than is required during construction, it is therefore likely to cause less disturbance to foraging behaviours in harbour porpoise.

209. Therefore, the potential for adverse effect due to underwater noise from O&M activities is considered to be the same or less than that assessed for underwater noise from other construction activities (including rock placement, trenching and cable laying) (as assessed in Section 3.4.3.1.2).

210. Therefore there is no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from permanent changes in hearing sensitivity (PTS) due to operational activities.

3.4.3.2.3 Impact 3: Impacts from underwater noise and disturbance associated with O&M vessels

Impact 3a: Auditory injury due to O&M vessels

211. During the O&M of North Falls, there could be up to 1,222 vessel round-trips per year (approximately 3.3 trips per day), representing an increase of up to 4% compared to average daily vessels in summer, and up to 4.4% compared to the daily vessels in winter.

212. During operation, there may be up to 22 vessels in the North Falls project area at any one time. As outlined in Section 3.4.3.1.3, there is the potential for PTS onset within 100m of each vessel, although this is likely an overestimation. As a worst case and unlikely scenario, an assessment for all 22 vessels has been undertaken (Table 3.28).

Table 3.28 Assessment of the potential for PTS due to medium and large vessels during O&M

Potential effect	Assessment of effect
22 vessels (total potential area of effect of 0.7km^2)	3 harbour porpoise (0.0007% of the NS MU reference population), based on the HiDef winter density estimate.

213. Given the small number of individuals affected (less than 1% of NS MU population; Table 3.28), there would be no adverse effect on the integrity of the

SNS SAC in relation to the conservation objectives for harbour porpoise from PTS due to vessel presence.

Impact 3b: Disturbance due to O&M vessels

214. The requirements for any potential maintenance work are currently unknown, however the work required, and impacts associated with underwater noise and disturbance from vessels during O&M would be less than those during construction.

215. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be 22, which is less than the 35 vessels that could be on site during construction. However, as a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.

216. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.

217. There would therefore be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from disturbance due to O&M vessels.

3.4.3.2.4 Impact 4: Barrier effects from underwater noise during O&M

218. The minimum separation distance between turbines would be 0.944km to 1.348km in the cross wind direction and 1.18km to 1.685km in the downwind direction, therefore there would be no overlap in the potential impact range (PTS) of <100m around each turbine, and there would be adequate room for marine mammals to move through the array area.

219. Harbour porpoise are known to be present and forage within operational wind farm areas (Section 3.4.3.2.1), and therefore it is unlikely that the presence of North Falls infrastructure would form a barrier to any movement of marine mammal species.

220. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from barrier effects from O&M underwater noise.

3.4.3.2.5 Impact 5: Increased risk of collision with vessels during operation

221. As noted in Section 3.4.3.2.3, it is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be up to 22, with the potential for up to 1,222 vessel two way round (or 2,444 one way transit) trips per year.

222. The number of harbour porpoise at risk of collision, per vessel, in UK waters, has been calculated as described for the construction phase, and has been used to calculate the number of individuals at risk of collision from the total number of vessel movements per year that are currently expected during the O&M phase. Vessel movements, where possible, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk.

223. It is estimated that up to six harbour porpoise (0.002% of the reference population) could be at risk of collision (see Table 12.80 of the ES). This is a highly precautionary assumption, as it is unlikely that harbour porpoise in the offshore project area would be at increased collision risk with vessels during the O&M phase, considering the minimal number of vessel movements compared to the existing number of vessel movements in the area, and that vessels within the offshore project area would be stationary for much of the time or very slow moving.

224. Less than 1% of the NS MU population would be at risk of collision, therefore, any increase in vessel collision risk during operation has been assessed as having no adverse effect on the integrity of the SNS SAC. This is in relation to the conservation objectives for harbour porpoise.

225. In addition, vessel operators will use good practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever practicable, in accordance with the VMP provided in the Outline PEMP (Document Reference: 7.6).

3.4.3.2.6 Impact 6: Effects of changes to prey availability and habitat quality

226. The potential impacts on fish species during O&M can result from temporary habitat loss / disturbance; permanent habitat loss; introduction of wind turbine foundations; scour protection and hard substrate; increased suspended sediments and sediment re-deposition; re-mobilisation of contaminated sediments; underwater noise; and EMF.

227. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13) provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any impacts on prey species have the potential to affect marine mammals. A summary of the key effects to prey species (and their relevance for harbour porpoise) is provided below.

228. Habitat loss will occur during the lifetime of North Falls as a result of structures, scour and external cable protection installed on the seabed. The introduction of hard substrate, such as wind turbine towers, foundations and associated scour protection and cable protection would increase habitat heterogeneity through the introduction of hard structures in an area predominantly characterised by sediment habitats. During operation of North Falls, the estimated total permanent habitat loss would be up to 5.37km^2 for the array area and 0.08km^2 for the offshore cable corridor (or a total of 5.5km^2). In ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13) this is considered minor to negligible, depending on the species in the context of the amount of similar available habitat in the wider area.

229. Increases in SSC within the water column and subsequent deposition onto the seabed may occur as a result of O&M activities. Disturbance caused by jack up vessel legs or anchors, as well as cable reburial and/or repair may result in small volumes of sediment being re-suspended. However, the volumes of sediment disturbed from such activities, as well as the overall duration of the disturbance, would be significantly less compared to construction.

230. The electromagnetic attributes of EMFs have the potential to disrupt organs used for navigation and foraging within a number of fish species. EMFs can have

attractive and repulsive effects, that can cause barrier effects dependent on the species and the spatial scale of EMF, for further information, see Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13). The cables will be buried, either within the seabed or under rock protection, resulting in a negligible impact zone for fish and shellfish.

231. The introduction of various man-made structures such as foundations and scour protection in soft sediment areas increases and changes habitat availability and type, resulting in locally altered biodiversity as species are able to establish and thrive in previously hostile environments (Wilhelmsson *et al.*, 2006; Birchenough and Degraer, 2020). Physical structures provide a foundation for settling invertebrates, which increase the organic matter surrounding the structure, and underpin artificial reef ecosystems through 'bottom-up' control of productivity. Increasing nutrient availability and biomass presents opportunities for all fish and shellfish species, from top predators to detritivores (Raoux *et al.*, 2017).

232. The benefit of this potential increase in prey availability to marine mammals has not yet been studied widely. However, the presence of an artificial reef does increase the abundance and biomass of species, and the increase in prey species availability increases the attractiveness of the area to predators (Devault *et al*., 2017; Paxton *et al.*, 2022). Increasing habitat heterogeneity may benefit harbour porpoise, that have shown to prefer variations in seabed topography (Isojunno *et al*., 2012, Brookes *et al.,* 2013, Stalder *et al*., 2020)

233. The introduction of new hard substrate in areas that are predominantly sandy or soft sediments may cause positive effects through potential habitat enhancement (Roach and Cohen, 2020).

234. The effects arising during the operational phase of North Falls are likely to be the same or less than those assessed for construction. The effects of changes to prey during operation would have no adverse effects on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise for North Falls.

3.4.3.2.7 Impact 7: Effects of changes to water quality

235. Potential changes in water quality during O&M could occur through:

- Deterioration in water quality due to increases in suspended sediment associated with cable repairs / reburial; and
- Deterioration in water quality associated with release of sediment bound contaminants during maintenance activities.

236. Any risk of accidental release of contaminants will be mitigated in line with the PEMP and any changes to water quality as a result of any accidental release of contaminants leading to potential changes in water quality at North Falls during O&M would be negligible.

237. As previously outlined, changes in water quality are considered to have negligible effect on marine mammals. Any effects on harbour porpoise would be less than those for construction (see Section 3.4.3.1.7) as activities during O&M which disturb the seabed would be less frequent and more localised than during construction.

238. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of any changes to water quality during O&M for North Falls.

3.4.3.3 Effects during decommissioning

239. Decommissioning would most likely involve the removal of the accessible installed components comprising all of the wind turbine components; part of the foundations (those above seabed level); and the sections of the infield cables close to the offshore structures, as well as sections of the offshore export cables. The process for removal of foundations is generally the reverse of the installation process. There would be no piling, and foundations may be cut to an appropriate level.

240. A decommissioning program will be provided to the Secretary of State (SoS) in accordance with section 105 of the Energy Act 2004 and further assessments would be carried out ahead of any decommissioning works to be undertaken, taking account of the techniques to be employed, any relevant mitigation measures required, and known information at that time, including relevant guidelines and requirements.

241. Effects during decommissioning would most likely include:

- Underwater noise and disturbance from decommissioning activities;
- Underwater noise and disturbance from vessels;
- Barrier effects as a result of underwater noise;
- Increased collision risk with vessels;
- Changes to prey resource; and
- Changes to water quality.

242. It is not possible to provide details of the methods that will be used during decommissioning at this time. However, it is expected that the activity levels will be comparable to construction (with the exception of pile driving noise which would not occur).

243. Therefore, the effects on harbour porpoise during decommissioning are assumed to be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling and therefore there would be no adverse effect on the integrity of the SNS SAC.

3.4.3.4 In-combination effects

244. The following in-combination assessment has been undertaken based on ES Volume 3.3 Appendix 12.6 (Document Reference: 3.3.11), and Section 12.8 of ES Chapter 12 (Document Reference: 3.1.14).

245. The in-combination effects assessed are;

- Disturbance from underwater noise due to the following sources;
  - Piling at other OWFs;
  - Construction activities at other OWFs;

- Vessels associated with OWFs;
- Geophysical surveys (such as those undertaken for OWFs);
- Aggregate extraction and dredging;
- Oil and gas installation projects;
- Oil and gas seismic surveys;
- Subsea cable and pipelines; and
- UXO clearance.

- Barrier effects of other OWFs;
- Increased collision risk with vessels; and
- Changes in prey resource.

3.4.3.4.1 In-combination impact 1: Disturbance from underwater noise

In-combination impact 1a: Assessment of underwater noise from piling at other OWFs

246. A list of UK and European OWF projects that may have the potential for overlapping piling with North Falls is provided in ES Chapter 12 (Document Reference: 3.1.14) (Table 12.90), and has been used to inform the assessment for in-combination effects due to piling at other OWFs.

247. Of the 30 UK and European OWFs screened in for having a construction period that could potentially overlap with the construction of the Project, six UK OWFs could be piling at the same time, which is currently estimated to take place in 2030/31 and are relevant for harbour porpoise for North Falls;

- Berwick Bank (formally Seagreen Charlie Delta Echo);
- Dogger Bank South (East and West) (DBS);
- Dudgeon Extension Project (DEP);
- Five Estuaries;
- Outer Dowsing; and
- Sheringham Shoal Extension Project (SEP).

248. Of these, Dogger Bank South, Dudgeon Extension Project, Five Estuaries, Outer Dowsing and Sheringham Shoal Extension Project are within 26km of the SNS SAC, and Five Estuaries, Dudgeon Extension Project and Sheringham Shoal Extension Project are within (or within 26km of) the winter area.

249. This more realistic short list of OWF projects that could be piling at the same time as North Falls could change as projects develop, but this is the best available information at the time of writing, and more accurately reflects the limitations and constraints to project delivery.

250. The commitment to the mitigation agreed through the MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) for all marine mammals, and therefore this assessment focuses on the potential for disturbance only.

251. The assessment for harbour porpoise for the North Falls project against the NS MU population has been based on the dose response approach, as the most realistic estimate of disturbance. The dose-response relationship used for harbour porpoise was developed by Graham *et al.,* (2017) using data collected during Phase 1 of piling at the Beatrice OWF, further details of this assessment can be found in the ES Chapter 12 Section 12.5.1.1.4 (Document Reference: 3.1.14). The assessment for other OWFs included is based on project specific information regarding the number of harbour porpoise at risk of disturbance.

252. The assessment against the seasonal (20%) and spatial (10%) disturbance thresholds has been undertaken based on the approach to disturbance as per the current advice from the SNCBs (JNCC *et al*., 2020) on the assessment of effect on the harbour porpoise designated SACs;

    - The potential impact area during single pile installation, based on the 26km EDR for harbour porpoise, with a potential disturbance area of 2,123.7km^2.

253. It should be noted that the potential areas of disturbance assume that there is no overlap in the areas of disturbance between different projects and are therefore highly conservative (particularly in the case of Five Estuaries and North Falls piling on the same day).

254. This assessment has been based on the potential for disturbance due to piling at other OWF projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.50 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity.

255. The approach to the CEA for piling at OWFs is based on the potential for single piling at each OWF at the same time as single piling at North Falls. It is expected that single piling at each project would represent the most realistic scenario, as this approach allows for some of the OWFs not to be piling at the same time, while others could be simultaneously piling; it is considered highly unlikely that all other OWFs would be simultaneously piling at exactly the same time as piling at North Falls. However, an assessment of multiple piles at each project has also been provided under the SNS SAC disturbance thresholds as a worst-case assessment. This assessment will be updated during the post-consent phase, for the final SIP, and will take into account actual project piling programmes and worst-case scenarios in terms of the number of piles per day.

256. It is important to note the actual duration for active piling time which could disturb marine mammals is only a very small proportion of the potential construction period, of an equivalent to approximately 18.4 days (mono piling duration of 427.5 hours for WTG and 15 hours for OSP/OCP) for North Falls.

Assessment against the North Sea MU population

257. For harbour porpoise, the potential worst case scenario of other OWFs piling at the same time as North Falls is assessed in Table 3.29. Up to 8.1% of the reference population could potentially be disturbed, however, this is very precautionary, as it is unlikely that all other OWF projects could be piling at exactly the same time as piling at North Falls.

Table 3.29 Quantitative assessment for in-combination disturbance for harbour porpoise due to piling at other OWFs (number of individuals at risk of disturbance is based on project specific reporting, and rounded up to nearest whole number)

Project	Approach to disturbance assessment	Maximum number of individuals potentially disturbed during single piling
North Falls	*Based on dose response*	*1,072*
Berwick Bank (Seagreen Charlie Delta Echo)[9]	Based on underwater noise contours	1,754
DBS (East and West)[10]	Based on dose response	12,208
DEP[11]	Based on dose response	804
Five Estuaries[12]	Based on dose response	7,031
Outer Dowsing[13]	Based on dose response	3,981
SEP[14]	Based on dose response	582
Total number of harbour porpoise		**27,432**
Percentage of NS MU		**8.09%**

258. In practice, the potential temporary effects would be less than those predicted in this assessment as there is likely to be a great deal of variation in timing, duration, and hammer energies used throughout the various OWF project construction periods.

259. Additional assessments using iPCoD modelling were undertaken to predict the harbour porpoise population effect due to cumulative disturbance from piling, using the number at risk of disturbance from each project as provided in Table 3.29.

260. For the in-combination scenario assessed (see the ES Appendix 12.6 (Document Reference: 3.3.11) for details of the projects considered, and their parameters) using the reference population (338,918) of the NS MU for harbour porpoise, the iPCoD model predicts there to be little effect on the harbour porpoise population over time from disturbance due to piling at all seven OWF projects (Plate 3.1 and Table 3.30).

261. The median population size was predicted to be 100% of the un-impacted population size at the end of 2028 (one year after the piling has commenced in the wider area year after the piling has commenced). By the end of 2032 (the year piling ends) the median population size for the impacted population is

[9] Based on single piling (SSE Renewables, 2022)
[10] Based on a single pile at Dogger Bank South East and Dogger Bank South West in isolation (RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited, 2023)
[11] Based on single piling (Equinor New Energy, 2023)
[12] Based on single piling (Five Estuaries Wind Farm Ltd, 2023)
[13] Based on single piling (Outer Dowsing Offshore Wind, 2023)
[14] Based on single piling (Equinor New Energy Ltd, 2022)

predicted to be 99.26% of the un-impacted population size. Beyond 2032, the impacted population is expected to maintain the same stable trajectory as the un-impacted population (as far as 2052 which is the end point of the modelling, at which point the median impacted to un-impacted ratio is 99.23%; Table 3.30).

262. The modelling indicates there would be no adverse effect on the integrity of the SNS SAC due to cumulative disturbance from piling, due to there being less than a 1% population level effect on average per year over both the first six years and 25 year modelled periods.

Table 3.30 Results of the iPCoD modelling for the cumulative assessment, giving the mean population size of the harbour porpoise population (wider reference population) for years up to 2053 for both impacted and un-impacted populations in addition to the median ratio between their population sizes.

Year	Un-impacted population mean	Impacted population mean	Median impacted as % of un-impacted
Start	338,920	338,920	100.00
End of 2028	338,500	338,500	100.00
End of 2029	337,899	337,383	99.94
End of 2032	338,403	334,311	99.26
End of 2037	337,367	333,065	99.21
End of 2047	336,291	332,063	99.23
End of 2052	338,129	333,888	99.23

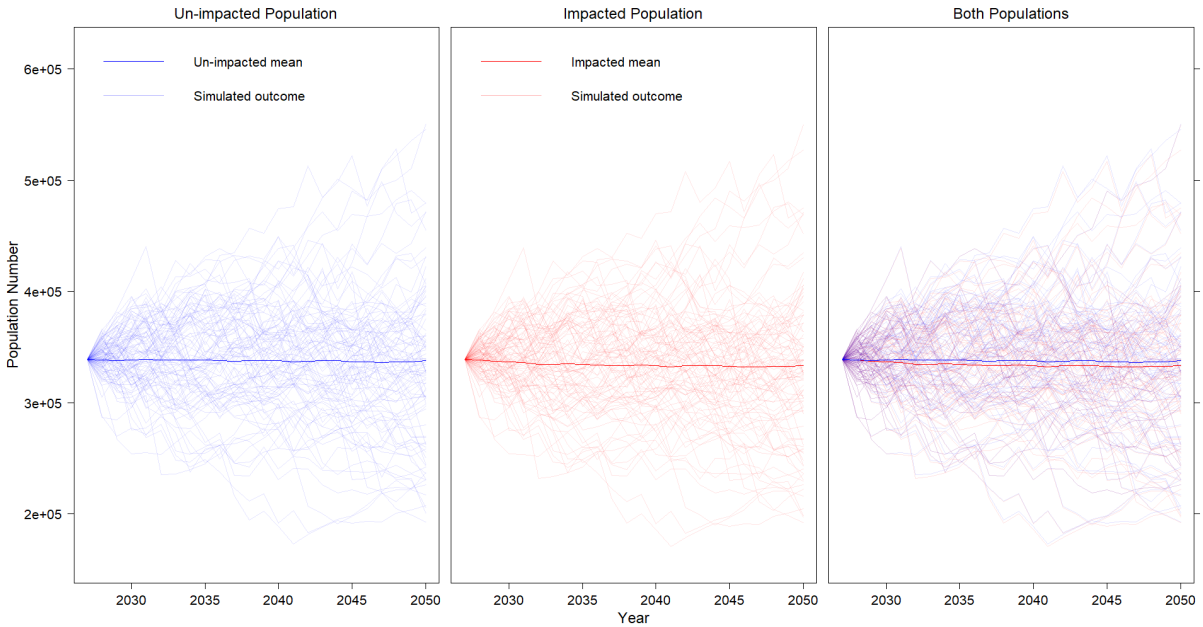


Plate 3.1 Simulated worst-case harbour porpoise population sizes for both the un-impacted and the impacted populations for the in-combination assessment

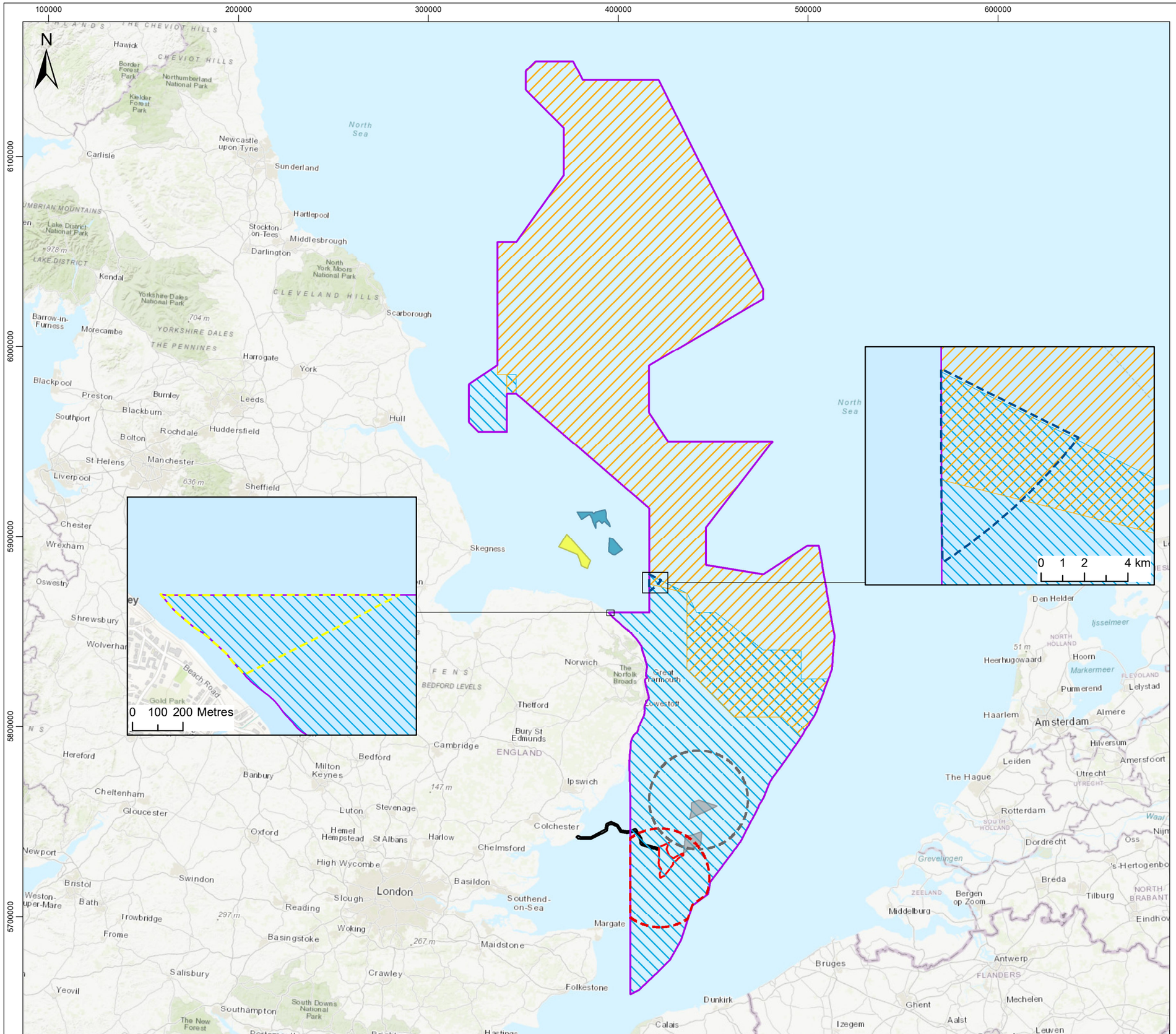
Spatial Assessment

263. Figure 3.3 to Figure 3.6 shows the disturbance area overlaps for all OWFs assessed with the potential for disturbance. As noted above, the only other OWFs

with the potential for piling to overlap with North Falls, and within 26km of the winter area of the SNS SAC, are DEP, SEP, and Five Estuaries.

264. For each OWF with the potential for disturbance within the winter area of the SNS SAC, the area of potential impact for single piling or multiple piling that overlaps with the winter areas has been estimated, based on the worst-case scenarios for the maximum, minimum and average overlaps.

265. Dudgeon Extension Project, Sheringham Shoal Extension Project and Five Estuaries all have assessed for the potential for up to two piling locations on any given day within the winter period, therefore, the following assessments provide scenarios for North Falls and the in-combination projects to be either single piling or piling at two locations on any given day. If North Falls and Five Estuaries were to be piling on the same day, the area of disturbance would overlap, and therefore the following assessment against the spatial threshold takes this into account. The disturbance areas for each project separately are also provided, as they are used within the following seasonal (10%) threshold assessment.



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Southern North Sea (SNS) Special Area of Conservation (SAC)

Disturbance Ranges

- North Falls
- Five Estuaries
- Dudgeon Extension
- Sheringham Shoal Extension

Harbour Porpoise Southern North Sea (SNS) SAC Seasonal Areas

- Summer
- Winter

Offshore Wind Farm Sites

- Dudgeon Extension
- Sheringham Shoal Extension
- Five Estuaries

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Maximum Area of Disturbance within the Southern North Sea SAC from One Monopile in Any One Day at Each of the In-Combinations OWFs

Rev	Date	Remarks	Drwn	Chkd
01	28/02/2024	First issue	FC	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0513	3.3

Scale	Plot Size	Datum	Projection
1:2,000,000	A3	WGS84	UTM31N

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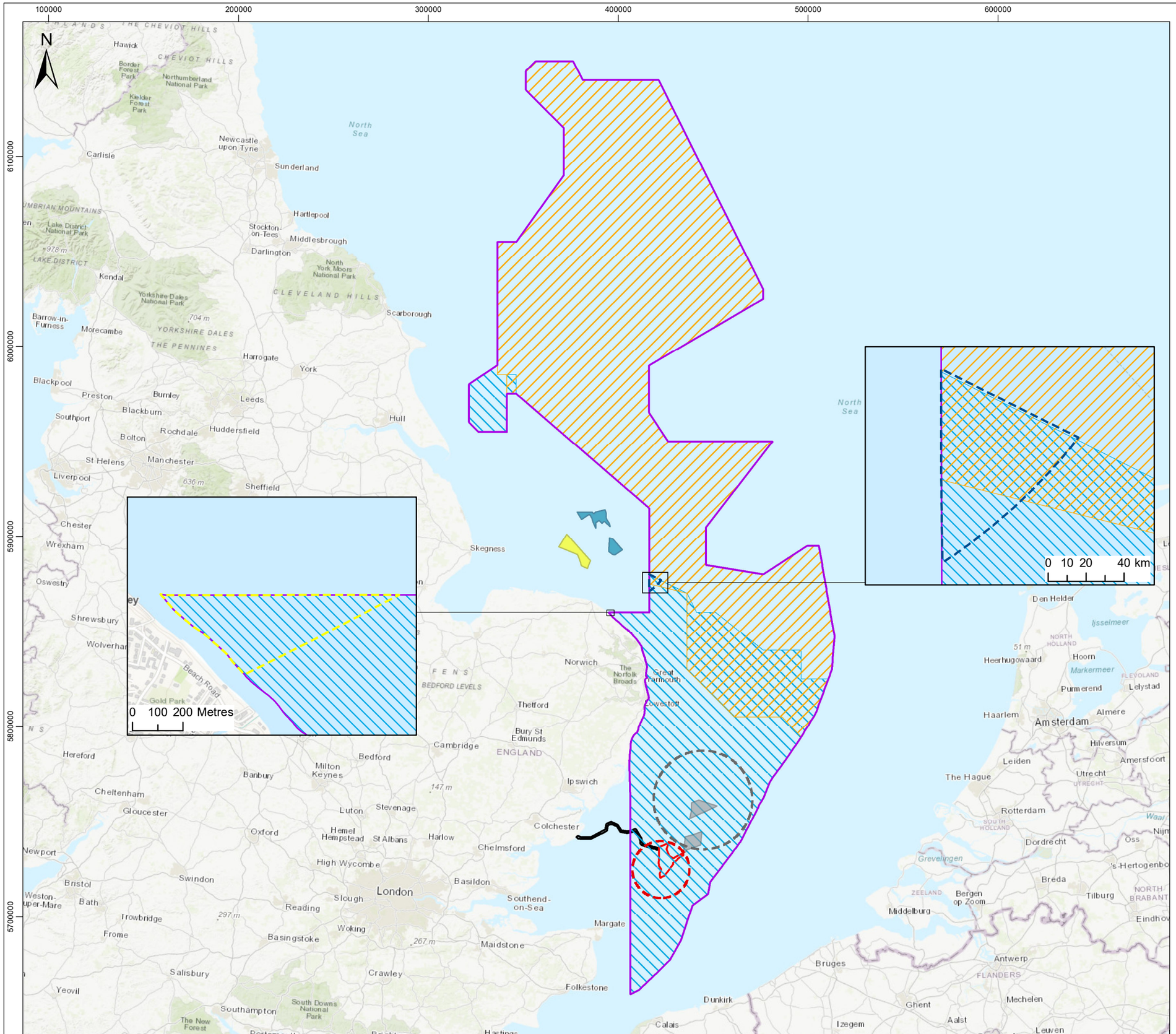
Enhancing Society Together

NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0513_DR_OneMonopile_InCombination.mxd



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Southern North Sea (SNS) Special Area of Conservation (SAC)

Disturbance Ranges

- North Falls
- Five Estuaries
- Dudgeon Extension
- Sheringham Shoal Extension

Harbour Porpoise Southern North Sea (SNS) SAC Seasonal Areas

- Summer
- Winter

Offshore Wind Farm Sites

- Dudgeon Extension
- Sheringham Shoal Extension
- Five Estuaries

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Maximum Area of Disturbance within the Southern North Sea SAC from One Pin Pile at North Falls, and One Monopile at Each of the In-Combinations OWFs

Rev	Date	Remarks	Drwn	Chkd
01	29/04/2024	First issue	FC	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0541	3.4

Scale	Plot Size	Datum	Projection
1:2,000,000	A3	WGS84	UTM31N

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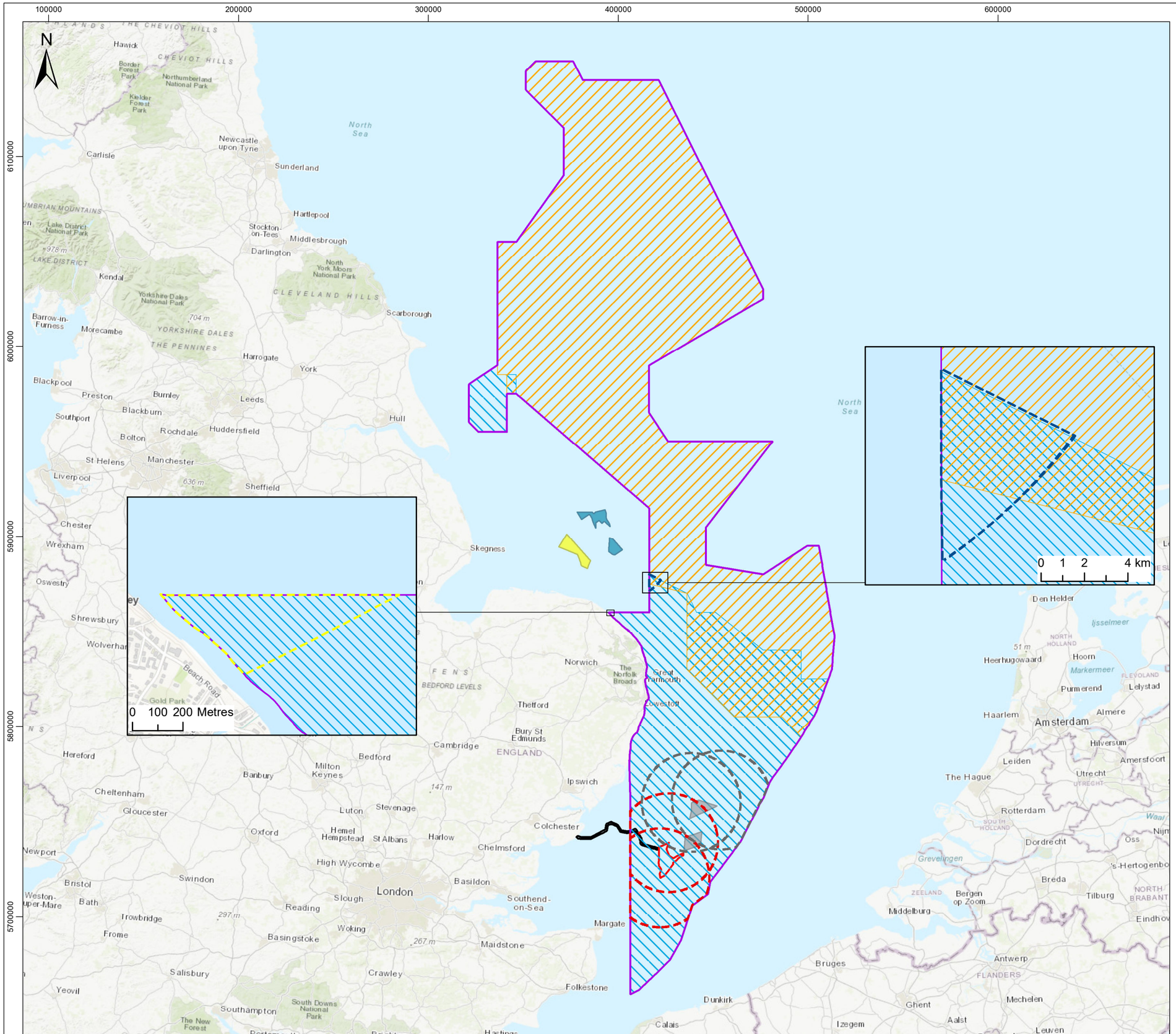
NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0541_DR_OnePinPile_NF_OneMonopile_InCombination.mxd



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Southern North Sea (SNS) Special Area of Conservation (SAC)

Disturbance Ranges

- North Falls
- Five Estuaries
- Dudgeon Extension
- Sheringham Shoal Extension

Harbour Porpoise Southern North Sea (SNS) SAC Seasonal Areas

- Summer
- Winter

Offshore Wind Farm Sites

- Dudgeon Extension
- Sheringham Shoal Extension
- Five Estuaries

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Maximum Area of Disturbance within the Southern North Sea SAC from Two Monopiles in Any One Day at Each of the In-Combinations OWFs

Rev	Date	Remarks	Drwn	Chkd
01	29/04/2024	First issue	FC	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0542	3.5

Scale	Plot Size	Datum	Projection
1:2,000,000	A3	WGS84	UTM31N

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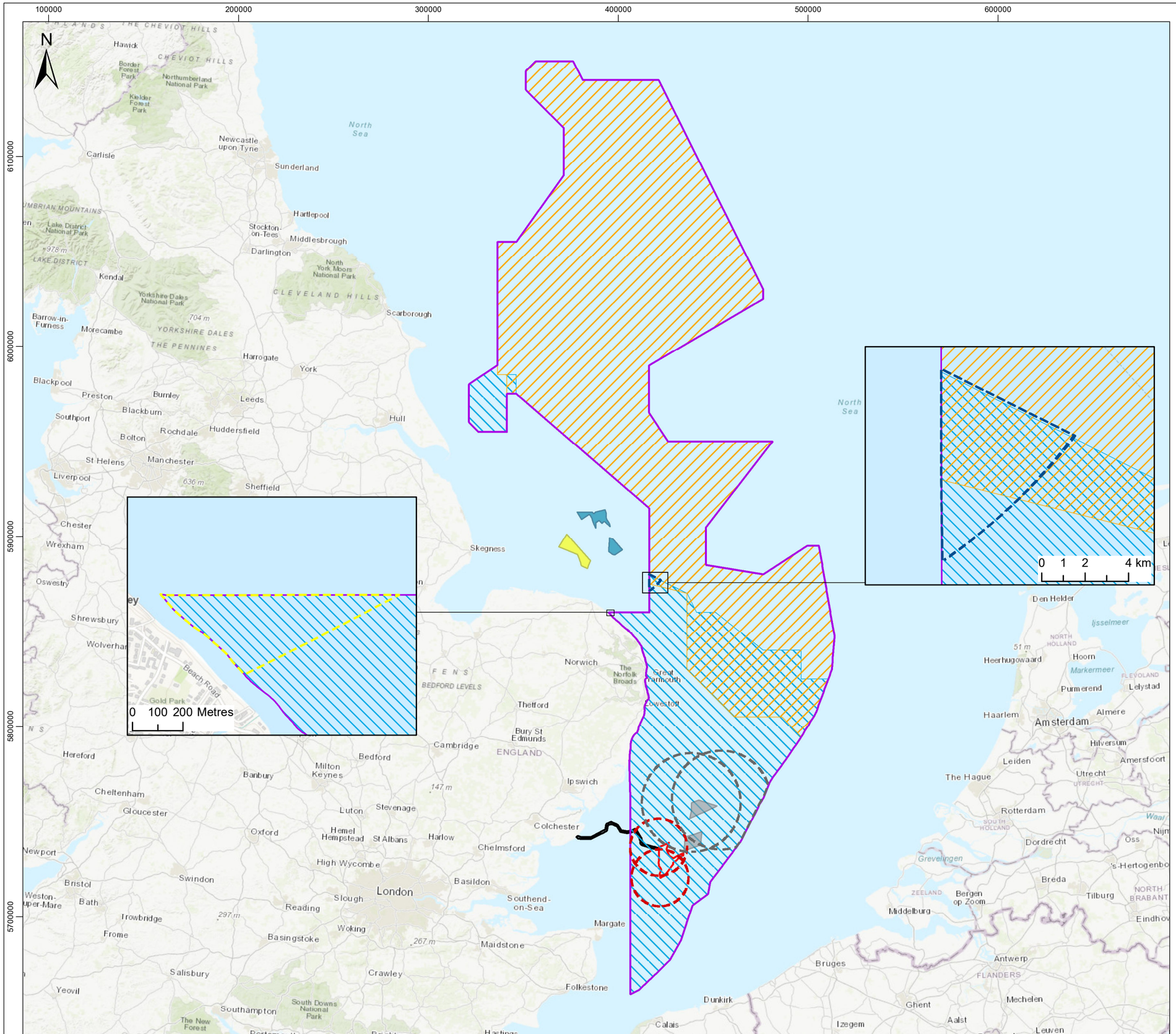
NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0542_DR_TwoMonopiles_InCombination.mxd



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Southern North Sea (SNS) Special Area of Conservation (SAC)

Disturbance Ranges

- North Falls
- Five Estuaries
- Dudgeon Extension
- Sheringham Shoal Extension

Harbour Porpoise Southern North Sea (SNS) SAC Seasonal Areas

- Summer
- Winter

Offshore Wind Farm Sites

- Dudgeon Extension
- Sheringham Shoal Extension
- Five Estuaries

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Maximum Area of Disturbance within the Southern North Sea SAC from Two Pin Piles at North Falls, and Two Monopiles at Each of the In-Combinations OWFs

Rev	Date	Remarks	Drwn	Chkd
01	29/04/2024	First issue	FC	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0543	3.6

Scale	Plot Size	Datum	Projection
1:2,000,000	A3	WGS84	UTM31N

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NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0543_DR_TwoPinPiles_NF_TwoMonopiles_InCombination.mxd

266. The estimated maximum, minimum and average overlap with the SNS SAC summer and winter areas are outlined in Table 3.31 for single location piling at North Falls, on the same day as single location monopiling at other OWF, and in Table 3.32 for multiple location piling at North Falls, on the same day as multiple location monopiling at other OWF. As noted in Section 3.4.3.1.1, North Falls have committed to only pile at one monopile location (without NAS) per day during the winter period.

Table 3.31 Estimated maximum, minimum, and average overlaps with the SNS SAC Winter Area from single piling at other OWFs on the same day as single piling at North Falls

In-combination assessment scenario	Maximum overlap with seasonal area	Minimum overlap with seasonal area	Average overlap with seasonal area
Winter area - single monopile location at other OWFs with a single monopile location at North Falls			
North Falls	*2,055.5m²*	*1,789.2km²*	*1,922.4km²*
DEP[15]	30.3km²	0.00km²	15.2km²
Five Estuaries[16]	2,123.7km²	1,836km²	1,979.5km²
SEP[15]	0.15km²	0.00km²	0.07km²
North Falls and Five Estuaries together, taking account of overlap in disturbance	3,808.5km²	2,025.9km²	2,917.2km²
Total for winter area (including DEP, SEP, and the overlap of North Falls and Five Estuaries together)	**3,839.0km² (30.24% of the winter area)**	**2,025.9km² (15.96% of the winter area)**	**2,932.5km² (23.10% of the winter area)**
Winter area - single monopile location at other OWFs with a single jacket location at North Falls			
North Falls	*706.9km²*	*706.6km²*	*706.8km²*
DEP[15]	30.3km²	0.00km²	15.2km²
Five Estuaries[16]	2,123.7km²	1,836km²	1,979.5km²
SEP[15]	0.15km²	0.00km²	0.07 km²
North Falls and Five Estuaries together, taking account of overlap in disturbance	2,830.6km² [17]	2,019.2km² [18]	2,424.9km²
Total for winter area (including DEP, SEP, and the overlap of North Falls and Five Estuaries together)	**2,861.1km² (22.54% of the winter area)**	**2,019.2km² (15.90% of the winter area)**	**2,440.2km² (19.22% of the winter area)**

[15] Taken from SEP and DEP Examination addendum note (Equinor, 2023)
[16] Taken from Five Estuaries PEIR draft RIAA (Five Estuaries, 2023)
[17] No overlap in disturbance areas
[18] Pin pile disturbance area would be wholly within the monopile disturbance area, as a best-case

Table 3.32 Estimated maximum, minimum, and average overlaps with the SNS SAC Winter Area from multiple location piling at other OWFs on the same day as piling at North Falls

In-combination assessment scenario	Maximum overlap with seasonal area	Minimum overlap with seasonal area	Average overlap with seasonal area
Winter area – two monopile locations per day at other OWFs with one monopile (without NAS) location at North Falls			
North Falls	*2,055.5m²*	*1,789.2km²*	*1,922.4km²*
DEP[19]	30.5km²	0.00km²	15.3km²
Five Estuaries[16]	3,453km²	1,836km²	2,644.5km²
SEP[15]	0.15km²	0.00km²	0.07km²
North Falls and Five Estuaries together, taking account of overlap in disturbance	4,368.0km²	2,069.3km²	3,218.7km²
Total for winter area (including DEP, SEP, and the overlap of North Falls and Five Estuaries together)	**4,398.7km² (34.6% of the winter area)**	**2,069.3km² (16.3% of the winter area)**	**3,234.1km² (25.5% of the winter area)**
Winter area – two monopile locations per day at other OWFs with two jacket locations at North Falls			
North Falls	*1,236.5km²*	*740.3km²*	*988.4km²*
DEP[15]	30.5km²	0.00km²	15.3km²
Five Estuaries[16]	3,453km²	1,836km²	2,644.5km²
SEP[15]	0.15 km²	0.00km²	0.07 km²
North Falls and Five Estuaries together, taking account of overlap in disturbance	3,703.4km²	2,062.5km² [20]	2,883.0km²
Total for winter area (including DEP, SEP, and the overlap of North Falls and Five Estuaries together)	**3,703.4km² (29.2% of the winter area)**	**2,062.5km² (16.25% of the winter area)**	**2,883.0km² (22.71% of the winter area)**
Winter area – two monopile locations per day at other OWFs with one monopile and one jacket location at North Falls			
North Falls	*2,183.55km²*	*1,789.20km²*	1,986.4*km²*
DEP[15]	30.5km²	0.00km²	15.3km²
Five Estuaries[16]	3,453km²	1,836km²	2,644.5km²
SEP[15]	0.15 km²	0.00km²	0.07 km²
North Falls and Five Estuaries together, taking account of overlap in disturbance	4,030.6km²	2,069.3km²	3,045.0km²

[19] Taken from SEP and DEP Examination addendum note (Equinor, 2023)
[20] Pin pile disturbance areas would be wholly within the monopile disturbance areas, as a best-case.

In-combination assessment scenario	Maximum overlap with seasonal area	Minimum overlap with seasonal area	Average overlap with seasonal area
Total for winter area (including DEP, SEP, and the overlap of North Falls and Five Estuaries together)	**4,061.3km^2 (32.0% of the winter area)**	**2,069.3km^2 (16.30% of the winter area)**	**3,060.4km^2 (24.10% of the winter area)**

267. For single location piling, the spatial (20%) threshold is exceeded for both a single monopile at North Falls and all other projects, and for a single pin pile and a single monopile at other projects. For multiple location, the spatial (20%) threshold is also exceeded in all scenarios.

268. The assessment indicates that more than 20% of the winter area could be affected, based on the maximum potential overlaps for all OWFs, for both monopile and pin pile scenarios at North Falls (Table 3.31 and Table 3.32). However, as discussed in Section 3.4.3.1.1, mitigation and management measures for North Falls will be provided through the SIP to ensure there is no breach of the spatial (20%) threshold.

269. In line with the conclusions of the Review of Consents (RoC) HRA (BEIS, 2020) it is expected that all other OWFs will also have to produce a SIP to ensure that the spatial threshold is not exceeded and there is no significant disturbance and no adverse effect on the integrity of the SNS SAC. This could include the use of noise abatement and reduction measures (which would reduce the EDR to 15km), and / or seasonal restrictions and agreements on when OWF piling could be undertaken.

270. It is also important to note that the in-combination assessments are based on the worst-case for all possible OWFs. As projects develop and programmes are established there will be changes to the potential piling periods for each OWF project. There will also be limitations on the fabrication of wind turbines and the vessels available to install the wind turbine foundations. Therefore, it is unlikely that all OWFs would or could be all piling at the same time.

271. With the use of appropriate mitigation and management measures defined through the SIP process, to be approved by the MMO, an adverse effect on the integrity of the SNS SAC will be avoided.

Seasonal average

272. Seasonal averages have been calculated by multiplying the average effect on any given day in each season by the proportion of days within the season on which piling could occur (i.e. taking into account the average of effect / area of overlap with the SNS SAC and number of days piling per season). Calculations can be seen in Table 3.33. As noted in Section 3.4.3.1.1, North Falls have committed to only pile at one monopile location (without NAS) per day during the winter period.

273. For North Falls, the number of days of piling is based on the same parameters as set out for the project alone in Section 3.4.3.1.1. For other projects, the assessment is based on the number of days of piling in project specific reporting.

274. As a worst-case, no allowance has been made for downtime as a result of technical issues and no assumptions have been made for reloading of piling vessels with foundations.

275. The assessment against the seasonal (10%) threshold for North Falls piling with other OWFs shows that there is the potential for exceedance of the threshold for the winter area, with the exception of either only one monopile location (without NAS) at North Falls during the winter season, and for one monopile and one jacket location at North Falls.

Table 3.33 Estimated seasonal averages for the SNS SAC Winter Area from single piling at other OWFs which could be piling on the same day as single piling at North Falls

In-combination project	Winter period with potential piling activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	Estimated seasonal average
Winter area - single monopile location at other OWFs with a single monopile location at North Falls				
North Falls	*2030-2031*	*1,922.4km²*	*59 days*	*4.91%*
DEP[21]	2028-2031	15.2km²	32 days	0.02%
Five Estuaries[22]	2027-2030	1,979.5km²	81 days	6.9%
SEP[21]	2028-2031	0.07km²	25 days	0.00008%
Total for winter area	**All projects could be piling in 2030 winter season**	**-**	**-**	**11.83% of the winter area on average over the winter season**
Winter area - single monopile location at other OWFs with a single jacket location at North Falls				
North Falls	*2030-2031*	*706.8km²*	182 days (as worst-case)	5.57%
DEP	2028-2031	15.2km²	32 days	0.02%
Five Estuaries[22]	2027-2030	1,979.5km²	81 days	6.9%
SEP[21]	2028-2031	0.07 km²	25 days	0.00008%
Total for winter area	**All projects could be piling in 2030 winter season**	**-**	**-**	**12.49% of the winter area on average over the winter season**
Winter area – two monopile locations per day at other OWFs with one monopile location at North Falls				
North Falls	*2030-2031*	*1,922.4km²*	*59 days*	*4.91%*
DEP[21]	2028-2031	15.3km²	17 days	0.02%

[21] Taken from SEP and DEP Examination addendum note (Equinor, 2023)
[22] Taken from Five Estuaries PEIR draft RIAA (Five Estuaries, 2023)

In-combination project	Winter period with potential piling activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	Estimated seasonal average
Five Estuaries[23]	2027-2030	2,644.5km^2	41 days[24]	4.7%
DEP[21]	2028-2031	0.07km^2	13 days	0.00008%
Total for winter area	**All projects could be piling in 2030 winter season**	**-**	**-**	**9.63% of the winter area on average over the winter season**
Winter area – two monopile locations per day at other OWFs with two jacket pile locations at North Falls				
North Falls	*2030-2031*	*988.4km^2*	*182 days*	*7.79%*
DEP[21]	2028-2031	15.3km^2	17 days	0.02%
Five Estuaries[26]	2027-2030	2,644.5km^2	41 days[25]	4.7%
SEP[21]	2028-2031	0.07 km^2	13 days	0.00008%
Total for winter area	**All projects could be piling in 2030 winter season**	**-**	**-**	**12.51% of the winter area on average over the winter season**
Winter area – two monopile locations per day at other OWFs with one monopile and one jacket pile location at North Falls				
North Falls	*2030-2031*	*1,986.4km^2*	*Four days + 55 days of single monopile location*	*4.75%*
DEP[21]	2028-2031	15.3km^2	17 days	0.02%
Five Estuaries[26]	2027-2030	2,644.5km^2	41 days[26]	4.7%
SEP[21]	2028-2031	0.07 km^2	13 days	0.00008%
Total for winter area	**All projects could be piling in 2030 winter season**	**-**	**-**	**9.47% of the winter area on average over the winter season**

276. As discussed in Section 3.4.3.1.1, mitigation and management measures for North Falls will be provided for within the final SIP in the post-consent phase,

[23] Taken from Five Estuaries PEIR draft RIAA (Five Estuaries, 2023). In order to finalise the in-combination assessment a six-month cut-off date prior to DCO submission, was agreed through the Evidence Plan Process.
[24] Not presented in project specific reporting, but assumed to be 50% of days required for single monopile per day piling
[25] Not presented in project specific reporting, but assumed to be 50% of days required for single monopile per day piling
[26] Not presented in project specific reporting, but assumed to be 50% of days required for single monopile per day piling

which will ensure the seasonal (10%) threshold is not breached. This could include the use of noise abatement and temporal restrictions.

277. All other OWFs will also have to produce a SIP to ensure that the spatial and seasonal thresholds are not exceeded (e.g., commitment is made within Five Estuaries Wind Farm Ltd., 2023).and there is no significant disturbance and no adverse effect on the integrity of the SNS SAC.

278. With the use of appropriate mitigation and management measures defined through the SIP process, and to be approved by the MMO, an adverse effect on the integrity of the SNS SAC will be avoided.

In-combination impact 1b: Assessment of underwater noise from construction activities (other than piling) and vessel presence at other OWFs

279. All OWFs with construction dates that have the potential to overlap with the construction dates for North Falls have the potential for other construction activities (such as seabed preparation, dredging, trenching, cable installation, rock placement, drilling and vessels) to occur at the same time as other construction activities at North Falls. See Appendix 12.6 (Document Reference: 3.3.11) for further information on the screening process for other OWFs.

280. OWFs screened in for other construction activities (including vessels) that could have an in-combination effect with other construction activities (including vessels) at North Falls during the construction period of 2027 - 2031 are:

- Dunkerque;
- East Anglia Hub (East Anglia ONE North);
- Hornsea Project Four;
- Hornsea Project Three;
- Nordlicht I;
- Nordlicht II;
- Nordsee Cluster A - N-3.7;
- Nordsee Cluster A - N-3.8;
- Norfolk Vanguard;
- Rampion 2; and
- West of Orkney.

281. This assessment has been based on the potential for disturbance due to construction activities at other OWF projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.50 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity.

282. While the other OWFs that have been assessed under the in-combination piling assessment have the potential for overlapping construction phases, as well as those listed above, they are already assessed under a worst case of piling overlaps. As the disturbance areas for piling are significantly larger than the disturbance areas for other construction activities (or vessels), an assessment of

piling at those projects would produce a much higher potential for effect than an assessment for in-combination effects with other construction activities, and they are therefore not included under the assessment for other construction activities (including vessels) as set out below. As noted above, Table 3.50 provides an overall assessment including the potential for disturbance from all OWFs that may be undergoing construction at the same time as North Falls, and where those OWFs' piling windows overlap with North Falls, piling has been included as a worst-case.

283. It should be noted that the assessment of underwater noise from other construction activities (including vessels) is not an additive effect when considered with the potential for disturbance from piling, as the potential for disturbance from other construction activities have significantly lower effect areas when compared to piling, and therefore in the case of piling and other activities taking place at the same time, harbour porpoise effected from construction activities would be within the area for disturbance of piling itself.

284. In addition, it is important to consider OWFs that have the potential for disturbance effects to overlap with the SNS SAC. Therefore, OWFs that are within the SNS SAC and included in the in-combination assessment are Hornsea Project Four and Norfolk Vanguard, which are in the summer SNS SAC area. OWFs included due to being within the winter SNS SAC area are East Anglia ONE North and Norfolk Vanguard[27].

Assessment against the North Sea MU population

285. For any projects where project specific information is not available, the potential disturbance from OWFs during non-piling construction activities, such as vessel noise, seabed preparation, rock placement and cable installation, has been based on the disturbance area for multiple construction activities taking place at North Falls (as for the approach for North Falls alone), and the relevant SCANS-IV density. Project specific information has been used wherever practicable.

286. For harbour porpoise, based on the worst case scenario, for all OWFs that could be constructing at the same time as North Falls, up to 0.75% of the reference population could be potentially disturbed (Table 3.34).

Table 3.34 Quantitative assessment for in-combination disturbance for harbour porpoise due to construction activities (including vessels) at other OWFs

Project	Harbour porpoise density (km^2)	Effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response as worst-case*		*1,072*
Dunkerque*	0.2714	201.1	55

[27] To note, Norfolk Vanguard lies wholly within the SNS SAC summer area and NV West slightly overlaps the winter area as well.

Project	Harbour porpoise density (km^2)	Effect area (km^2)	Maximum number of individuals potentially disturbed
East Anglia ONE North[28]	Taken from projects' own assessment		4
Hornsea Project Four[29]	Not quantitively assessed		-
Hornsea Project Three[30]	Not quantitively assessed		-
Nordlicht I*	0.6169	201.1	125
Nordlight II*	0.6169	201.1	125
Nordsee Cluster A - N-3.7*	0.6169	201.1	125
Nordsee Cluster A - N-3.8*	0.6169	201.1	125
Norfolk Vanguard[31]	Taken from projects' own assessment		906
Rampion 2[32]	Not assessed		-
West of Orkney[33]	Not assessed		-
Total number of harbour porpoise			**2,537**
Percentage of NS MU			**0.75%**

* Project specific assessment unavailable, generic approach used to inform the assessment

287. It should be noted that while the projects included within the in-combination assessment for disturbance from other OWFs constructing at the same time were done so based on the current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the harbour porpoise that could be at risk of disturbance during the offshore construction period of North Falls.

Spatial assessment

288. If other construction activities were undertaken within the winter area at the same time as monopiling at North Falls within the winter area, the potential area of disturbance could be 20.7% of the winter SNS SAC area.

[28] Possible behavioural response due to multiple vessels (East Anglia ONE North Limited, 2021)
[29] Not quantitively assessed in Project's own assessment (Orsted Power (UK) Ltd, 2019)
[30] Not quantitively assessed in Project's own assessment (Orsted Power (UK) Ltd, 2018)
[31] Based on all individuals within windfarm areas at risk of disturbance from other activities (Norfolk Vanguard Limited, 2018)
[32] SAC not screened in in Project's own assessment (Rampion Extension Development Limited, 2023)
[33] SAC not screened in in Project's own assessment (Offshore Wind Power Limited, 2023)

Table 3.35 Quantitative assessment for in-combination disturbance of harbour porpoise due to construction activities (including vessels) at other OWFs

In-combination project / activity	Maximum overlap with seasonal area (with monopiling at North Falls)	Maximum overlap with seasonal area (with pin piling at North Falls)
North Falls	2,055.5km^2	706.9km^2
East Anglia ONE North[34]	341km^2	341km^2
Norfolk Vanguard[35]	228km^2	228km^2
Total for winter area	**20.7% of the winter area**	**10.1% of the winter area**

289. Displacement of harbour porpoise may exceed 20% of the winter seasonal component of the SNS SAC during the construction of other OWFs on the same day as piling at North Falls. However, as discussed in Section 3.4.3.1.1, mitigation and management measures for North Falls will be provided through the SIP to ensure there is no breach of the spatial (20%) threshold.

290. It is also important to note that the in-combination assessments are based on the worst-case for all possible OWFs. As projects develop and programmes are established there will be changes to the potential construction periods for each OWF project.

291. With the use of appropriate mitigation and management measures defined through the SIP process, to be approved by the MMO, an adverse effect on the integrity of the SNS SAC will be avoided and this assessment will be reviewed and presented at the DCO application stage.

Seasonal average

292. The seasonal averages have been calculated by multiplying the maximum area on any one day by the proportion of days within the season on which other construction activity (including vessels) could occur (Table 3.36). It has been assumed that construction activity could be undertaken throughout the winter season.

Table 3.36 Estimated seasonal averages with the SNS SAC winter area from other construction activity (including vessels) on the same day as single piling at North Falls

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: Other construction activity (including vessels) at the same time as a single monopile at North Falls			
Single monopile at North Falls	1,922.4km^2	59 days	4.91%

[34] Based on East Anglia ONE North HRA, it was assumed the whole offshore development area is within the winter area for the non-piling construction activity assessment (ScottishPower Renewables, 2019)

[35] Based on Norfolk Vanguard HRA spatial assessment (Vattenfall, 2018)

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: Other construction activity (including vessels) at the same time as a single monopile at North Falls			
East Anglia ONE North other construction activity	341km^2	182 days	2.69%
Norfolk Vanguard other construction activity	228km^2	182 days	1.80%
Total	**-**	**-**	**9.40% of the winter area on average over the season**
Winter area: Other construction activity (including vessels) at the same time as pin piling at North Falls			
Single pin pile at North Falls	706.9km^2	182 days (as worst-case)	5.57%
East Anglia ONE North other construction activity	341km^2	182 days	2.69%
Norfolk Vanguard other construction activity	228km^2	182 days	1.8%
Total	**-**	**-**	**10.06% of the winter area on average over the season**

293. As discussed in Section 3.4.3.1.1, mitigation and management measures for North Falls will be provided for within the final SIP in the post-consent phase, which will ensure the seasonal (10%) threshold is not breached. This could include the use of noise abatement and temporal restrictions.

294. All other OWFs will also have to produce a SIP to ensure that the spatial and seasonal thresholds are not exceeded, and there is no significant disturbance and no adverse effect on the integrity of the SNS SAC.

295. With the use of appropriate mitigation and management measures defined through the SIP process, to be approved by the MMO, an adverse effect on the integrity of the SNS SAC will be avoided.

In-combination impact 1c: Assessment of disturbance from other industries and activities

296. During the construction period for North Falls, there is the potential for disturbance to harbour porpoise associated with other potential noise sources, including:

- Geophysical surveys associated with other OWFs;
- Aggregate extraction and dredging;
- Oil and gas installation projects;
- Oil and gas seismic surveys;

- Subsea cable and pipelines;
- Other marine renewable projects (such as wave and tidal projects);
- Disposal sites; and
- UXO clearance.

297. For the installation of oil and gas infrastructure, marine renewable projects, and disposal sites, all potential projects have been screened out. Further information on the CEA screening (and these results) are provided in the ES Appendix 12.6 (Document Reference: 3.3.11).

Disturbance from geophysical surveys

298. As outlined in the ES Appendix 12.6 (Document Reference: 3.3.11), OWF geophysical surveys using Sub-Bottom Profilers (SBPs) and Ultra-Short Base Line (USBL) systems have the potential to disturb marine mammals and have therefore been screened into the CEA, as a precautionary approach.

299. The potential disturbance range used in the in-combination assessment is based on the SNCB guidance for assessment for harbour porpoise.

300. This assessment has been based on the potential for disturbance from geophysical surveys (e.g. surveys using high resolution sources), in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.50 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from geophysical surveys.

301. Assessments for the RoC HRA for the SNS SAC (BEIS, 2020), modelled the potential for disturbance due to the use of a SBP, and results indicated that there is the potential for a possible behavioural response in harbour porpoise at up to 3.77km (44.65km^2) from the source. The current guidance for assessing the significance of noise disturbance for harbour porpoise SACs (JNCC *et al*., 2020) recommends the use of an EDR of 5km (78.54km^2) for geophysical surveys.

302. Following the current SNCB guidance for the assessment of geophysical surveys disturbance on harbour porpoise, it should be assessed as a moving source, rather than a stationary one (i.e. the distance at which a survey vessel could travel in one day, with a 5km buffer area). It is difficult to determine what the potential area of effect would be when taking into account it is a moving source (as it is difficult to predict how far a vessel may survey in a day).

303. Based on survey vessels travelling at a speed of 4.5 to 5 knots, up to 199km could be surveyed in one day. This however does not take into account the survey downtime for line changes, weather, or other technical reason. A review of seismic surveys within the UK indicated that surveys were being undertaken for approximately 52% of the time (BEIS, 2020). Taking this into account, up to 103.5km of surveys could be undertaken in one day, resulting in a potential disturbance area of 1,113.5km^2 with the 5km EDR buffer applied. This is highly precautionary as it is unlikely that the whole survey area would be within the SNS SAC. A more realistic assessment has been undertaken based on a disturbance area of 256km^2, as set out in JNCC (2023). As JNCC (2023) state, this is based on the largest estimated daily disturbance footprint as assessed by HRAs for sub-bottom profiler surveys.

Assessment against the North Sea MU population

304. It is currently not possible to estimate the location or number of potential OWF geophysical surveys that could be undertaken at the same time as construction and potential piling activity at North Falls. However, analysis of the geophysical surveys reported to the Marine Noise Registry (MNR), indicated in the year 2021 in the North Sea, there was a total of 30 sub-bottom profiler surveys carried out for a total of 257 days. The amount undertaken in 2021 suggests an average of less than one geophysical survey at any one time within a year.

305. It is therefore assumed, as a worst case scenario, that there could potentially be up to two geophysical surveys in North Sea at any one time, during the construction of North Falls within the wider MU.

306. As the location of the potential geophysical surveys is currently unknown, the following assessments are based on the density estimates, with a density estimate of 0.55/km^2 for harbour porpoise (based on the North Sea Assessment Unit (AU) as presented in Gilles *et al*., 2023).

307. For up to two geophysical surveys undertaken at the same time as construction of North Falls, with no other in-combination activities, up to 0.39% of the NS MU population may be disturbed.

Table 3.37 Quantitative assessment for in-combination disturbance of marine mammals due to up to two geophysical surveys at OWFs

Potential in-combination effect	Marine mammal density (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed (% of reference population)
North Falls	*Based on dose response as worst case*		*1,072*
Two geophysical surveys	0.55	512 (256 per survey)	282 (0.08%)
Total number of harbour porpoise			**1,354**
Percentage of NS MU			**0.39%**

Spatial assessment

308. As it is currently not possible to estimate the location or number of potential OWF geophysical surveys that could be undertaken at the same time as construction of North Falls, and due to the smaller area of the winter area of the SNS SAC in comparison to the North Sea area that has been assessed above, it is assumed, as a worst case scenario, that there could potentially be up to one geophysical survey in the winter area of the SNS SAC at any one time, during construction of North Falls, based on the MNR analysis as stated above.

309. If one geophysical survey was undertaken within the SNS SAC winter area (with an area of 256km^2), at the same time as piling at North Falls (maximum overlap area of 2,055.5km^2 for monopiles), the potential maximum area of disturbance could be 2,311.5km^2, which would be approximately 18.2% of the winter area.

For pin piles, the in-combination disturbance area would be 962.9km^2 (7.6% of the winter SNS SAC area) (Table 3.38).

Table 3.38 Estimated overlaps with the SNS SAC winter area from one geophysical survey at OWFs on the same day as single piling at North Falls

In-combination assessment scenario	Maximum overlap with seasonal area for monopiling at North Falls	Maximum overlap with seasonal area for pin piling at North Falls
North Falls	*2,055.5km^2*	*706.9km^2*
One geophysical survey	256km^2	256km^2
Total for winter area	**2,311.5km^2 (18.2% of the winter area)**	**962.^{9}km^2 (7.6% of the winter area)**

310. The displacement of harbour porpoise therefore would not exceed 20% of the winter seasonal component of the SNS SAC during a geophysical survey on the same day as piling at North falls. Therefore, under these circumstances, there would be no significant disturbance and no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to underwater noise from North Falls piling in-combination with a geophysical survey.

Seasonal average

311. The seasonal averages have been calculated by multiplying the maximum area on any one day by the proportion of days within the season on which geophysical surveys could occur (Table 3.39). It has been assumed that a geophysical survey could be undertaken throughout the winter season (i.e., on average, up to one geophysical survey is undertaken within the winter area on any one day).

Table 3.39 Estimated seasonal averages with the SNS SAC winter area from geophysical surveys on the same day as single piling at North Falls

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: A geophysical survey at the same time as a single monopile at North Falls			
Single monopile at North Falls	2,055.5km^2	59 days	5.25%
One geophysical survey (at any one time)	256km^2	182 days	2.02%
Total	**-**	**-**	**7.27% of the winter area on average over the season**
Winter area: A geophysical survey at the same time as pin piling at North Falls			
Single pin pile at North Falls	706.9km^2	182 days (as worst-case)	5.57%
One geophysical survey	256km^2	182 days	2.02%

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: A geophysical survey at the same time as a single monopile at North Falls			
Total	**-**	**-**	**7.59% of the winter area on average over the season**

312. The assessment indicates that in the case of either monopiles or pin piles at North Falls, less than 10% of the winter area of the SNS SAC could be affected, due to geophysical surveys being undertaken on the same day as piling at North Falls. With the use of appropriate mitigation and management measures defined through the SIP process, to be approved by the MMO, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to underwater noise (other than piling) from North falls in-combination with geophysical surveys.

Disturbance from aggregate extraction and dredging

313. As a precautionary approach, a total of six aggregate extraction and dredging projects are included in the in-combination assessment for the potential in-combination disturbance. See Appendix 12.6 (Document Reference: 3.3.11) for further information on the screening for all aggregate and dredging projects.

314. This assessment has been based on the potential for disturbance from aggregate and dredging projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.50 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from these screened in aggregate and dredging projects.

Assessment against the North Sea MU population

315. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al*., 2010). As a worst case assessment, a disturbance range of 600m for up to six operational aggregate projects at the same time as North Falls construction has been undertaken. A disturbance range of 600m would result in a potential disturbance area of 1.13km^2 for each project, or up to 6.8km^2 for all six aggregate projects.

316. For the potential for in-combination disturbance from aggregate and dredging projects undertaken at the same time as construction of North Falls, with no other in-combination activities, up to 0.32% of the NS MU population may be disturbed (Table 3.40).

Table 3.40 Quantitative assessment for in-combination disturbance of harbour porpoise due to aggregate and dredging projects

Potential in-combination effect	Marine mammal density (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed (% of reference population)
North Falls	*Based on dose response as worst case*		*1,072*
Aggregate and dredging projects (1.13km^2 disturbance area per project)	0.55	6.78	4 (0.001%)
Total number of harbour porpoise			**1,076**
Percentage of NS MU			**0.32%**

Spatial assessment and seasonal average

317. None of the screened in aggregate projects are within (or within 600m of) the winter area of the SNS SAC. Therefore, an assessment against the spatial and seasonal thresholds has not been undertaken.

318. Therefore, under these circumstances there would be no significant disturbance and no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to underwater noise (other than piling) from North Falls in-combination with aggregate extraction and dredging activities.

Disturbance from oil and gas seismic surveys

319. It is currently not possible to estimate the number of potential oil and gas seismic surveys that could be undertaken at the same time as construction and potential piling activity at North Falls. Therefore, it has been assumed that at any one time, up to two seismic surveys could be taking place at the same time within the wider North Sea, and that one seismic survey could be undertaken in the winter area of the SNS SAC.

320. This assessment has been based on the potential for disturbance from seismic surveys (associated with oil and gas projects), in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.50 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including these seismic surveys.

Assessment against the North Sea MU population

321. This assessment for the potential disturbance due to oil and gas seismic surveys is based on the potential impact area during seismic surveys, with an EDR of 12km (452.4km^2 per survey, or 904.8km^2 for two surveys). However, as stated above for geophysical surveys, under the JNCC *et al.*, 2020 guidelines for assessing effects at harbour porpoise designated sites, seismic surveys should be considered as a moving source.

322. Following the same approach as undertaken for geophysical surveys above, and using 12km EDR, the total disturbance area for a seismic survey would be

2,936.4km^2 (or 5,872.8km^2 for two surveys). As noted in JNCC (2023), this is an unrealistically large potential disturbance area since there will be breaks in surveying for line changes, and it is highly likely that surveys would undertake a transect design with lines at less than 500m apart, which would reduce the overlap area. Weather and other technical delays would also decrease the time of seismic surveying each day. Therefore, JNCC (2023) use a seismic survey disturbance area of 1,759 km^2, as the largest estimated disturbed area for a species project in the SNS SAC. This area has therefore been used in the following assessments.

323. For oil and gas seismic surveys undertaken at the same time as construction of North Falls, up to 0.9% of the NS MU population may be disturbed (Table 3.41).

Table 3.41 Quantitative assessment for in-combination disturbance of harbour porpoise due to up to two oil and gas seismic surveys

Potential in-combination effect	Marine mammal density (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed (% of reference population)
North Falls	*Based on dose response approach*		*1,072*
Up to two seismic surveys	0.55	3,518	1,935 (0.56%)
Total number of harbour porpoise			**3,007**
Percentage of NS MU			**0.9%**

Spatial assessment

324. Analysis of MNR reports indicates that in the North Sea during 2021 there were 20 seismic surveys carried out for a total of 475 days. This gives a potential for just over 1 seismic survey to be undertaken at any one time in the North Sea, therefore it is realistic for the Winter SNS SAC area to include one seismic survey within assessments. If one seismic survey was undertaken within the winter area (with an area of 1,759km^2), at the same time as monopiling at North Falls within the winter area, the potential area of disturbance could be 3,814.5km^2 which would be 27.68% of the winter area. For pin piles, the total area within one seismic survey would be 2,465.9km^2, or 19.42% of the winter SNS SAC area (Table 3.42).

Table 3.42 Estimated overlaps with the SNS SAC winter area from one seismic survey at OWFs on the same day as single piling at North Falls

In-combination assessment scenario	Maximum overlap with seasonal area for monopiling at North Falls	Maximum overlap with seasonal area for pin piling at North Falls
North Falls	2,055.5km^2	706.9km^2
One seismic survey	1,759km^2	1759km^2
Total for winter area	**3,814.5km^2 (27.68% of the winter area)**	**2,465.9km^2 (19.42% of the winter area)**

325. The assessment indicates that more than 20% of the winter area could be affected, based on the maximum overlapping scenario.

326. In line with the conclusions of the RoC HRA (BEIS, 2020), a SIP will be developed for North Falls, which will set out the approach to deliver any Project-level mitigation or management measures, to ensure that the spatial threshold is not exceeded and there is no significant disturbance and no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

327. With the use of appropriate mitigation and management measures defined through the SIP process, to be approved by the MMO, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of in-combination disturbance effects from underwater noise during piling at North Falls and oil and gas seismic surveys.

Seasonal average

328. The seasonal averages have been calculated by multiplying the maximum area on any one day by the proportion of days within the season on which seismic surveys could occur (Table 3.43). Analysis of MNR data indicated an average of 4 survey days per seismic survey in the winter season with a total of 16 days in total in winter 2021 in the North Sea. Therefore, 20 days have been included for potential seismic surveys. This is a precautionary approach due to seismic surveys being less common in the winter season, and a lack of oil and gas activity within proximity to the development area.

Table 3.43 Estimated seasonal averages with the SNS SAC summer and winter areas from seismic surveys on the same day as single piling at North Falls

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: A seismic survey at the same time as a single monopile at North Falls			
Single monopile at North Falls	2,055.5km^2	59 days	5.25%
One seismic survey (at any one time)	1,759km^2	20 days	1.52%
Total	**-**	**-**	**6.77% of the winter area on average over the season**
Winter area: A seismic survey at the same time as pin piling at North Falls			
Single pin pile at North Falls	706.9km^2	182 days (as worst-case)	5.57%
One seismic survey	1,759km^2	20 days	1.52%
Total	**-**	**-**	**7.09% of the winter area on average over the season**

329. The assessment indicates that in the case of either monopiles or pin piles at North Falls, less than 10% of the winter area of the SNS SAC could be affected, due to seismic surveys being undertaken on the same day as piling at North Falls. With the use of appropriate mitigation and management measures defined through the SIP process, to be approved by the MMO, there would be no adverse effect on

the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to underwater noise (other than piling) from North Falls in-combination with seismic surveys.

Disturbance from subsea cables and pipelines

330. Only two subsea pipeline have been screened into the in-combination assessment (ES Volume 3.3, Appendix 12.6, Document Reference: 3.3.11), Sea Link and Tarchon Energy Interconnector. Published findings for the Sea Link project indicate the maximum disturbance range from construction activities will be up to 5km (with a disturbance area on 78.54km^2).

331. As Tarchon Energy is currently at scoping stage and there is limited information available, therefore the Sea Link disturbance ranges have been applied for this project to inform the in-combination assessment with North Falls. Therefore, a disturbance area of up to 157.08km^2 has been assessed for the two projects screened in.

332. This assessment has been based on the potential for disturbance from subsea cable and pipeline projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.50 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from the screened in cable and pipeline projects.

Assessment against the North Sea MU population

333. For disturbance from subsea cables and pipeline projects, and no other in-combination activities, up to 0.34% of the NS MU population may be disturbed (Table 3.44).

Table 3.44 Quantitative assessment for in-combination disturbance of marine mammals due to cable and pipeline projects

Potential in-combination effect	Marine mammal density (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed (% of reference population)
North Falls	*Based on dose response as worst case*		*1,072*
Sea Link[36]	0.68	78.54	54
Tarchon Energy Interconnector	0.55	78.54	44
Total number of harbour porpoise			**1,170**
Percentage of NS MU			**0.34%**

Spatial assessments

334. Sea Link and Tarchon Energy Interconnector are within the winter area of the SNS SAC. If they were constructed at the same time as North Falls piling, the

[36] Taken from Sea Link PEIR (2023)

potential area of disturbance could be 2,212.58km^2, which would be approximately 17.43% of the winter area. If pin piling was undertaken at North Falls at the same time as the projects, the potential for disturbance would cover an area of 863.98km^2 (or 6.81% of the SNS SAC winter area) (Table 3.45).

Table 3.45 Estimated overlaps with the SNS SAC winter area from sub-sea cable and pipeline projects on the same day as single piling at North Falls

In-combination assessment scenario	Maximum overlap with seasonal area for monopiling at North Falls	Maximum overlap with seasonal area for pin piling at North Falls
North Falls	2,055.5km^2	706.9km^2
Cable and pipeline projects	157.08km^2	157.08km^2
Total for winter area	**2,212.58km^2 (17.43% of the winter area)**	**863.98km^2 (6.81% of the winter area)**

335. The displacement of harbour porpoise therefore would not exceed 20% of the winter seasonal component of the SNS SAC during subsea cable and pipeline projects on the same day as piling at North falls. Therefore, under these circumstances, there would be no significant disturbance and no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to underwater noise (other than piling) from North Falls in-combination with subsea cables and pipelines.

Seasonal average

336. The seasonal averages have been calculated by multiplying the maximum area on any one day by the proportion of days within the season on which cable and pipeline projects (Sea Link and Tarchon Energy) could occur. It has been assumed that construction activities at the cabling projects could take place throughout the winter season (Table 3.46).

Table 3.46 Estimated seasonal averages with the SNS SAC winter area from subsea cable and pipeline projects on the same day as single piling at North Falls

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: A seismic survey at the same time as a single monopile at North Falls			
Single monopile at North Falls	2,055.5km^2	59 days	5.25%
Cable and pipeline projects	157.08km^2	182 days	1.24%
Total	**-**	**-**	**6.49% of the winter area on average over the season**
Winter area: A seismic survey at the same time as pin piling at North Falls			
Single pin pile at North Falls	706.9km^2	182 days (as worst-case)	5.57%

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: A seismic survey at the same time as a single monopile at North Falls			
Cable and pipeline projects	157.08km^2	182 days	1.24%
Total	**-**	**-**	**5.81% of the winter area on average over the season**

337. The assessment indicates that on average less than 10% of the winter area of the SNS SAC could be affected, due to subsea cable and pipeline projects being undertaken on the same day as piling at North Falls. Therefore, under these circumstances, there would be no significant disturbance and no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to underwater noise (other than piling) from North Falls in-combination with subsea cables and pipelines.

Disturbance from UXO clearance

338. As for piling, the potential risk of PTS in marine mammals from in-combination effects has been screened out from further consideration in the CEA; if there is the potential for any PTS, suitable mitigation would be put in place to reduce any risk to marine mammals. Therefore, the CEA only considers potential disturbance effects.

339. This assessment has been based on the potential for disturbance due to UXO clearance activities for other projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.50 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from UXO clearance activities. UXO clearance at North Falls itself has not been included within these assessments, as it is not currently being applied for. A full assessment for UXO clearance at North Falls would be undertaken through the separate Marine Licencing process, and will include consideration of the potential for in-combination effects.

340. As for geophysical surveys, the location of the UXO clearance is not currently known, and the following assessment is therefore based on the North Sea AU harbour porpoise density of 0.55/km^2.

341. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, including harbour porpoise, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Existing guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010a).

342. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly

the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The CEA is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.

Assessment against the North Sea MU population

343. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity at North Falls, and therefore, on a worst case basis, the potential for one high-order clearance and one low-order clearance has been assessed as having the potential to take place at the same time (or on the same day).

344. The potential impact area of 2,123.7km^2 per project, based on 26km EDR for UXO high order detonation, and 78.5km^2 for low-order detonation, following the current SNCB guidance for the assessment of impact to harbour porpoise in the SNS SAC.

345. For harbour porpoise, based on the worst case scenario, of one high order and one low order UXO detonation at the same time as North Falls piling up to 0.66% of the reference population could be potentially disturbed (Table 3.47).

Table 3.47 Quantitative assessment for in-combination disturbance of harbour porpoise due to UXO clearance

Potential in-combination effect	Marine mammal density (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response as worst case*		*1,072*
One high-order UXO detonation	0.55	2,123.7	1,168 (0.34%)
One low-order UXO detonation	0.55	78.5	44 (0.01%)
Total number of harbour porpoise (% of reference population)			**2,240 (0.66%)**

Spatial assessment

346. If one high-order UXO detonation was undertaken within the winter area (with an area of 2,123.7km^2), at the same time as monopiling at North Falls, the potential average area of disturbance could be 4,179.2km^2 which would be approximately 32.92% of the winter area (or up to 2,830.6km^2 (22.3% of the SNS SAC winter area for a pin piling at North Falls with high-order UXO clearance)).

347. For one low-order detonation with monopiling at North Falls, the potential average area of disturbance could be 2,134km^2 which would be approximately 16.81% of the winter area (or up to 785.4km^2 (6.19% of the SNS SAC winter area for a pin piling at North Falls with low-order UXO clearance)).

Table 3.48 Estimated overlaps with the SNS SAC winter area from UXO clearance on the same day as single piling at North Falls

In-combination assessment scenario	Maximum overlap with seasonal area for monopiling at North Falls	Maximum overlap with seasonal area for pin piling at North Falls
North Falls	*2,055.5km²*	*706.9km²*
One high-order UXO detonation	2,123.7km²	2,123.7km²
Total for winter area	**4,179.2km² (32.92% of the winter area)**	**2,830.6km² (22.3% of the winter area)**
One low-order UXO detonation	78.5 km²	78.5 km²
Total for winter area	**2,134km² (16.81% of the winter area)**	**785.4km² (6.19% of the winter area)**

348. The displacement of harbour porpoise would not exceed 20% of the winter seasonal component of the SNS SAC on any given day during single low-order UXO detonations in the winter areas at the same time as piling at North Falls, however, the 20% threshold would be exceeded for any high-order UXO clearance on the same day (within the winter season) as piling at North Falls.

349. With the use of appropriate mitigation and management measures defined through the SIP process, to be approved by the MMO, there would be no significant disturbance and no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to underwater noise (other than piling) from North Falls in-combination with UXO clearance activities at other OWF projects.

Seasonal average

350. The seasonal averages have been calculated by multiplying the average area on any one day by the proportion of days within the season on which UXO clearance could occur (Table 3.49). Analysis of MNR data in 2021 indicated there were 4 days of UXO clearance in total in the winter season, with an average of 2 days per clearance. As a precautionary approach 20 days of potential UXO clearance has been included in the assessment. It is assumed majority of the detonations will be low order clearances therefore 90% of the days have been assessed as potentially being a low order clearance.

Table 3.49 Estimated seasonal averages with the SNS SAC summer and winter areas from UXO clearance on the same day as single piling at North Falls

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: One high order UXO detonation at the same time as a single monopile at North Falls			
Single monopile at North Falls	2,055.5km²	59 days	5.25%
One high order UXO detonation	2,123.7km²	2 days	0.18%

In-combination project / activity	Average overlap with seasonal area	Number of piling days for in-combination effects with North Falls	In-combination assessment scenario
Winter area: One high order UXO detonation at the same time as a single monopile at North Falls			
Total	**-**	**-**	**5.43% of the winter area on average over the season**
Winter area: One high order UXO detonation at the same time as pin piling at North Falls			
Single pin pile at North Falls	**706.9km^2**	182 days (as worst-case)	5.57%
One high order UXO detonation	2,123.7km^2	2 days	**0.18%**
Total	**-**	**-**	**5.75% of the winter area on average over the season**
Winter area: One low order UXO detonation at the same time as a single monopile at North Falls			
Single monopile at North Falls	2,055.5km^2	59 days	5.25%
One low order UXO detonation	78.5 km^2	18 days	0.06%
Total	**-**	**-**	**5.31% of the winter area on average over the season**
Winter area: One low order UXO detonation at the same time as pin piling at North Falls			
Single pin pile at North Falls	706.9km^2	182 days (as worst-case)	5.57%
One low order UXO detonation	78.5 km^2	18 days	0.06%
Total	**-**	**-**	**5.63% of the winter area on average over the season**

351. The assessment indicates that for all scenarios with UXO clearance at the same time as piling at North Falls, less than 10% of the winter areas of the SNS SAC could be affected, if there was one high-order UXO detonation at the same time as monopiling at North Falls, or for any low-order clearance with piling at North Falls.

352. Therefore there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to underwater noise (other than piling) from North Falls in-combination with UXO clearance activities at other OWF projects.

In-combination effect 1: overall in-combination disturbance effects from all noise sources

353. Each of the above described noise sources with the potential for disturbance on harbour porpoise are quantitively assessed together in Table 3.50.

354. For harbour porpoise, for noisy activities with the potential for in-combination disturbance effects together with piling at North Falls, up to 2.46% of the population at risk of disturbance.

355. Based on the worst-case scenarios and very precautionary approach, there is the potential for up to 73% of the winter area to be disturbed on any one day, and up to 22% to be disturbed over the season (Table 3.50). It should be noted that the largest impacts estimated in the in-combination assessment are due to possible effects from seismic surveys (which are unrelated to North Falls or any OWF) and UXO clearance. Behavioural effects from UXO clearance, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010) and therefore could be excluded from the total.

Table 3.50 Quantitative assessment for all noisy activities with the potential for in-combination disturbance effects for harbour porpoise

Impact	Number of individuals	Spatial overlap	Seasonal overlap
Worst case disturbance at North Falls (Table 3.17; 3.18; Table 3.19) and piling at other OWFs (Table 3.29; Table 3.31; Table 3.33)	Based on iPCoD modelling, <1% of the population disturbed over the first six years and 25 year period modelled.	4,398.7km^2 (34.6%)	12.51%
Construction activities (including vessels) at other OWFs (Table 3.34)	1,465	569km^2 (4.48%)	4.49%
Up to two geophysical surveys (Table 3.37; Table 3.39)	282	256km^2 (2.02%)	2.02%
Aggregates and dredging (Table 3.40)	4	0km^2	0%
Up to two oil and gas seismic surveys (Table 3.41; Table 3.43)	1,935	1,759.0km^2 (13.85%)	1.52%
Subsea cables and pipelines (Table 3.44; Table 3.46)	98	157.08km^2 (0.79%)	1.24%
High order UXO clearance (as a worst-case) (Table 3.47)	1,168	2,123.7km^2 (16.73%)	0.18%
Total for all activities and projects	**4,952 plus population modelling results (2.46% of the NS MU)**	**9,263.48km^2 (72.96% of the SNS SAC winter area)**	**21.96%**

356. It should be noted that while the projects included within the in-combination assessment for disturbance from other activities and industries were done so based on the current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and

worst case estimate of the harbour porpoise that could be at risk of disturbance during the two year offshore construction period of North Falls.

357. This in-combination assessment will be refined and updated during the SIP process post-consent, to take account of the latest information on project programmes and any detail on project-level mitigation commitments or marine licence conditions from the in-combination projects. The final assessment will also take account of the potential for overlaps in the disturbance areas of all activities, and whether they are likely to take place on the same day or within the same season to refine the assessments. The assessment will also take into account the number of days of each activity included. It is expected that taking these points into consideration would reduce the overlaps.

358. Potential mitigation and management measures for North Falls as are presented in the Outline SIP. NFOW will seek to ensure that there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of North Falls in-combination with other plans and projects, by ensuring both the spatial (20%) and seasonal (10%) thresholds are not breached. As noted in Section 3.4.3.1.1, North Falls have committed to only pile at one monopile location (without NAS) per day during the winter period to ensure there is no breach of the spatial threshold for North Falls alone.

3.4.3.4.2 In-combination impact 2: Barrier effects

359. For the assessment of the potential for barrier effects due to underwater noise from projects undergoing construction, the effect to marine mammal species would be as per the assessments provided in Table 3.50, for in-combination disturbance effects due to all noisy activities.

360. It is important to note that the majority of the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of these other OWFs and other noise sources from North Falls, the maximum underwater impact ranges for disturbance at other projects would not overlap with the maximum underwater impact ranges for disturbance at North Falls during piling and construction.

361. The exception to this is for the potential for overlap in North Falls and Five Estuaries piling (and construction programmes) for either the monopile or pin pile disturbance ranges. Therefore, there is a potential for underwater noise from North Falls and Five Estuaries to result in a barrier of movement to marine mammals. However, this would be a short term and temporary impact, with studies showing that harbour porpoise return to the area shortly after activity has ceased (Graham *et al.*, 2019). In addition, the offshore project area is not located on any known migration routes for harbour porpoise, and the disturbance ranges do not reach the coastline (which could cause a barrier to movement).

362. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.

363. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from in-combination barrier effects.

3.4.3.4.3 In-combination impact 3: Vessel related effects

In-combination impact 3a: Disturbance from vessels associated with operational OWFs

364. While it is unknown exactly how many vessels would be on any OWF site during their operation, it is expected that impacts associated with underwater noise and disturbance from vessels during operation would be less than those during construction as assessed above.

365. If the response is displacement from the area, marine mammals will return once the vessel has passed, and therefore any impacts from vessel presence will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.

366. As an example, an increase of 22 vessels (at any one time) within North Falls during operation is significantly less than the Heinänen and Skov (2015) threshold of 80 vessels per day within 5km^2 (22 vessels within the 223.4km^2 project area would be less than 0.1 vessels per km^2, or 0.5 vessels per 5km^2, per day).

367. Currently available monitoring studies for operational wind farms suggests that marine mammals are not significantly disturbed, and that any effect is localised and temporary (e.g. Diederichs *et al*., 2008; Teilmann *et al.,* 2006; McConnell *et al.,* 2012). Harbour porpoise and seals have also been found to continue to forage within operational wind farm sites (Lindeboom *et al*., 2011; Russell *et al*., 2014). These monitoring studies suggest that there is no significant disturbance from operational wind farms, which may have a number of vessels present at any one time.

368. Vessels associated with offshore wind farm operation are likely to undertake similar activities to those for construction, albeit with much lower frequency. Russel (2016) found that harbour seal foraged within an area undergoing offshore wind farm construction. Benhemma-Le Gall *et al.,* (2021) found that harbour porpoise could be disturbed up to 4km from construction related vessels, although a higher proportion are disturbed at 2km.

369. It is expected that the vessel movements to an operational OWF, and from any port, will be incorporated within existing vessel routes and therefore to areas where marine mammals may already be accustomed to their presence. The increase in vessel presence from operational OWFs is expected to be relatively small compared to the baseline levels of vessel movements in the area. It is also expected that good practice measures, as implemented for North Falls, would be in place for all operational OWFs, further limiting the potential for disturbance.

370. Once on-site, OWF vessels would be stationary or slow moving, as they undertake the activity they are associated with, and therefore the potential for disturbance would be minimal.

371. A quantitative assessment for in-combination disturbance from vessels associated with operational OWFs has not been undertaken due to there being no information on the potential number of vessels present at relevant projects. However, as described above, the potential for vessel disturbance is considered to be localised and temporary, and marine mammals are expected to return to the project areas shortly after vessels have left the area.

372. No mitigation is proposed for underwater noise from operation and maintenance vessels, as there is no risk of an effect. However, vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any impacts, including increased disturbance. All vessel movements will be kept to the minimum number that is required to reduce potential impacts, including increased disturbance.

373. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from disturbance associated with O&M vessels.

In-combination impact 3b: Increased collision risk with vessels

374. The increased collision risk even using a very precautionary approach, has predicted there would be a low number of individuals at risk (with 7 harbour porpoise at risk during the construction phase being the highest number at risk).

375. Vessel movements to and from any port will be incorporated within existing vessel routes and therefore there would be no increased collision risk as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in the Harwich or Lowestoft areas (indicative areas).

376. Once on-site, OWF vessels would be stationary or slow moving, as they undertake the activity they are associated with. Therefore, there is a low risk of any increased collision risk for harbour porpoise, if any.

377. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low or negligible. Therefore, increased collision risk from aggregate extraction and dredging has been screened out from further consideration in the in-combination assessment.

378. Good practice measures, as implemented for North Falls, would ensure any risk of vessels colliding with marine mammals is avoided.

379. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from in-combination increased collision risk with vessels.

3.4.3.4.4 In-combination impact 4: Changes in prey resource

380. For any potential changes to prey resources, it has been assumed that any likely significant effects on harbour porpoise prey species from underwater noise, including piling, would be the same or less than those for harbour porpoise. Therefore, there would be no additional in-combination effects other than those assessed for harbour porpoise, i.e. if prey are disturbed from an area as a result of underwater noise, harbour porpoise will be disturbed from the same or greater area. As a result any changes to prey resources would not affect harbour porpoise as they would already be disturbed from the area.

381. Any effects to prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat for prey species in the surrounding area.

382. Taking into account the assessment for North Falls alone (Section 3.4.3.2.6), with a similar level of effect at other projects and activities[37], along with the range of prey species taken by harbour porpoise and the extent of their foraging ranges, there would be no potential for in-combination effect on harbour porpoise populations as a result of changes to prey resources.

383. Therefore, there would be no adverse effect on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise from in-combination changes in prey resource.

3.5 Humber Estuary SAC and Ramsar

3.5.1 Site overview

384. The Humber is the second largest coastal plain estuary in the UK, and the largest on the east coast of Britain. Grey seal are present as a qualifying feature of the Humber Estuary SAC (Natural England, 2009).

385. The Humber Estuary SAC is located, at closest point, 230km from North Falls. Therefore, there is no potential for direct effect on the SAC as a result of the construction, operation, maintenance or decommissioning of North Falls. However, due to the foraging range of grey seal and the movement of grey seal along the east coast of England, there is the potential for effects on foraging grey seal from the Humber Estuary SAC in the vicinity of North Falls.

386. Note that the SAC is largely coincident[38] with the Humber Estuary Ramsar site for which grey seal are listed under Ramsar Criterion 3. This criterion states "*A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.*"

3.5.1.1 Qualifying Feature

3.5.1.1.1 Grey seal

387. There is a considerable amount of movement of grey seals among different areas and regional subunits of the North Sea, and there is no evidence to suggest that grey seals on the North Sea coasts of Denmark, Germany, the Netherlands, or France are independent from those in the UK (SCOS, 2022).

388. Compared with other times of the year, grey seal in the UK spend longer hauled out during their annual moult (between December and April) and during their breeding season, in eastern England, pupping occurs mainly between early November and mid-December (SCOS, 2022).

[37] Including Berwick Bank, DBS, DEP and SEP, Five Estuaries, Outer Dowsing, East Anglia Hub, and Norfolk Vanguard, which all concluded minimal effects from a localised area (SSE Renewables, 2022; RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited, 2023; Equinor New Energy Ltd, 2022; Five Estuaries Wind Farm Ltd, 2023; Outer Dowsing Offshore Wind, 2023; East Anglia ONE North Limited, 2021; Norfolk Vanguard Limited, 2018).

[38] There is a small section of coast at Easington which is included in the Ramsar site which is not included within the SAC.

389. North Falls is located approximately 40km offshore (at the closest point to shore).

390. The Donna Nook haul-out site is within the Humber Estuary SAC and represents the current best grey seal population estimate of the SAC. In August 2021 there were 3,897 grey seal counted at Donna Nook (SCOS, 2022).

391. A relatively low number of grey seal were recorded during the site-specific aerial surveys, with a total of 13 individuals recorded during the 24 surveys, however, in addition, a total of 23 unidentified seal species were recorded, as well as 17 seal / small cetacean species, a proportion of which are expected to be grey seal.

392. Throughout the surveys the numbers of grey seal, or individuals that could be grey seal (i.e. seal species and seal / small cetacean species) were relatively similar year-round, with no clear change seasonally. Due to the low number of grey seal sightings, absolute density and abundance estimates were not possible to derive from the site-specific surveys.

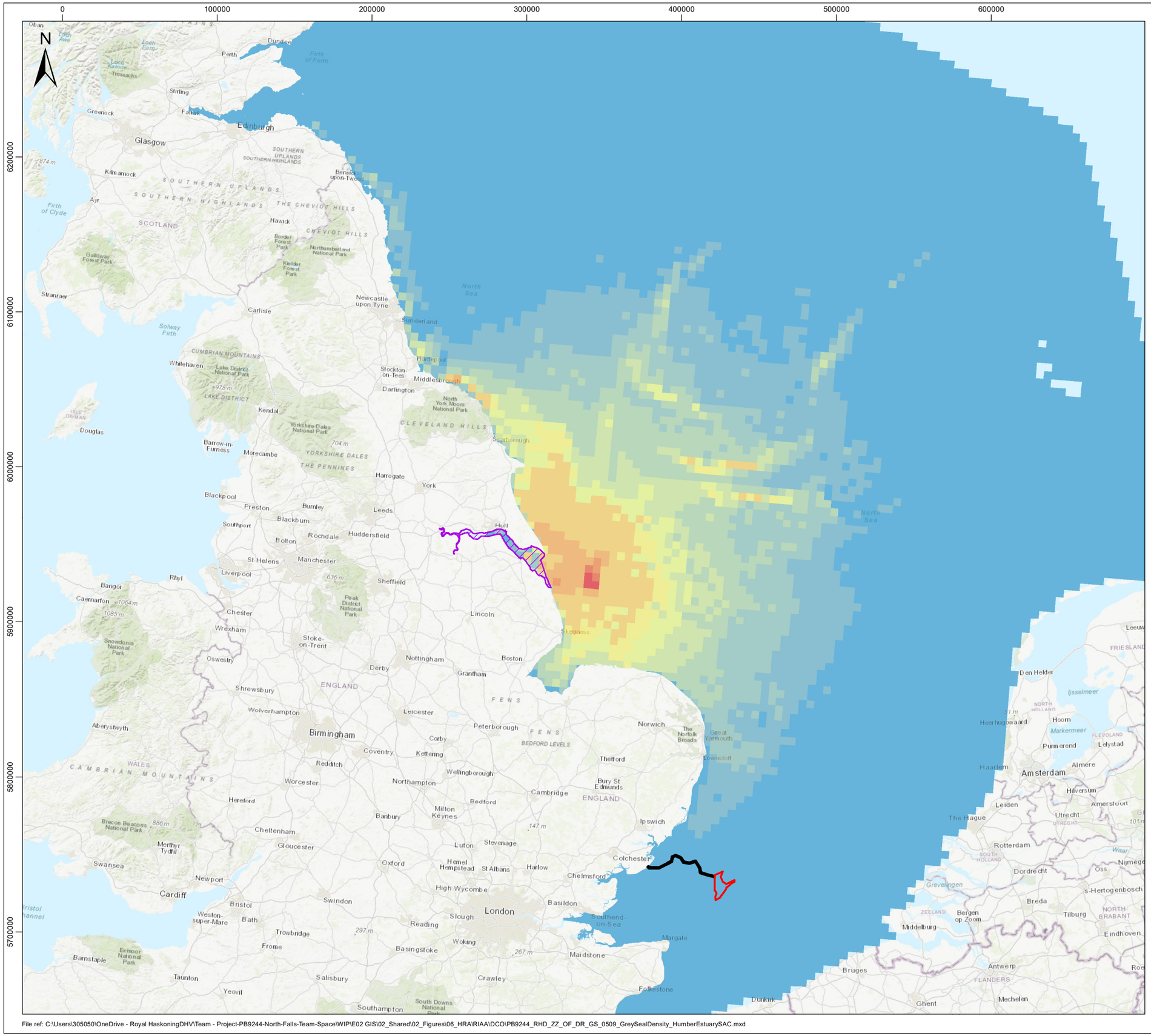
393. *Carter et al., (2022)* produced habitat-based predictions of at-sea distribution for grey seals in the British Isles. The resultant density of seals at-sea maps show the relative density of seals in each 5km by 5km grid cell. As well as the total grey seals at-sea densities, Carter *et al*., (2022) provide SAC specific densities. These SAC specific densities provide the relative density of grey seal that are associated with each SAC. These SAC specific density estimates have been used to calculate the density of grey seal associated with the Humber Estuary SAC present within the North Falls project areas (Figure 3.7). This effectively apportions the potential for effect to only those seals affected that are associated with the SAC itself.

394. The assessments are based on mean relative density estimates for the Humber Estuary SAC from Carter *et al.,* (2022) as a worst-case. The corrected SAC grey seal count was used to generate absolute densities from the relative density data of Carter *et al*., (2022). This at-sea population number is 13,351[39], based on the total population of grey seal at the Humber Estuary SAC (provided in Table 3.51), and calculating against a correction factor of 0.8616 (Russell *et al*., 2015; Carter *et al.,* 2020) to take account of those individuals at sea only.

395. The mean at sea relative density estimates of grey seal for North Falls, and all offshore export cable areas calculated from Carter *et al.,* (2022) are:

    - 0.005 individuals per km^2 for the array area; and
    - 0.013 individuals per km^2 for the total offshore cable corridor.

[39] Note this is not the total SAC population estimate, as accounts for only those seals that are at-sea and not those that could be hauled-out.



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Humber Estuary Special Area of Conservation (SAC)

Mean Grey Seal At-Sea Usage (% per 25km²)

- 0.001 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.04
- 0.05 - 0.06
- 0.07 - 0.08
- 0.09 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 2.00

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Grey Seal At-Sea Mean Densities for the Individuals Associated with the Humber Estuary SAC

Rev	Date	Remarks	Drwn	Chkd
01	22/02/2024	First issue	JH	SB

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0509	3.7

Scale	Plot Size	Datum	Projection
1:2,400,000	A3	WGS84	UTM31N

Royal HaskoningDHV
Enhancing Society Together

NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0509_GreySealDensity_HumberEstuarySAC.mxd

396. The total Humber Estuary SAC population has been corrected to take account of the number of seals not available to count during the surveys. Approximately 0.2515 grey seals are available to count within the August surveys (i.e. are hauled-out), and therefore this has been used as a correction factor, to derive the grey seal SAC population (Table 3.51).

Table 3.51 Grey seal counts and population estimates

Population area	Grey seal haul-out count	Source of haul-out count data	Correction factor for seals not available to count	Grey seal SAC population
Humber Estuary SAC population estimate	3,897	SCOS 2022	0.2515	15,495

397. Assessments are undertaken against the total SAC population estimate of 15,495 seals, for both the project alone and in-combination.

3.5.2 Conservation objectives

398. The Conservation Objectives (Natural England, 2018a) are "*To ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring*:

- *The extent and distribution of qualifying natural habitats and habitats of qualifying species*
- *The structure and function (including typical species) of qualifying natural habitats*
- *The structure and function of the habitats of qualifying species*
- *The supporting processes on which qualifying natural habitats and habitats of qualifying species rely*
- *The populations of qualifying species, and*
- *The distribution of qualifying species within the site*."

399. For grey seal within the Humber Estuary SAC, the specific targets are to;

- Maintain the population size within the site;
- Maintain the reproductive and recruitment capability of the species;
- Maintain the presence and spatial distribution of the species and their ability to undertake key life stage and behaviours;
- Maintain connectivity of the habitat within sites and the wider environment to allow movement of migratory species;
- Restrict the introduction and spread of non-native species and pathogens, and their impacts;
- Maintain the extent and spatial distribution of the following supporting habitats; foraging and haul out sites;
- Maintain the cover / abundance of preferred food items required by the species;

- Maintain the natural physio-chemical properties of the water;
- Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement is not significantly altered or constrained;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain water quality to mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. suspended concentrations of sediment, plankton and other material) in areas where this species is, or could be present.

400. Note that with regard to the Ramsar designation, Natural England advice states that for Ramsar sites, a decision has been made by Defra and Natural England not to produce Conservation Advice packages. As the provisions on the Habitats Regulations relating to HRA extend to Ramsar sites, Natural England considers the Conservation Advice packages for the overlapping European Marine Site designations to be, in most cases, sufficient to support the management of the Ramsar interests. Therefore, the conservation objectives listed above cover both the SAC and Ramsar requirements.

3.5.3 Shadow appropriate assessment

401. For the assessments, the potential for any effects are considered in relation to the Humber Estuary SAC Conservation Objectives for grey seal as outlined in Table 3.52.

Table 3.52 Likely Significant Effects of North Falls in relation to the conservation objectives of the Humber Estuary SAC for grey seal

Conservation Objective for grey seal	Likely Significant Effect
The extent and distribution of qualifying natural habitats and habitats of qualifying species.	No potential pathway for effect. There will be no significant change to the extent and distribution of the habitats of qualifying species in the SAC.
The structure and function (including typical species) of qualifying natural habitats.	No potential pathway for effect. There will be no significant change to the structure and function (including typical species) of qualifying natural habitats.
The structure and function of the habitats of qualifying species.	No potential pathway for effect. There will be no significant change to the structure and function of the habitats of the qualifying species however there is the potential for barrier effects from underwater noise on grey seals therefore it has been assessed further for construction, O&M and decommissioning phases.
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely.	No potential pathway for effect. There will be no significant change to the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely. However, there may be potential changes to water quality and changes to prey resource, therefore, these have been

Conservation Objective for grey seal	Likely Significant Effect
	assessed further for construction, O&M and decommissioning phases.
The populations of qualifying species.	Increased collision risk with vessels will be considered further for construction, O&M and decommissioning phases.
The distribution of qualifying species within the site.	No potential pathway for effect. There will be no significant change to the distribution of qualifying species within the site. However, significant disturbance and displacement as a result of increased underwater noise levels have the potential to have an effect on the seals foraging at sea and have been considered further for construction, O&M and decommissioning phases.

3.5.3.1 Effects during construction

402. Likely significant effects during construction may arise through disturbance from activities during the installation of offshore infrastructure. Underwater noise during piling, as well as disturbance associated with underwater noise from other construction activities and the presence of vessels offshore, are considered. Potential displacement from important habitat areas and impacts on prey species are also considered.

403. The likely significant effects during construction assessed for marine mammals are:

- Auditory injury and disturbance or behavioural impacts resulting from underwater noise during piling, and due to ADD activation prior to piling;
  - Permanent auditory injury (PTS) due to impact piling.
  - Disturbance due to impact piling.
  - Disturbance due to ADD activation prior to piling.
- Auditory injury and disturbance or behavioural impacts resulting from underwater noise during other construction activities, including seabed preparations, rock placement and cable installation;
  - Permanent auditory injury (PTS) due to other construction activities.
  - Disturbance due to other construction activities.
- Impacts resulting from the deployment of construction vessels:
  - Underwater noise and disturbance from construction vessels;
    - Permanent auditory injury (PTS) due to construction vessels.
    - Disturbance due to construction vessels.
  - Vessel interaction (collision risk).
- Barrier effects as a result of underwater noise;
- Changes to water quality; and
- Changes to prey resource.

404. The potential for disturbance at seal haul-out sites has not been assessed for the Humber Estuary SAC. Due to the distance between North Falls and the SAC, there is no potential for an effect to the haul-out sites within the site.

3.5.3.1.1 Impact 1: Effects of underwater noise associated with piling

405. A range of foundation options are being considered for North Falls, including monopiles, jackets (with pin piles), suction buckets for both monopiles and jacket pin piles, and gravity-based for both monopiles and jacket pin piles. Of these, monopiles and jackets (with pin piles) may require piling. As a worst case scenario for underwater noise, it has been assumed that all foundations could be piled, although drive-drill-drive installation may be used.

406. Impact piling is a source of high-level underwater noise, which can cause both physiological (e.g. lethal, physical injury and auditory injury) and behavioural (e.g. disturbance and masking of communication) effects on marine mammals.

407. Should a seal be very close to the source, the high peak pressure sound levels have the potential to cause death or physical injury, with any severe injury potentially leading to death, if no adequate mitigation is in place. High exposure levels from underwater noise sources can cause auditory injury or hearing impairment, taking the form of a permanent loss of hearing sensitivity (PTS).

Impact 1a: Permanent auditory injury (PTS) due to impact piling

408. Any PTS would be permanent, and individuals within the potential impact area are considered to have very limited capacity to avoid such effects, and unable to recover from the effects.

409. PTS can occur instantaneously from acute exposure to high noise levels, such as single strike (SPL_{peak}) of the maximum hammer energy applied during piling. PTS can also occur as a result of prolonged exposure to increased noise levels, such as during the duration of pile installation (SEL_{cum}).

410. The underwater noise modelling was based on the worst-case scenarios for monopiles and pin piles as shown in Section 3.4.3.1.1.

PTS from a single strike

411. The underwater noise modelling results for the predicted impact ranges and areas for PTS from a single strike of both the starting and the maximum hammer energy for the worst case location for grey seal is shown in Table 3.53 (see ES Appendix 12.3, Document Reference: 3.3.8).

412. The worst-case for a single hammer strike is for full hammer energy, and therefore this has been used to inform the following assessments. An assessment of the likely significant effect from a single strike at the starting hammer energy has been provided in Appendix 12.4 (Document Reference: 3.3.9).

Table 3.53 The predicted impact ranges for PTS for grey seals, at the worst case modelling location (East), for the starting and maximum hammer energies of both monopiles and pin piles

Hammer energy	Potential impact ranges (and areas) for PTS	
Starting hammer energy	**Monopile (900kJ)**	**Jacket pin pile (660kJ)**
	<50m (<0.01km^2)	<50m (<0.01km^2)

Hammer energy	Potential impact ranges (and areas) for PTS	
Maximum hammer energy	**Monopile (6,000kJ)**	**Jacket pin pile (4,400kJ)**
	60m (0.01km^2)	50m (0.01km^2)

413. An assessment of the maximum number of individuals that could be at risk of instantaneous PTS, due to a single strike at the maximum hammer energy, for both monopiles and jacket pin piles, is presented in Table 3.54, based on the effect areas as presented in Table 3.53.

Table 3.54 Assessment of the potential for instantaneous PTS due to a single strike of the maximum hammer energy for a monopile and jacket pin pile for grey seal

Piling scenario	Assessment of effect
PTS due to a single strike of a monopile at maximum hammer energy (SPL_{peak})	0.00005 grey seal associated with the Humber Estuary SAC (0.0000003% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2.
PTS due to a single strike of a jacket pin pile at maximum hammer energy (SPL_{peak})	0.00005 grey seal associated with the Humber Estuary SAC (0.0000003% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2.

PTS from cumulative exposure

414. Table 3.55 presents the underwater noise modelling results for the predicted impact ranges and areas for PTS due to the cumulative exposure of monopiles and jacket pin piles at the worst case location.

415. The potential cumulative impact ranges are the same for either one or three sequential monopiles, or for one or six sequential jacket pin piles.

416. It is important to note that this assessment for PTS from cumulative exposure is highly precautionary. There is a lot of variation in the potential impact ranges for SEL_{cum} at each location and between locations. It should be noted, the maximum hammer energy is only likely to be required at a few of the piling installation locations and for shorter periods of time.

Table 3.55 The predicted impact ranges for PTS in grey seals, at the worst case modelling location (East location), for the cumulative exposure of both monopiles and pin piles

Marine mammal species	Potential impact ranges (and areas) for PTS due to cumulative exposure Monopile (6,000kJ)	Jacket pin pile (4,400kJ)
Single pile installation in a 24 hour period	**One monopile**	**One jacket pin pile**
Grey seal	<100m (<0.10km^2)	<100m (<0.10km^2)
Multiple sequential pile installations in a 24 hour period	**Three sequential monopiles**	**Six sequential jacket pin piles**
Grey seal	<100m (<0.10km^2)	<100m (<0.10km^2)

417. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for both sequential monopiles and jacket pin piles, is presented in Table 3.56.

Table 3.56 Assessment of the potential for PTS due to the cumulative exposure of sequential monopiles or jacket pin piles in a 24 hour period for grey seal

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of three sequential monopiles in a 24 hour period (SEL_{cum})	0.0005 grey seal associated with the Humber Estuary SAC (0.000003% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2.
PTS due to the cumulative exposure of six sequential jacket pin piles in a 24 hour period (SEL_{cum})	0.0005 grey seal associated with the Humber Estuary SAC (0.000003% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2.

PTS from cumulative exposure from multiple piling locations

418. The simultaneous piling scenario assumes that animals are within potential impact ranges for a much longer period (i.e. they would be travelling from one pile location to another which piling is ongoing), and therefore cumulative impact ranges are much larger than for the cumulative exposure ranges of one pile at a time.

419. The potential impact ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect only.

420. Where the potential impact areas are not large enough to interact with each other (i.e. they do not meet), the results for the respective locations and scenarios are used (the results of the modelling for the East and South locations are used to inform the assessment, to align with the modelling locations used for the simultaneous modelling).

421. Table 3.57 presents the underwater noise modelling results for the predicted impact ranges and areas for PTS due to the cumulative exposure of simultaneous monopiles and jacket pin piles at the East and South modelling locations. These locations were chosen as they have the potential for the largest 'spread' in terms of underwater noise propagation (as they are the two furthest apart locations). The modelling includes three monopiles being installed sequentially at each location at the same time, and six jacket pin piles being installed sequentially at each location at the same time.

Table 3.57 The predicted impact ranges for PTS grey seals at the East and South modelling locations, for the cumulative exposure of multiple monopiles and pin pile installations at the same time

Marine mammal species	Potential impact areas for PTS due to cumulative exposure of simultaneous pile installations	
	Monopile (6,000kJ)	Jacket pin piles (4,400kJ)
Multiple sequential pile installations in a 24 hour period (for the East and South modelling locations together)	**Three sequential monopiles at the East location and three sequential monopile at the South location**	**Six sequential jacket pin piles at the East location and six sequential jacket pin piles at the South location**
Grey seal	East = <0.1km^2 South = <0.1km^2 **Total together = no overlap, therefore maximum simultaneous effect area is 0.2km^2.**	East = <0.1km^2 South = <0.1km^2 **Total together = no overlap, therefore maximum simultaneous effect area is 0.2km^2.**

422. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for the simultaneous piling of monopiles and jacket pin piles, is presented in Table 3.58.

Table 3.58 Assessment of the potential for PTS due to the cumulative exposure of simultaneous monopiles or jacket pin piles at the same time

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of simultaneous monopile installations (SEL_{cum})	0.001 grey seal associated with the Humber Estuary SAC (0.000007% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2.
PTS due to the cumulative exposure of simultaneous jacket pin pile installations (SEL_{cum})	0.001 grey seal associated with the Humber Estuary SAC (0.000007% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2.

Summary for Impact 1a

423. The potential for PTS onset due to either a single strike (Table 3.54), from the cumulative exposure of sequential piling at one location (Table 3.56), or from the cumulative exposure of sequential piling at multiple locations (Table 3.58), would impact less than 1% of the grey seal Humber Estuary SAC population in all cases.

424. Therefore, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal from PTS from pile installation.

Impact 1b: Disturbance effects due to impact piling

425. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al*., 2007).

426. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of marine mammals, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.

427. Disturbance from construction activities (including piling) may have behavioural consequences on marine mammals in the study area, including reduced time spent foraging at sea as animals move away from sources of noise, displacement from vessels, etc. Repeated disruptions can have cumulative negative effects on the bioenergetic budget of marine species, with the potential for long-term effects on survival and reproductive rates (Christiansen *et al*., 2013).

428. Hastie *et al*., (2021) studied the change in foraging behaviour of grey seal when exposed to underwater noise. A high density and low density area of prey was present within an experimental pool, and speakers were located at each prey patch. During the control periods, seals would forage mainly at the high-density patch, but also at the low-density patch for a smaller proportion of time. When the seals were exposed to noise at the low density patch, there was a reduction in foraging of 16-28%, however, when seals were exposed to noise at the high

density prey patch, there was no change in foraging in comparison to control periods (Hastie *et al*., 2021). This indicates that seals would choose to remain at a noisy environment, if there were good prey resources at the same location (Hastie *et al*., 2021).

429. Russell *et al* (2016) have shown that harbour seal are present in significantly reduced number up to a distance of 25km during piling (or a disturbance area of 1,963.5km^2). This range has been used to determine the number of grey seal that may be disturbed during piling at North Falls (Table 3.59).

Table 3.59 Assessment of the potential for disturbance to grey seal based on a disturbance range of 25km for both monopiles and jacket pin piles

Piling scenario	Assessment of effect
For a single piling event	10 grey seal associated with the Humber Estuary SAC (0.06% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2.
For two simultaneous piling events*	20 grey seal associated with the Humber Estuary SAC (0.13% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2.

** not taking into account any overlap between disturbance areas between the two locations*

Dose response curve assessment

430. Where sufficient scientific evidence exists, a species-specific dose-response assessment has been undertaken rather than using the disturbance ranges that is described above, as per current good practice guidance (Southall *et al*., 2021). Further details on the dose response curve assessment can be found in Section 3.4.3.1.1.

431. For grey seal, the Carter *et al*., (2022) Humber Estuary SAC specific density estimates were used.

432. The estimated number of grey seal and percentage of the Humber Estuary SAC reference population that could be disturbed as a result of underwater noise during piling at North Falls is presented in Table 3.60.

Table 3.60 Number of grey seal (and % of reference population) that could be disturbed during piling at North Falls based on the dose-response approach

Piling scenario	Assessment of effect
Instantaneous behavioural disturbance due to a single, maximum energy monopile strike (SEL_{SS})	9 grey seal (0.05% of the Humber Estuary SAC reference population)
Instantaneous behavioural disturbance due to a single, maximum energy pin pile strike (SEL_{SS})	8 grey seal (0.05% of the Humber Estuary SAC reference population)

433. For a single piling event the worst case would be 0.05% of the Humber Estuary SAC reference population to be at risk of disturbance (Table 3.60). This would be from monopiles.

434. The assessments above show that less than 5% of the Humber Estuary SAC population would be disturbed as a result of piling, and therefore there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal.

Impact 1c: Disturbance effects due to ADD activation

435. The assessments of the potential disturbance during any ADD activation is indicative only, as the final requirements for mitigation in the MMMP will be determined prior to construction.

436. Mitigation to reduce the risk of PTS could include activation of ADDs prior to the soft-start commencing. The period of time that an ADD is required to be activated for is dependent on the potential PTS ranges for each species, and their known swim speeds, as used within the underwater noise modelling.

437. Based on the swim speeds of each species[40], and the maximum ranges of cumulative PTS onset for the installation of one pile, the ADD would be required to be activated for a period of 37 minutes prior to piling, for both monopiles and jacket pin piles. This would result in grey seal fleeing to a range of 3.33km (or an area of 34.84km^2), further than the modelled cumulative PTS onset range of 100m for both monopiles and jacket pin piles).

Table 3.61 Assessment of the potential for disturbance due to ADD activation for both monopile and jacket pin piles

Marine mammal species	Assessment of effect
Grey seal	0.2 grey seal (0.001% of the Humber Estuary SAC population), based on the array area density of 0.005/km^2.

438. The ADD activation would ensure marine mammals are beyond the maximum impact range for instantaneous PTS due to a single strike of the maximum hammer energy for both monopiles and jacket pin piles. ADD activation prior to the soft-start would also reduce the number of marine mammals at risk of PTS from cumulative exposure.

439. There would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal from disturbance from ADD activation.

3.5.3.1.2 Impact 2: Effects from underwater noise associated with other construction activities

440. Potential sources of underwater noise during construction activities, other than piling, include seabed preparation, dredging, rock placement, trenching and cable installation.

441. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during noisy activities (ES Appendix 12.3, Document Reference: 3.3.8) and determine the likely significant effects on marine mammals.

[40] Of 1.5m/s for grey seal (Otani *et al*., 2000).

Impact 2a Permanent auditory injury (PTS) due to other construction activities

442. Underwater noise modelling for the predicted impact ranges and areas for PTS from the cumulative exposure of other construction activities has been undertaken. For SEL_{cum} calculations, the duration of the noise is also considered, with all sources operating for a worst case of 24-hours in a day.

443. The results of the underwater noise modelling do not define impact ranges of <100m, and therefore, where the impact ranges are less than that, the results show impact ranges of <100m (it is possible that the actual impact ranges are therefore considerably lower).

444. The results of the underwater noise modelling (Table 3.62) indicate that grey seals would have to be <100m (precautionary maximum range) from the continuous noise source at the onset of the activity to be exposed to noise levels that could induce PTS. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal.

445. There is the potential that more than one of these other construction activities could be underway at either array area, or within the offshore export cable or interconnector corridors, at the same time. As a worst case and unlikely scenario, an assessment for all four activities being undertaken simultaneously has also been undertaken.

Table 3.62 The predicted impact ranges for cumulative PTS for other construction activities on grey seal

Other construction activity scenario	Potential impact ranges (and areas) for PTS Cable laying, suction dredging, cable trenching, and rock placement*
One other construction activity	<100m (0.031km^2)
All four construction activities taking place at the same time	0.126km^2

** effect areas are based on the area of a circle, with the impact range as the radius*

446. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in Table 3.63, based on the effect areas as presented in Table 3.62.

Table 3.63 Assessment of the potential for PTS due to other construction activities, including cable laying, suction dredging, cable trenching, and rock placement, for one activity taking place at any one time

Other construction activity scenario	Assessment of effect
One construction activity	0.0002 grey seal associated with the Humber Estuary SAC (0.000001% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2, or 0.0004 grey seal associated with the Humber Estuary SAC (0.000003% of the Humber Estuary SAC population) based on the offshore cable corridor density of 0.013/km^2.
All four construction activities taking place at the same time	0.0006 grey seal associated with the Humber Estuary SAC (0.000004% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2, or 0.002 grey seal associated with the Humber Estuary SAC (0.000010% of the Humber Estuary SAC population) based on the offshore cable corridor density of 0.013/km^2.

447. Given the small number of individuals affected (less than one), there would be no adverse effect of PTS in grey seal from other construction activities either alone or taking place simultaneously on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal.

Impact 2b: Disturbance effects due to other construction activities

448. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

449. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance impact on marine mammals.

450. There is limited data on the potential for a behavioural response or disturbance of grey seal from other construction activities. A review of various studies was used to determine the maximum potential disturbance range for other construction activities and vessels. During the construction of two Scottish OWFs (Beatrice OWF and Moray East OWF), Benhemma-Le Gall *et al.*, (2021), reported a 4km (50.3km^2) reduction in harbour porpoise presence and this has been used as the disturbance range for other construction activities, including vessels. As harbour porpoise are the most sensitive marine mammal species, this 4km potential disturbance range has been used for grey seal as a worst case, due to the absence of any other data to inform an assessment.

451. Based on the 4km disturbance range (as reported by Benhemma-Le Gall *et al.*, 2021 for harbour porpoise), the following assessment assumes that either one or up to four other construction activities could be taking place at the same time. This assumes that the disturbance would only affect the area around the vessel at the time of the activity taking place, and that individuals would return to the disturbed area once the activity had either completed or transited to a new location.

452. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities, based on the 4km potential disturbance range, is presented in Table 3.64. This is a precautionary approach as it is unlikely that grey seal would react in the same manner as harbour porpoise to the other construction activities that are expected to be taking place in the offshore project area.

Table 3.64 Assessment of the potential for disturbance due to one or up to four construction activities taking place, including cable laying, suction dredging, cable trenching, and rock placement

Scenario	Assessment of effect
One activity (50.27km2)	0.3 grey seal associated with the Humber Estuary SAC (0.002% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2, or 0.6 grey seal associated with the Humber Estuary SAC (0.004% of the Humber Estuary SAC population) based on the offshore cable corridor density of 0.013/km^2.

Scenario	Assessment of effect
Four activities (201.06km^2)	1 grey seal associated with the Humber Estuary SAC (0.006% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2, or 3 grey seal associated with the Humber Estuary SAC (0.02% of the Humber Estuary SAC population) based on the offshore cable corridor density of 0.013/km^2.

453. Given the small number of individuals affected (less than 1% of the population), there would be no adverse effect of disturbance on grey seal from other construction activities either alone or taking place simultaneously on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal.

Summary for Impact 2

454. It should be noted that this is not an additive effect when considered with the potential for PTS or disturbance from piling, as the potential for PTS or disturbance from other construction activities have significantly lower effect areas when compared to piling, and therefore in the case of piling and other activities taking place at the same time, seals effected from construction activities would be within the area for PTS or disturbance of piling itself.

455. Based on the above assessments, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal from PTS or disturbance effects due to other construction activities.

3.5.3.1.3 Impact 3: Effects from underwater noise and disturbance associated with construction vessels

456. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise due to vessel presence (ES Appendix 12.3, Document Reference: 3.3.8) and determine the likely significant effects on grey seal.

Impact 3a: Permanent auditory injury (PTS) due to construction vessels

457. The underwater noise modelling results for the predicted impact range and area of <100m (0.031km^2) for PTS from the cumulative exposure of vessels within the site predicted. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.

458. The results of the underwater noise modelling do not define impact ranges of <100m, and therefore, where the impact ranges are less than that, the results show impact ranges of <100m (it is possible that the actual impact ranges are therefore considerably lower).

459. The results of the underwater noise modelling indicate that grey seals would have to be <100m (precautionary maximum range) from the continuous noise source to be exposed to noise levels that could induce PTS. It is therefore highly unlikely that any marine mammal would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal.

460. There is the potential that up to 35 vessels may be present in the North Falls site at any one time during construction (with a total potential PTS onset area of

1.1km^2). As a worst case and unlikely scenario, an assessment for all 35 vessels has been undertaken alongside an assessment for an individual vessel (see Table 3.65).

Table 3.65 Assessment of the potential for PTS to grey seal from one or up to 35 construction vessels

Scenario	Assessment of effect
One construction vessel (0.031km^2)	0.0002 grey seal associated with the Humber Estuary SAC (0.000001% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2, or 0.0004 grey seal (0.000003% of the Humber Estuary SAC population) based on the offshore cable corridor density of 0.013/km^2.
35 construction vessels (1.1km^2)	0.005 grey seal associated with the Humber Estuary SAC (0.00004% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2, or 0.014 grey seal (0.00009% of the Humber Estuary SAC population) based on the offshore cable corridor density of 0.013/km^2.

Impact 3b: Disturbance effects due to construction vessels

461. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

462. Seals vary in their reaction to vessels depending on vessel type and proximity to haul out sites; however, disturbance (flushing behaviour) has been demonstrated at haul-out sites in the UK up to 200m away if there are pups present (Cates and Acevedo-Gutiérrez, 2017). Land-based disturbance has been shown to cause higher levels of disturbance compared to marine sources, and smaller, quiet vessels like kayaks can cause the highest levels of flushing behaviour (Bonner, 2021). In areas of high vessel traffic, there are habituation effects and disturbance behaviour is generally reduced (Strong *et al*., 2010).

463. Jones *et al*., (2017) produced usage maps characterising densities of grey and harbour seals and ships around the British Isles, which were used to produce risk maps of seal co-occurrence with shipping traffic. The analysis indicates that rates of co-occurrence were highest within 50km of the coast, close to seal haul-outs. When considering exposure to shipping traffic in isolation, the study found no evidence relating to declining seal population trajectories with high levels of co-occurrence between seals and vessels.

464. If the behavioural response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed, and therefore any impacts from underwater noise as a result of construction vessels will be both localised and temporary. Therefore, it is considered that there would be no adverse effect from disturbance from underwater noise associated with vessels on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal.

Summary for Impact 3

465. There would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal from permanent changes in

hearing sensitivity (PTS) or for the potential for disturbance due to construction vessels.

466. No mitigation is required for underwater noise impacts due to the presence of vessels, however, vessel good practice measures would reduce the potential for effect. The measures include ensuring that vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any impacts, including increased disturbance in accordance with the VMP provided in the Outline PEMP (Document Reference: 7.6).

3.5.3.1.4 Impact 4: Barrier effects from underwater noise during construction

467. Underwater noise during construction could have the potential to create a barrier effect, preventing movement or migration of marine mammals between important feeding and / or breeding areas, or potentially increasing swimming distances if marine mammals avoid the site and go around it. However, the offshore project area is not located on any known migration routes for marine mammals.

468. The array area is located 40km from the coast at closest point. The nearest seal haul-out site is at Gunfleet Sands, approximately 2.8km from the offshore cable corridor at its closest point. Note that this is a tidal haul-out site, and is only exposed at low tide, so is not a haul-out site that would be used for pupping.

469. Telemetry studies (see ES Appendix 12.2, Document Reference: 3.3.7) and the relatively low seal at sea usage (Carter *et al*., 2022; see ES Appendix 12.2, Document Reference: 3.3.7) in and around the offshore project area do not indicate any regular seal foraging routes through the sites.

470. The greatest potential barrier effect for marine mammals could be from underwater noise during piling. Piling would not be constant during the piling phases and construction periods. There will be gaps between the installations of individual piles, and if installed in groups there could be time periods when piling is not taking place as piles are brought out to the site. There will also be potential delays for weather or other technical issues.

471. Various research projects indicate there is no lasting disturbance or exclusion of seals around OWF sites during operation (Diederichs *et al*., 2008; Lindeboom *et al*., 2011; Marine Scotland, 2012; McConnell *et al.,* 2012; Russell *et al.,* 2014; Teilmann *et al.,* 2006, Tougaard *et al.,* 2009). As it is predicted that marine mammals will return once the activity has been completed, any effects from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of marine mammals.

472. Grey seals have foraging ranges of up to 448km (Carter *et al*., 2022), with foraging trips lasting up to 30 days (SCOS, 2021). Therefore, if there are any potential barrier effects from underwater noise, grey seals would be able to compensate by travelling to other foraging areas within their range.

473. Tagged grey seal from Donna Nook and Blakeney revealed that of the 19 tagged seals, 17 entered an operational wind farm off the southern North Sea coast (Russell *et al.,* 2016). Five of the seals entered a total of three different operational wind farms, and one entered nine operational wind farms as well as

a wind farm under construction. The operational sites with the highest number of grey seal within the sites were those closest to their haul-out sites (with Humber Gateway having the most grey seals present (n=12), and Sheringham Shoal having four individual seals present during the tagging study).

474. There is unlikely to be any significant long-term impacts from any barrier effects, as any areas affected would be relatively small in comparison to the range of grey seals and would not be continuous throughout the offshore construction period. It is therefore considered that, for barrier effects as a result of underwater noise, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal.

3.5.3.1.5 Impact 5: Increased risk of collision with vessels during construction

475. During offshore construction, there will be an increase in vessel traffic within the array area and offshore cable corridor. However, it is anticipated that vessels would follow an established shipping route to the relevant ports in order to minimise vessel traffic in the wider area. The approximate number of two way round trips (vessel movements) during construction is estimated to be 2,532 over two years. The number of vessels on site at any one time during construction is estimated to be up to 35 vessels.

476. Seals in and around the offshore project area and in the wider SNS area would typically be habituated to the presence of vessels (given the existing levels of marine traffic, see Chapter 15 Shipping and Navigation, Document Reference: 3.1.17) and would be able to detect and avoid vessels.

477. Seals are able to detect and avoid vessels. However, vessel strikes are known to occur, possibly due to distraction whilst foraging and socially interacting, or due to the marine mammals' inquisitive nature (Wilson *et al.,* 2007). Therefore, increased vessel movements, especially those outside recognised vessel routes, can pose an increased risk of vessel collision to marine mammals. Studies have shown that larger vessels are more likely to cause the most severe or lethal injuries, with vessels over 80m in length causing the most damage to marine mammals (Laist *et al*., 2001). Vessels travelling at high speeds are considered to be more likely to collide with marine mammals, and those travelling at speeds below 10 knots would rarely cause any serious injury (Laist *et al.,* 2001).

478. Thomsen *et al*. (2006) reviewed the effects of ship noise on seal species. As seals use lower frequency sound for communicating (with acute hearing capabilities at 2 kHz) there is the potential for detection, avoidance and masking effects in seals.

479. There is currently limited information on the collision risk of marine mammals in the SNS. To estimate the potential collision risk of vessels associated with North Falls during construction, the potential risk rate per vessel has been calculated for grey seals, which is then used to calculate the total risk to grey seals due to the presence of an additional 35 vessels at any one time during construction (See ES Chapter 12, Section 12.6.1.5, Document Reference 3.1.14). The collision risk has been estimated by using data from the SMASS.

480. SMASS record and investigate all marine mammal strandings reported to them in Scotland. For the 2003 to 2020 period, SMASS identified the cause of death for a total of 470 of the 1,909 reported grey seal strandings. Of these, four died

as a result of physical trauma following probable impact from a ship or boat. This results in a collision risk rate of 0.009.

481. To inform this assessment, the total number of grey seals in UK waters has been compared against the total vessels present in UK waters, as well as the potential collision risk rate of each species based on the SMASS data. The total UK populations are taken from SCOS (2022). The total presence of vessels in UK waters is taken from the total vessel transits within the 2015 AIS data, which is the latest publicly available.

482. The assessment (See ES Chapter 12, Section 12.5.1.5 and Table 12.62, Document Reference: 3.1.14) predicts that up to one (0.9) individual grey seal may be at risk of collision per construction year (or 0.006% of the Humber Estuary SAC population).

483. This is a highly precautionary assumption, as it is unlikely that marine mammals in the offshore project area would be at increased collision risk with vessels during construction, considering the minimal number of vessel movements compared to the existing number of vessel movements in the area, and that vessels within the offshore project area would be stationary for much of the time or very slow moving.

484. In summary, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal for any increase in vessel collision risk during construction.

485. In addition, vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. Vessel operators will use good practice to reduce any risk of collisions with marine mammals Measures include reducing the speed of vessel transits wherever practicable; keeping vessel movements to a minimum and movements will be incorporated into recognised vessel routes, further details of these measures in the VMP.

3.5.3.1.6 Impact 6: Changes to prey availability and habitat quality

486. The likely significant effects on prey species during construction can result from physical disturbance and loss of seabed habitat; increased SSC and sediment re-deposition; and underwater noise. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13) provides an assessment of these impact pathways on the relevant fish and shellfish species, and concludes impacts of negligible to minor adverse significance in EIA terms.

487. During construction activities, the worst-case footprint for disturbance would be 5.5km^2. Predominantly medium and coarse-grained sediment type were found at North Falls (see Chapter 8 Marine Geology, Oceanography and Physical Processes, Document Reference: 3.1.10), typically remaining close to the seabed and settling quickly once disturbed. The worst-case level of sediment smothering and deposition would be approximately <1mm, short-lived (minutes) and localised. Increases in suspended sediment are therefore expected to cause localised and short-term increases in SSC only and not significantly affect fish species.

488. The data and analysis in ES Chapter 9 Marine Water and Sediment Quality (Document Reference: 3.1.11) indicates that levels of contaminants within the North Falls offshore site are low and do not contain elevated levels to cause concern.

489. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13), provides an assessment of the potential underwater noise impacts on fish and shellfish species and predicts that impacts would be of a temporary nature (see Chapter 11 (Document Reference: 3.1.13) for a detailed assessment of underwater noise impacts on fish species). Potential sources of underwater noise and vibration during construction include piling, increased vessel traffic, seabed preparation, rock placement and cable installation. Of these, piling is considered to produce the highest levels of underwater noise and therefore has the greatest potential to result in adverse impacts on fish.

490. Piling could have mortality/injury effects, but under a realistic fleeing animal assumption, ranges at which mortality/potential mortal injury and recoverable injury could occur would be reduced to less than 100m (see ES Chapter 11 Tables 11.21 to 11.34, Document Reference: 3.1.13). Therefore, any effect on prey populations would be highly localised.

491. The outputs of the underwater noise modelling for the spatial worst-case scenario indicate that TTS may occur at distances up to 15km and 16km assuming a fleeing animal scenario (single pin pile and sequential pin pile installation), increasing to up to 33km and 42km when considering a stationary receptor (single monopile and sequential monopiles installation). Behavioural responses would be expected within these ranges and potentially in wider areas depending on the hearing ability of the species under consideration (see ES Chapter 11 Table 11.21 to 11.34, Document Reference: 3.1.13). However, the potential for behavioural response does not indicate that prey would actually leave the area (and in many cases this would not be possible within the duration of a piling event).

492. It is unlikely that there would be significant changes to prey over the entire area. It is more likely that effects would be restricted to an area around the working sites. There is unlikely to be any additional displacement of grey seal as a result of any changes in prey availability during piling as grey seal would also be disturbed from the area.

493. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13) provides an assessment of the potential changes of fishing activity by the presence of safety zones associated with the project during construction. The predicted impact would be of negligible impact given the short-term and temporary nature of the construction phase.

494. Grey seal are opportunistic feeders, preying on a variety of species, dominated by sandeel. Within the SNS, their diet is more varied where grey seals also prey on flat fish, sandy benthic, large gadid prey and scorpion fish (the latter mainly during autumn/winter) (Wilson & Hammond, 2019). They prefer habitat with rock, mixed and coarse sediment (Huon *et al.,* 2015), creating habitat heterogeneity that provides niches for a wide range of species and consequently prey availability (Jones *et al.,* 2014).

495. Despite the relatively large grey seal foraging ranges of 448km (Carter *et al*., 2022), the potential impacts of physical disturbance, temporary habitat loss, increased SSC, re-mobilisation of contaminated sediment on changes in prey availability at North Falls are localised and short in duration.

496. It is highly unlikely that there would be significant changes to prey over the entire area. It is more likely that effects would be restricted to an area around the working sites, and the potential areas for habitat loss.

497. Taking this into account the precautionary approach, along with the separation distance from the Humber Estuary SAC and no potential for any direct effect on the Humber Estuary SAC, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal as a result of any changes to prey availability during construction for North Falls.

3.5.3.1.7 Impact 7: Changes to water quality

498. Potential changes in water quality during construction could occur through:

- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, array, and cables;
- Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and OSP/OCP;
- Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
- Deterioration in water quality associated with release of sediment bound contaminants.

499. North Falls are committed to the use of good practice techniques and due diligence regarding the potential for pollution throughout all construction activities. As a result, an outline PEMP will be developed to accompany the DCO application. The final PEMP would be agreed with the MMO prior to construction and would include, for example, measures to control accidental release of drilling fluids whilst ensuring that any chemicals used are listed on the OSPAR List of Substances Used and Discharged Offshore which are considered PLONOR (OSPAR, 2021).

500. Any direct impacts to marine mammals as a result of any contaminated sediment during construction activities are unlikely as any exposure is more likely to be through potential indirect impacts via prey species.

501. Taking into account the distance between the Humber Estuary SAC and North Falls, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal due to any changes in water quality during the construction of North Falls.

3.5.3.2 Effects during O&M

502. The effects during O&M that have been assessed for are:

- Auditory injury and disturbance or behavioural impacts resulting from operational WTGs;

- Permanent auditory injury (PTS).
- Disturbance.

- Auditory injury and disturbance or behavioural impacts resulting from underwater noise during maintenance activities, including cable protection and cable reburial;
  - Permanent auditory injury (PTS).
  - Disturbance.
- Impacts resulting from the deployment of vessels:
  - Underwater noise and disturbance from vessels;
    - Permanent auditory injury (PTS).
    - Disturbance.
- Vessel interaction (collision risk).
- Barrier effects as a result of underwater noise;
- Changes to water quality; and
- Changes to prey resource and habitat quality.

3.5.3.2.1 Impact 1: Impacts from underwater noise associated with operational WTGs

503. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during the operational phase and determine the likely significant effects on marine mammals (ES Appendix 12.3 Document Reference: 3.3.8).

Impact 1a: Permanent auditory injury (PTS) due to operational wind turbine noise

504. The underwater noise modelling results for the predicted impact ranges and areas for PTS from the cumulative exposure of operational WTGs, show the potential impact range is <100m (0.031km^2) for grey seals, for each WTG. For SEL_{cum} calculations, the duration of the noise is also considered, with operating WTGs for a worst case of 24-hours in a day. The full underwater noise modelling results are provided in Appendix 12.4 (Document Reference: 3.3.9).

505. The reported PTS onset range of less than 100m is likely an overestimation, as the underwater noise modelling does not define impact ranges of <100m. The TTS modelling results also show an effect range of <100m, indicating that the actual potential PTS ranges would be much lower than the reported 100m. Therefore, the potential for any PTS effect is expected to be present in localised areas only, and is not expected to cause a significant risk of PTS onset in the grey seal population.

Impact 1b: Disturbance effects due to operational wind turbine noise

506. Currently available data indicates that there is no lasting disturbance or exclusion of seals around OWF sites during operation (Diederichs *et al*., 2008; Lindeboom *et al*., 2011; Marine Scotland, 2012; McConnell *et al*., 2012; Russell *et al*., 2014; Scheidat *et al*., 2011; Teilmann *et al*., 2006; Tougaard *et al*., 2005, 2009a,

2009b). Data collected suggests that any behavioural responses for seals may only occur up to a few hundred metres away (Touggard *et al*., 2009b; McConnell *et al*., 2012).

507. Monitoring studies at Nysted and Rødsand have indicated that operational activities have had no impact on regional seal populations (Teilmann *et al*., 2006; McConnell *et al*., 2012). Seals have been shown to forage within operational OWFs (e.g. Lindeboom *et al*., 2011; Russell *et al*., 2014), indicating no restriction to movements in operational OWF sites.

508. For the potential for disturbance due to operational WTGs, the effect significance has been assessed as having no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal.

Summary for Impact 1

509. There are no adverse effects on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal for permanent changes in hearing sensitivity (PTS) and potential for disturbance due to operational WTG noise.

3.5.3.2.2 Impact 2: Impacts from underwater noise associated with O&M activities

510. Disturbance to marine mammals foraging at sea may occur as a result of displacement from vessel traffic and sources of noise, including those associated with O&M activities.

511. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities, and if an individual is within close proximity at the onset of the activity. Therefore, it is highly unlikely for there to be any PTS due to these activities.

512. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction.

513. As there is expected to be less noisy activities during the operation phase than is required during construction (see Section 3.5.3.1.2), it is therefore likely to cause less disturbance.

514. There is therefore no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal for permanent changes in hearing sensitivity (PTS) and potential disturbance due to these operational activities.

3.5.3.2.3 Impact 3: Impacts from underwater noise and disturbance associated with O&M vessels

515. During the operation and maintenance of North Falls, there could be up to 1,222 vessel round-trips per year (approximately 3.3 trips per day), representing an increase of up to 1.2% compared to average daily vessels in summer, and up to 2.3% compared to the daily vessels in winter.

516. As outlined in Section 3.5.3.1.3, the potential for PTS is only likely in very close proximity to vessels (<100m), although this is likely an overestimation. The specific requirements for any potential maintenance work are currently unknown, however the work required is likely to be similar to those activities assessed for construction.

517. During operation, there may be up to 22 vessels in the North Falls project area at any one time. (with a total potential PTS onset area of 0.7km^2). As a worst case and unlikely scenario, an assessment for all 22 vessels has been undertaken alongside an assessment for an individual vessel (see Table 3.66).

Table 3.66 Assessment of the potential for PTS to grey seal from O&M vessels

Scenario	Assessment of effect
22 construction vessels (with a total PTS onset area 0.7km^2)	0.003 grey seal associated with the Humber Estuary SAC (0.00002% of the Humber Estuary SAC population) based on the array area density of 0.005/km^2, or 0.009 grey seal (0.00006% of the Humber Estuary SAC population) based on the offshore cable corridor density of 0.013/km^2.

518. If the response is displacement from the area, it is predicted that grey seal will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary.

519. There is no potential for adverse effects on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal due to O&M vessels.

3.5.3.2.4 Impact 4: Barrier effects from underwater noise during O&M

520. The separation distance between turbines would be a minimum of 0.944km to 1.348km in the cross wind direction and 1.18km to 1.685km in the downwind direction, therefore there would be no overlap in the potential impact range of <100m around each turbine and there would be adequate room for marine mammals to move through the array area.

521. While seal species are known to transit along the coastline, there would be sufficient room for them to swim through the array through the operational period. In addition, seal species are known to be present and forage within operational array areas (see Section 3.5.3.2.1), and therefore it is concluded that the presence of North Falls infrastructure would not form a barrier to any movement of marine mammal species.

522. Therefore, no barrier effects as a result of underwater noise during O&M are anticipated, and there are no adverse effects on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal.

3.5.3.2.5 Impact 5: Increased risk of collision with vessels during operation

523. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be up to 22, with the potential for up to 1,222 vessel two way round trips per year.

524. The number of individuals at risk of collision, per vessel, in UK waters, has been calculated as described for the construction phase (Section 3.5.3.1.5). Vessel movements, where possible, will be incorporated into recognised vessel routes

and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk.

525. It is estimated that 0.9 grey seal (0.006% of the Humber Estuary SAC population) could be at risk of collision (see Table 12.81, Chapter 12 of the ES, Document Reference: 3.1.14). This is a highly precautionary assumption, as it is unlikely that grey seal in the offshore project area would be at increased collision risk with vessels during the O&M phase, considering the minimal number of vessel movements compared to the existing number of vessel movements in the area, and that vessels within the offshore project area would be stationary for much of the time or very slow moving.

526. Less than 1% of the Humber Estuary SAC population would be at risk of collision during O&M, therefore there are no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal.

527. In addition, vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. Vessel operators will use good practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever practicable, as described in the VMP.

3.5.3.2.6 Impact 6: Changes to water quality

528. Potential changes in water quality during O&M could occur through:

- Deterioration in water quality due to increases in suspended sediment associated with cable repairs / reburial; and
- Deterioration in water quality associated with release of sediment bound contaminants during maintenance activities.

529. Any risk of accidental release of contaminants will be mitigated in line with the PEMP and any changes to water quality as a result of any accidental release of contaminants leading to potential changes in water quality at North Falls during O&M would be negligible.

530. Any effects on grey seal would be less than those for construction (see Section 3.5.3.1.7) as activities during O&M which disturb the seabed would be less frequent and more localised than during construction.

531. Therefore, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal as a result of any changes to water quality during O&M for North Falls.

3.5.3.2.7 Impact 7: Changes to prey availability and habitat quality

532. Taking into account the distance between North Falls and the Humber Estuary SAC there are no potential direct changes to prey resource within the SAC. Any potential changes to prey availability within or in proximity to North Falls during O&M would be less than those assessed during construction (see Section 3.5.3.2.7) as there would be no piling, fewer disturbing activities etc.

533. Therefore, there would be no adverse effects on grey seal and on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal due to changes to prey resource from O&M at North Falls.

3.5.3.3 Effects during decommissioning

534. Likely significant effects on grey seals associated with decommissioning have not been assessed in detail, as further assessments will be carried out ahead of any decommissioning works to be undertaken taking account of known information at that time, including relevant guidelines and requirements. A detailed decommissioning programme will be provided to the regulator prior to construction that will give details of the techniques to be employed and any relevant mitigation measures required.

535. Decommissioning would most likely involve the removal of the accessible installed components comprising all of the wind turbine components; part of the foundations (those above seabed level); and the sections of the infield cables close to the offshore structures, as well as sections of the offshore export cables. The process for removal of foundations is generally the reverse of the installation process. There would be no piling, and foundations may be cut to an appropriate level.

536. Likely significant effects during decommissioning would most likely include:

- Underwater noise and disturbance from decommissioning activities;
- Underwater noise and disturbance from vessels;
- Barrier effects as a result of underwater noise;
- Increased collision risk with vessels;
- Barrier effects due to underwater noise during decommissioning;
- Changes to water quality; and
- Changes to prey resource.

537. It is not possible to provide details of the methods that will be used during decommissioning at this time. However, it is expected that the activity levels will be comparable to construction (with the exception of pile driving noise which would not occur).

538. Therefore, the likely significant effects on grey seals during decommissioning would be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling.

3.5.3.4 In combination effects

539. The following in-combination assessment has been undertaken based on the CEA Screening Appendix, and Section 12.9 of ES Chapter 12 (Document Reference: 3.1.14).

540. The in-combination effects assessed are;

- Disturbance from underwater noise due to the following sources;
  - Piling at other OWFs;
  - Construction activities at other OWFs;

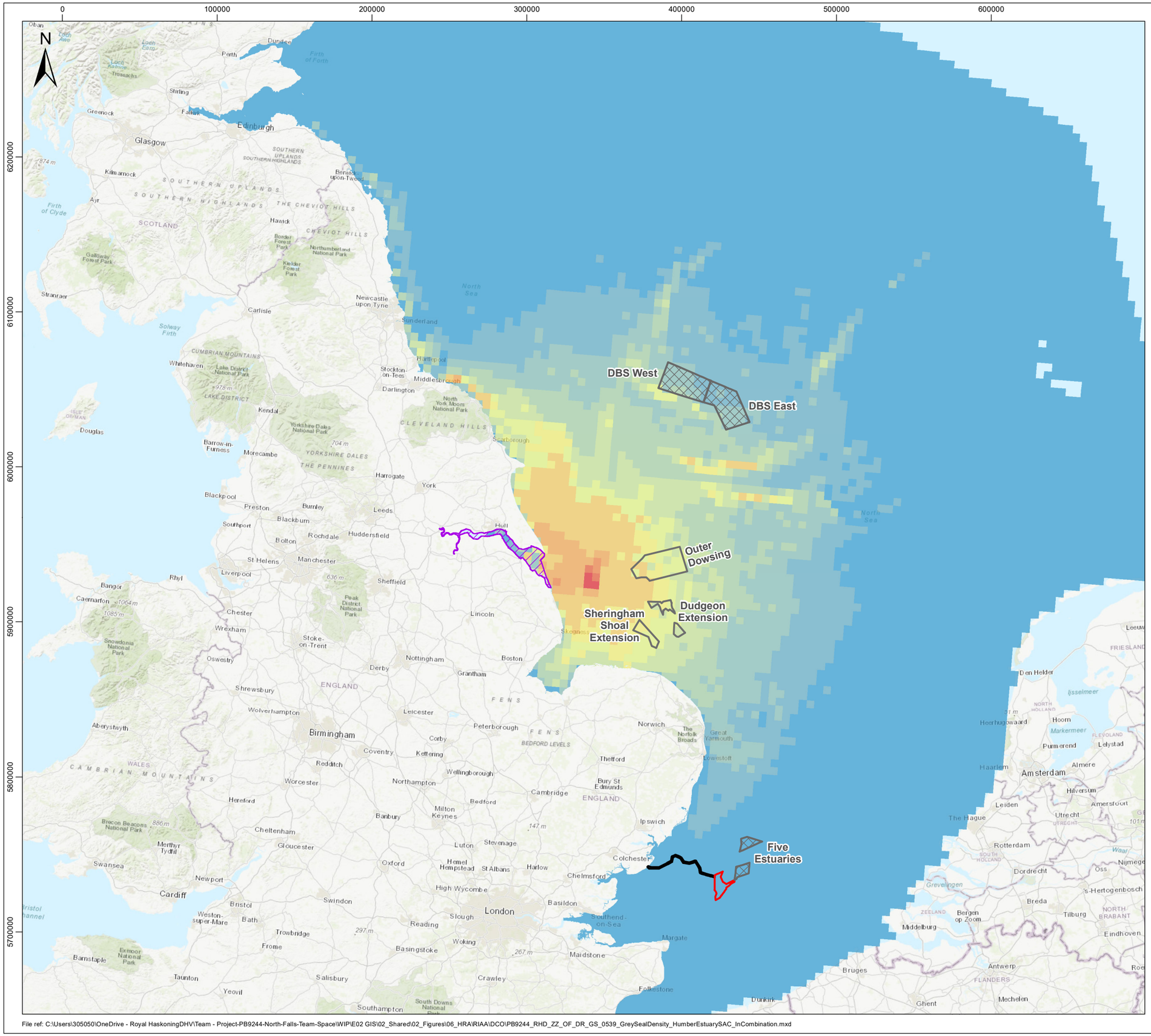
    - Vessels associated with maintenance of OWFs;
    - Geophysical surveys for OWFs;
    - Aggregate extraction and dredging;
    - Oil and gas installation projects;
    - Oil and gas seismic surveys;
    - Subsea cable and pipelines; and
    - UXO clearance.
  - Barrier effects of other OWFs;
  - Increased collision risk with vessels; and
  - Changes in prey resource.

3.5.3.4.1 In-combination impact 1: Disturbance from underwater noise

In-combination impact 1a: Assessment of underwater noise from piling at other OWFs

541. A list of UK and European OWF projects that may have the potential for overlapping piling with North Falls is provided in ES Chapter 12 (Document Reference: 3.1.14) (Table 12.90), and has been used to inform the assessment for in-combination effects due to piling at other OWFs.

542. For grey seal at the Humber Estuary SAC, other OWFs were included in the assessment against the SAC population where the *Carter et al., (2022)* densities for the individuals associated with the Humber Estuary SAC show presence within the 5km x 5km grid cells that overlap with the other OWF (or where there is a presence of seals within the potential disturbance area of the other OWF, e.g. within 25km for other OWFs that may be piling). Figure 3.8 shows the Humber Estuary SAC relative densities against all OWFs screened in for assessment.



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Offshore Wind Farm Site
- Proposed Offshore Wind Farm Site
- Humber Estuary Special Area of Conservation (SAC)

Mean Grey Seal At-Sea Usage (% per 25km²)

- 0.001 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.04
- 0.05 - 0.06
- 0.07 - 0.08
- 0.09 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 2.00

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Grey Seal At-Sea Mean Densities for the Individuals Associated with the Humber Estuary SAC

Rev	Date	Remarks	Drwn	Chkd
01	23/04/2024	First issue	FC	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0539	3.8

Scale	Plot Size	Datum	Projection
1:2,400,000	A3	WGS84	UTM31N

Royal HaskoningDHV
Enhancing Society Together

NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0539_GreySealDensity_HumberEstuarySAC_InCombination.mxd

543. Of the 20 UK and European OWFs screened in for having a construction period that could potentially overlap with the construction of the Project, the below are relevant to grey seal associated with the Humber Estuary SAC and could be piling at the same time as North Falls, which is currently estimated to take place in 2030/31;

- Dogger Bank South (East and West) (DBS);
- Dudgeon Extension Project (DEP);
- Five Estuaries;
- Outer Dowsing; and
- Sheringham Shoal Extension Project (SEP).

544. Of these, all are shown to have grey seal associated with the Humber Estuary SAC present within the project areas.

545. This short list of OWF projects that could be piling at the same time as North Falls could change as projects develop, but this is the best available information at the time of writing, and reflects the limitations and constraints to project delivery.

546. The commitment to the mitigation agreed through the MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) for all marine mammals, and therefore this assessment focuses on the potential for disturbance only.

547. For grey seal, the in-combination assessment is based on the dose response approach.

548. For other projects included in the in-combination assessment, the number of grey seals potentially disturbed is based on the project specific publications or gained using the average density estimate across the Carter *et al.,* (2022) relative density dataset for the Humber Estuary SAC, where project specific information is not available.

549. It should be noted that the potential areas of disturbance assume that there is no overlap in the areas of disturbance between different projects and are therefore highly conservative. For example, Five Estuaries and North Falls are within 10km of each other, Sheringham Shoal Extension Project and Dudgeon Extension Project are approximately 10km from each other at their closest points, and Outer Dowsing is less than 15km from Dudgeon Extension Project.

550. The approach to the in-combination assessment for piling at OWFs is based on the potential for single piling at each OWF at the same time as single piling at the North Falls. This approach allows for some of the OWFs not to be piling at the same time, while others could be simultaneously piling (further information is available in the ES Appendix 12.4, Volume 3.3). This is considered to be the most realistic worst case scenario, as it is highly unlikely that all other OWFs would be simultaneously piling at exactly the same time as piling at North Falls.

551. It is important to note the actual duration for active piling time which could disturb marine mammals is only a very small proportion of the potential construction period, of up to approximately 18.4 days for North Falls.

552. This assessment has been based on the potential for disturbance due to piling at other OWF projects, in-combination with North Falls piling activity (as the worst

case assessment for North Falls). Table 3.75 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity.

553. The in-combination assessment for disturbance from piling is provided in Table 3.67. Up to 1,461 seals may be disturbed, if all projects were piling at the same time, or 9.43% of the Humber Estuary SAC population. The majority of grey seal at risk of disturbance is as a result of projects other than North Falls. This is very precautionary, as it is unlikely that all other OWF projects could be piling at exactly the same time as piling at North Falls.

Table 3.67 Quantitative assessment for in-combination disturbance for grey seal from piling at other OWFs

Project	Grey seal density (based on the Humber Estuary SAC relative densities) (/km^2)	Effect area (km^2)	Maximum number of grey seal potentially disturbed during single piling
North Falls	*Based on dose response*		*9*
DEP[41]	Based on dose response		166
DBS[42]	Based on dose response		346
Five Estuaries[43]	Based on dose response		168
Outer Dowsing[44]	0.29	2,124	615
SEP[45]	Based on dose response		157
Total number of seals			**1,461**
Percentage of Humber Estuary SAC			**9.43%**

554. Additional assessments using iPCoD modelling were undertaken to predict the grey seal population effect due to in-combination disturbance from piling.

555. For the in-combination scenario assessed (see the ES Appendix 12.6 (Document Reference: 3.3.11) for details of the projects considered and their parameters) using the reference population (15,495) of the Humber Estuary SAC for grey seal, the iPCoD model predicts there to be little effect on the grey seal population over time from disturbance due to piling (Plate 3.2 and Table 3.68).

556. The median population size was predicted to be 100% of the un-impacted population size at the end of 2028 (1 year after the piling has commenced in the wider area year after the piling has commenced). By the end of 2032 (the year piling ends) the median population size for the impacted population is predicted to be 99.99% of the un-impacted population size. Beyond 2032, the impacted population is expected to maintain the same stable trajectory as the un-impacted population (as far as 2052 which is the end point of the modelling, at which point

[41] Based on single piling (Equinor New Energy, 2023)
[42] RIAA not available at time of writing, therefore, generic approach used to inform the assessment using 25km range and SAC specific Carter *et al*., 2022 densities
[43] Based on single piling (Five Estuaries Wind Farm Ltd, 2023)
[44] Based on single piling (Outer Dowsing Offshore Wind, 2023)
[45] Based on single piling (Equinor New Energy Ltd, 2022)

the median impacted to un-impacted ratio is 100%; Table 3.68). Therefore, there would be no adverse effect on grey seal of the Humber Estuary SAC, due to the in-combination disturbance of multiple OWFs piling at the same time.

Table 3.68 Results of the iPCoD modelling for the in-combination assessment, giving the mean population size of the grey seal Humber Estuary SAC population for years up to 2053 for both impacted and un-impacted populations in addition to the median ratio between their population sizes.

Year	Un-impacted population mean	Impacted population mean	Median impacted as % of un-impacted
Start	15,496	15,496	100.00
End of 2028	15,636	15,636	100.00
End of 2029	15,812	15,812	100.00
End of 2032	16,252	16,247	99.99
End of 2037	17,084	17,080	100.00
End of 2047	18,870	18,865	100.00
End of 2052	19,732	19,727	100.00

Plate 3.2 Simulated worst-case grey seal Humber Estuary SAC population sizes for both the un-impacted and the impacted populations for the in-combination assessment

In-combination impact 1b: Assessment of underwater noise from construction activities (other than piling) and vessel presence at other OWFs

557. All OWFs with construction dates that have the potential to overlap with the construction dates for North Falls have the potential for other construction activities (such as seabed preparation, dredging, trenching, cable installation, rock placement, drilling and vessels) to occur at the same time as other construction activities at North Falls. See Appendix 12.6 (Document Reference: 3.3.11) for further information on the screening process for other OWFs.

558. For grey seal at the Humber Estuary SAC, other OWFs were included in the assessment against the SAC population where the Carter *et al*. (2022) densities for the individuals associated with the Humber Estuary SAC show presence within the 5km x 5km grid cells that overlap with the other OWF (or where there is a presence of seals within the potential disturbance area of the other OWF).

559. OWFs screened in for other construction activities (including vessels) that could have an in-combination effect with other construction activities at North Falls was narrowed down to:

- East Anglia Hub (East Anglia ONE North);
- Dunkerque;
- Hornsea Project Four;
- Hornsea Project Three; and
- Norfolk Vanguard.

560. This assessment has been based on the potential for disturbance due to construction activities at other OWF projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.75 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity.

561. While the other OWFs that have been assessed under the in-combination piling assessment have the potential for overlapping construction phases, as well as those listed above, they are already assessed under a worst case of piling overlaps. As the disturbance areas for piling are significantly larger than the disturbance areas for other constriction activities, an assessment of piling at those projects would produce a much higher potential for in-combination effect than an assessment for in-combination effects with other construction activities, and they are therefore not included under the assessment for other construction activities as set out below. As noted above, Table 3.75 provides an overall assessment including the potential for disturbance from all OWFs that may be undergoing construction at the same time as North Falls, and where those OWFs' piling windows overlap with North Falls, piling has been included as a worst-case.

562. Noise sources which could cause potential disturbance during OWF construction activities, other than pile driving, can include vessels, seabed preparation, cable installation works and rock placement. Project specific information has been used wherever possible. If no project specific detail is available, a generic assessment approach has been used using the Carter *et al*. (2022) densities, and based on the on the worst case disturbance range of 4km, for up to four activities taking place at the same time, with an area of 201.1km^2.

563. The in-combination assessment for other construction activities (including vessels) at OWF concludes that up to 59 individuals may be disturbed (or 0.4% of the SAC population) (Table 3.69).

Table 3.69 Quantitative assessment for in-combination disturbance for grey seal due to construction activities (including vessels) at other OWFs

Project	Grey seal density (based on the Humber Estuary SAC relative densities) (/km²)	Effect area (km²)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		9
East Anglia ONE North[46]	Based on projects' own assessment		10
Dunkerque*	0.003	201.1	0.6
Hornsea Project Four[47]	Not quantitatively assessed		-
Hornsea Project Three[48]	Not quantitatively assessed		-
Norfolk Vanguard[49]	Based on projects' own assessment		39
Total number of seals			**59**
Percentage of Humber Estuary SAC			**0.4%**

* Project specific assessment unavailable, generic approach used to inform the assessment

564. It should be noted that, while the projects included within the in-combination assessment were screened in on the basis of current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the marine mammals that could be at risk of disturbance during the two year offshore construction period of North Falls.

In-combination impact 1c: Assessment of disturbance from other industries and activities

565. During the construction period for North Falls, there is the potential for disturbance to grey seals associated with other potential noise sources, including:

- Geophysical surveys associated with other OWFs;
- Aggregate extraction and dredging;
- Oil and gas installation projects;
- Oil and gas seismic surveys;
- Subsea cable and pipelines;
- Other marine renewable projects (such as wave and tidal projects);

[46] (East Anglia ONE North Limited, 2021)
[47] Not quantitively assessed in Project's own assessment (Orsted Power (UK) Ltd, 2019)
[48] Not quantitively assessed in Project's own assessment (Orsted Power (UK) Ltd, 2018)
[49] (Norfolk Vanguard Limited, 2018)

- Disposal sites; and
- UXO clearance.

566. For the installation of oil and gas infrastructure, marine renewable projects, and disposal sites, all potential projects have been screened out. Further information on the CEA screening (and these results) are provided in the ES Appendix 12.6 (Volume 3.3).

Disturbance from geophysical surveys

567. As outlined in the ES Appendix 12.6 (Document Reference: 3.3.11), OWF geophysical surveys using SBPs and USBL systems have the potential to disturb marine mammals and have therefore been screened into the in-combination assessment, as a precautionary approach. The potential disturbance range used in the in-combination assessment is based on the SNCB guidance for assessment for harbour porpoise.

568. This assessment has been based on the potential for disturbance from geophysical surveys, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.75 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from geophysical surveys.

569. Assessments for the RoC HRA for the SNS SAC (BEIS, 2020), modelled the potential for disturbance due to the use of a SBP, and results indicated that there is the potential for a possible behavioural response in harbour porpoise at up to 3.77km (44.65km^2) from the source. The current guidance for assessing the significance of noise disturbance for harbour porpoise SACs (JNCC *et al*., 2020) recommends the use of an EDR of 5km (78.54km^2) for geophysical surveys.

570. As a worst case, it has been assumed that all grey seal within 5km of the survey source, a total area of 78.54km^2, could be disturbed.

571. For geophysical surveys with sub-bottom profilers, it is realistic and appropriate to base the assessments on the potential impact area around the vessel, as the potential for disturbance would be around the vessel at any one time. Seals would not be at risk throughout the entire area surveyed in a day, as animals would return once the vessel had passed, and the disturbance had ceased.

572. It is currently not possible to estimate the location or number of potential OWF geophysical surveys that could be undertaken at the same time as construction and potential piling activity at North Falls. It is therefore assumed, as a worst case scenario, that there could potentially be up to two geophysical surveys in the North Sea at any one time, during construction of North Falls, with a total disturbance area of 157.1km^2 (see Section 3.4.3.4.1).

573. As the location of the potential geophysical surveys is currently unknown, the following assessment for grey seal uses the average density estimate across the *Carter et al., (2022)* relative density dataset for the Humber Estuary SAC of 0.053/km^2. This therefore assumes that there could be up to two geophysical surveys within the area at which grey seal associated with the Humber Estuary SAC may be present.

574. For up to two geophysical surveys undertaken at the same time as construction of North Falls, with no other in-combination activities, up to 0.11% of the Humber Estuary SAC population may be disturbed (Table 3.70).

Table 3.70 Quantitative assessment for in-combination disturbance of marine mammals due to up to two geophysical surveys at OWFs

Potential in-combination effect	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*	*9*
Up to two geophysical surveys	157.08	9
Total number of seals		**18**
Percentage of Humber Estuary SAC		**0.11%**

Disturbance from Aggregate extraction and dredging

575. As a precautionary approach, a total of six aggregate extraction and dredging projects are included in the CEA for the potential in-combination disturbance (see the ES Appendix 12.6, Document Reference: 3.3.11).

576. Taking into account the small potential impact ranges, distances of the aggregate extraction and dredging projects from North Falls, the potential for contribution to in-combination effects is very small. Therefore, risk of PTS for grey seals from aggregate extraction and dredging has been screened out from further consideration in the in-combination assessment.

577. This assessment has been based on the potential for disturbance from aggregate and dredging projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.75 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from these screened in aggregate and dredging projects.

578. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al.*, 2010). As a worst case assessment, a disturbance range of 600m has also been applied to grey seal has been assumed for up to six operational aggregate projects at the same time as North Falls construction. This would result in a potential disturbance area of 1.13km^2 for each project, or up to 6.8km^2 for all six aggregate projects.

579. For the potential for in-combination disturbance from aggregate and dredging projects undertaken at the same time as construction of North Falls, with no other in-combination activities, up to 0.06% of the Humber Estuary SAC population may be disturbed (Table 3.71).

Table 3.71 Quantitative assessment for in-combination disturbance of marine mammals due to aggregate and dredging projects

Potential in-combination effect	Grey seal density (based on the Humber Estuary SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*9*

Potential in-combination effect	Grey seal density (based on the Humber Estuary SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
Aggregate and dredging projects (1.13km^2) disturbance area per project)	0.053	6.8	0.4
Total number of seals			**10**
Percentage of Humber Estuary SAC			**0.06%**

Disturbance from oil and gas seismic surveys

580. It is currently not possible to estimate the number of potential oil and gas seismic surveys that could be undertaken at the same time as construction and potential piling activity at North Falls. Therefore, it has been assumed that at any one time, up to two seismic surveys could be taking place at the same time.

581. This assessment has been based on the potential for disturbance from seismic surveys (associated with oil and gas projects), in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.75 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including these seismic surveys.

582. This assessment for the potential disturbance due to oil and gas seismic surveys is based on the following:

- There is little available information on the potential for disturbance from seismic surveys for grey seal, however, observations of behavioural changes in other seal species have shown avoidance reactions up to 3.6km from the source for a seismic survey (Harris *et al*., 2001). A more recent assessment of potential for disturbance to seal species, as a result of seismic surveys, shows potential disturbance ranges from 13.3km to 17.0km from source (BEIS, 2020). These ranges are based on modelled impact ranges, using the National Marine Fisheries Service Level B harassment threshold of 160dB, for a noise source of 3,070 cubic inches, 4,240 cubic inches, or 8,000 cubic inches.
- A potential disturbance range of 17.0km (or disturbance area of 907.9km^2 for one survey, and 1,815.8km^2 for up to two seismic surveys) will therefore be applied to grey seal due to a lack of species-specific information.

583. As the location of the potential seismic surveys is currently unknown, the following assessments for grey seal use the average density estimate across the *Carter et al., (2022)* relative density dataset for the Humber Estuary SAC of 0.053/km^2. This therefore assumes that there could be up to two seismic surveys within the area at which grey seal associated with the Humber Estuary SAC may be present.

584. For oil and gas seismic surveys undertaken at the same time as construction of North Falls, up to 0.7% of the Humber Estuary SAC population may be disturbed (Table 3.72).

Table 3.72 Quantitative assessment for in-combination disturbance of marine mammals due to up to two oil and gas seismic surveys

Potential in-combination effect	Grey seal density (based on the Humber Estuary SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*9*
Up to two seismic surveys	0.053	1,815.8	97
Total number of seals			**106**
Percentage of Humber Estuary SAC			**0.7%**

Disturbance from subsea cables and pipelines

585. Only two subsea pipeline have been screened into the in-combination assessment, Sea Link and Tarchon Energy Interconnector. Published findings for the Sea Link project indicate the maximum disturbance range from construction activities will be up to 5km (with a disturbance area on 78.54km^2).

586. As Tarchon Energy is currently at scoping stage and there is limited information available, therefore the Sea Link disturbance ranges have been applied for this project to inform the in-combination assessment with North Falls. Therefore, a disturbance area of up to 157.08km^2 has been assessed for the two projects screened in.

587. This assessment has been based on the potential for disturbance from subsea cable and pipeline projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.75 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from the screened in cable and pipeline projects.

588. The density for the projects has been estimated based on the Carter *et al.,* (2022) relative density data for the Humber Estuary SAC, with an estimated density (for only those grey seals that are associated with the Humber Estuary SAC) of 0.053/km^2.

589. For disturbance from subsea cables and pipeline projects, and no other in-combination activities, up to 0.11% of the Humber Estuary SAC population may be disturbed (Table 3.73).

Table 3.73 Quantitative assessment for in-combination disturbance of grey seals due to cable and pipeline projects

Potential in-combination effect	Grey seal density (based on the Humber Estuary SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*9*
Cable and pipeline projects	0.053	157.08	10
Total number of seals			**19**
Percentage of Humber Estuary SAC			**0.11%**

Disturbance from UXO clearance

590. As for piling, the potential risk of PTS in marine mammals from in-combination effects has been screened out from further consideration in the CEA; if there is the potential for any PTS, suitable mitigation would be put in place to reduce any risk to marine mammals. Therefore, the CEA only considers potential disturbance effects.

591. This assessment has been based on the potential for disturbance due to UXO clearance activities for other projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.75 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from UXO clearance activities. UXO clearance at North Falls itself has not been included within these assessments, as it is not currently being applied for. A full assessment for UXO clearance at North Falls would be undertaken through the separate Marine Licencing process, and will include consideration of the potential for in-combination effects.

592. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity at North Falls, and therefore, on a worst case basis, the potential for one high-order clearance and one low-order clearance has been assessed as having the potential to take place at the same time.

593. The potential impact area during a single UXO clearance event is based on the modelled worst case impact range at North Falls for TTS / fleeing response (weighted SEL) of 22.0km (1,520.5km^2) for high-order clearance and 0.8km (2.01km^2) for low-order clearance.

594. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010).

595. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.

596. As the location of the potential UXO clearances are currently unknown, the following assessment for grey seal uses the average density estimate across the Humber Estuary SAC of 0.053/km^2.

597. For grey seal, based on the worst case scenario, of one high order and one low order UXO detonation at the same time as North Falls piling up to 0.58% of the reference population could be potentially disturbed (Table 3.74).

Table 3.74 Quantitative assessment for in-combination disturbance of grey seals due to UXO clearance

Potential in-combination effect	Grey seal density (based on the Humber Estuary SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*9*
One high-order UXO detonation	0.053	1,520.5	81
One low-order UXO detonation	0.053	2.01	0.1
Total number of seals			**90**
Percentage of Humber Estuary SAC			**0.58%**

In-combination impact 1: Summary of in-combination effect 1: assessment of disturbance from all noisy activities associated with offshore industries

598. Each of the above described other noise sources are quantitively assessed together in Table 3.75.

599. For grey seal, for noisy activities with the potential for in-combination disturbance effects together with piling at North Falls, up to 2.6% of the population at risk of disturbance.

600. It should be noted that while the projects included within the in-combination assessment for disturbance from other activities and industries were done so based on the current knowledge of their possible construction or activity windows, and it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the grey seals that could be at risk of disturbance during the two year offshore construction period of North Falls.

601. As shown in the above assessments, the majority of grey seal at risk of disturbance are from OWF piling, with those projects that are within close proximity of the Humber Estuary SAC contributing a large proportion of the in-combination disturbance. Therefore, there is limited opportunity for North Falls to significantly reduce the overall potential disturbance effect to the Humber Estuary SAC population.

602. However, as this is a temporary effect and less than 5% of the Humber Estuary SAC population is affected, there is no adverse effect on the integrity of the Humber Estuary SAC site in relation to the conservation objectives for grey seal.

Table 3.75 Quantitative assessment for all noisy activities with the potential for in-combination disturbance effects for grey seals

Noisy activity	Maximum number of grey seal potentially disturbed
North Falls piling and piling at other OWFs	*Based on iPCoD modelling, <1% of the population disturbed over the first six years and 25 year period modelled.*
Construction activities (including vessels) at other OWFs	50
Up to two geophysical surveys	9

Noisy activity	Maximum number of grey seal potentially disturbed
Aggregates and dredging	0.4
Up to two oil and gas seismic surveys	97
Subsea cables and pipelines	10
UXO clearance	81
Total number of individuals	**248 plus population modelling results**
Percentage of Humber Estuary SAC	**2.6%**

3.5.3.4.2 In-combination impact 2: Barrier effects

603. For the assessment of the potential for barrier effects due to underwater noise from projects undergoing construction, the effect to marine mammal species would be as per the assessments provided in Table 3.75, for in-combination disturbance effects due to all noisy activities.

604. It is important to note that the majority of the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of these other OWFs and other noise sources from North Falls, the maximum underwater impact ranges for disturbance at other projects would not overlap with the maximum underwater impact ranges for disturbance at North Falls during piling and construction.

605. The exception to this is for the potential for overlap in North Falls and Five Estuaries piling (and construction programmes) for either the monopile of pin pile disturbance ranges. Therefore, there is a potential for underwater noise from North Falls and Five Estuaries to result in a barrier of movement to marine mammals. However, the offshore project area is not located on any known migration routes for marine mammals, and the disturbance ranges do not overlap with any seal haul out sites.

606. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.

607. There would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal due to barrier effects.

3.5.3.4.3 In-combination impact 3: Vessel related effects

In-combination impact 3a: Disturbance from vessels associated with operational OWFs

608. While it is unknown exactly how many vessels would be on any OWF site during their operation, it is expected that impacts associated with underwater noise and disturbance from vessels during operation would be less than those during construction as assessed above.

609. If the response is displacement from the area, marine mammals will return once the vessel has passed, and therefore any impacts from vessel presence will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.

610. Currently available monitoring studies for operational wind farms suggests that marine mammals are not significantly disturbed, and that any effect is localised and temporary (e.g. Diederichs *et al*., 2008; Teilmann *et al*., 2006; McConnell *et al.*, 2012). Harbour porpoise and seals have also been found to continue to forage within operational wind farm sites (Lindeboom *et al*., 2011; Russell *et al.,* 2014). These monitoring studies suggest that there is no significant disturbance from operational wind farms, which may have a number of vessels present at any one time.

611. Vessels associated with offshore wind farm operation are likely to undertake similar activities to those for construction, albeit with much lower frequency. Russel (2016) found that harbour seal foraged within an area undergoing offshore wind farm construction.

612. It is expected that the vessel movements to an operational OWF, and from any port, will be incorporated within existing vessel routes and therefore to areas where marine mammals may already be accustomed to their presence. The increase in vessel presence from operational OWFs is expected to be relatively small compared to the baseline levels of vessel movements in the area. It is also expected that good practice measures, as implemented for North Falls, would be in place for all operational OWFs, further limiting the potential for disturbance.

613. Once on-site, OWF vessels would be stationary or slow moving, as they undertake the activity they are associated with, and therefore the potential for disturbance would be minimal.

614. A quantitative assessment for in-combination disturbance from vessels associated with operational OWFs has not been undertaken due to there being no information on the potential number of vessels present at relevant projects. However, as described above, the potential for vessel disturbance is considered to be localised and temporary, and marine mammals are expected to return to the project areas shortly after vessels have left the area.

615. No mitigation is proposed for underwater noise from operation and maintenance vessels, as there is no risk of an effect. However, vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any impacts, including increased disturbance. All vessel movements will be kept to the minimum number that is required to reduce any likely significant effects, including increased disturbance.

616. Therefore, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal due to disturbance from operational vessels.

In-combination impact 3b: Increased collision risk with vessels

617. The increased collision risk even using a very precautionary approach, has an effect significance of minor adverse (with mitigation), with a low number of marine mammals at risk.

618. Vessel movements to and from any port will be incorporated within existing vessel routes and therefore there would be no increased collision risk as the increase in the number OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas.

619. Once on-site, OWF vessels would be stationary or slow moving, as they undertake the activity they are associated with. Therefore, the risk of any increased collision risk for grey seals would be negligible, if any.

620. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low or negligible. Therefore, increased collision risk from aggregate extraction and dredging has been screened out from further consideration in the in-combination assessment.

621. Good practice measures, as implemented for North Falls, would ensure any risk of vessels colliding with grey seals is avoided.

622. Therefore, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal as a result of collision risk.

3.5.3.4.4 In-combination impact 4: Changes in prey resource

623. For any potential changes to prey resources, it has been assumed that any likely significant effects on grey seal prey species from underwater noise, including piling, would be the same or less than those for grey seal. Therefore, there would be no additional in-combination effects other than those assessed for grey seal, i.e. if prey are disturbed from an area as a result of underwater noise, grey seal will be disturbed from the same or greater area. As a result any changes to prey resources would not affect grey seal as they would already be disturbed from the area.

624. Any effects to prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat for prey species in the surrounding area.

625. Taking into account the assessment for North Falls alone (Section 3.5.3.1.6), with a similar level of effect at other projects and activities[50], along with the range of prey species taken by grey seal and the extent of their foraging ranges, there would be no potential for in-combination effect on grey seal populations as a result of changes to prey resources.

626. Therefore, there would be no adverse effect on the integrity of the Humber Estuary SAC in relation to the conservation objectives for grey seal as a result of changes in prey resource.

[50] Including Berwick Bank, DBS, DEP and SEP, Five Estuaries, Outer Dowsing, East Anglia Hub, and Norfolk Vanguard, which all concluded minimal effects from a localised area (SSE Renewables, 2022; RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited, 2023; Equinor New Energy Ltd, 2022; Five Estuaries Wind Farm Ltd, 2023; Outer Dowsing Offshore Wind, 2023; East Anglia ONE North Limited, 2021; Norfolk Vanguard Limited, 2018).

3.6 The Wash and North Norfolk Coast SAC

3.6.1 Site overview

627. The Wash and North Norfolk Coast SAC (TW & NNC SAC), located on the east coast of England, is the largest embayment in the UK, and the extensive intertidal flats both within TW & NNC SAC, and extending along the north Norfolk coast, provide ideal conditions for harbour seal breeding and haul-out sites. Harbour seal are a primary reason for the designation of TW & NNC SAC.

628. TW & NNC SAC is located, at closest point, 150km from the closest point at North Falls. Therefore, there is no potential for direct effects on the SAC as a result of the construction, operation, maintenance or decommissioning of North Falls. However, due to the foraging range of harbour seals, there is the potential for effects on foraging harbour seal from TW & NNC SAC in the vicinity of North Falls.

3.6.1.1 Qualifying features

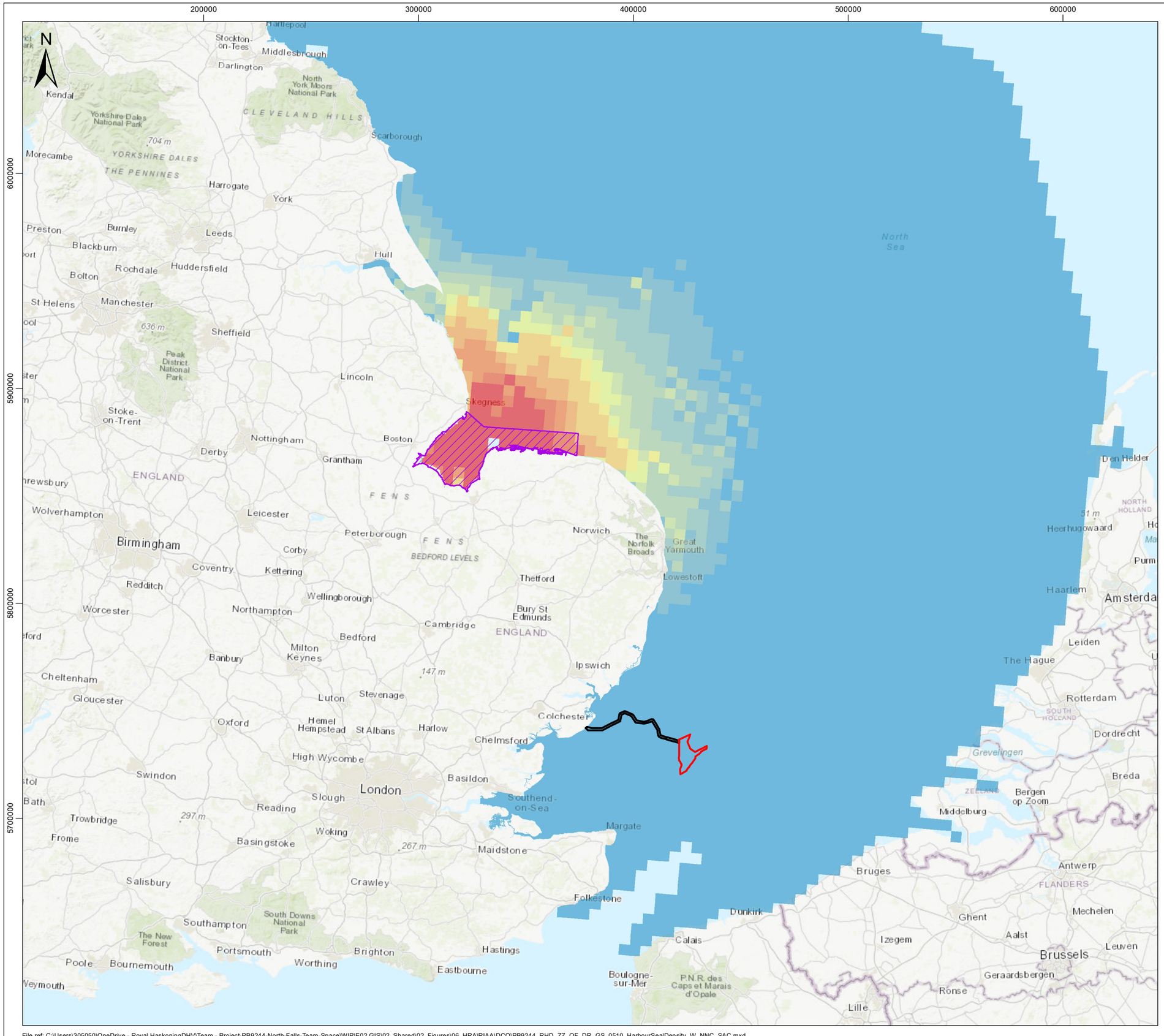
3.6.1.1.1 Harbour seal

629. Principal harbour seal haul-out sites in TW & NNC SAC include Blakeney Point and The Wash (SCOS, 2021).

630. In the 2021 August seal haul-out count for The Wash sites and Blakeney Point, an average of 2,667 harbour seal were counted within The Wash, and an average of 181 harbour seals at the Blakeney Points site, with a total average count of 2,848 for the haul-out sites associated with The Wash and North Norfolk Coast SAC (SCOS, 2021).

631. No harbour seal sightings were confirmed during the site-specific aerial surveys, however there was a total of 23 individuals within unidentified seal species and 17 individuals within the seal/ small cetacean group recorded through the 24 survey dates, a proportion of which could be harbour seal (although the majority are expected to be grey seal). Absolute density and abundance estimates were not possible to derive from the site-specific surveys.

632. The harbour seal density estimates for North Falls have been calculated from the latest seal at sea maps produced by (Carter *et al*., 2022), based on the 5km x 5km grids that overlap with each area (see the ES Appendix 12.2, Document Reference: 3.3.7), and using the density data for The Wash and North Norfolk Coast SAC (Figure 3.9). This effectively apportions the potential for effect to only those seals that are affected that are associated with the SAC itself.



Legend

- North Falls Array Area
- Offshore Cable Corridor
- The Wash and North Norfolk Coast Special Area of Conservation (SAC)

Mean Harbour Seal At-Sea Usage (% per 25km²)

- 0.001 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.04
- 0.05 - 0.06
- 0.07 - 0.08
- 0.09 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 2.00

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Harbour Seal At-Sea Mean Densities for Those Individuals Associated with The Wash and North Norfolk Coast SAC

Rev	Date	Remarks	Drwn	Chkd
01	22/02/2024	First issue	FC	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0510	3.9

Scale	Plot Size	Datum	Projection
1:1,750,000	A3	WGS84	UTM31N

Royal HaskoningDHV
Enhancing Society Together

NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0510_HarbourSealDensity_W_NNC_SAC.mxd

633. The total harbour seal population in the British Isles, at sea, is approximately 40,600 individuals, based on the corrected values and most recent haul-out counts for the UK (SCOS, 2021). The total at-sea harbour seal population for The Wash has been estimated as 3,258[51], based on the total population of harbour seal of this SAC (provided in Table 3.76 below), and calculating against a correction factor of 0.8236 (Russell *et al.*, 2015; Carter *et al.,* 2020) to take account of those individuals at sea only. This is the population estimate used with the Carter *et al.,* (2022) data to calculate density estimates for North Falls.

634. The mean at sea relative density estimates of harbour seal for North Falls, and all offshore export cables areas, based on the SAC specific densities from Carter *et al*., (2022), are:

- 0.000010 individuals per km^2 for the array area; and
- 0.0011 individuals per km^2 for the offshore export cable.

635. The total TW & NNC SAC population has been corrected to take account of the number of seals not available to count during the surveys. Approximately 0.72 harbour seals (Lonergan *et al.*, 2013) are available to count within the August surveys (i.e. are hauled-out), and therefore this has been used as a correction factor, to derive the total harbour seal SAC population (Table 3.76).

Table 3.76 Harbour seal counts and population estimates

Population area	Harbour seal haul-out count	Source of haul-out count data	Correction factor for seals not available to count	Harbour seal SAC population
Total SAC population	2,848	SCOS 2022	0.72	3,956

636. Assessments are undertaken against the total SAC population estimate of 3,956 seals, for both the project alone and in-combination.

3.6.2 Conservation objectives

637. The Conservation Objectives (Natural England, 2018b) are “To ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- *The extent and distribution of qualifying natural habitats and habitats of qualifying species*
- *The structure and function (including typical species) of qualifying natural habitats*
- *The structure and function of the habitats of qualifying species*
- *The supporting processes on which qualifying natural habitats and habitats of qualifying species rely*

[51] Note this is not the total SAC population estimate, as accounts for only those seals that are at-sea and not those that could be hauled-out.

- *The populations of qualifying species, and,*
- *The distribution of qualifying species within the site*."

638. For harbour seal within TW & NNC SAC, the specific targets are to;

- Maintain the population size within the site;
- Maintain the reproductive and recruitment capability of the species;
- Maintain the presence and spatial distribution of the species and their ability to undertake key life stage and behaviours;
- Maintain connectivity of the habitat within sites and the wider environment to allow movement of migratory species;
- Restrict the introduction and spread of non-native species and pathogens, and their impacts;
- Maintain the extent and spatial distribution of the following supporting habitats; foraging and haulout sites;
- Maintain the abundance of preferred food items required by the species;
- Maintain the natural physio-chemical properties of the water;
- Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement is not significantly altered or constrained;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain water quality to mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. suspended concentrations of sediment, plankton and other material) in areas where this species is, or could be present.

639. Due to the decline in the harbour seal population within TW & NNC SAC, Natural England are in the process of updating the Conservation Objectives of the SAC. As these are not yet finalised, the assessments are based on the current Conservation Objectives as noted above.

3.6.3 Shadow appropriate assessment

640. For the assessments for TW & NNC SAC, the potential for effects is considered in relation to the SAC Conservation Objectives for harbour seal (Table 3.77).

Table 3.77 Likely Significant effects of North Falls in relation to the conservation objectives of TW & NNC SAC for harbour seal

Conservation Objective for harbour seal	Likely Significant Effect
The extent and distribution of qualifying natural habitats and habitats of qualifying species.	No potential LSE.

Conservation Objective for harbour seal	Likely Significant Effect
	There will be no significant change to the extent and distribution of the habitats of qualifying species in the SAC.
The structure and function (including typical species) of qualifying natural habitats.	No potential LSE. There will be no significant change to the structure and function (including typical species) of qualifying natural habitats.
The structure and function of the habitats of qualifying species.	No potential LSE. There will be no significant change to the structure and function of the habitats of the qualifying species however there is the potential for barrier effects from underwater noise on harbour seals therefore it has been assessed further for construction, O&M and decommissioning phases.
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely.	No potential LSE. There will be no significant change to the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely. However, there may be potential changes to water quality and changes to prey resource, therefore, these have been assessed further for construction, O&M and decommissioning phases.
The populations of qualifying species.	Increased collision risk with vessels may cause a potential LSE which will be considered further for construction, O&M and decommissioning phases.
The distribution of qualifying species within the site.	No potential LSE. There will be no significant change to the distribution of qualifying species within the site. However, significant disturbance and displacement as a result of increased underwater noise levels have the potential to have an effect on the seals foraging at sea and will be considered further for construction, O&M and decommissioning phases.

3.6.3.1 Effects during construction

641. Likely significant effects during construction may arise through disturbance from activities during the installation of offshore infrastructure. Underwater noise during piling, as well as disturbance associated with underwater noise from other construction activities and the presence of vessels offshore, are considered. Potential displacement from important habitat areas and impacts on prey species are also considered.

642. The likely significant effects during construction assessed for marine mammals are:

- Auditory injury and disturbance or behavioural impacts resulting from underwater noise during piling, and due to ADD activation prior to piling;
  - Permanent auditory injury (PTS) due to impact piling.
  - Disturbance due to impact piling.
  - Disturbance due to ADD activation prior to piling.

- Auditory injury and disturbance or behavioural impacts resulting from underwater noise during other construction activities, including seabed preparations, rock placement and cable installation;
    - Permanent auditory injury (PTS) due to other construction activities.
    - Disturbance due to other construction activities.
- Impacts resulting from the deployment of construction vessels:
    - Underwater noise and disturbance from construction vessels;
        - Permanent auditory injury (PTS) due to construction vessels.
        - Disturbance due to construction vessels.
    - Vessel interaction (collision risk).
- Barrier effects as a result of underwater noise;
- Changes to water quality; and
- Changes to prey resource.

643. The potential for disturbance at seal haul-out sites has not been assessed for TW & NNC SAC. Due to the distance between North Falls and the SAC, there is no potential for an effect to the haul-out sites within the site.

3.6.3.1.1 Impact 1: Effects of underwater noise associated with piling

644. A range of foundation options are being considered for North Falls, including monopiles, jackets (with pin piles), suction buckets for both monopiles and jacket pin piles, and gravity-based for both monopiles and jacket pin piles. Of these, monopiles and jackets (with pin piles) may require piling. As a worst case scenario for underwater noise, it has been assumed that all foundations could be piled, although drive-drill-drive installation may be used.

645. Impact piling is a source of high-level underwater noise, which can cause both physiological (e.g. lethal, physical injury and auditory injury) and behavioural (e.g. disturbance and masking of communication) effects on marine mammals.

646. Should a seal be very close to the source, the high peak pressure sound levels have the potential to cause death or physical injury, with any severe injury potentially leading to death, if no adequate mitigation is in place. High exposure levels from underwater noise sources can cause auditory injury or hearing impairment, taking the form of a permanent loss of hearing sensitivity (PTS).

647. The underwater noise modelling was based on the worst-case scenarios for monopiles and pin piles as shown in Section 3.4.3.1.1.

Impact 1a: Permanent auditory injury (PTS) due to impact piling

648. Any PTS would be permanent, and harbour seal within the potential impact area are considered to have very limited capacity to avoid such effects, and unable to recover from the effects.

649. PTS can occur instantaneously from acute exposure to high noise levels, such as single strike (SPL_{peak}) of the maximum hammer energy applied during piling. PTS can also occur as a result of prolonged exposure to increased noise levels, such as during the duration of pile installation (SEL_{cum}).

PTS from a single strike

650. The underwater noise modelling results (see ES Appendix 12.3 (Document Reference: 3.3.8) for details) show the predicted impact ranges and areas for PTS from a single strike of the maximum hammer energy for the worst case location (Table 3.78).

651. The worst-case for a single hammer strike is for full hammer energy, and therefore this has been used to inform the following assessments. An assessment of the likely significant effect from a single strike at the starting hammer energy has been provided in Appendix 12.4 (Document Reference: 3.3.9).

Table 3.78 The predicted impact ranges for PTS for harbour seals, at the worst case modelling location (East), for the starting and maximum hammer energies of both monopiles and pin piles

Hammer energy	Potential impact ranges (and areas) for PTS	
Starting hammer energy	**Monopile (900kJ)**	**Jacket pin pile (660kJ)**
	<50m (<0.01km^2)	<50m (<0.01km^2)
Maximum hammer energy	**Monopile (6,000kJ)**	**Jacket pin pile (4,400kJ)**
	60m (0.01km^2)	50m (0.01km^2)

652. An assessment of the maximum number of individuals that could be at risk of instantaneous PTS, due to a single strike at the maximum hammer energy, for both monopiles and jacket pin piles, is presented in Table 3.79, based on the effect areas as presented in Table 3.78.

Table 3.79 Assessment of the potential for instantaneous PTS due to a single strike of the maximum hammer energy for a monopile and jacket pin pile for harbour seal

Piling scenario	Assessment of effect
PTS due to a single strike of a monopile at maximum hammer energy (SPL_{peak})	0.00000010 harbour seal associated with TW & NNC SAC (0.000000003% of TW & NNC SAC population) based on the array area density of 0.000010/km^2.
PTS due to a single strike of a jacket pin pile at maximum hammer energy (SPL_{peak})	0.00000010 harbour seal associated with TW & NNC SAC (0.000000003% of TW & NNC SAC population) based on the array area density of 0.000010/km^2.

PTS from cumulative exposure

653. The SEL_{cum} is a measure of the total received noise over the whole piling operation. The SEL_{cum} range indicates the distance from the piling location that if the receptor were to start fleeing in a straight line from the noise source starting at a range closer than the modelled range it would receive a noise exposure in excess of the criteria threshold, and if the receptor were to start fleeing from a range further than the modelled range it would receive a noise exposure below the criteria threshold.

654. The underwater noise modelling results showed the predicted impact ranges and areas for PTS due to the cumulative exposure of monopiles and jacket pin piles at the worst case location (refer to Table 3.80 for PTS ranges).

655. It is important to note that assessment for PTS from cumulative exposure is highly precautionary. There is a lot of variation in the potential impact ranges for SEL_{cum}

at each location and between locations, and the maximum hammer energy will not be required at all locations.

Table 3.80 The predicted impact ranges for PTS in harbour seals, at the worst case modelling location (East location), for the cumulative exposure of both monopiles and pin piles

Marine mammal species	Potential impact ranges (and areas) for PTS due to cumulative exposure Monopile (6,000kJ)	Jacket pin pile (4,400kJ)
Single pile installation in a 24 hour period	**One monopile**	**One jacket pin pile**
Harbour seal	<100m (<0.10km^2)	<100m (<0.10km^2)
Multiple sequential pile installations in a 24 hour period	**Three sequential monopiles**	**Six sequential jacket pin piles**
Harbour seal	<100m (<0.10km^2)	<100m (<0.10km^2)

656. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for both sequential monopiles and jacket pin piles, is presented in Table 3.81.

Table 3.81 Assessment of the potential for PTS due to the cumulative exposure of sequential monopiles or jacket pin piles in a 24 hour period for harbour seal

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of three sequential monopiles in a 24 hour period (SEL_{cum})	0.000001 harbour seal associated with TW & NNC SAC (0.00000003% of the with TW & NNC SAC population) based on the array area density of 0.000010/km^2.
PTS due to the cumulative exposure of six sequential jacket pin piles in a 24 hour period (SEL_{cum})	0.000001 harbour seal associated with TW & NNC SAC (0.00000003% of TW & NNC SAC population) based on the array area density of 0.000010/km^2.

PTS from cumulative exposure from multiple piling locations

657. The simultaneous piling scenario assumes that animals are within potential impact ranges for a much longer period (i.e. they would be travelling from one pile location to another which piling is ongoing), and therefore cumulative impact ranges are much larger than for the cumulative exposure ranges of one pile at a time.

658. The potential impact ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect only.

659. Where the potential impact areas are not large enough to interact with each other (i.e. they do not meet), the results for the respective locations and scenarios are used (the results of the modelling for the South and East locations are used to inform the assessment, to align with the modelling locations used for the simultaneous modelling.

660. Table 3.82 presents the underwater noise modelling results for the predicted impact ranges and areas for PTS due to the cumulative exposure of simultaneous monopiles and jacket pin piles at the East and South modelling locations. These locations were chosen as they have the potential for the largest 'spread' in terms of underwater noise propagation (as they are the two furthest apart locations).

The modelling includes three monopiles being installed sequentially at each location at the same time, and six jacket pin piles being installed sequentially at each location at the same time.

Table 3.82 The predicted impact ranges for PTS harbour seals at the East and South modelling locations, for the cumulative exposure of multiple monopiles and pin pile installations at the same time

Marine mammal species	Potential impact areas for PTS due to cumulative exposure of simultaneous pile installations	
	Monopile (6,000kJ)	Jacket pin piles (4,400kJ)
Multiple sequential pile installations in a 24 hour period (for the East and South modelling locations together)	**Three sequential monopiles at the East location and three sequential monopile at the South location**	**Six sequential jacket pin piles at the East location and six sequential jacket pin piles at the South location**
Harbour seal	East = <0.1km^2 South = <0.1km^2 **Total together = no overlap, therefore maximum simultaneous effect area is 0.2km^2.**	East = <0.1km^2 South = <0.1km^2 **Total together = no overlap, therefore maximum simultaneous effect area is 0.2km^2.**

661. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for the simultaneous piling of monopiles and jacket pin piles for harbour seal is presented in Table 3.83.

Table 3.83 Assessment of the potential for PTS due to the cumulative exposure of simultaneous monopiles or jacket pin piles at the same time

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of simultaneous monopile installations (SEL_{cum})	0.000002 harbour seal associated with TW & NNC SAC (0.0000001% of the Wash & NNC SAC population) based on the array area density of 0.000010/km^2.
PTS due to the cumulative exposure of simultaneous jacket pin pile installations (SEL_{cum})	0.000002 harbour seal associated with TW & NNC SAC (0.0000001% of the Wash & NNC SAC population) based on the array area density of 0.000010/km^2.

Summary for Impact 1a

662. The potential for PTS onset due to either a single strike (Table 3.79), from the cumulative exposure of sequential piling at one location (Table 3.81), or from the cumulative exposure of sequential piling at multiple locations (Table 3.83), would impact less than 1% of the harbour seal TW & NNC SAC population in all cases.

663. Therefore, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal of PTS on harbour seal from pile installation.

Impact 1b: Disturbance effects due to impact piling

664. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary

or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al*., 2007).

665. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of marine mammals, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.

666. Disturbance from construction activities (including piling) may have behavioural consequences on marine mammals in the study area, including reduced time spent foraging at sea as animals move away from sources of noise, displacement from vessels, etc. Repeated disruptions can have cumulative negative effects on the bioenergetic budget of marine species, with the potential for long-term effects on survival and reproductive rates (Christiansen *et al*., 2013).

667. Hastie *et al*., (2021) studied the change in foraging behaviour of grey seal when exposed to underwater noise. A high density and low density area of prey was present within an experimental pool, and speakers were located at each prey patch. During the control periods, seals would forage mainly at the high-density patch, but also at the low-density patch for a smaller proportion of time. When the seals were exposed to noise at the low density patch, there was a reduction in foraging of 16-28%, however, when seals were exposed to noise at the high density prey patch, there was no change in foraging in comparison to control periods (Hastie *et al*., 2021). This indicates that seals would choose to remain at a noisy environment, if there were good prey resources at the same location (Hastie *et al*., 2021).

668. Harbour seal exhibit alternate periods of foraging and resting at haul out sites (during which limited, or no feeding occurs). Prolonged fasting also occurs in these species during annual breeding and moult, when there are marked seasonal changes in body condition (Rosen and Renouf, 1997; Bäcklin *et al*., 2011). Although adult seals may be relatively robust to short term (weeks rather than days) changes in prey resources, young and small individuals have a more sensitive energy balance. This is exhibited through effects of mass dependent survival (Harding *et al*., 2005).

669. Russell *et al.,* (2016) showed that harbour seal are present in significantly reduced number up to a distance of 25km during piling (or a disturbance area of 1,963.5km^2) (Russell *et al*., 2016). This range has been used to determine the number of harbour seal that may be disturbed during piling at North Falls (Table 3.84).

Table 3.84 Assessment of the potential for disturbance to harbour seal based on a disturbance range of 25km for both monopiles and jacket pin piles

Piling scenario	Assessment of effect
For a single piling event	0.02 harbour seal associated with TW & NNC SAC (0.0005% of TW & NNC SAC population) based on the array area density of 0.000010/km^2.
For two simultaneous piling events*	0.04 harbour seal associated with TW & NNC SAC (0.001% of TW & NNC SAC population) based on the array area density of 0.000010/km^2.

** not taking into account any overlap between disturbance areas between the two locations*

Dose response curve assessment

670. Where sufficient scientific evidence exists, a species-specific dose-response assessment has been undertaken rather than using the disturbance ranges that is described above, as per current good practice guidance (Southall *et al*., 2021). Further details on the dose response curve assessment can be found in Section 3.4.3.1.1.

671. For harbour seal, the Carter *et al*., (2022) TW & NNC SAC specific density estimates were used.

672. The estimated number of harbour seal and percentage of the TW & NNC SAC reference population that could be disturbed as a result of underwater noise during piling at North Falls is presented in Table 3.85.

Table 3.85 Number of harbour seal (and % of reference population) that could be disturbed during piling at North Falls based on the dose-response approach

Piling scenario	Assessment of effect
Instantaneous behavioural disturbance due to a single, maximum energy monopile strike (SEL_{SS})	0.11 harbour seal (0.003% of the Humber Estuary SAC reference population)
Instantaneous behavioural disturbance due to a single, maximum energy pin pile strike (SEL_{SS})	0.101 harbour seal (0.003% of the Humber Estuary SAC reference population)

673. For a single piling event the worst case would be 0.003% of the TW & NNC SAC reference population to be at risk of disturbance (Table 3.85). This would be from monopiles.

674. For disturbance based on the known impact ranges for harbour seals, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal, for either monopiles or jacket pin piles.

Impact 1c: Disturbance effects due to ADD activation

675. The assessments of the potential disturbance during any ADD activation is indicative only, as the final requirements for mitigation in the MMMP will be determined prior to construction.

676. Mitigation to reduce the risk of PTS could include activation of ADDs prior to the soft-start commencing. The period of time that an ADD is required to be activated for is dependent on the potential PTS ranges for each species, and their known swim speeds, as used within the underwater noise modelling.

677. Based on the swim speeds of each species (of 1.5m/s for harbour seal (Otani *et al*., 2000)), and the maximum ranges of cumulative PTS onset for the installation of one pile (Table 3.86), the ADD would be required to be activated for a period of 37 minutes prior to piling, for both monopiles and jacket pin piles. This would result in harbour seal fleeing to a range of 3.33km further than the modelled cumulative PTS onset range of 100m for both monopiles and jacket pin piles).

Table 3.86 Assessment of the potential for disturbance due to ADD activation for both monopile and jacket pin piles

Marine mammal species	Assessment of effect
Harbour seal	0.0004 harbour seal (0.000009% of the W&NNC SAC population), based on the array area density of 0.00001/km^2.

678. The ADD activation would ensure marine mammals are beyond the maximum impact range for instantaneous PTS due to a single strike of the maximum hammer energy for both monopiles and jacket pin piles. ADD activation prior to the soft-start would also reduce the number of marine mammals at risk of PTS from cumulative exposure.

679. There would be no adverse effects for disturbance based on the known impact ranges for marine mammals for harbour seal and the integrity of TW & NNC SAC, for either monopiles or jacket pin piles.

3.6.3.1.2 Impact 2: Effects from underwater noise associated with other construction activities

680. Potential sources of underwater noise during construction activities, other than piling, include seabed preparation, dredging, rock placement, trenching and cable installation.

681. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during noisy activities (ES Appendix 12.3, Document Reference: 3.3.8**)** and determine the likely significant effects on marine mammals.

Impact 2a: Permanent auditory injury (PTS) due to other construction activities

682. The underwater noise modelling results show the predicted impact ranges and areas for PTS from the cumulative exposure of other construction activities. For SEL_{cum} calculations, the duration of the noise is also considered, with all sources operating for a worst case of 24-hours in a day. The predicted impact ranges for cumulative PTS for other construction activities on harbour seals indicated <100m (0.031km^2) (Table 3.87).

683. The results of the underwater noise modelling do not define impact ranges of <100m, and therefore, where the impact ranges are less than that, the results show impact ranges of <100m (it is possible that the actual impact ranges are therefore considerably lower).

684. The results of the underwater noise modelling (Table 3.87) indicate that harbour seal would have to be <100m (precautionary maximum range) from the continuous noise source at the onset of the activity to be exposed to noise levels that could induce PTS. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal.

685. There is the potential that more than one of these other construction activities could be underway at either array area, or within the offshore export cable or interconnector corridors, at the same time. As a worst case and unlikely scenario, an assessment for all four activities being undertaken simultaneously has also been undertaken.

Table 3.87 The predicted impact ranges for cumulative PTS for other construction activities in harbour seal

Other construction activity scenario	Potential impact ranges (and areas) for PTS Cable laying, suction dredging, cable trenching, and rock placement*
One other construction activity	<100m (0.031km^2)
All four construction activities taking place at the same time	0.126km^2

686. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in Table 3.88, based on the effect areas as presented in Table 3.87.

Table 3.88 Assessment of the potential for PTS due to other construction activities, including cable laying, suction dredging, cable trenching, and rock placement, for one activity taking place at any one time

Other construction activity scenario	Assessment of effect
One construction activity	0.0000003 harbour seal associated with TW & NNC SAC (0.000000008% of TW & NNC SAC population) based on the array area density of 0.000010/km^2, or 0.00003 harbour seal associated with the Wash & NNC SAC (0.0000009% of TW & NNC SAC population) based on the offshore cable corridor density of 0.0011/km^2.
All four construction activities taking place at the same time	0.0000013 harbour seal associated with TW & NNC SAC (0.00000003% of TW & NNC SAC population) based on the array area density of 0.000010/km^2, or 0.00014 harbour seal associated with TW & NNC SAC (0.000004% of TW & NNC SAC population) based on the offshore cable corridor density of 0.0011/km^2.

687. Given the small number of individuals affected, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal for PTS in harbour seal from other construction activities either alone or taking place simultaneously.

Impact 2b: Disturbance effects due to other construction activities

688. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

689. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance impact on marine mammals.

690. There is limited data on the potential for a behavioural response or disturbance of harbour seal from other construction activities (or other continuous noise sources). In 2012, 25 harbour seal from The Wash were tagged, as well as a further 10 from the Thames (Russell, 2016

691.). Of those, 24 of the tags were in place for sufficient time to determine key foraging areas of harbour seal in the SNS. The results of this study show foraging activity of harbour seal off the coast off Norfolk (Russell, 2016). The results of this tagging study show foraging activity within Sheringham Shoal OWF which was undergoing construction, with turbine installation undertaken from 2011 to 2012, and cabling works from 2010 to 2012. This indicates that harbour seal will still undertake foraging activity during wind farm construction activities.

692. A review of various studies was used to determine the maximum potential disturbance range for other construction activities and vessels. During the construction of two Scottish OWFs (Beatrice OWF and Moray East OWF), Benhemma-Le Gall *et al*., (2021), reported a 4km (50.3km^2) reduction in harbour porpoise presence and this has been used as the disturbance range for other construction activities, including vessels. As harbour porpoise are the most sensitive marine mammal species, this 4km potential disturbance range has been used for harbour seal as a worst case, due to the absence of any other data to inform an assessment.

693. Based on the 4km disturbance range, up to four other construction activities (201.06km^2) could be taking place at the same time. This assumes that the disturbance would only affect the area around the vessel at the time of the activity taking place, and that harbour seal would return to the disturbed area once the activity had either completed or transited to a new location.

694. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range is presented in Table 3.89. This is a precautionary approach as it is unlikely that harbour seal would react in the same manner as harbour porpoise to the other construction activities that are expected to be taking place in the offshore project area.

Table 3.89 Assessment of the potential for disturbance due to one or up to four construction activities taking place at the same time, including cable laying, suction dredging, cable trenching, and rock placement

Scenario	Assessment of effect
One activity (50.27km^2)	0.0005 harbour seal associated with TW & NNC SAC (0.000013% of TW & NNC SAC population) based on the array area density of 0.000010/km^2, or 0.06 population) based on the offshore cable corridor density of 0.0011/km^2.
Four activities (201.06km^2)	0.002 harbour seal associated with TW & NNC SAC (0.00005% of TW & NNC SAC population) based on the array area density of 0.000010/km^2, or 0.2 harbour seal associated with TW & NNC SAC (0.006% of TW & NNC SAC population) based on the offshore cable corridor density of 0.0011/km^2.

Summary for impact 2

695. For permanent changes in hearing sensitivity (PTS) and potential disturbance due to other construction activities (without any mitigation), there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal.

3.6.3.1.3 Impact 3: Effects from underwater noise and disturbance associated with construction vessels

696. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise due to vessel presence (ES Appendix 12.3, Document Reference: 3.3.8) and determine the likely significant effects on harbour seal.

Impact 3a: Permanent auditory injury (PTS) due to construction vessels

697. The underwater noise modelling results show the predicted impact ranges and areas for PTS from the cumulative exposure of vessels within the site. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.

698. The results of the underwater noise modelling do not define impact ranges of <100m, and therefore, where the impact ranges are less than that, the results show impact ranges of <100m (it is possible that the actual impact ranges are therefore considerably lower).

699. The results of the underwater noise modelling indicate that harbour seal would have to be <100m (precautionary maximum range) from the continuous noise source to be exposed to noise levels that could induce PTS. It is therefore highly unlikely that any marine mammal would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal.

700. There is the potential that up to 35 vessels (1.1km^2) may be present in the North Falls site at any one time during construction. As a worst case and unlikely scenario, an assessment for all 35 vessels has been undertaken alongside and assessment for an individual vessel (see Table 3.90).

Table 3.90 Assessment of the potential for PTS to harbour seal from one or up to 35 construction vessels

Scenario	Assessment of effect
One construction vessel (0.031km^2)	0.0000003 harbour seal associated with TW & NNC SAC (0.000000008% of TW & NNC SAC population) based on the array area density of 0.000010/km^2, or 0.00003 harbour seal (0.0000009% of TW & NNC SAC population) based on the offshore cable corridor density of 0.0011/km^2.
35 construction vessels (1.1km^2)	0.00001 harbour seal associated with TW & NNC SAC (0.0000003% of TW & NNC SAC population) based on the array area density of 0.000010/km^2, or 0.001 harbour seal (0.00003% of TW & NNC SAC population) based on the offshore cable corridor density of 0.0011/km^2.

Impact 3b: Disturbance effects due to construction vessels

701. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

702. Seals vary in their reaction to vessels depending on vessel type and proximity to haul out sites; however, disturbance (flushing behaviour) has been demonstrated

at haul-out sites in the UK up to 200m away if there are pups present (Cates and Acevedo-Gutiérrez, 2017). Land-based disturbance has been shown to cause higher levels of disturbance compared to marine sources, and smaller, quiet vessels like kayaks can cause the highest levels of flushing behaviour (Bonner, 2021). In areas of high vessel traffic, there are habituation effects and disturbance behaviour is generally reduced (Strong *et al*., 2010). A 2019 study on harbour seals in Scotland found that 30 minutes after a disturbance event, seals return to 52% pre-disturbance levels at haul-out sites and 94% four hours after disturbance (Paterson, 2019).

703. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any effects from underwater noise as a result of construction activities, other than piling, will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance for harbour seals.

704. Construction vessel activity may generate underwater noise at sound levels and frequencies for sufficient durations to disturb marine mammals. Whilst the main focus of concern remains on the loudest noise sources such as impact piling, dredging etc., intense vessel activity during construction may also alter the acoustic habitat and disturb marine mammal species (Merchant *et al*., 2014). During the periods when piling is underway, vessel noise is unlikely to add an additional impact to those assessed for piling, as the vessels and vessel noise would be within the maximum impact areas assessed.

705. Jones *et al*., (2017) produced usage maps characterising densities of grey and harbour seals and ships around the British Isles, which were used to produce risk maps of seal co-occurrence with shipping traffic. The analysis indicates that rates of co-occurrence were highest within 50km of the coast, close to seal haul-outs. When considering exposure to shipping traffic in isolation, the study found no evidence relating to declining seal population trajectories with high levels of co-occurrence between seals and vessels. For example, in areas of east England where the harbour seal population is increasing there are high intensities of vessels (Duck and Morris, 2016; Jones *et al*., 2017).

706. If the behavioural response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed, and therefore any impacts from underwater noise as a result of construction vessels will be both localised and temporary. Therefore, it is considered that there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal from disturbance from underwater noise associated with vessels.

Summary for impact 3

707. For permanent changes in hearing sensitivity (PTS) and potential for disturbance due to construction vessels, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal.

708. No mitigation is required for underwater noise impacts due to the presence of vessels, however, vessel good practice measures would reduce the potential for effect. The measures include ensuring that vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any

impacts, including increased disturbance. All vessel movements will be kept to the minimum number that is required to reduce effects on marine mammals, including increased disturbance.

3.6.3.1.4 Impact 4: Barrier effects from underwater noise during construction

709. Underwater noise during construction could have the potential to create a barrier effect, preventing movement or migration of marine mammals between important feeding and / or breeding areas, or potentially increasing swimming distances if marine mammals avoid the site and go around it. However, the offshore project area not located on any known migration routes for marine mammals.

710. The array area is located 40km from the coast at closest point. The nearest seal haul-out site at Gunfleet Sands, approximately 2.8km from the offshore cable corridor at its closest point. Note that this is a tidal haul-out site, and is only exposed at low tide, so is not a haul-out site that would be used for pupping.

711. Telemetry studies and the relatively low seal at sea usage (Carter *et al*., 2022) in and around the offshore project area do not indicate any regular seal foraging routes through the sites. Russell (2016) have shown that harbour seal will still undertake foraging activity during wind farm construction activities.

712. A tagging study was undertaken for harbour seals within the outer Thames estuary, through the Thames Harbour Seal Conservation Project (Barker *et al*., 2014). This study included the tagging of harbour seals in 2012. The results of this tagging study were used to define foraging areas of harbour seal within the outer Thames area. The activity of the seals while tagged was used to identify key foraging areas, with five such areas being found. These were all located within 4.5km of the nearest haul-out site (Barker *et al*., 2014). These foraging locations were plotted against the OWFs in the area (at the time of the study), which shows that GGOW (immediately to the east of North Falls) is not located near to any of the five identified key foraging areas (Barker *et al*., 2014), with the closest being north east Buxey Sand, at more than 10km from the offshore cable corridor, and 47km from the array area.

713. The greatest potential barrier effect for marine mammals could be from underwater noise during piling. Piling would not be constant during the piling phases and construction periods. There will be gaps between the installations of individual piles, and if installed in groups there could be time periods when piling is not taking place as piles are brought out to the site. There will also be potential delays for weather or other technical issues.

714. There is unlikely to be the potential for any barrier effects from underwater noise for other construction activities and vessels, as it is predicted that marine mammals will return once the activity has been completed, and therefore any effects from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of marine mammals.

715. Harbour seal have foraging ranges of up to 273km (Carter *et al*., 2022). Therefore, if there are any potential barrier effects from underwater noise, marine mammals would be able to compensate by travelling to other foraging areas within their range.

716. There is unlikely to be any significant long-term impacts from any barrier effects, as any areas affected would be relatively small in comparison to the range of harbour seals and would not be continuous throughout the offshore construction period. It is therefore considered that, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal for barrier effects as a result of underwater noise.

3.6.3.1.5 Impact 5: Increased risk of collision with vessels during construction

717. During offshore construction, there will be an increase in vessel traffic within the offshore project area. However, it is anticipated that vessels would follow an established shipping route to the relevant ports in order to minimise vessel traffic in the wider area.

718. Seals in and around the offshore project area and in the wider SNS area would typically be habituated to the presence of vessels (given the existing levels of marine traffic, see Chapter 15 Shipping and Navigation, Document Reference: 3.1.17) and would be able to detect and avoid vessels.

719. However, vessel strikes are known to occur, possibly due to distraction whilst foraging and socially interacting, or due to the marine mammals' inquisitive nature (Wilson *et al*., 2007). Therefore, increased vessel movements, especially those outside recognised vessel routes, can pose an increased risk of vessel collision to marine mammals. Studies have shown that larger vessels are more likely to cause the most severe or lethal injuries, with vessels over 80m in length causing the most damage to marine mammals (Laist *et al*., 2001). Vessels travelling at high speeds are considered to be more likely to collide with marine mammals, and those travelling at speeds below 10 knots would rarely cause any serious injury (Laist *et al*., 2001).

720. Thomsen *et al*. (2006) reviewed the effects of ship noise on seal species. As seals use lower frequency sound for communicating (with acute hearing capabilities at 2 kHz) there is the potential for detection, avoidance and masking effects in seals. Thomsen *et al.* (2006) consider that ship noise around 2 kHz could be heard above ambient noise (but not necessarily avoided) at a distance of approximately 3 km for harbour seals, and the zone of audibility will be approximately 20 km for vessels with a much lower frequency noise of 0.25 kHz (ambient noise = 94 and 91 dB rms re 1 µPa at 0.25 and 2 kHz, respectively). The zone of responsiveness of harbour seal is considered to be at a maximum of 400 m from the vessel, although the frequency of the sound source, and the speed at which the vessel is travelling would affect the distance at which harbour seal may react (Thomsen *et al.,* 2006).

721. There is currently limited information on the collision risk of marine mammals in the SNS. To estimate the potential collision risk of vessels associated with North Falls during construction, the potential risk rate per vessel has been calculated for harbour seals, which is then used to calculate the total risk to harbour seals due to the presence of an additional 35 vessels at any one time during construction (See ES Chapter 12, Section 12.6.1.5, Document Reference: 3.1.14). The collision risk has been estimated by using data from the SMASS.

722. SMASS record and investigate all marine mammal strandings reported to them in Scotland. Between 2003 and 2020, 791 stranded harbour seal were investigated with a cause of death established by SMASS. A total of 13 were

attributed to a physical trauma of unknown cause, and four to physical trauma following impact from a vessel. This results in a collision risk rate of 0.028.

723. To inform this assessment, the total number of harbour seals in UK waters has been compared against the total vessels present in UK waters, as well as the potential collision risk rate of each species based on the SMASS data. The total UK populations are taken from SCOS (2022). The total presence of vessels in UK waters is taken from the total vessel transits within the 2015 AIS data, which is the latest publicly available.

724. The assessment (See ES, Section 12.6.1.5 and Table 12.63) predicts that up to one (0.8) harbour seal may be at risk of collision per construction year (or 0.02% of TW & NNC SAC population).

725. This is a highly precautionary assumption, as it is unlikely that marine mammals in the offshore project area would be at increased collision risk with vessels during construction, considering the minimal number of vessel movements compared to the existing number of vessel movements in the area, and that vessels within the offshore project area would be stationary for much of the time or very slow moving.

726. In summary, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal for any increase in vessel collision risk during construction.

727. In addition, vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. Vessel operators will use good practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever practicable.

3.6.3.1.6 Impact 6: Changes to prey availability and habitat quality

728. The likely significant effects on prey species during construction can result from physical disturbance and loss of seabed habitat; increased SSC and sediment re-deposition; and underwater noise. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13) provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms.

729. During construction activities, the worst-case footprint for disturbance would be 5.5km^2. Predominantly medium and coarse-grained sediment type were found at North Falls (see Chapter 8 Marine Geology, Oceanography and Physical Processes, Document Reference: 3.1.10), typically remaining close to the seabed and settling quickly once disturbed. The worst-case level of sediment smothering and deposition would be approximately <1mm, short-lived (minutes) and localised. Increases in suspended sediment are therefore expected to cause localised and short-term increases in SSC only and not significantly affect fish species.

730. The data and analysis in ES Chapter 9 Marine Water and Sediment Quality (Document Reference: 3.1.11) indicates that levels of contaminants within the North Falls offshore site are low and do not contain elevated levels to cause concern.

731. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13), provides an assessment of the potential underwater noise impacts on fish and shellfish species and predicts that impacts would be of a temporary nature (see Chapter 11 (Document Reference: 3.1.13) for a detailed assessment of underwater noise impacts on fish species). Potential sources of underwater noise and vibration during construction include piling, increased vessel traffic, seabed preparation, rock placement and cable installation. Of these, piling is considered to produce the highest levels of underwater noise and therefore has the greatest potential to result in adverse impacts on fish.

732. Piling could have mortality/injury effects, but under a realistic fleeing animal assumption, ranges at which mortality/potential mortal injury and recoverable injury could occur would be reduced to less than 100m (see ES Table 11.21 to 11.34). Therefore, any effect on prey populations would be highly localised.

733. The outputs of the underwater noise modelling for the spatial worst-case scenario indicate that TTS may occur at distances up to 16km and 17km assuming a fleeing animal scenario (single pin pile and sequential pin pile installation), increasing to up to 33km and 39km when considering a stationary receptor (single monopile and sequential monopiles installation). Behavioural responses would be expected within these ranges and potentially in wider areas depending on the hearing ability of the species under consideration (see ES Chapter 11 Table 11.21 to 11.34 (Document Reference: 3.1.13)). However, the potential for behavioural response does not indicate that prey would actually leave the area (and in many cases this would not be possible within the duration of a piling event).

734. It is unlikely that there would be significant changes to prey over the entire area. It is more likely that effects would be restricted to an area around the working sites. There is unlikely to be any additional displacement of harbour seals as a result of any changes in prey availability during piling as harbour seals would also be disturbed from the area.

735. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13) provides an assessment of the potential changes in fishing activity by the presence of safety zones associated with the project during construction. The predicted impact would be of negligible impact given the short-term and temporary nature of the construction phase.

736. Harbour seals are considered generalist feeders, and feed on a variety of species, e.g., large gadids (Wilson & Hammond, 2019). Despite the large foraging ranges of 273km (Carter *et al*., 2022), harbour seals in a study in Orkney spent the majority of time within a few kilometres off the coast (Jones *et al*., 2016). This is in line with a tagging study of 25 harbour seal from The Wash which mainly utilised foraging grounds off the coast of Norfolk (near Sheringham Shoal Extension Project and Dudgeon Extension Project, Sheringham Shoal and Dudgeon OWFs) and a relatively lower level of activity at Hornsea Projects One, Two, and Four, as well as Dogger Bank A (Russell, 2016).

737. The potential impacts of physical disturbance, temporary habitat loss, increased SSC, re-mobilisation of contaminated sediment on changes in prey availability associated with the construction at North Falls would be localised and short in duration and would therefore be unlikely to affect harbour seals in TW & NNC SAC.

738. Taking into account this precautionary approach, along with the separation distance from TW & NNC SAC and no potential for any direct effect on TW & NNC SAC, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal as a result of any changes to prey availability during construction for North Falls.

3.6.3.1.7 Impact 7: Changes to water quality

739. Potential changes in water quality during construction could occur through:

- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, array, and cables;
- Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and OSP/OCP;
- Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
- Deterioration in water quality associated with release of sediment bound contaminants.

740. North Falls are committed to the use of good practice techniques and due diligence regarding the potential for pollution throughout all construction activities. As a result, an outline PEMP will be developed to accompany the DCO application. The final PEMP would be agreed with the MMO prior to construction and would include, for example, measures to control accidental release of drilling fluids whilst ensuring that any chemicals used are listed on the OSPAR List of Substances Used and Discharged Offshore which are considered PLONOR (OSPAR, 2021).

741. Any direct impacts to marine mammals as a result of any contaminated sediment during construction activities are unlikely as any exposure is more likely to be through potential indirect impacts via prey species.

742. There would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal due to any changes in water quality during the construction of North Falls.

3.6.3.2 Effects during O&M

743. The likely significant effects during O&M that have been assessed for are:

- Auditory injury and disturbance or behavioural impacts resulting from operational WTGs;
  - Permanent auditory injury (PTS).
  - Disturbance.
- Auditory injury and disturbance or behavioural impacts resulting from underwater noise during maintenance activities, including cable protection and cable reburial;
  - Permanent auditory injury (PTS).
  - Disturbance.
- Impacts resulting from the deployment of vessels:

- Underwater noise and disturbance from vessels;
  - Permanent auditory injury (PTS).
  - Disturbance.
- Vessel interaction (collision risk).
- Barrier effects as a result of underwater noise;
- Changes to water quality; and
- Changes to prey resource and habitat quality.

3.6.3.2.1 Impact 1: Impacts from underwater noise associated with operational WTGs

744. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during the operational phase and determine the likely significant effects on marine mammals (ES Appendix 12.3, Document Reference: 3.3.8).

Impact 1a: Permanent auditory injury (PTS) due to operational wind turbine noise

745. The underwater noise modelling results show the predicted impact ranges and areas for PTS from the cumulative exposure of operational WTGs. For SEL_{cum} calculations, the duration of the noise is also considered, with operating WTGs for a worst case of 24-hours in a day. The potential impact ranges for PTS for harbour seal is <100m (0.031km^2). The full underwater noise modelling results are provided in Appendix 12.4 (Document Reference: 3.3.9).

746. The reported PTS onset range of less than 100m is likely an overestimation, as the underwater noise modelling does not define impact ranges of <100m. The TTS modelling results also show an effect range of <100m, indicating that the actual potential PTS ranges would be much lower than the reported 100m. Therefore, the potential for any PTS effect is expected to be present in localised areas only, and is not expected to cause a significant risk of PTS onset in the harbour seal population.

Impact 1b: Disturbance effects due to operational wind turbine noise

747. Currently available data indicates that there is no lasting disturbance or exclusion of seals around OWF sites during operation (Diederichs *et al*., 2008; Lindeboom *et al*., 2011; Marine Scotland, 2012; McConnell *et al*., 2012; Russell *et al*., 2014; Scheidat *et al*., 2011; Teilmann *et al*., 2006; Tougaard *et al*., 2005, 2009a, 2009b). Data collected suggests that any behavioural responses for seal may only occur up to a few hundred metres away (Touggard *et al*., 2009b; McConnell *et al*., 2012).

748. Monitoring studies at Nysted and Rødsand have also indicated that operational activities have had no impact on regional seal populations (Teilmann *et al*., 2006; McConnell *et al*., 2012). Tagged harbour seals have been recorded within two operational OWF sites (Alpha Ventus in Germany and Sheringham Shoal in UK) with the movement of several of the seals suggesting foraging behaviour around WTGs (Russell *et al*., 2014).

749. Modelling of noise effects of operational OWFs suggest that harbour seals are not considered to be at risk of displacement (Marmo *et al*., 2013).

750. There is limited data on the potential for a behavioural response or disturbance from operational WTG noise.

Summary for impact 1

751. There would be no adverse effects for permanent changes in hearing sensitivity (PTS) and disturbance due to operational WTG noise on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal.

3.6.3.2.2 Impact 2: Impacts from underwater noise associated with O&M activities

752. Disturbance to marine mammals foraging at sea may occur as a result of displacement from vessel traffic and sources of noise, including those associated with O&M activities.

753. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities, and if the marine mammal is within close proximity at the onset of the activity. Therefore, it is highly unlikely for there to be any PTS due to these activities.

754. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction.

755. As there are expected to be less noisy activities during the operation phase than is required during construction (see Section 3.6.3.1.2, it is therefore likely to cause less disturbance to foraging behaviours in all species present in the study area.

756. There would be no adverse effects on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal for permanent changes in hearing sensitivity (PTS) and potential disturbance due to these operational activities,.

3.6.3.2.3 Impact 3: Impacts from underwater noise and disturbance associated with O&M vessels

757. The specific requirements for any potential maintenance work are currently unknown, however the work required is likely to be similar to those activities assessed for construction.

758. As outlined in Section 3.6.3.1.3, the potential for PTS is only likely in very close proximity to vessels (<100m) and if the marine mammal is within close proximity. During operation, there may be up to 22 vessels in the North Falls project area at any one time, compared to the 35 vessels that would be on site during construction.

759. As a worst case and unlikely scenario, an assessment for all 22 vessels has been undertaken (see Table 3.91).

Table 3.91 Assessment of the potential for PTS to harbour seal from one or up to 35 construction vessels

Scenario	Assessment of effect
22 construction vessels (with a total PTS onset area of 0.7km^2)	0.000007 harbour seal associated with TW & NNC SAC (0.0000002% of TW & NNC SAC population) based on the array area density of 0.000010/km^2, or 0.0008 harbour seal (0.00002% of TW & NNC SAC population) based on the offshore cable corridor density of 0.0011/km^2.

760. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary.

761. There would be no potential for adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal from operational noise from vessels.

3.6.3.2.4 Impact 4; Barrier effects from underwater noise during O&M

762. The separation distance between turbines would be a minimum of 0.944km to 1.348km in the cross wind direction and 1.18km to 1.685km in the downwind direction, therefore there would be no overlap in the potential impact range of <100m around each turbine and there would be adequate room for marine mammals to move through the array area.

763. While seal species are known to transit along the coastline, there would be sufficient room for them to swim through the array through the operational period. In addition, seal species are known to be present and forage within operational wind farm areas (see Section 3.6.3.2.1), and therefore it is concluded that the presence of North Falls infrastructure would not form a barrier to any movement of marine mammal species.

764. Therefore, there is no adverse effect on the integrity of TW & NNC SAC in relation to the conservative objectives for harbour seal for barrier effects as a result of underwater noise during O&M.

3.6.3.2.5 Impact 5: Increased risk of collision with vessels during operation

765. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be up to 22, with the potential for up to 1,222 vessel two way round trips per year.

766. The number of marine mammals at risk of collision, per vessel, in UK waters, has been calculated as described for the construction phase (Section 3.6.3.1.5), and has been used to calculate the number of each marine mammal species at risk of collision from the total number of vessel movements per year that are currently expected during the O&M phase. Vessel movements, where possible, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk.

767. It is estimated that 0.8 harbour seal (0.02% of TW & NNC SAC population) could be at risk of collision. This is a highly precautionary assumption, as it is unlikely that harbour seal in the offshore project area would be at increased collision risk with vessels during the O&M phase, considering the minimal number of vessel movements compared to the existing number of vessel movements in the area,

and that vessels within the offshore project area would be stationary for much of the time or very slow moving.

768. Less than 1% of the TW & NNC SAC population would be at risk of collision during the O&M phase. Therefore, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal for any increase in vessel collision risk during O&M.

769. In addition, vessel operators will use good practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever practicable.

3.6.3.2.6 Impact 6: Changes to water quality

770. Potential changes in water quality during O&M could occur through:

- Deterioration in water quality due to increases in suspended sediment associated with cable repairs / reburial; and
- Deterioration in water quality associated with release of sediment bound contaminants during maintenance activities.

771. Any risk of accidental release of contaminants will be mitigated in line with the PEMP and any changes to water quality as a result of any accidental release of contaminants leading to potential changes in water quality at North Falls during O&M would be negligible.

772. Any effects on harbour seal would be less than those for construction (see Section 3.6.3.1.7) as activities during O&M which disturb the seabed would be less frequent and more localised than during construction.

773. Therefore, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal as a result of any changes to water quality during O&M for North Falls.

3.6.3.2.7 Impact 7: Changes to prey availability and habitat quality

774. Taking into account the long distance between North Falls and TW & NNC SAC, there are no potential direct changes to prey resource within the SAC. Any potential changes to prey availability within or in proximity to North Falls during O&M would be less than those assessed during construction (see Section 3.6.3.1.6) as there would be no piling, fewer disturbing activities etc.

775. Therefore, there would be no adverse effects on harbour seal and on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal due to changes to prey availability and habitat quality as a result of North Falls O&M.

3.6.3.3 Effects during decommissioning

776. Likely significant effects on harbour seals associated with decommissioning have not been assessed in detail, as further assessments will be carried out ahead of any decommissioning works to be undertaken taking account of known information at that time, including relevant guidelines and requirements. A detailed decommissioning programme will be provided to the regulator prior to construction that will give details of the techniques to be employed and any relevant mitigation measures required.

777. Decommissioning would most likely involve the removal of the accessible installed components comprising all of the wind turbine components; part of the foundations (those above seabed level); and the Sections of the infield cables

close to the offshore structures, as well as Sections of the offshore export cables. The process for removal of foundations is generally the reverse of the installation process. There would be no piling, and foundations may be cut to an appropriate level.

778. Likely significant effects during decommissioning would most likely include:

- Underwater noise and disturbance from decommissioning activities;
- Underwater noise and disturbance from vessels;
- Barrier effects as a result of underwater noise;
- Increased collision risk with vessels;
- Barrier effects due to underwater noise during decommissioning;
- Changes to water quality; and
- Changes to prey resource.

779. It is not possible to provide details of the methods that will be used during decommissioning at this time. However, it is expected that the activity levels will be comparable to construction (with the exception of pile driving noise which would not occur).

780. Therefore, the likely significant effects on harbour seals during decommissioning would be the same or less than those assessed for construction due to the processes of decommissioning being the reverse of the installation, without the need for piling.

3.6.3.4 In-combination effects

781. The following in-combination assessment has been undertaken based on the CEA Screening Appendix, and Section 12.9 of ES Chapter 12 (Document Reference: 3.1.14).

782. The in-combination effects assessed are;

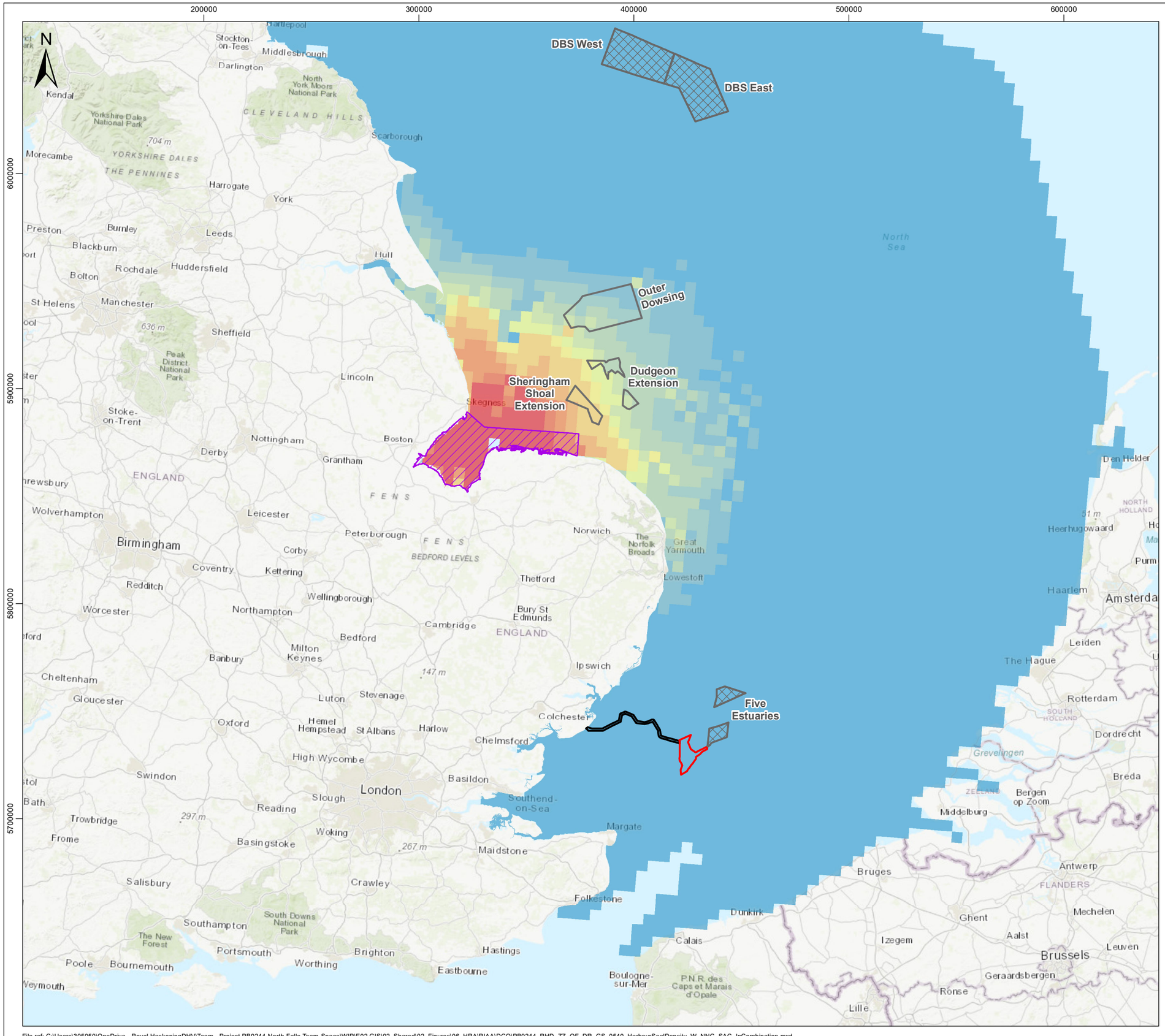
- Disturbance from underwater noise due to the following sources;
  - Piling at other OWFs;
  - Construction activities at other OWFs;
  - Geophysical surveys for OWFs;
  - Aggregate extraction and dredging;
  - Oil and gas installation projects;
  - Oil and gas seismic surveys;
  - Subsea cable and pipelines; and
  - UXO clearance.
- Barrier effects of other OWFs;
- Increased collision risk with vessels; and
- Changes in prey resource.

3.6.3.4.1 In-combination impact 1: Disturbance from underwater noise

In-combination impact 1a: Assessment of underwater noise from piling at other OWFs

783. A list of UK and European OWF projects that may the potential for overlapping piling with North Falls is provided in ES Chapter 12 (Document Reference: 3.1.14) (Table 12.90), and has been used to inform the assessment for in-combination effects due to piling at other OWFs.

784. For harbour seal associated with TW & NNC SAC, other OWFs were included in the assessment against the SAC population where the *Carter et al., (2022)* densities for the individuals associated with the SAC show presence within the 5km x 5km grid cells that overlap with the other OWF (or where there is a presence of seals within the potential disturbance area of the other OWF, e.g. within 25km for other OWFs that may be piling). Figure 3.10 shows TW & NNC SAC relative densities against all OWFs screened in for assessment.



Legend

- North Falls Array Area
- Offshore Cable Corridor
- Offshore Wind Farm Site
- Proposed Offshore Wind Farm Site
- The Wash and North Norfolk Coast Special Area of Conservation (SAC)

Mean Harbour Seal At-Sea Usage (% per 25km²)

- 0.001 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.04
- 0.05 - 0.06
- 0.07 - 0.08
- 0.09 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 2.00

0 12.5 25 50 nm

0 25 50 100 km

Drawing Title

Harbour Seal At-Sea Mean Densities for Those Individuals Associated with The Wash and North Norfolk Coast SAC

Rev	Date	Remarks	Drwn	Chkd
01	23/04/2024	First issue	FC	GS

Drawing Number	Figure Number
PB9244-RHD-ZZ-OF-DR-GS-0540	3.10

Scale	Plot Size	Datum	Projection
1:1,750,000	A3	WGS84	UTM31N

Royal HaskoningDHV
Enhancing Society Together

NORTH FALLS
Offshore Wind Farm

File ref: C:\Users\305050\OneDrive - Royal HaskoningDHV\Team - Project-PB9244-North-Falls-Team-Space\WIP\E02 GIS\02_Shared\02_Figures\06_HRA\RIAA\DCO\PB9244_RHD_ZZ_OF_DR_GS_0540_HarbourSealDensity_W_NNC_SAC_InCombination.mxd

785. Of the 30 UK and European OWFs screened in for having a construction period that could potentially overlap with the construction of the Project, five UK OWFs relevant to harbour seal effects could be piling at the same time, which is currently estimated to take place in 2030 to 20231 for North Falls;

- Dudgeon Extension Project;
- Dogger Bank South (East and West);
- Five Estuaries;
- Outer Dowsing; and
- Sheringham Shoal Extension Project.

786. Of these, all are shown to have harbour seal associated with TW & NNC SAC present within the project areas.

787. This short list of OWF projects that could be piling at the same time as North Falls could change as projects develop, but this is the best available information at the time of writing, and reflects the limitations and constraints to project delivery.

788. The commitment to the mitigation agreed through the MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) for all marine mammals, and therefore this assessment focuses on the potential for disturbance only.

789. For harbour seal, the in-combination assessment is based on the dose response approach.

790. For other projects included in the in-combination assessment the number of seals impacted were based on the project specific publications or gained using the average density estimate across the Carter *et al*., (2022) relative density dataset for TW & NNC SAC.

791. It should be noted that the potential areas of disturbance assume that there is no overlap in the areas of disturbance between different projects and are therefore highly conservative. For example, Five Estuaries and North Falls are within 10km of each other, Sheringham Shoal Extension Project and Dudgeon Extension Project are approximately 10km from each other at their closest points and Outer Dowsing is less than 15km from Dudgeon Extension Project

792. The approach to the in-combination assessment for piling at OWFs is based on the potential for single piling at each wind farm at the same time as single piling at the North Falls. This approach allows for some of the OWFs not to be piling at the same time, while others could be simultaneously piling (further information is available in the ES Appendix 12.6, Document Reference: 3.3.11). This is considered to be the most realistic worst case scenario, as it is highly unlikely that all other wind farms would be simultaneously piling at exactly the same time as piling at North Falls.

793. It is important to note the actual duration for active piling time which could disturb marine mammals is only a very small proportion of the potential construction period, of up to approximately 18.4 days for North Falls.

794. This assessment has been based on the potential for disturbance due to piling at other OWF projects, in-combination with North Falls piling activity (as the worst

case assessment for North Falls). Table 3.100 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity.

795. As shown in Table 3.92 below, North Falls accounts for a very small proportion of harbour seal that may be disturbed due to OWF piling (0.0125% of the total seals at risk of disturbance). This is very precautionary, as it is unlikely that all other OWF projects could be piling at exactly the same time as piling at North Falls.

Table 3.92 Quantitative assessment for in-combination disturbance for harbour seal from piling at other OWFs

Project	Harbour seal density (based on TW & NNC SAC relative densities) (/km^2)	Effect area (km^2)	Maximum number of harbour seal potentially disturbed during single piling
North Falls	*Based on dose response*		*0.11*
DEP[52]	Based on dose response		31
DBS[53]	Based on dose response		2
Five Estuaries[54]	Based on dose response		3
Outer Dowsing[55]	Based on dose response		35
SEP[56]	Based on dose response		62
Total number of seals			134
Percentage of SAC population			3.36%

796. Additional assessments using iPCoD modelling were undertaken to predict the harbour seal population effect due to in-combination disturbance from piling.

797. For the in-combination scenario assessed (see the ES Appendix 12.6 (Document Reference: 3.3.11) for details of the projects considered, and their parameters) using the reference population (3,956) of TW & NNC SAC for harbour seal, the iPCoD model predicts there to be little effect on the harbour seal population over time from disturbance due to piling (Plate 3.3 and Table 3.93).

798. The median population size was predicted to be 100% of the un-impacted population size at the end of 2028 (1 year after the piling has commenced in the wider area year after the piling has commenced). By the end of 2032 (the year piling ends) the median population size for the impacted population is predicted to be 100.13% of the un-impacted population size. Beyond 2032, the impacted population is expected to maintain the same stable trajectory as the un-impacted population (as far as 2052 which is the end point of the modelling, at which point the median impacted to un-impacted ratio is 100%; Table 3.93).

[52] Based on single piling (Equinor New Energy, 2023)
[53] RIAA not available at time of writing, therefore, generic approach used to inform the assessment using 25km range and SAC specific Carter *et al.,* 2022 densities
[54] Based on single piling (Five Estuaries Wind Farm Ltd, 2023)
[55] Based on single piling (Outer Dowsing Offshore Wind, 2023)
[56] Based on single piling (Equinor New Energy Ltd, 2022)

Table 3.93 Results of the iPCoD modelling for the in-combination assessment, giving the mean population size of the harbour seal TW & NNC SAC population for years up to 2053 for both impacted and un-impacted populations in addition to the median ratio between their population sizes.

Year	Un-impacted population mean	Impacted population mean	Median impacted as % of un-impacted
Start	3,954	3,954	100.00
End of 2028	3,244	3,244	100.00
End of 2029	2,671	2,671	100.00
End of 2032	1,475	1,477	100.13
End of 2037	548	549	100.00
End of 2047	74	75	100.00
End of 2052	27	28	100.00

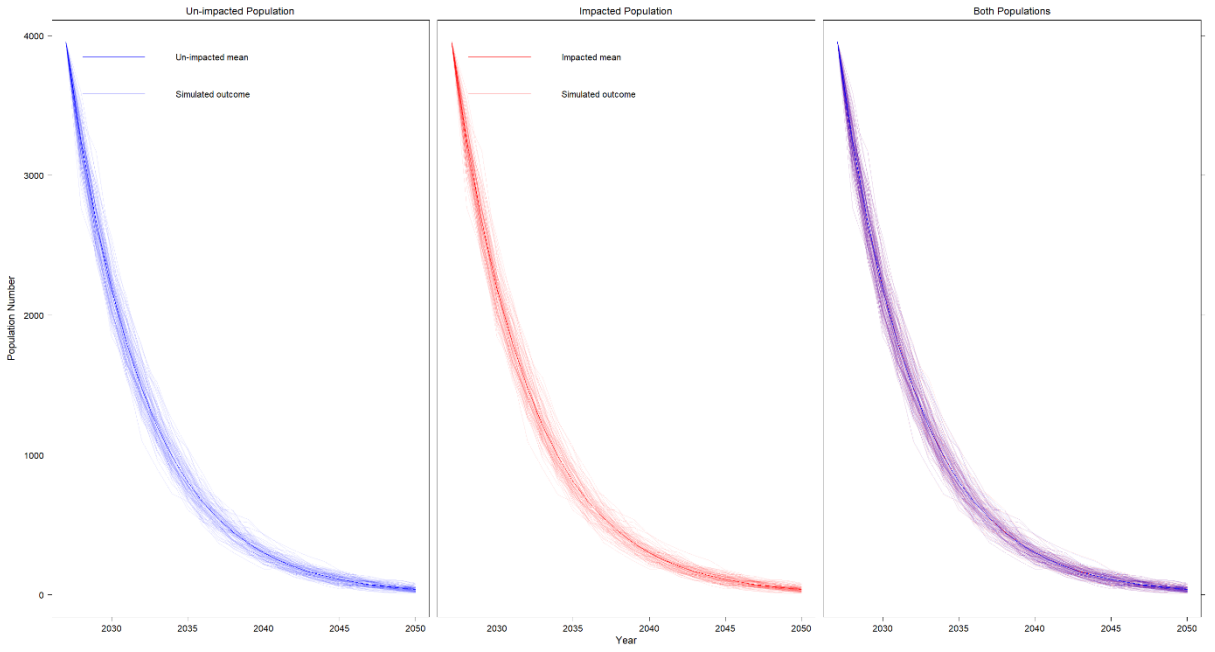


Plate 3.3 Simulated worst-case harbour seal The Wash and North Norfolk Coast SAC population sizes for both the un-impacted and the impacted populations for the in-combination assessment

In-combination impact 1b: Assessment of underwater noise from construction activities (other than piling) and vessel presence at other OWFs

799. All OWFs with construction dates that have the potential to overlap with the construction dates for North Falls have the potential for other construction activities (such as seabed preparation, dredging, trenching, cable installation, rock placement, drilling and vessels) to occur at the same time as other construction activities at North Falls.

800. For harbour seal at TW & NNC SAC, other OWFs were included in the assessment against the SAC population where the *Carter et al., (2022)* densities for the individuals associated with SAC show presence within the 5km x 5km grid

cells that overlap with the other OWF (or where there is a presence of seals within the potential disturbance area of the other OWF).

801. OWFs screened in for other construction activities (including vessels) that could have an in-combination effect with other construction activities at North Falls was narrowed down to:

- East Anglia ONE North;
- Dunkerque;
- Hornsea Project Four;
- Hornsea Project Three; and
- Norfolk Vanguard.

802. This assessment has been based on the potential for disturbance due to construction activities at other OWF projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.100 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity.

803. While the other OWFs that have been assessed under the in-combination piling assessment have the potential for overlapping construction phases, as well as those listed above, they are already assessed under a worst case of piling overlaps. As the disturbance areas for piling are significantly larger than the disturbance areas for other constriction activities, an assessment of piling at those projects would produce a much higher potential for in-combination effect than an assessment for in-combination effects with other construction activities, and they are therefore not included under the assessment for other construction activities as set out below. As noted above, Table 3.100 provides an overall assessment including the potential for disturbance from all OWFs that may be undergoing construction at the same time as North Falls, and where those OWFs' piling windows overlap with North Falls, piling has been included as a worst-case.

804. Noise sources which could cause potential disturbance during OWF construction activities, other than pile driving, can include vessels, seabed preparation, cable installation works and rock placement. The potential impact area, based on the worst case disturbance range of 4km, for up to four activities taking place at the same time, with an area of 201.1km^2, is used to inform the assessment.

805. Based on the projects that could have construction overlapping with North Falls, up to 0.68% of the SAC population could be temporarily disturbed (Table 3.94).

Table 3.94 Quantitative assessment for in-combination disturbance for harbour seal due to construction activities (including vessels) at other OWFs

Project	Harbour seal density (based on The Wash and North Norfolk Coast SAC relative densities) (/km^2)	Effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*0.11*
East Anglia ONE North[57]	Based on projects' own assessment		2.7
Dunkerque*	0.00002	201.1	0.004
Hornsea Project Four[58]	Not quantitively assessed	201.1	-
Hornsea Project Three[59]	Not quantitively assessed	201.1	-
Norfolk Vanguard[60]	All within OWF at risk	201.1	24
Total number of seals			27
Percentage of wider reference population			0.68%

* Project specific assessment unavailable, generic approach used to inform the assessment

806. It should be noted that while the projects included within the in-combination assessment for disturbance from other OWFs constructing at the same time were done so based on the current knowledge of their possible construction or activity windows, and it is very unlikely that all activities would be taking place on the same day or in the same season, this therefore likely represents an over-precautionary and worst case estimate of the marine mammals that could be at risk of disturbance during the two year offshore construction period of North Falls.

In-combination impact 1c: Assessment of disturbance from other industries and activities

807. During the construction period for North Falls, there is the potential for disturbance to marine mammals associated with other potential noise sources, including:

- Geophysical surveys associated with other OWFs;
- Aggregate extraction and dredging;
- Oil and gas installation projects;
- Oil and gas seismic surveys;
- Subsea cable and pipelines;
- Other marine renewable projects (such as wave and tidal projects);
- Disposal sites; and
- UXO clearance.

[57] (East Anglia ONE North Limited, 2021)
[58] Not quantitively assessed in Project's own assessment (Orsted Power (UK) Ltd, 2019)
[59] Not quantitively assessed in Project's own assessment (Orsted Power (UK) Ltd, 2018)
[60] (Norfolk Vanguard Limited, 2018)

808. For the installation of oil and gas infrastructure, marine renewable projects, and disposal sites, all potential projects have been screened out. Further information on the CEA screening (and these results) are provided in the ES Appendix 12.6, Document Reference: 3.3.11.

Disturbance from geophysical surveys

809. It is currently not possible to estimate the number of potential OWF geophysical surveys that could be undertaken at the same time as construction and potential piling activity at North Falls.

810. This assessment has been based on the potential for disturbance from geophysical surveys, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.100 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from geophysical surveys.

811. As outlined in the ES Appendix 12.6 (Document Reference: 3.3.11), OWF geophysical surveys using SBPs and USBL systems have the potential to disturb marine mammals and have therefore been screened into the in-combination assessment, as a precautionary approach.

812. The potential disturbance range used in the in-combination assessment is based on the SNCB guidance for assessment for harbour porpoise.

813. Assessments for the RoC HRA for the SNS SAC (BEIS, 2020), modelled the potential for disturbance due to the use of a SBP, and results indicated that there is the potential for a possible behavioural response in harbour porpoise at up to 3.77km (44.65km^2) from the source. The current guidance for assessing the significance of noise disturbance for harbour porpoise SACs (JNCC *et al*., 2020) recommends the use of an EDR of 5km (78.54km^2) for geophysical surveys.

814. As a worst case, it has been assumed that all harbour seal within 5km of the survey source, a total area of 78.54km^2 could be disturbed.

815. For geophysical surveys with sub-bottom profilers, it is realistic and appropriate to base the assessments on the potential impact area around the vessel, as the potential for disturbance would be centred around the vessel at any one time. Seals would not be at risk throughout the entire area surveyed in a day, as animals would return once the vessel had passed, and the disturbance had ceased.

816. It is currently not possible to estimate the location or number of potential OWF geophysical surveys that could be undertaken at the same time as construction and potential piling activity at North Falls. It is therefore assumed, as a worst case scenario, that there could potentially be up to two geophysical surveys in the North Sea at any one time, during construction of North Falls, with a total disturbance area of 157.1km^2.

817. As the location of the potential geophysical surveys is currently unknown, the following assessment for harbour seal uses the average density estimate across the *Carter et al., (2022)* relative density dataset for TW & NNC SAC of 0.027/km^2. This therefore assumes that there could be up to two geophysical surveys within the area in which harbour seal associated with TW & NNC SAC may be present.

818. For up to two geophysical surveys undertaken at the same time as construction of North Falls, with no other in-combination activities, up to 0.13% of the TW & NNC SAC population may be disturbed (Table 3.95).

Table 3.95 Quantitative assessment for in-combination disturbance of harbour seals due to up to two geophysical surveys at OWFs

Potential in-combination effect	Harbour seal density (based on TW & NNC SAC relative densities) (/km²)	Potential in-combination effect area (km²)	Maximum number of individuals potentially disturbed
North Falls	*based on dose response*		*0.11*
Up to two geophysical surveys	0.027	157.08	5
Total number of seals			5
Percentage of SAC population			0.13%

Disturbance from aggregate extraction and dredging

819. Taking into account the small potential impact ranges, distances of the aggregate extraction and dredging projects from North Falls, the potential for contribution to in-combination effects is very small. Therefore, risk of PTS for harbour seal from aggregate extraction and dredging has been screened out from further consideration in the in-combination assessment.

820. As a precautionary approach, a total of six aggregate extraction and dredging projects are included in the CEA for the potential in-combination disturbance.

821. This assessment has been based on the potential for disturbance from aggregate and dredging projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.100 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from these screened in aggregate and dredging projects.

822. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al.*, 2010). As a worst case assessment, a disturbance range of 600m for harbour seal for up to six operational aggregate projects at the same time as North Falls construction This would result in a potential disturbance area of 1.13km^2 for each project, or up to 6.8km^2 for all six aggregate projects.

823. For the potential for in-combination disturbance from aggregate and dredging projects undertaken at the same time as construction of North Falls, with no other in-combination activities, up to 0.007% of the TW & NNC SAC population may be disturbed (Table 3.96).

Table 3.96 Quantitative assessment for cumulative disturbance of harbour seal due to aggregate and dredging projects

Potential in-combination effect	Harbour seal density (based on TW & NNC SAC relative densities) (/km²)	Potential in-combination effect area (km²)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*0.11*

Potential in-combination effect	Harbour seal density (based on TW & NNC SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
Aggregate and dredging projects (1.13km^2 disturbance area per project)	0.027	6.8	0.184
Total number of seals			0.3
Percentage of SAC population			0.007%

Disturbance from oil and gas seismic surveys

824. It is currently not possible to estimate the number of potential oil and gas seismic surveys that could be undertaken at the same time as construction and potential piling activity at North Falls. Therefore, it has been assumed that at any one time, up to two seismic surveys could be taking place at the same time.

825. This assessment has been based on the potential for disturbance from seismic surveys (associated with oil and gas projects), in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.100 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including these seismic surveys.

826. This assessment for the potential disturbance due to oil and gas seismic surveys is based on the following:

- There is little available information on the potential for disturbance from seismic surveys for harbour seal, however, observations of behavioural changes in other seal species have shown avoidance reactions up to 3.6km from the source for a seismic survey (Harris *et al.*, 2001). A more recent assessment of potential for disturbance to seal species, as a result of seismic surveys, shows potential disturbance ranges from 13.3km to 17.0km from source (BEIS, 2020).
- A potential disturbance range of 17.0km (or disturbance area of 907.9km^2 for one survey, and 1,815.8km^2 for up to two seismic surveys) will therefore be applied to harbour seal due to a lack of species-specific information.

827. As the location of the potential geophysical surveys is currently unknown, the following assessment for harbour seal uses the average density estimate across the Carter *et al., (2022)* relative density dataset for TW & NNC SAC of 0.027/km^2. This therefore assumes that there could be up to two geophysical surveys within the area at which harbour seal associated with TW & NNC SAC may be present.

828. For oil and gas seismic surveys undertaken at the same time as construction of North Falls, up to 1.3% of the TW & NNC SAC population may be disturbed (Table 3.97).

Table 3.97 Quantitative assessment for in-combination disturbance of harbour seal due to up to two oil and gas seismic surveys

Project	Harbour seal density (based on TW & NNC SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*0.11*
Up to two seismic surveys	0.27	1,815.8	50

Project	Harbour seal density (based on TW & NNC SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
Total number of seals			50
Percentage of SAC population			1.3%

Disturbance from subsea cables and pipelines

829. Only two subsea pipeline have been screened into the in-combination assessment, Sea Link and Tarchon Energy Interconnector. Published findings for the Sea Link project indicate the maximum disturbance range from construction activities will be up to 5km (with a disturbance area on 78.54km^2).

830. As Tarchon Energy is currently at scoping stage and there is limited information available, therefore the Sea Link disturbance ranges have been applied for this project to inform the in-combination assessment with North Falls. Therefore, a disturbance area of up to 157.08km^2 has been assessed for the two projects screened in.

831. This assessment has been based on the potential for disturbance from subsea cable and pipeline projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.100 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from the screened in cable and pipeline projects.

832. The density for the projects have been estimated based on the *Carter et al., (2022)* relative density data for TW & NNC SAC, with an estimated density (for only those harbour seals that are associated with the SAC) of 0.001/km^2.

833. For disturbance from subsea cables and pipeline projects, and no other in-combination activities, up to 0.007% of the TW & NNC SAC population may be disturbed (Table 3.98).

Table 3.98 Quantitative assessment for in-combination disturbance of harbour seal due to cable and pipeline projects

Project	Harbour seal density (based on TW & NNC SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*0.11*
Cable and pipeline projects	0.001	157.08	0.16
Total number of seals			0.27
Percentage of SAC population			0.007%

Disturbance from UXO clearance

834. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity at North Falls, and therefore, on a worst case basis, the potential for one high-order clearance and one low-order clearance has been assessed as having the potential to take place at the same time.

835. This assessment has been based on the potential for disturbance due to UXO clearance activities for other projects, in-combination with North Falls piling activity (as the worst case assessment for North Falls). Table 3.100 provides an assessment for all noisy activities taking place at the same time as North Falls piling activity, including from UXO clearance activities. UXO clearance at North Falls itself has not been included within these assessments, as it is not currently being applied for. A full assessment for UXO clearance at North Falls would be undertaken through the separate Marine Licencing process, and will include consideration of the potential for in-combination effects.

836. The potential impact area during a single UXO clearance event, based on the modelled worst case impact range at North Falls for TTS / fleeing response (weighted SEL) of 22.0km (1,520.5km^2) for high-order clearance and 0.8km (2.01km^2) for low-order clearance.

837. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010).

838. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.

839. As the location of the potential UXO clearances are currently unknown, the following assessment for harbour seal uses the average density estimate across TW & NNC SAC of 0.027/km^2.

840. For harbour seal, based on the worst case scenario, of one high order and one low order UXO detonation at the same time as North Falls piling, up to 1.04% of the reference population could be potentially disturbed (Table 3.99).

Table 3.99 Quantitative assessment for in-combination disturbance of harbour seal due to UXO clearance

Potential in-combination effect	Harbour seal density (based on TW & NNC SAC relative densities) (/km^2)	Potential in-combination effect area (km^2)	Maximum number of individuals potentially disturbed
North Falls	*Based on dose response*		*0.11*
One high-order UXO detonation	0.027	1,520.5	42
One low-order UXO detonation	0.027	2.01	0.05
Total number of seals			42
Percentage of SAC population			1.04%

In-combination impact 1: Summary of in-combination effect 1: assessment of disturbance from all noisy activities associated with offshore industries

841. Each of the above described other noise sources are quantitively assessed together in Table 3.100.

842. For noisy activities (other than OWF) with the potential for in-combination disturbance effects together with piling at North Falls, for harbour seal, up to 3.2% of the SAC population is at risk of disturbance, if all included activities were undertaken at the same time.

843. It should be noted that while the projects included within the in-combination assessment for disturbance from other activities and industries were done so based on the current knowledge of their possible construction or activity windows, and it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the marine mammals that could be at risk of disturbance during the three year offshore construction period of North Falls.

844. As shown in the above assessments, the majority of harbour seal at risk of disturbance are from OWF piling, with those projects that are within close proximity of TW & NNC SAC contributing a large proportion of the in-combination disturbance. Therefore, there is limited opportunity for North Falls to significantly reduce the overall potential disturbance effect to TW & NNC SAC population.

Table 3.100 Quantitative assessment for all noisy activities with the potential for in-combination disturbance effects for harbour seal

Noisy activity	Maximum number of harbour seal potentially disturbed
North Falls piling and piling at other OWFs	*Based on iPCoD modelling, <1% of the population disturbed over the first six years and 25 year period modelled.*
Construction activities (including vessels) at other OWFs	27
Up to two geophysical surveys	5
Aggregates and dredging	0.2
Up to two oil and gas seismic surveys	50
Subsea cables and pipelines	0.16
UXO clearance	42
Total number of individuals	125
Percentage of TW & NNC SAC	3.2%

3.6.3.4.2 In-combination impact 2: Barrier effects

845. For the assessment of the potential for barrier effects due to underwater noise from projects undergoing construction, the effect to marine mammal species would be as per the assessments provided in Table 3.100, for in-combination disturbance effects due to all noisy activities.

846. It is important to note that the majority of the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of these other OWFs and other noise

sources from North Falls, the maximum underwater impact ranges for disturbance at other projects would not overlap with the maximum underwater impact ranges for disturbance at North Falls during piling and construction.

847. The exception to this is for the potential for overlap in North Falls and Five Estuaries piling (and construction programmes) for either the monopile of pin pile disturbance ranges. Therefore, there is a potential for underwater noise from North Falls and Five Estuaries to result in a barrier of movement to marine mammals. However, the offshore project area is not located on any known migration routes for marine mammals, and the disturbance ranges do not overlap with any seal haul out sites.

848. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.

849. There would be no adverse effect due to barrier effects on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal from barrier effects.

3.6.3.4.3 In-combination impact 3a: Disturbance from vessels associated with operational OWFs

850. While it is unknown exactly how many vessels would be on any OWF site during their operation, it is expected that impacts associated with underwater noise and disturbance from vessels during operation would be less than those during construction as assessed above.

851. If the response is displacement from the area, marine mammals will return once the vessel has passed, and therefore any impacts from vessel presence will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.

852. As an example, an increase of 22 vessels (at any one time) within North Falls during operation is significantly less than the Heinänen and Skov (2015) threshold of 80 vessels per day within 5km^2 (22 vessels within the 223.4km^2 project area would be less than 0.1 vessels per km^2, or 0.5 vessels per 5km^2, per day). There is likely to be a similar level of vessel presence across all operational wind farms within the North Sea, and therefore it is unlikely there would be any potential for a significant effect for harbour seal.

853. Currently available monitoring studies for operational wind farms suggests that marine mammals are not significantly disturbed, and that any effect is localised and temporary (e.g. Diederichs *et al.,* 2008; Teilmann *et al.,* 2006; McConnell *et al*., 2012). Harbour porpoise and seals have also been found to continue to forage within operational wind farm sites (Lindeboom *et al.,* 2011; Russell *et al.,* 2014). These monitoring studies suggest that there is no significant disturbance from operational wind farms, which may have a number of vessels present at any one time.

854. Vessels associated with offshore wind farm operation are likely to undertake similar activities to those for construction, albeit with much lower frequency. Russel (2016) found that harbour seal foraged within an area undergoing offshore wind farm construction.

855. It is expected that the vessel movements to an operational OWF, and from any port, will be incorporated within existing vessel routes and therefore to areas where marine mammals may already be accustomed to their presence. The increase in vessel presence from operational OWFs is expected to be relatively small compared to the baseline levels of vessel movements in the area. It is also expected that good practice measures, as implemented for North Falls, would be in place for all operational OWFs, further limiting the potential for disturbance.

856. Once on-site, OWF vessels would be stationary or slow moving, as they undertake the activity they are associated with, and therefore the potential for disturbance would be minimal.

857. A quantitative assessment for in-combination disturbance from vessels associated with operational OWFs has not been undertaken due to there being no information on the potential number of vessels present at relevant projects. However, as described above, the potential for vessel disturbance is considered to be localised and temporary, and marine mammals are expected to return to the project areas shortly after vessels have left the area.

858. No mitigation is proposed for underwater noise from operation and maintenance vessels, as there is no risk of an effect. However, vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any impacts, including increased disturbance. All vessel movements will be kept to the minimum number that is required to reduce effects, including increased disturbance.

859. Therefore, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal due to disturbance from vessels associated with operational OWFs.

3.6.3.4.4 In-combination impact 3b: Increased collision risk with vessels

860. The increased collision risk even using a very precautionary approach, has an effect significance of minor adverse (with mitigation), with a low number of marine mammals at risk.

861. Vessel movements to and from any port will be incorporated within existing vessel routes and therefore there would be no increased collision risk as the increase in the number OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas.

862. Once on-site, OWF vessels would be stationary or slow moving, as they undertake the activity they are associated with. Therefore, the risk of any increased collision risk for marine mammals would be negligible, if any.

863. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low or negligible. Therefore, increased collision risk from aggregate extraction and dredging has been screened out from further consideration in the in-combination assessment.

864. Good practice measures, as implemented for North Falls, would ensure any risk of vessels colliding with marine mammals is avoided.

865. There would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal from increased collision risk.

3.6.3.4.5 In-combination impact 4: Changes in prey resource

866. For any potential changes to prey resources, it has been assumed that the effects on harbour seal prey species from underwater noise, including piling, would be the same or less than those for harbour seal. Therefore, there would be no additional in-combination effects other than those assessed for harbour seal (i.e. if prey are disturbed from an area as a result of underwater noise, harbour seal will be disturbed from the same or greater area). As a result any changes to prey resources would not affect harbour seal as they would already be disturbed from the area.

867. Any effects to prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat for prey species in the surrounding area.

868. Taking into account the assessment for North Falls alone (Sections 3.6.3.1.6), with a similar level of effect at other projects and activities[61], along with the range of prey species taken by harbour seal and the extent of their foraging ranges, there would be no potential for in-combination effect on harbour seal populations as a result of changes to prey resources.

869. Therefore, there would be no adverse effect on the integrity of TW & NNC SAC in relation to the conservation objectives for harbour seal from changes in prey resource.

3.7 Other European sites

3.7.1 Conservation objectives

870. All the screened in European Designated Sites use the OSPAR Conservation Objectives (OSPAR, 2024):

    1. To protect, conserve and restore species, habitats and ecological processes which have been adversely affected by human activities;
    2. To prevent degradation of, and damage to, species, habitats and ecological processes, following the precautionary principle; and
    3. To protect and conserve areas that best represent the range of species, habitats and ecological processes in the maritime area.

871. These Conservation Objectives align with those for the UK sites as set out in Section 3.4.2 for harbour porpoise of the SNS SAC, Section 3.5.2 for grey seal

[61] Including Berwick Bank, DBS, DEP and SEP, Five Estuaries, Outer Dowsing, East Anglia Hub, and Norfolk Vanguard, which all concluded minimal effects from a localised area (SSE Renewables, 2022; RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited, 2023; Equinor New Energy Ltd, 2022; Five Estuaries Wind Farm Ltd, 2023; Outer Dowsing Offshore Wind, 2023; East Anglia ONE North Limited, 2021; Norfolk Vanguard Limited, 2018).

of the Humber Estuary SAC, and Section 3.6.2 for harbour seal of TW & NNC SAC. For harbour porpoise, the OSPAR Conservation Objectives are aligned with objectives two and three of the SNS SAC (Table 3.101).

872. For grey seal and harbour seal, the OSPAR Conservation Objectives are aligned with the last four objectives of both the Humber Estuary SAC, and TW & NNC SAC respectively. Therefore, the assessments as provided in Sections 3.4.3, 3.5.3, and 3.6.3, for the SNS SAC, Humber Estuary SAC and TW & NNC SAC respectively, would also apply to those species specific relevant transboundary SACs.

Table 3.101 Alignment of UK Conservation Objectives and EU Designated Sites' Conservation Objectives

European designated site	Species	Alignment with UK Conservation Objectives
Vlaamse Banken SAC	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Speciale beschermingszone 1 (SBZ 1 / ZPS 1) SPA	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Vlakte van de Raan SCI	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Baie de Canche et couloir des trois estuaries SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Bancs des Flandres SAC	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Dunes De La Plaine Maritime Flamande SAC	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Estuaire De La Canche, Dunes Picardes Plaquees Sur L'ancienne Falaise, Foret D'hardelot Et Falaise D'equihen SAC	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Estuaires et littoral picards (baies de Somme et d'Authie) SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.

European designated site	Species	Alignment with UK Conservation Objectives
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Recifs Gris-Nez Blanc-Nez SAC	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Borkum-Riffgrund SCI	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Nationalpark Niedersachsisches Wattenmeer SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Doggersbank SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Duinen Ameland SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Duinen en Lage Land Texel SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Duinen Goeree & Kwade Hoek SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Duinen Terschelling SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Duinen Vlieland SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Grevelingen SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Klaverbank SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.

European designated site	Species	Alignment with UK Conservation Objectives
Noordzeekustzone SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Oosterschelde SPA and SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Vlakte van de Raan SAC	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Voordelta SAC and SPA	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
Waddenzee SAC	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
Westerschelde and Saeftinghe SAC	Harbour porpoise	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 1-3 of the SNS SAC.
	Harbour seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of the Humber Estuary SAC.
	Grey seal	OSPAR COs 1-3 (for the Vlammse Banken SAC) align with COs 3-6 of TW & NNC SAC.

873. The following sections provide an overview of each screened in transboundary SAC, together with a conclusion on its potential for adverse effect based on the assessments provided for harbour porpoise of the SNS SAC, grey seal of the Humber Estuary SAC, and harbour seal of TW & NNC SAC, as outlined above.

3.7.2 Vlaamse Banken SAC

3.7.2.1 Site overview

874. The Vlaamse Banken SAC has been recognised as an SAC since October 2012. The SAC is a designated site for harbour porpoise, harbour seal and grey seal (EUNIS, 2024); all of which have been screened in for assessment.

875. The Vlaamse Banken SAC covers an area of 1,099 km^2. The closest point to the North Falls array area is 34km.

3.7.2.2 Qualifying feature

3.7.2.2.1 Harbour porpoise

876. There is no site-specific data on harbour porpoise estimates available. Hence, a wider search approach was applied. More reliable data on abundance data could be derived from data collected in all Belgian waters.

877. Average densities in the Belgium waters range from 0.2-4 animals/km^2; a total was estimated at 10,000 harbour porpoises or 3% of the best North Sea population estimate (Haelters, 2016).

878. There are seasonal differences in distribution: aerial and acoustic surveys indicated that harbour porpoise is abundant in late winter and early spring, with lower numbers in more offshore and northerly waters during late spring and summer. In autumn, harbour porpoise densities in offshore areas (Haelters *et al.,* 2010).

3.7.2.2.2 Harbour seal

879. A study in 2010 revealed that along the Belgian coast, no harbour seal colonies or stable haul out sites exist anymore (Hassani *et al*., 2010). The Belgian sightings & strandings database however logged 598 harbour seal sightings since 2002 (Belgian Marine Data Centre, 2023) along the Belgium coast.

880. Harbour seal abundance and distribution has been assessed for the Greater North Sea and Celtic Sea. Belgium however is not listed as having seal monitoring programmes (OSPAR, 2017). Belgium is joined with Netherlands in the Belgium Coast and Dutch Delta Assessment Unit, and together account for <1% of the relative proportion of harbour seals in each assessment unit.

881. Tracking data of harbour seals (Carter *et al*., 2020 (Plate 3.4); 2022 (Plate 3.5), and Vincent *et al.,* 2017 (Plate 3.6)) show some trips from the southeast of the UK and the Belgian-French coastline, although there is a higher level of connectivity with TW & NNC SAC. This suggests that harbour seals from the Vlaamse Banken SAC could potentially utilise this corridor as well, possibly becoming affected by activities at North Falls, such as vessel collision and underwater noise, although this connectivity is likely to be limited.

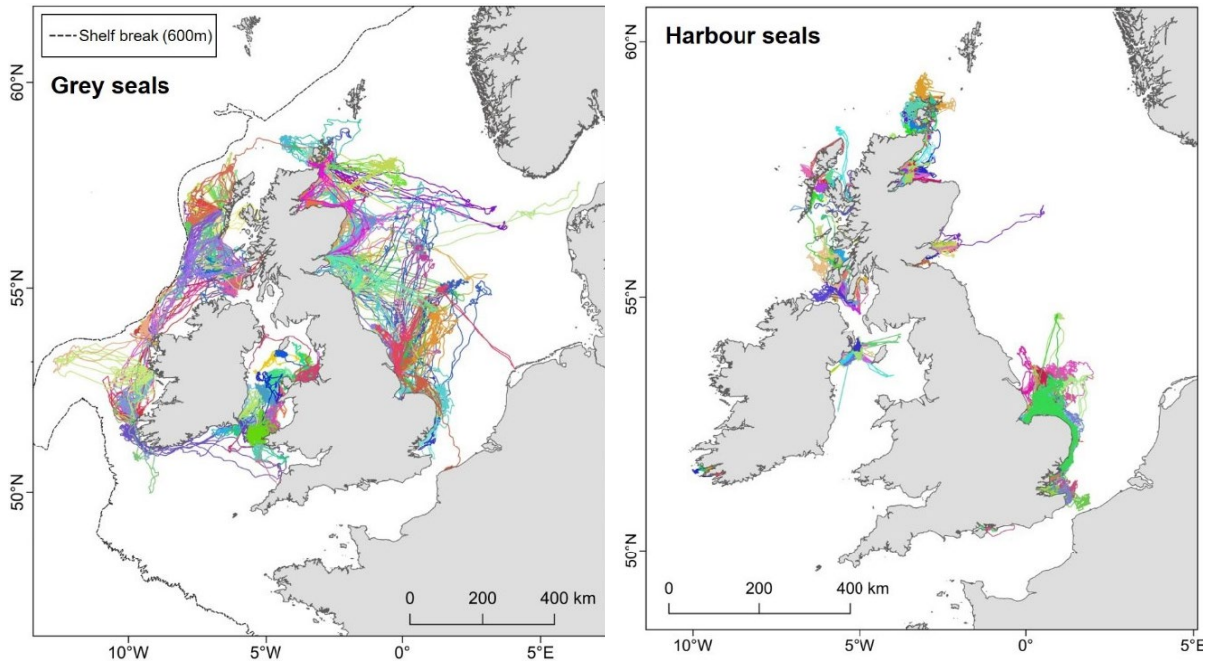


Plate 3.4 Tracking data for grey and harbour seals (coloured by individual (grey seals = 114; harbour seals = 239)) (Carter *et al.*, 2020)

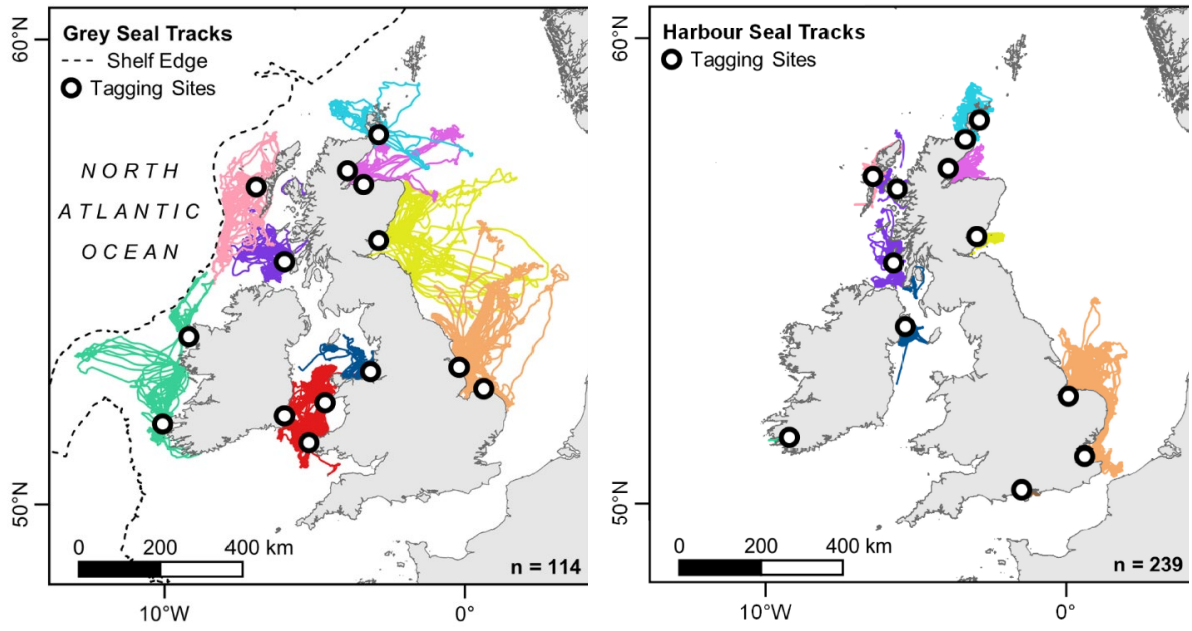


Plate 3.5 Tracking data for grey seal and harbour seals, colour-coded by habitat preference region (data shown have been cleaned to remove erroneous location estimates, trips between regions and locations during the corresponding species' breeding season) (Carter *et al.*, 2022)

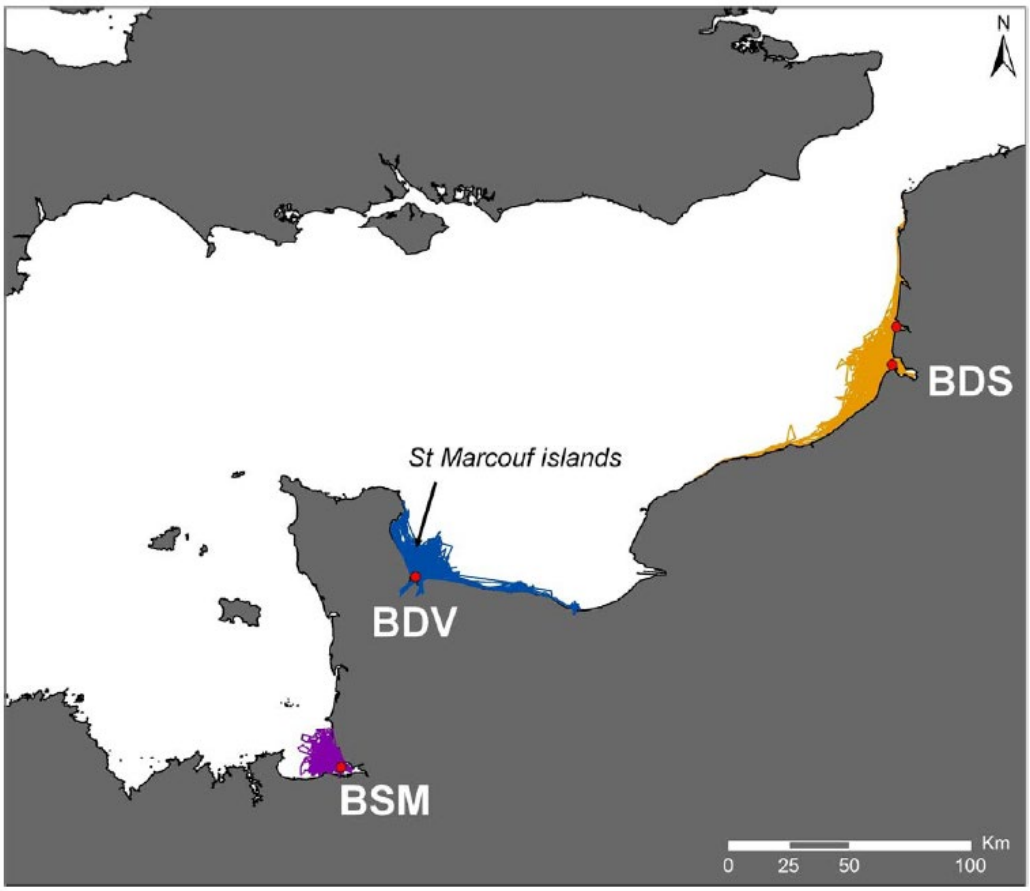


Plate 3.6 Harbour seal telemetry tracks from Baie du Mont Saint-Michel (BSM) (6 individuals tracked in 2006 and 2007, in purple), Baie des Veys (BDV) (12 individuals tracked in 2007 and 2008, in blue) and Baie de Somme (BDS) (10 individuals tracked in 2010, in orange) (Vincent *et al.*, 2017).

882. Within Belgium, there are no known seal colonies, however seals are known to be present and the number is increasing; in 2021 18 harbour seals were regularly sighted hauling out along the Belgium coast (ICES, 2023). A total of 32 unidentified seals and two harbour seals were recorded during aerial surveys from 2016 to 2020 (across Belguim waters), indicating a low presence of harbour seals (Silvia *et al*., 2021). In 2023, 40 seals were recorded during aerial surveys; however none were identified to species level (Haelters & Kerchof, 2024). There are no site specific population counts available for harbour seal of the Vlaamse Banken SAC.

3.7.2.2.3 Grey seal

883. Along the southern Dutch and Belgian coasts, small groups are regularly observed, but no colonies have yet been established (Härkönen *et al*., 2007).

884. Grey seal tracking data (Carter *et al*., 2020 (Plate 3.4); 2022 (Plate 3.5), and Vincent *et al.,* 2017 (Plate 3.7)) showed grey seals tagged in Britain are more likely to use the wider offshore North Sea area, with limited examples of tracked grey seals swimming to the north coast of France, Belgium, or Germany. Grey seals tagged in France are more likely to travel along the north coast of France and Belgium, although there is movement of seals to south-east England. This suggests that grey seals in Vlaamse Banken SAC are less likely to be connected to the North Falls area than the Humber Estuary SAC.

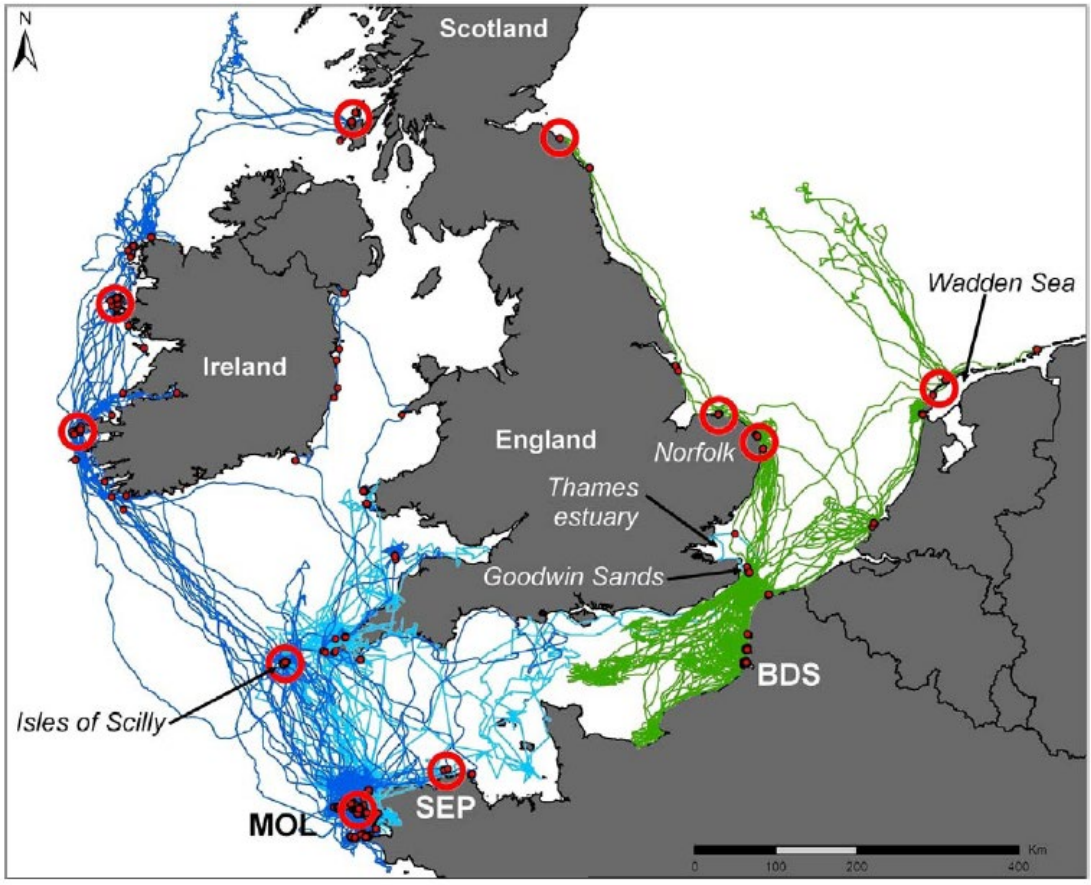


Plate 3.7 Grey seal telemetry tracks from Molene archipelago (MOL) (15 individuals from 1999 to 2003, in light blue, and 19 individuals from 2010 to 2013, in dark blue) and Baie de Somme (BDS) (11 individuals tracked in 2012, in green) (Vincent *et al*., 2017)

885. As mentioned above; there are no known seal colonies within Belgium, however seals are known to be present and the number is increasing; in 2023, compared to previous years, there were few seals in the spring (March to May) and relatively many in the autumn (September to November) (Haelters & Kerchof, 2024). The majority of the seals had been identified as harbour seal, however, there were grey seals recorded amongst them. A survey carried out in 2021, only recorded three grey seal hauled out along the Belgium coast (ICES, 2023).

886. As stated for harbour seal, aerial surveys were carried out from 2016 to 2020 (across Belguim waters); Haelters & Kerchof, 2024), where there were ten grey seals recorded and a total of 32 unidentified seals recorded during which could be attributed to grey seal, although this still represents a low number (Paoletti *et al*., 2021). Although this is a higher number than harbour seal recordings, it is difficult to identify seals to a species level via aerial data, however grey seal are more distinguishable with their long roman nose. However grey seal are documented to occur in lower numbers compared to harbour seal (Paoletti *et al*., 2021).

3.7.2.3 Shadow appropriate assessment

887. To assess the site most appropriately, despite the lack of site-specific species population data, a precautionary approach for the assessment has been used.

3.7.2.3.1 Harbour porpoise

888. The SNS SAC assessment for harbour porpoise (Section 3.4.3) is deemed to be the worst-case scenario because as the North Falls site lies within the SAC boundaries. Given the distance between the Project and Vlaamse Banken SAC the potential effects on harbour porpoise would likely to be less than those assessed in the SNS SAC. In addition, as the harbour porpoise population form part of a wider population (i.e. across the North Sea), the assessments undertaken for the SNS SAC (Section 3.4.3) would also be valid for any other designated site within the North Sea MU with harbour porpoise screened in, and therefore for the Vlaamse Banken SAC.

889. See Section 3.7.2.3 for the conclusions of the appropriate assessment for harbour porpoise of the Vlaamse Banken SAC.

3.7.2.3.2 Harbour seal

890. The assessments undertaken for harbour seals not associated with a particular SAC (i.e. those undertaken within the ES Chapter 12, Document Reference: 3.1.14) show that for the worst-case underwater noise effects (i.e. from piling), less than one (<0.0002) harbour seal would be at risk of injury, and seven individuals would be at risk of disturbance. While for disturbance this could be a significant proportion of the harbour seal count in Belgium, it is highly unlikely that all seals present at North Falls would be associated with the Vlaamse Banken SAC, given the rarity of harbour seal within Belgium waters, and the limited connectivity with Belgium waters as shown by the tagging studies summarised above. Therefore, the number of harbour seal associated with the Vlaamse Banken SAC would be significantly less than noted above.

891. The assessments undertaken for harbour seals not associated with a particular SAC (i.e. those undertaken within the ES Chapter 12, Document Reference: 3.1.14) for vessel collision risk show less than one harbour seal (<0.3) at risk. As noted above, it is highly unlikely that all harbour seal present at the North Falls

site would be from the Vlaamse Banken SAC, and therefore the number of harbour seal at risk of collision, that are associated with the Vlaamse Banken SAC, would be significantly less than this.

892. The assessments undertaken for harbour seals not associated with a particular SAC (i.e. those undertaken within the ES Chapter 12, Document Reference: 3.1.14) for changes to water quality and prey availability show that there would be no potential for significant effect to harbour seal. Given the limited connectivity of any harbour seal associated with the Vlaamse Banken SAC and the North Falls site, the potential effect is likely to be minimal.

893. See Section 3.7.2.3 for the conclusions of the appropriate assessment for harbour seal of the Vlaamse Banken SAC.

3.7.2.3.3 Grey seal

894. The assessments undertaken for grey seals not associated with a particular SAC (i.e. those undertaken within the ES Chapter 12, Document Reference: 3.1.14) show that for the worst-case underwater noise effects (i.e. from piling), less than one (0.014) grey seal would be at risk of injury, and a potential 112 grey seal would be at risk of disturbance. While for disturbance this could be a significant proportion of the grey seal presence in Belgium, it is highly unlikely that all seals present at North Falls would be associated with the Vlaamse Banken SAC, given the rarity of grey seal within Belgium waters, and the limited connectivity with Belgium waters as shown by the tagging studies summarised above. Therefore, the number of grey seal associated with the Vlaamse Banken SAC would be significantly less than noted above.

895. The assessments undertaken for grey seal not associated with a particular SAC (i.e. those undertaken within the ES Chapter 12, Document Reference: 3.1.14) for vessel collision risk show less than one grey seal (0.009) at risk. As noted above, it is highly unlikely that all grey seal present at the North Falls site would be from the Vlaamse Banken SAC, and therefore the number of grey seal at risk of collision, that are associated with the Vlaamse Banken SAC, would be significantly less than this.

896. The assessments undertaken for grey seals not associated with a particular SAC (i.e. those undertaken within the ES Chapter 12, Document Reference: 3.1.14) for changes to water quality and prey availability show that there would be no potential for significant effect to grey seal. Given the limited connectivity of any grey seal associated with the Vlaamse Banken SAC and the North Falls site, the potential effect is likely to be minimal.

897. See Section 3.7.2.3 for the conclusions of the appropriate assessment for grey seal of the Vlaamse Banken SAC.

Summary

898. Table 3.102 summarises the assessment of likely significant effects on Vlaamse Banken SAC on the species that were screened in for further assessment as a qualifying feature, based on the assessments undertaken for the SNS SAC for harbour porpoise (Section 3.4.3), Humber Estuary for grey seal (Section 3.5.3), and TW & NNC SAC for harbour seal (Section 3.6.3), under the assumption that greater connectivity is expected for the sites within the UK, and therefore the

greater potential for effect would be present (and assessed) for the UK sites as noted above.

899. Disturbance from underwater noise for North Falls alone and in combination with other projects and activities is unlikely to result any significant disturbance or barrier effects for foraging harbour porpoise, harbour seal or grey seal. Under these circumstances, there is no adverse effect on the integrity of the Vlaamse Banken SAC in relation to the conservation objectives for harbour porpoise, grey seal or harbour seal.

Table 3.102 Summary of potential construction effects for qualifying features of the Vlaamse Banken SAC (x = no potential for adverse effect on site integrity; ✓= potential for adverse effect on site integrity)

	CO 1 & 2				CO 2	CO 1 & 2	CO 3		COs 1 - 3
Qualifying features	**Underwater noise from piling**	**Underwater noise from other noisy activities**	**Underwater noise from vessels**	**Underwater noise from operational WTGs**	**Barrier effect from underwater noise**	**Collision risk**	**Prey availability / habitat quality**	**Water quality**	**In-combination**
Construction phase									
Harbour porpoise	x	x	x	N/A	x	x	x	x	x
Grey Seal	x	x	x	N/A	x	x	x	x	x
Harbour seal	x	x	x	N/A	x	x	x	x	x
Operational phase									
Harbour porpoise	N/A	x	x	x	x	x	x	x	N/A
Grey Seal	N/A	x	x	x	x	x	x	x	N/A
Harbour seal	N/A	x	x	x	x	x	x	x	N/A
Decommissioning phase									
Harbour porpoise	N/A	x	x	N/A	x	x	x	x	N/A
Grey Seal	N/A	x	x	N/A	x	x	x	x	N/A
Harbour seal	N/A	x	x	N/A	x	x	x	x	N/A

3.7.3 SBZ 1 / ZPS 1 SPA

3.7.3.1 Site overview

900. The SBZ 1 / ZPS 1 SPA been recognised as an SPA since October 2005. The SPA is also a designated site for harbour seals (EUNIS, 2024).

901. The SBZ 1 / ZPS 1 SPA covers an area of 63 km^2. The SPAs closest point to the North Falls array area is 63km.

3.7.3.2 Qualifying feature

902. This SPA lies within the Vlaamse Banken SAC (as assessed in Section 3.7.2); it is therefore likely that the information on harbour seal will overlap.

3.7.3.2.1 Harbour seal

903. There is no site-specific data on harbour seal estimates available. Harbour seals are frequenting here for predation reasons (Natura 2000) but may also be due to the proximity to the resting site at Phare du Walde. This site lies approximately 50km west of the SAC, where a record number of 1,329 harbour seals were hauled out in 2021 (Poncet *et al*., 2023). The southernmost harbour seal colonies in the NE Atlantic lie in northern France; with an increasing number since mid-1990 (Andersen & Olsen, 2010; Poncet *et al*., 2021).

3.7.3.3 Shadow appropriate assessment

904. In order to assess the effects of North Falls on the integrity of the SBZ 1 / ZPS 1 SPA, refer to the assessment of Vlaamse Banken SAC (Section 3.7.1). The effects on SBZ 1 / ZPS 1 SPA will be similar, as it is nested within the Vlaamse Banken SAC (see Table 3.102).

905. Therefore, there is no adverse effect on the integrity of the SBZ 1 / ZPS 1 SPA in relation to the conservation objectives for harbour seal.

3.7.4 Vlakte van de Raan SCI

3.7.4.1 Site overview

906. The Vlakte van de Raan SCI has been recognised as an SCI since December 2009. The SAC is a designated site for harbour porpoise, grey seals and harbour seals (EUNIS, 2024); all of which have screened into this assessment.

907. The Vlakte van de Raan SCI covers an area of 175km^2. The SCIs closest point to the North Falls array area is 85km.

3.7.4.2 Qualifying features

3.7.4.2.1 Harbour porpoise

908. In a report by Flanders Research Institute for Agriculture, Fisheries and Food, it stated that the area of the Vlakte van den Raan SCI has the lowest densities of harbour porpoise found in Belgian waters (Degraer & Hostens, 2016).

909. Average densities in 2008 and 2009, as estimated by aerial monitoring covering most of the Belgian part of the North Sea (with the exclusion of a nearshore 5 km strip) 0.05 in August to 1.01 animals/km^2 in April (Haelters *et al*., 2011).

910. The extent is unclear to which the SCI is of special significance to the normal reproduction, mortality and age structure of harbour porpoise and so it concluded that the ecological value for harbour porpoise is negligible and hence the conservation status to change to ‘unfavourable-inadequate’ (Jak *et al*. 2009).

911. The specific conservation target is to maintain the habitat and population of the species may be adopted for this SCI to a restoration task (Jak *et al*. 2009).

3.7.4.2.2 Grey seal

912. Along the southern Dutch and Belgian coasts small groups are regularly observed, but no colonies have yet been established (Härkönen *et al*., 2007).

913. At site level there is no data on grey seals; it is proposed that grey seals may forage here but have their refuge elsewhere (Jak *et al*., 2009).

3.7.4.2.3 Harbour seal

914. Telemetry data shows evidence that presence of harbour seal is limited due to the lack of tidal flats and is therefore not used as reproduction or haul out area (Jak *et al*., 2009).

3.7.4.3 Shadow appropriate assessment

915. In order to assess the effects of North Falls on the integrity of the Vlakte van de Raan SCI, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on Vlakte van de Raan SCI will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Vlakte van de Raan SCI.

916. Therefore, there is no adverse effect on the integrity of the Vlakte van de Raan SCI in relation to the conservation objectives for harbour porpoise, grey seal or harbour seal.

3.7.5 Baie de Canche et couloir des trois estuaries SAC

3.7.5.1 Site overview

917. The Baie de Canche et couloir des trois estuaries SAC has been recognised as an SAC since October 2008. The SAC is a designated site for harbour porpoise, grey seals and harbour seals (EUNIS, 2024), however, only grey seal and harbour seal have been screened into this assessment.

918. The Baie de Canche et couloir des trois estuaries SAC covers an area of 333 km^2. The closest point to the North Falls array area is 119km.

3.7.5.2 Qualifying features

3.7.5.2.1 Grey seal

919. There is no site-specific data on grey seal estimates available. The SAC is situated near three significant haul-out sites - Baie de Somme, which adjoins the SAC, and Baie d'Authie and Baie de Canche, both within the SAC boundary. Grey seal numbers here have increased exponentially since 2010, with a maximum number of 494 grey seals hauled during moult (February- March) at Baie de Somme. A count of 20 grey seals hauled out during moult and 161 hauled out during summer in 2021 at Baie d'Authie (Poncet *et al*., 2023). For seals hauled out at Baie de Canche, recent surveys conducted in 2020 and 2021 reported counts of only one to two grey seals (Poncet *et al*., 2023), whilst a survey conducted in 2019 recorded 108 grey seals during moult (Poncet *et al*., 2021).

920. Based on the extensive swimming ranges of grey seals (448 km; Carter *et al*., 2022), the seals from these sites could potentially use the offshore area for foraging reasons.

3.7.5.2.2 Harbour seal

921. There is no site-specific data on harbour seal estimates available. Based on the foraging range of harbour seal (273 km; Carter *et al*., 2022), individuals from this site could potentially use the offshore area for foraging reasons.

3.7.5.3 Shadow appropriate assessment

922. In order to assess the effects of North Falls on the integrity of the Baie de Canche et couloir des trois estuaries SAC, refer to the assessment of Vlaamse Banken

SAC (Section 3.7.2.3; Table 3.102), as the effects on Baie de Canche et couloir des trois estuaries SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Baie de Canche et couloir des trois estuaries SAC.

923. Therefore, there is no adverse effect on the integrity of the Baie de Canche et couloir des trois estuaries SAC in relation to the conservation objectives for grey seal or harbour seal.

3.7.6 Bancs des Flandres SAC

3.7.6.1 Site overview

924. The Bancs des Flandres SAC has been recognised as an SAC since February 2016. The SAC is a designated site for harbour porpoise, grey seals and harbour seals (EUNIS, 2024); all of which have been screened in for further assessment.

925. The Bancs des Flandres SAC covers an area of 1,129km^2. The SACs closest point to the North Falls array area is 37km.

3.7.6.2 Qualifying features

3.7.6.2.1 Harbour porpoise

926. Data shows that this area is one of the two French sites commonly frequented by the harbour porpoise to forage (Natura 2000).

927. However, there is no site-specific data on harbour porpoise estimates available. Hence, a wider search approach was applied. More reliable data could be derived from data collected in the English Channel. According to SCANS III, the estimates for harbour porpoise abundance was zero in the English Channel (Hammonds et al. 2017). Distribution maps by the Sea Watch Foundation showed no sightings in the western part of the English Channel apart from December, near the English coast by the Isle of Wight. Observed density distributions between1994 and 2011 are mainly below 0.3 in 25km grid cells (Heinaenen & Skov, 2015).

3.7.6.2.2 Harbour seal

928. Based on the extensive swimming ranges of grey seals (448 km; Carter *et al*., 2022), the seals from these sites could potentially use the offshore area for foraging reasons.

929. There is no site-specific data on harbour seal estimates available. Harbour seals are frequenting here for predation reasons (Natura 2000) but may also be due to the proximity to the resting site at Phare du Walde. During moult (late July- early September) in 2021, surveys counted a maximum number of 25 harbour seals in 2021, 17 seals in 2020 (Poncet *et al*., 2023), and 16 in 2019 (Poncet *et al*., 2021). These haul out sites present the southernmost harbour seal colonies in the NE Atlantic where increasing numbers have been recorded since mid-1990 (Andersen and Olsen, 2010; Poncet *et al*., 2021).

3.7.6.2.3 Grey seal

930. There is no site-specific data on grey seal abundance within the SAC. Nearby, approximately 5km south of the SAC, is a major grey seal-haul out-site, Phare du Walde, France. During moult in 2021 (February-March), the maximum number of

grey seal that hauled out was 1,329, but no pups were recorded in 2020 nor 2021 (Poncet *et al*., 2023).

931. Plate 3.8 indicates an important haul out sites for grey seals, with maximum numbers of seals in the summer of 282 and 117 during moulting (February-March) (Poncet *et al*. 2021).

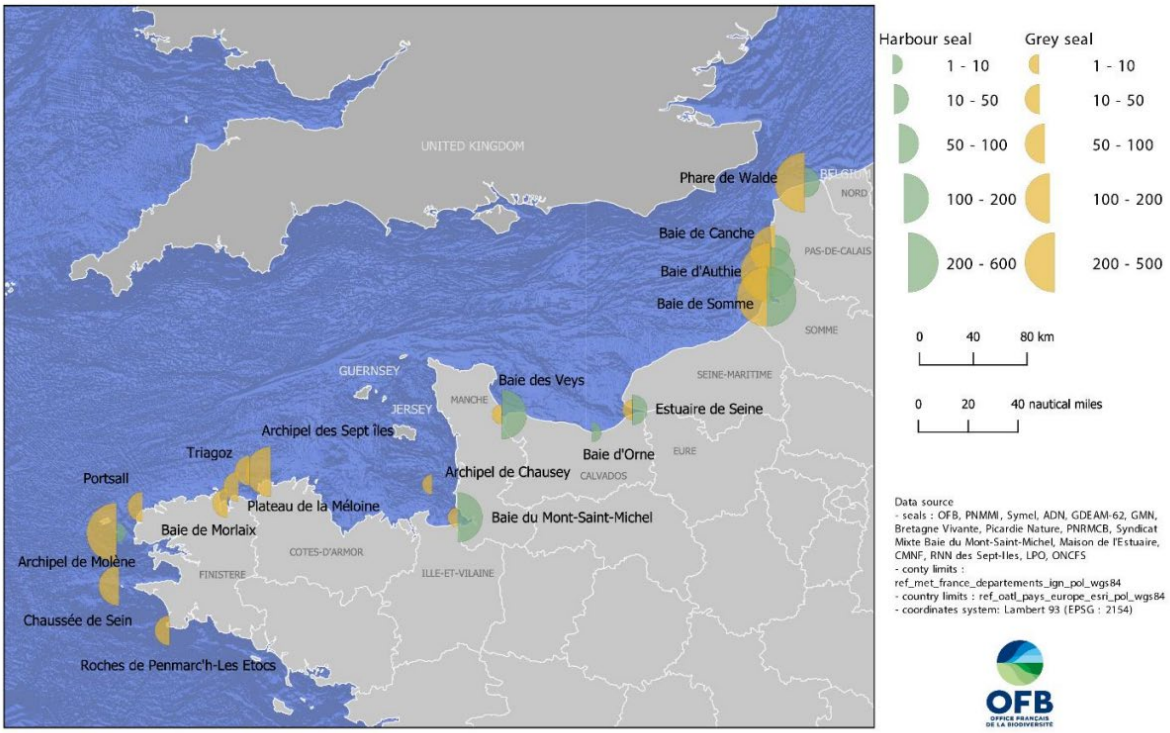


Plate 3.8 Grey seal haul out sites (source: Poncet *et al.,* 2019)

3.7.6.3 Shadow appropriate assessment

932. In order to assess the effects of North Falls on the integrity of the Bancs des Flandres SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on Bancs des Flandres SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Bancs des Flandres SAC.

933. Therefore, there is no adverse effect on the integrity of the Bancs des Flandres SAC in relation to the conservation objectives for harbour porpoise, grey seal or harbour seal.

3.7.7 Dunes De La Plaine Maritime Flamande SAC

3.7.7.1 Site overview

934. The Dunes De La Plaine Maritime Flamande SAC been recognised as an SAC since April 2007. The SAC is a designated site for harbour seals (EUNIS, 2024).

935. The Dunes De La Plaine Maritime Flamande SAC covers an area of 44km^2 and is nestled between coast and the Banc des Flandres SAC. The closest point to the North Falls array area is 69km.

3.7.7.2 Qualifying feature

3.7.7.2.1 Harbour seal

936. This SAC borders with the Bancs des Flandres SAC, thus the available information for harbour seal is the same as outlined in Section 3.7.6.2.2.

3.7.7.3 Shadow appropriate assessment

937. In order to assess the effects of North Falls on the integrity of the Dunes De La Plaine Maritime Flamande SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on Dunes De La Plaine Maritime Flamande SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Dunes De La Plaine Maritime Flamande SAC.

938. Therefore, there is no adverse effect on the integrity of the Dunes De La Plaine Maritime Flamande SAC in relation to the conservation objectives for harbour seal.

3.7.8 Estuaire De La Canche, Dunes Picardes Plaquées Sur L'ancienne Falaise, Forêt d'Hardelot Et Falaise D'equihen SAC

3.7.8.1 Site overview

939. The SAC has been recognised as an SAC since April 2002. The SAC is a designated site for harbour seals (EUNIS, 2024).

940. The Estuaire De La Canche, Dunes Picardes Plaquées Sur L'ancienne Falaise, Forêt d'Hardelot Et Falaise D'equihen SAC covers an area of 17km^2. The SAC's closest point to the North Falls array area is 73km.

3.7.8.2 Qualifying features

3.7.8.2.1 Harbour seal

941. There is no site-specific data on harbour seal estimates available, but in the most southern part of the SAC is an important harbour seal haul out site, Baie de Canche. During moult in 2021 (late July-early September), a maximum of 69 harbour seals were counted (Poncet *et al*., 2023). Harbour seals are likely to use the SAC as their feeding grounds (Natura 2000).

942. Based on the swimming ranges of harbour seals (273km; Carter *et al*., 2022), the seals from these sites could potentially use the offshore project area for foraging reasons.

3.7.8.3 Shadow appropriate assessment

943. In order to assess the effects of North Falls on the integrity of the Estuaire De La Canche, Dunes Picardes Plaquées Sur L'ancienne Falaise, Forêt d'Hardelot Et Falaise D'equihen SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Estuaire De La Canche, Dunes Picardes Plaquées Sur L'ancienne Falaise, Forêt d'Hardelot Et Falaise D'equihen SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and

therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Estuaire De La Canche, Dunes Picardes Plaquées Sur L'ancienne Falaise, Forêt d'Hardelot Et Falaise D'equihen SAC.

944. Therefore, there is no adverse effect on the integrity of the Estuaire De La Canche, Dunes Picardes Plaquées Sur L'ancienne Falaise, Forêt d'Hardelot Et Falaise D'equihen SAC in relation to the conservation objectives for harbour seal.

3.7.9 Estuaires et littoral picards (baies de Somme et d'Authie) SAC

3.7.9.1 Site overview

945. The Estuaires et littoral picards (baies de Somme et d'Authie) SAC been recognised as an SAC since March 1999. The SAC is a designated site for grey seal and harbour seal; both of which have been screened in for further assessment (EUNIS, 2024)

946. The Estuaires et littoral picards (baies de Somme et d'Authie) SAC covers an area of 156km^2. The closest point to the North Falls array area is 139km.

3.7.9.2 Qualifying features

3.7.9.2.1 Grey seal

947. There is no site-specific data on grey seal estimates available. The SAC encompasses two major haul-out sites: Baie de Somme and Baie d'Authie. During moult (February- March) a maximum number of 494 and 20 grey seals hauled out at Baie de Somme and Baie d'Authie, respectively during 2021 surveys (Poncet *et al*., 2023).

948. Based on the extensive swimming ranges of grey seals (448 km; Carter *et al*., 2022), the seals from these sites could potentially use the offshore area for foraging reasons.

3.7.9.2.2 Harbour seal

949. There is no site-specific data on harbour seal estimates available. Based on the swimming ranges of harbour seals (273 km; Carter *et al.,* 2022), the seals from these sites could potentially use the offshore area for foraging reasons.

3.7.9.3 Shadow appropriate assessment

950. In order to assess the effects of North Falls on the integrity of the Estuaires et littoral picards (baies de Somme et d'Authie) SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Estuaires et littoral picards (baies de Somme et d'Authie) SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Estuaires et littoral picards (baies de Somme et d'Authie) SAC.

951. Therefore, there is no adverse effect on the integrity of Estuaires et littoral picards (baies de Somme et d'Authie) SAC in relation to the conservation objectives for grey seal or harbour seal.

3.7.10 Recifs Gris-Nez Blanc-Nez SAC

3.7.10.1 Site overview

952. The Recifs Gris-Nez Blanc-Nez SAC been recognised as an SAC since May 2015. The SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024) since October 2008. All three marine mammal species have been screened in for assessment.

953. The Recifs Gris-Nez Blanc-Nez SAC covers an area of 292km^2. The SACs closest point to the North Falls array area is 73km.

3.7.10.2 Qualifying features

3.7.10.2.1 Harbour porpoise

954. The site assessment states that this is a relatively important site for the harbour porpoise, which is regularly visited (Natura 2000). However, there is no site-specific data on harbour porpoise estimates available. Hence, a wider search approach was applied. More reliable data on abundance data could be derived from data collected in the English Channel.

955. According to SCANS III, the estimates for harbour porpoise abundance was zero in survey block C (English Channel) (Hammonds *et al*. 2017. Distribution maps by the SeaWatch Foundation showed no sightings in the western part of the English Channel apart from near the English coast by the Isle of Wight (December). Observed density distributions between 1994 and 2011 are mainly below 0.3 in 25km grid cells (Heinaenen & Skov, 2015).

3.7.10.2.2 Grey seal

956. There is no site-specific data on grey seal estimates available. Grey seals are frequenting here for predation reasons (Natura 2000) travelling from the nearest haul-out site, Phare du Walde, approximately 18km west of the SAC. During moult in 2021 (February-March), the maximum number of grey seal that hauled out was 1,329, but no pups recorded in 2020 nor 2021 (Poncet *et al*., 2023). Approximately 27km from the SAC lies another haul-out site, Baie de Canche. Recent surveys conducted in 2020 and 2021 reported counts of only one to two grey seals (Poncet *et al*., 2023). However, a survey conducted in 2019 recorded 108 grey seals during moult (Poncet *et al*., 2021). Baie de Somme, 45km from the SAC, held 297 grey seals, with three pups born during the summer 2021 moult surveys.

3.7.10.2.3 Harbour seal

957. There is no site-specific data on harbour seal estimates available. The haul-out sites described for grey seal are the same for harbour seal. Baie de Somme (approximately 45km from the SAC) is the main breeding colony for harbour seals in mainland France, where 59% of the national harbour seal pup production is recorded, with 178 pups born here in 2021.

958. During moult in 2021 (late July-early September), a maximum of 25, 668 and 69 harbour seals were hauled at Phare de Walde, Baie de Somme and Baie de Canche, respectively (Poncet *et al*., 2023).

959. Based on the swimming ranges of harbour seals (273 km; Carter *et al*., 2022), the seals from these sites could potentially use the offshore area for foraging reasons.

3.7.10.3 Shadow appropriate assessment

960. In order to assess the effects of North Falls on the integrity of the Recifs Gris-Nez Blanc-Nez SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Recifs Gris-Nez Blanc-Nez SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Recifs Gris-Nez Blanc-Nez SAC.

961. Therefore, there is no adverse effect on the integrity of the Recifs Gris-Nez Blanc-Nez SAC in relation to the conservation objectives for harbour porpoise, grey seal or harbour seal.

3.7.11 Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC

3.7.11.1 Site overview

962. The Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC been recognised as an SAC since August 2015. The SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024). All three of the listed marine mammal species have been screened in for assessment.

963. The Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC covers an area of 11km^2. The closest point to the North Falls array area is 82km.

3.7.11.2 Qualifying features

964. This SAC borders with the Recif Gris-Nez Blanc-Nez SAC, thus the available information is the same as outlined in Section 3.7.10.2.

3.7.11.2.1 Harbour porpoise

965. Comments in the site assessment state that this is a relatively important site for the harbour porpoise, which is regularly visited (Natura 2000).

966. However, there is no site-specific data on harbour porpoise estimates available. Hence, a wider search approach was applied. More reliable data on abundance data could be derived from data collected in the English Channel.

967. According to SCANS III, the estimates for harbour porpoise abundance was zero in survey block C (English Channel) (Hammonds et al. 2017. Distribution maps by the SeaWatch Foundation showed no sightings in the western part of the English Channel apart from near the English coast by the Isle of Wight (December). Observed density distributions between 1994 and 2011 are mainly below 0.3 in 25km grid cells (Heinaenen& Skov, 2015).

3.7.11.2.2 Grey seal

968. There is no site-specific data on grey seal estimates available. Grey seals are frequenting here for predation reasons (Natura 2000) but may also be due to the proximity to two haul-out sited north-east and south of the SAC, Phare du Walde and Baie de Canche, respectively. At Phare du Walde, approximately 16km west of the SAC, maximum of 282 grey seals haul out in the summer and 117 during

moulting (February- March). At Baie de Canche approximately 108 grey seals were counted in 2019 during moult (February-March) (Poncet *et al.* 2021).

3.7.11.2.3 Harbour seal

969. There is no site-specific data on harbour seal estimates available. Harbour seals are frequenting here for predation reasons (Natura 2000) but may also be due to the proximity to two haul-out sited north-east and south of the SAC, Phare du Walde and Baie de Canche, respectively. At Phare du Walde, maximum numbers of harbour seals hauled out during molt (late July- early September) were 16 in 2019, and at Baie de Canche 49 harbour seals and 4 pups were counted in 2019 during moult (February-March) (Poncet *et al.* 2021).

3.7.11.3 Shadow appropriate assessment

970. In order to assess the effects of North Falls on the integrity of the Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC.

971. Therefore, there is no adverse effect on the integrity of the Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC in relation to the conservation objectives for harbour porpoise, grey seal, or harbour seal.

3.7.12 Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC

3.7.12.1 Site overview

972. The Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC been recognised as an SAC since February 2016. The SAC is a designated site for harbour porpoise, grey seals, and harbour seals (EUNIS, 2024); all of which have been screened in for assessment.

973. The Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC covers an area of 682km^2. The closest point to the North Falls array area is 82km.

3.7.12.2 Qualifying features

3.7.12.2.1 Harbour porpoise

974. There is no site-specific data on harbour porpoise estimates available. Hence, a wider search approach was applied. More reliable data on abundance data could be derived from data collected in the English Channel.

975. According to SCANS III, the estimates for harbour porpoise abundance was zero in survey block C (English Channel) (Hammonds *et al*., 2017). Distribution maps by the SeaWatch Foundation showed no sightings in the western part of the English Channel apart from December, near the English coast by the Isle of Wight. Observed density distributions between 1994 and 2011 are mainly below 0.3 in 25km grid cells (Heinaenen& Skov, 2015).

3.7.12.2.2 Grey seal

976. There is no site-specific data on grey seal estimates available. Grey seals are frequenting here for predation reasons (Natura 2000) travelling from the nearest haul-out site, Phare du Walde, approximately 38km west of the SAC. During moult in 2021 (February-March), the maximum number of grey seal that hauled out was 1,329, but no pups recorded in 2020 nor 2021 (Poncet *et al*., 2023). Approximately 20km south-west from the SAC lies another haul-out site, Baie de Canche. Recent surveys conducted in 2020 and 2021 reported counts of only one to two grey seals (Poncet *et al*., 2023). However, a survey conducted in 2019 recorded 108 grey seals during moult (Poncet *et al*., 2021). Baie de Somme, 40km from the SAC, held 297 grey seals, with three pups born during the summer 2021 moult surveys.

3.7.12.2.3 Harbour seal

977. There is no site-specific data on harbour seal estimates available. The SAC lies offshore of three important haul-out sites at baie de Somme, baie d'Authie and baie de Canche. Based on the swimming ranges of harbour seals (273 km; Carter *et al.,* 2022), the seals from these sites could potentially use the offshore area for foraging reasons. During moult (late July-early September) a maximum of 777 harbour seals were counted at all three locations and would give the best estimate of regional population numbers. The pup production was the highest at Baie de Somme with 149 pups, the highest of all French haul-out sites (Poncet *et al*., 2021).

3.7.12.3 Shadow appropriate assessment

978. In order to assess the effects of North Falls on the integrity of the Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC.

979. Therefore, there is no adverse effect on the integrity of the Ridens et dunes hydrauliques du detroit du Pas-de-Calais SAC in relation to the conservation objectives for harbour porpoise, grey seal, or harbour seal.

3.7.13 Borkum Riffgrund SCI

3.7.13.1 Site overview

980. The Borkum Riffgrund SCI has been recognised as a SCI since May 2004. The SCI designated site has harbour porpoise, grey seals and harbour seals as a qualifying feature (EUNIS, 2024), however, only grey seal has been screened in for this assessment.

981. The Borkum Riffgrund SCI covers an area of 625km^2. The closest point to the array area is 368km.

3.7.13.2 Qualifying features

3.7.13.2.1 Grey seal

982. There is no site-specific data available for grey seals. The north Dutch coastline is also an important foraging zone and migration route for grey seal (Brasseur *et al*., 2010).

983. Telemetry tagging studies of grey seals, undertaken from key haul-out sites along the north coast of France show connectivity of grey seals from the east coast of England to the north coasts of France, Belgium, and the Netherlands, (for tagged individuals from 2012; Vincent *et al.,* 2017).

3.7.13.3 Shadow appropriate assessment

984. In order to assess the effects of North Falls on the integrity of the Borkum Riffgrund SCI, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Borkum Riffgrund SCI will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Borkum Riffgrund SCI.

985. Therefore, there is no adverse effect on the integrity of the Borkum Riffgrund SCI in relation to the conservation objectives for grey seal.

3.7.14 Nationalpark Niedersachsisches Wattenmeer SAC

3.7.14.1 Site overview

986. The Nationalpark Niedersachsisches Wattenmeer SAC has been recognised as an SAC since October 1998. The SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024), however, only grey seal has been screened into this assessment.

987. The Nationalpark Niedersachsisches Wattenmeer SAC covers an area of 2,770km^2. The SACs closest point to the Projects is 370km.

3.7.14.2 Qualifying features

988. The Nationalpark Niedersachsisches Wattenmeer SAC is adjacent to the Borkum Riffgrund SCI therefore the populations of grey seal will be very similar, refer to Section 3.7.13 for further details on the qualifying features.

3.7.14.2.1 Grey seal

989. There is no site-specific data available for grey seals. The north Dutch coastline is also an important foraging zone and migration route for grey seal (Brasseur *et al*., 2010).

990. Telemetry tagging studies of grey seals, undertaken from key haul-out sites along the north coast of France show connectivity of grey seals from the east coast of England to the north coasts of France, Belgium, and the Netherlands, (for tagged individuals from 2012; Vincent *et al.,* 2017).

3.7.14.3 Shadow appropriate assessment

991. In order to assess the effects of North Falls on the integrity of the Nationalpark Niedersachsisches Wattenmeer SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Nationalpark Niedersachsisches Wattenmeer SAC will be less than those assessed for the

Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Nationalpark Niedersachsisches Wattenmeer SAC.

992. Therefore, there is no adverse effect on the integrity of the Nationalpark Niedersachsisches Wattenmeer SAC in relation to the conservation objectives for grey seal.

3.7.15 Doggersbank SAC

3.7.15.1 Site overview

993. The Doggersbank SAC has been recognised as an SAC since October 2012. The SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024); however, only grey seal has been screened into this assessment.

994. The Doggersbank SAC covers an area of 4,735km^2. The SACs closest point to the Projects is 296km.

3.7.15.2 Qualifying features

3.7.15.2.1 Grey seal

995. In 2018 it had been reported a maximum of 400 individual grey seals were counted (Natura 2000). Within the greater area of the Dutch Delta, harbour seal counts ranged from 677- 2581 from (2011-2021) (Central Bureau of Statistics *et al*., 2023).

3.7.15.3 Shadow appropriate assessment

996. In order to assess the effects of North Falls on the integrity of the Doggersbank SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Doggersbank SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Doggersbank SAC.

997. Therefore, there is no adverse effect on the integrity of the Doggersbank SAC in relation to the conservation objectives for grey seal.

3.7.16 Duinen Ameland SAC

3.7.16.1 Site overview

998. The Duinen Ameland SAC has been recognised as an SAC since March 2000. The SAC is a designated site for the grey seal (EUNIS, 2024).

999. The Duinen Ameland SAC covers an area of 21km^2. The SAC's closest point to North Falls is 298km.

3.7.16.2 Qualifying feature

3.7.16.2.1 Grey seal

1000. There is no site-specific data available for grey seals. The north Dutch coastline is also an important foraging zone and migration route for grey seal (Brasseur *et al*., 2010).

1001. Telemetry tagging studies of grey seals, undertaken from key haul-out sites along the north coast of France show connectivity of grey seals from the east coast of England to the north coasts of France, Belgium, and the Netherlands, (for tagged individuals from 2012; Vincent *et al.*, 2017).

3.7.16.3 Shadow appropriate assessment

1002. In order to assess the effects of North Falls on the integrity of the Duinen Ameland SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Duinen Ameland SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Duinen Ameland SAC.

1003. Therefore, there is no adverse effect on the integrity of the Duinen Ameland SAC in relation to the conservation objectives for grey seal.

3.7.17 Duinen en Lage Land Texel SAC

3.7.17.1 Site overview

1004. The Duinen en Lage Land Texel SAC has been recognised as an SAC since August 2002. The SAC is a designated site for the grey seal (EUNIS, 2024).

1005. The Duinen en Lage Land Texel SAC covers an area of 41km^2. The SAC's closest point to North Falls is 220km.

3.7.17.2 Qualifying features

3.7.17.2.1 Grey seal

1006. Natura 2000 reports indicate a maximum of 50 seals were counted in this SAC (last reports updated in 2018).

1007. This SAC borders with the Waddenzee SAC, thus the available information is the same as outlined in Section 3.7.24.2.

3.7.17.3 Shadow appropriate assessment

1008. In order to assess the effects of North Falls on the integrity of the Duinen en Lage Land Texel SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Duinen en Lage Land Texel SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Duinen en Lage Land Texel SAC.

1009. Therefore, there is no adverse effect on the integrity of the Duinen en Lage Land Texel SAC in relation to the conservation objectives for grey seal.

3.7.18 Duinen Goeree & Kwade Hoek SAC

3.7.18.1 Site overview

1010. The Duinen Goeree & Kwade Hoek SAC been recognised as an SAC since July 1998. The SAC is a designated site for the grey seal and harbour seal (EUNIS, 2024); both of which have been screened in for this assessment.

1011. The Duinen Goeree & Kwade Hoek SAC covers an area of 16km^2. The SAC's closest point to North Falls is 126km.

3.7.18.2 Qualifying features

1012. This SAC borders with the Waddenzee SAC, thus the available information is the same as outlined in Section 3.7.24.2.

3.7.18.3 Shadow appropriate assessment

1013. In order to assess the effects of North Falls on the integrity of the Duinen Goeree & Kwade Hoek SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Duinen Goeree & Kwade Hoek SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Duinen Goeree & Kwade Hoek SAC.

1014. Therefore, there is no adverse effect on the integrity of the Duinen Goeree & Kwade Hoek SAC in relation to the conservation objectives for either grey seal or harbour seal.

3.7.19 Duinen Terschelling SAC

3.7.19.1 Site overview

1015. The Duinen Terschelling SAC been recognised as an SAC since August 2002. The SAC is a designated site for the grey seal (EUNIS, 2024).

1016. The Duinen Terschelling SAC covers an area of 40km^2. The SAC's closest point to North Falls is 267km.

3.7.19.2 Qualifying features

3.7.19.2.1 Grey seal

1017. This SAC borders with the Waddenzee SAC, thus the available information is the same as outlined in Section 3.7.27.2.1.

3.7.19.3 Shadow appropriate assessment

1018. In order to assess the effects of North Falls on the integrity of the Duinen Terschelling SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Duinen Terschelling SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Duinen Terschelling SAC.

1019. Therefore, there is no adverse effect on the integrity of the Duinen Terschelling SAC in relation to the conservation objectives for grey seal.

3.7.20 Duinen Vlieland SAC

3.7.20.1 Site overview

1020. The Duinen Vlieland SAC been recognised as an SAC since August 2002. The SAC is a designated site for the grey seal (EUNIS, 2024).

1021. The Duinen Vlieland SAC covers an area of 15km^2. The SAC's closest point to North Falls is 248km.

3.7.20.2 Qualifying features

3.7.20.2.1 Grey seal

1022. This SAC borders with the Waddenzee SAC, thus the available information is the same as outlined in Section 3.7.27.2.1.

3.7.20.3 Shadow appropriate assessment

1023. In order to assess the effects of North Falls on the integrity of the Duinen Vlieland SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Duinen Vlieland SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Duinen Vlieland SAC.

1024. Therefore, there is no adverse effect on the integrity of the Duinen Vlieland SAC in relation to the conservation objectives for grey seal.

3.7.21 Grevelingen SAC

3.7.21.1 Site overview

1025. The Grevelingen SAC been recognised as an SAC since July 1998. The SAC is a designated site for the grey seal and harbour seal (EUNIS, 2024); both of which have been screened in for this assessment.

1026. The Grevelingen SAC covers an area of 138km^2. The SAC's closest point to North Falls is 122km.

3.7.21.2 Qualifying features

1027. This SAC forms part of the southern Dutch Delta region, together with other SACs (Oosterschelde SAC, Vlakte van de Raan SAC, Voordelta SAC, Westershelde and Saeftinghe SAC), thus the information on the wider area will be similar to one another.

3.7.21.2.1 Grey seal

1028. Natura 2000 reported a maximum of 10 grey seals present (last reports updated in 2018).

1029. The available information is the same as outlined in Section 3.7.24.2.2.

3.7.21.2.2 Harbour seal

1030. Natura 2000 reported 282 harbour seals to be present (last updated in 2018).

1031. The available information is the same as outlined in Section 3.7.24.2.1.

3.7.21.3 Shadow appropriate assessment

1032. In order to assess the effects of North Falls on the integrity of the Grevelingen SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Grevelingen SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no

adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Grevelingen SAC.

1033. Therefore, there is no adverse effect on the integrity of the Grevelingen SAC in relation to the conservation objectives for grey seal or harbour seal.

3.7.22 Klaverbank SAC

3.7.22.1 Site overview

1034. The Klaverbank SAC has been recognised as an SAC since December 2008. The SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024); however, only grey seal has been screened in for this assessment.

1035. The Klaverbank SAC covers an area of 1,539km^2. The SAC's closest point to North Falls is 240km.

3.7.22.2 Qualifying features

3.7.22.2.1 Grey seal

1036. Natura 2000 reported a maximum of 400 individual grey seals were counted (last reports updated in 2016).

3.7.22.3 Shadow appropriate assessment

1037. In order to assess the effects of North Falls on the integrity of the Klaverbank SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Klaverbank SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Klaverbank SAC.

1038. Therefore, there is no adverse effect on the integrity of the Klaverbank SAC in relation to the conservation objectives for grey seal.

3.7.23 Noordzeekustzone SAC

3.7.23.1 Site overview

1039. The Noordzeekustzone SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024) and has been recognised as an SAC since 2010. Both seal species have been screened in for this assessment.

1040. The Noordzeekustzone SAC covers an area of 1,445km^2. The SACs closest point to the North Falls array area is 190km.

3.7.23.2 Qualifying features

3.7.23.2.1 Grey seal

1041. Natura 2000 reported a maximum of 2,040 grey seals (last reports updated in 2018).

1042. This SAC borders with the Waddenzee SAC, thus the population information will be similar for Noordzeekustzone SAC as Waddenzee SAC, as outlined in Section 3.7.27.2.1.

3.7.23.2.2 Harbour seal

1043. Natura 2000 reported a total of 6,340 harbour seals (last reports updated in 2018).

1044. This SAC borders with the Waddenzee SAC, thus the population information will be similar for Noordzeekustzone SAC as Waddenzee SAC, as outlined in Section 3.7.27.2.2.

3.7.23.3 Shadow appropriate assessment

1045. In order to assess the effects of North Falls on the integrity of the Noordzeekustzone SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Noordzeekustzone SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Noordzeekustzone SAC.

1046. Therefore, there is no adverse effect on the integrity of the Noordzeekustzone SAC in relation to the conservation objectives for grey seal or harbour seal.

3.7.24 Oosterschelde SPA and SAC

3.7.24.1 Site overview

1047. The Oosterschelde SPA and SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024) and has been recognised as an SAC since November 1989. However, for this assessment only grey seal and harbour seal have been screened in.

1048. The Oosterschelde SPA and SAC covers an area of 370km^2. The SACs closest point to the North Falls array area is 114km.

3.7.24.2 Qualifying features

1049. This SAC forms part of the southern Dutch Delta region, together with other SACs (Grevelingen SAC, Vlakte van de Raan SAC, Voordelta SAC, Westershelde and Saeftinghe SAC), thus the information on the wider area will be similar to one another.

3.7.24.2.1 Harbour seal

1050. Within the greater area of the Dutch Delta, harbour seal counts ranged from 677- 2581 from (2011-2021) (Compendium of the Living Environment 2022).

3.7.24.2.2 Grey seal

1051. Natura 2000 reporting indicates a range of 1 and 30 individual grey seals were counted (last reports updated in 2018).

1052. Within the greater area of the Dutch Delta, harbour seal counts ranged from 677- 2581 from (2011-2021) (Central Bureau of Statistics *et al*., 2023).

3.7.24.3 Shadow appropriate assessment

1053. In order to assess the effects of North Falls on the integrity of the Oosterschelde SPA and SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Oosterschelde SPA and SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for

effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Oosterschelde SPA and SAC.

1054. Therefore, there is no adverse effect on the integrity of the Oosterschelde SPA and SAC in relation to the conservation objectives for grey seal or harbour seal.

3.7.25 Vlakte van de Raan SAC

3.7.25.1 Site overview

1055. The Vlakte van de Raan SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024) and has been recognised as an SAC since March 2011. All three marine mammal species have been screened in for assessment.

1056. The Vlakte van de Raan SAC covers an area of 190 km^2. The SACs closest point to the North Falls array area is 82km.

3.7.25.2 Qualifying features

1057. This SAC forms part of the southern Dutch Delta region, together with other SACs (Grevelingen SAC, Oosterschelde SAC, Voordelta SAC, Westershelde and Saeftinghe SAC), thus the information on the wider area will be similar to one another.

3.7.25.2.1 Harbour porpoise

1058. Harbour porpoise densities for the Dutch Delta region were estimated at 0.71 in summer 2019, totalling to 14,713 individuals (Geelhoed *et al.*, 2020).

3.7.25.2.2 Harbour seal

1059. A range of 101 and 250 individual harbour seals were counted (Natura 2000). Within the greater area of the Dutch Delta, harbour seal counts ranged from 677-2581 from (2011-2021) (Compendium of the Living Environment 2022).

3.7.25.2.3 Grey seal

1060. Natura 2000 reports indicate a maximum of 400 individual grey seals (last reports updated in 2018).

1061. The available information is the same as outlined in Section 3.7.24.2.2.

3.7.25.3 Shadow appropriate assessment

1062. In order to assess the effects of North Falls on the integrity of the Vlakte van de Raan SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Vlakte van de Raan SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Vlakte van de Raan SAC.

1063. Therefore, there is no adverse effect on the integrity of the Vlakte van de Raan SAC in relation to the conservation objectives for harbour porpoise, grey seal or harbour seal.

3.7.26 Voordelta SAC and SPA

3.7.26.1 Site overview

1064. The Voordelta SAC and SPA is designated for harbour porpoise, grey seal and harbour seal (EUNIS, 2024), has all of which have been screened into this assessment.

1065. The Voordelta SAC and SPA covers an area of 835km^2. The SACs closest point to the North Falls array area is 87km.

3.7.26.2 Qualifying features

1066. This SAC forms part of the southern Dutch Delta region, together with other SACs (Grevelingen SAC, Oosterschelde SAC, Vlakte van de Raan SAC, Westershelde and Saeftinghe SAC), thus the information on the wider area will be similar to one another.

3.7.26.2.1 Harbour porpoise

1067. Harbour porpoise densities for the Dutch Delta region were estimated at 0.71 in summer 2019, totalling to 14,713 individuals (Geelhoed *et al.,* 2020).

3.7.26.2.2 Harbour seal

1068. A range of 100-1000 permanent individuals were counted at this site (Natura 2000).

1069. Within the greater area of the Dutch Delta, harbour seal counts ranged from 677- 2581 from (2011-2021) (Compendium of the Living Environment 2022).

3.7.26.2.3 Grey seal

1070. Natura 2000 reported a maximum of 50-200 permanent individuals were counted at this site (last reports updated in 2018).

1071. For more information refer back to the adjacent Oostershelde SPA and SAC, Section 3.7.24.

3.7.26.3 Shadow appropriate assessment

1072. In order to assess the effects of North Falls on the integrity of the Voordelta SAC and SPA, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Voordelta SAC and SPA will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Voordelta SAC and SPA.

1073. Therefore, there is no adverse effect on the integrity of the Voordelta SAC and SPA in relation to the conservation objectives for harbour porpoise, grey seal or harbour seal.

3.7.27 Waddenzee SAC

3.7.27.1 Site overview

1074. The Waddenzee SAC has been recognised as an SAC since December 1996. The SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024), however only grey seal and harbour seal have been screened into this assessment.

1075. The Waddenzee SAC covers an area of 2,649km^2. The closest point to the North Falls array area is 217km.

3.7.27.2 Qualifying features

3.7.27.2.1 Grey seal

1076. The north Dutch coastline is an important foraging zone and migration route for grey seal (Brasseur *et al*., 2010). A study on the grey seal development in the Dutch part of the Wadden Sea shows that the growth of the breeding population is fuelled by the annual immigration of grey seals from the UK (Brasseur *et al*., 2014).

1077. As part of the Trilateral Seal Expert Group (TSEG), coordinated aerial surveys are conducted in Denmark, Germany and the Netherlands. Across the Wadden Sea and Helgoland, the counts during the pupping season resulted in a total count of 2,515 pups. This represents a growth of 13% over the past five years, and 10% compared to the season of 2021-2022 (Schop *et al*., 2022). In 2023, a total of 10,544 grey seals were counted during the moulting season in the Wadden Sea, which constitutes an increase of 18% compared to 2022 and 16% compared to 2021 (Brasseur *et al*., 2021).

3.7.27.2.2 Harbour seal

1078. In 2023, a total of 9,334 pups were counted by the TSEG. Although this represents an increase of 10% relative to the 2022 count of 8,514 pups (Galatius *et al*., 2023). During the moult in August 2023, a total of 22,621 harbour seals were counted in the Wadden Sea area by TSEG. This constitutes a decrease of 4% relative to the count in 2022 and is the lowest count since 2010. This is the third consecutive year with a decrease (Galatius *et al*., 2023).

3.7.27.3 Shadow appropriate assessment

1079. In order to assess the effects of North Falls on the integrity of the Waddenzee SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Waddenzee SAC and SPA will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Waddenzee SAC.

1080. Therefore, there is no adverse effect on the integrity of the Waddenzee SAC in relation to the conservation objectives for grey seal or harbour seal.

3.7.28 Westerschelde and Saeftinghe SAC

3.7.28.1 Site overview

1081. The Westerschelde and Saeftinghe SAC has been recognised as an SAC since February 2010. The SAC is a designated site for harbour porpoise, grey seal and harbour seal (EUNIS, 2024); all of which have been screened in for assessment.

1082. The Westerschelde and Saeftinghe SAC covers an area of 441km^2. The SACs closest point to the North Falls array area is 99km.

3.7.28.2 Qualifying features

1083. This SAC forms part of the southern Dutch Delta region, together with other SACs (Grevelingen SAC, Oosterschelde SAC, Voordelta SAC, Vlakte van de Raan SAC), thus the information on the wider area will be similar to one another.

3.7.28.2.1 Harbour porpoise

1084. A range of 1-10 permanent individuals were counted at this site (Natura 2000).

1085. Harbour porpoise densities for the Dutch Delta region were estimated at 0.71 in summer 2019, totalling to 14,713 individuals (Geelhoed *et al*., 2020).

3.7.28.2.2 Harbour seal

1086. A range of 51-100 permanent individuals were counted at this site (Natura 2000).

1087. Within the greater area of the Dutch Delta, harbour seal counts ranged from 359- 1435 from (2011-2021) (Compendium of the Living Environment 2022).

3.7.28.2.3 Grey seal

1088. Natura 2000 have reported a range of 1-20 permanent individuals were counted at this site (last reports updated in 2018).

1089. The available information is the same as outlined in Section 3.7.24.2.2.

3.7.28.3 Shadow appropriate assessment

1090. In order to assess the effects of North Falls on the integrity of the Westerschelde and Saeftinghe SAC, refer to the assessment of Vlaamse Banken SAC (Section 3.7.2.3; Table 3.102), as the effects on the Westerschelde and Saeftinghe SAC will be less than those assessed for the Vlaamse Banken SAC. The Vlaamse Banken SAC is the closest European site to North Falls, and therefore has the greatest potential for effect. Where no adverse effects have been concluded for Vlaamse Banken SAC, there would be no potential for adverse effect at Westerschelde and Saeftinghe SAC.

1091. Therefore, there is no adverse effect on the integrity of the Westerschelde and Saeftinghe SAC in relation to the conservation objectives for harbour porpoise, grey seal or harbour seal.

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