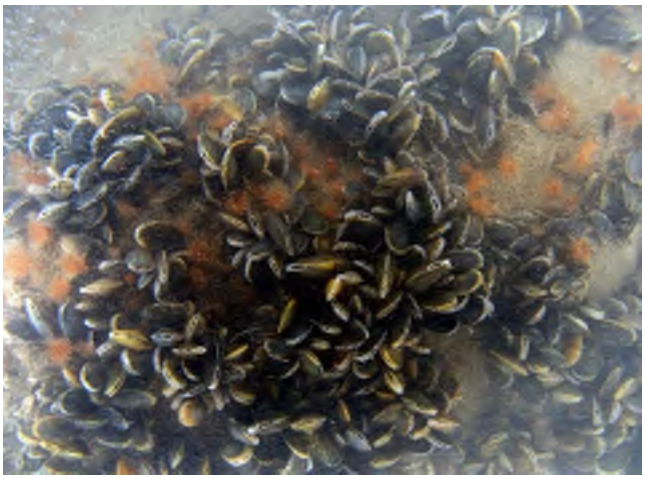
Marine Ecology Desk Review

WYG Environment Planning Transport Limited
RAF Lossiemouth Development Programme - A089116-93-11



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Executive Summary

Introduction

This desk review is supplementary to an Ecological Appraisal (EA) undertaken by WYG on behalf of the Defence Infrastructure Organisation (DIO) in relation to the RAF Lossiemouth site. This review deals solely with the proposed Long Sea Outfall (LSO), the requirement for which was unknown at the time of the initial EA.

The LSO has been designed to address concerns regarding the current drainage system in place at the RAF Lossiemouth site. Currently, the sites drainage is discharged into the Covesea burn, which is an open waterway running through the Moray Golf Course. Under the proposed development, effluent from the proposed Wastewater Treatment works (WwTw) and surface water runoff, which is known to contain de-icer from the aircraft, will be channelled through the LSO. Surface water is, and will continue to be, directed through interceptors and some of the proposed developments also incorporate Sustainable Drainage Systems (SuDS), which collectively serve as a preliminary treatment phase.

The surface water and effluent will run into an attenuation tank, sized to capture first flush flows and to help control flows further along the LSO. The attenuation tank has been designed to allow for rainfall events larger than those known to occur once in every 5 years, dependent on intensity. Short high intensity rainfall events may breach the attenuation tank and would then over-flow to the Covesea Burn. However, these events should be rare and any overflowing discharges will be heavily diluted by the excessive rainfall.

The resulting discharges will be released offshore via the LSO which will run between 600 m and 1000 m offshore from the Moray Golf Course. The discharge will need to comply with bathing water standards and the developers drainage team are working with Scottish Environment Protection Agency (SEPA) to ensure compliance. The proposed pipe alignment follows the existing LSO at the southern end of the site, the Covesea Burn position and avoids areas of protruding rock offshore. The pipe will be 600 mm in diameter, matching the dimensions of the existing LSO. The distance that the pipe will need to run into the Moray Firth (the location of the discharge point) will be informed by the results of topographic, geotechnical and hydrographic surveys and the discharge point will be designed to ensure adequate dilution of the discharges. It is likely that the proposed LSO will be buried as far out as the low tide (LAT) mark and beyond this, the pipe will sit on top of the seabed, weighted down with precast concrete anchors. This mirrors the construction of the existing LSO and should minimise the need for noisy construction offshore.

Baseline Ecological Conditions

The sediments in the Moray Firth are predominantly sands that are glacial in origin, reworked by hydrodynamic processes. Locally, muds accumulate in deeper waters and there are also patches of coarser, mixed sediments as well as areas of rock. Sites sampled closest to Lossiemouth, and along much of the southern coast were found to be characteristic of the biotope SS.SSa.IMuSa – Infralittoral Muddy Sand. This habitat supports important prey species including sandeels which are Priority Marine Feature. Although some broad-scale habitat modelling has been carried out across this area, very few samples have been taken at the proposed development site, so confidence in the predicted habitats is low for this particular area.

Designated Sites

The proposed long sea outfall at RAF Lossiemouth lies within the Moray Firth Special Area for Conservation (SAC) which was designated in 2005 for the protection of the Annex II species *Tursiops truncatus*, (bottlenose dolphin) as well as the Annex I Habitat, "*Sandbanks which are slightly covered by seawater at all times*" which can include gravelly and clean sands; muddy sands; eelgrass (*Zostera marina*) beds and / or maerl beds (composed of free-living Corallinaceae). It also lies within the Moray Firth proposed Special Protection Area (pSPA) selected to provide protection to important wintering grounds used for feeding, moulting and roosting by waterfowl, as well as for important foraging areas to the north, for breeding European shag *Phalacrocorax aristotelis*. It should be noted though that the breeding European shag populations are found at the northern perimeter of the pSPA and are not likely to be influenced in any way by the proposed development.

Protected Species

The following protected species are known to occur, or are thought very likely to occur, in close proximity to the proposed development site:

Cetaceans:	Bottlenose dolphin, *Tursiops truncatus,* Minke whale, *Balaenoptera acutorostrata,* Harbour porpoise*, Phocoena phocoena*
Other Marine Mammals:	Harbour seal, *Phoca vitulina* Grey seal, *Halichoerus grypus* European Otter, *Lutra lutra*
Sharks and Rays:	Basking shark, *Cetorhinus maximus* Porbeagle shark, *Lamna nasus* Blue shark, *Prionace glauca* Spiny dogfish, *Squalus acanthias* Common skate*, Dipturus batis* Sandy ray, *Leucoraja circularis*
Fish:	Atlantic salmon, *Salmo salar* Sandeels, *Ammodytes marinus* and *Ammodytes tobianus* Sea lamprey, *Petromyzon marinus* River lamprey, *Lampetra fluviatilis* European eel, *Anguilla anguilla*
Seabirds:	Red throated diver, *Gavia stellata* Great Northern diver, *Gavia immer* Slavonian grebe, *Podiceps auritus* Common eider duck, *Somateria mollisima* Long-tailed duck, *Clangula hyemalis* Common scoter, *Melanitta nigra* Velvet scoter, *Melanitta fusca* Common goldeneye, *Bucephala clangula* Red breasted merganser, *Mergus serrator*

Commercial Fisheries

There are no known active aquaculture sites for finfish or shellfish, or any protected shellfish waters in the vicinity of the proposed long sea outfall, with the nearest sites occurring in the Cromarty and Dornoch Firths.

The most important commercial species in the Moray Firth, in terms of value, are squid, lobster, brown crab, *Nephrops*, velvet crab and king scallop. The south side of the Moray Firth also supports and economically important hand line fishery for mackerel. Very little information was available regarding the inshore fishery activities occurring within the site of the proposed long sea outfall, but creel fishing has been observed during some of the investigative survey works.

Initial Impact Assessment

Receptor	Vulnerabilities	Significance
Sedimentary and Rock Habitats (not designated)	• Increased turbidity and sedimentation during construction • Loss / change of habitat • Nutrient enrichment / pollution events • Introduction of invasive non-native species	Small-scale development (and therefore impact) in a non-designated habitat that is ubiquitous along the southern shores of the Moray Firth Ecologically significant effects not anticipated but cannot be ruled out without additional survey work.
Sandbanks slightly covered by seawater at all times	• Increased turbidity and sedimentation during construction • Loss / change of habitat • Nutrient enrichment / pollution events • Introduction of invasive non-native species	The proposed development does not appear to coincide with the designated sandbank features but it will be imperative to assess the final location of the outfall and the footprint of likely affect relative to the designated sandbanks features once these are known Ecologically significant effects unlikely, but cannot be ruled out at this time
Cetaceans (including Bottlenose Dolphins)	• Noise during geotechnical surveys and construction • Nutrient enrichment / pollution events • Chemical contaminants (de-icer)	Noise disturbance will be temporary and will be mitigated through the use of Marine Mammal Observers (MMOs), soft starts and / or sound monitoring depending on the chosen construction methods Nutrient enrichment and pollution events are considered unlikely to be at a level that causes damage to cetaceans but more details of the discharges would be required to confirm this. Chemical contaminants can be carcinogenic for cetaceans but the anticipated concentrations of de-icer are not of a level likely to cause harm. Ecologically significant effects not anticipated providing appropriate mitigation actions are followed
Seals	• Noise during geotechnical surveys and construction	Noise disturbance will be temporary and will be mitigated through the use of Marine Mammal Observers (MMOs), soft starts and / or sound monitoring depending on the chosen construction methods Ecologically significant effects not anticipated providing appropriate mitigation actions are followed
Otter	• Noise during geotechnical surveys and construction • Chemical contaminants (de-icer)	The sensitivity of otters to noise is largely unknown. Nevertheless, Noise disturbance will be temporary and will be mitigated through the use of Marine Mammal Observers (MMOs), soft starts and / or sound monitoring depending on the chosen construction methods. Chemical contaminants can harm otters but the anticipated concentrations of de-icer are not of a level likely to have any impact. Ecologically significant effects not anticipated providing appropriate mitigation actions are followed

Receptor	Vulnerabilities	Significance
Sharks & Rays	• Noise during geotechnical surveys and construction	Rays are not considered to be sensitive to noise impacts but sharks can be and basking shark in particular may be attracted by noise making them vulnerable to propeller collisions. Noise disturbance will be temporary and will be mitigated through the use of Marine Mammal Observers (MMOs), soft starts and / or sound monitoring depending on the chosen construction methods Ecologically significant effects not anticipated providing appropriate mitigation actions are followed
Salmon	• Changes in water flow • Increased turbidity and sedimentation during construction	Changes in water flow and increased turbidity represent a barrier to salmon migration. Increased sedimentation during construction could choke salmon More details of construction will be required to determine the likelihood of an ecologically significant effect
Sandeels	• Loss / change of habitat	Sandeels are most likely to be associated with the designated sandbank features and therefore assuming the impact of the proposed long sea outfall does not extend out to these features, then it is unlikely that a development of this scale would have an ecologically significant effect on this species. Ecologically significant effects unlikely, but cannot be ruled out at this time
Other fish species	• Noise during geotechnical surveys and construction • Chemical contaminants (de-icer)	The European eel has a swim bladder and may therefore be sensitive to the noise of survey works and construction. However, there are only sporadic records of them in the area and ecologically significant effects would not therefore be anticipated. Eel and lamprey could feasibly be sensitive to compounds contained in de-icer but the levels to be released in the discharges are not likely to be high enough to cause significant harm.
Overwintering Seabirds	• Noise and visual disturbance during geotechnical surveys and construction • Increased turbidity and sedimentation during construction	None of the protected seabirds in this area are breeding and the noise impacts are temporary therefore ecologically significant impacts are not anticipated. Timing noisy activities to avoid the main periods of use by overwintering birds (most notably the period of flightlessness in moulting eider duck) would serve to avoid any disturbance Seabirds depend on their sight to catch prey and hence increased turbidity could decrease hunting success. That said turbidity changes are likely to be localised and therefore would be unlikely to lead to an ecologically significant effect.
Commercial Fisheries	• Access during surveys and construction • Loss / change of habitat • Increased turbidity and sedimentation during construction	There was insufficient evidence upon which to determine how the area of the proposed development was used by inshore fishers but it is possible potting and set nets are used in the vicinity. There may be issues around access and gear vulnerabilities during survey and construction works and it is possible that habitat changes could affect fishing in the longer term if the habitats become unsuitable for the target species. The likelihood of such effects being ecological significant on a development of this scale are very low.

Management and Mitigation of Impacts

Based on the different temporal sensitivity of the key ecological receptors that are likely to have some sensitivity to the construction associated with the proposed LSO development the optimal timing for construction in the spring between March and May. During this time, bottlenose dolphin are likely to be in the area but won't yet have reached their peak summer abundances, and most other sensitive receptors will be largely absent or present only in small numbers. It is also comparatively simple to mitigate against the noise disturbance on bottlenose dolphins using a Marine Mammal Observer (MMO).

If possible, it would be best to avoid construction work between July and September when eider ducks may be present in their flightless moulting phase, as they have a very limited capacity to move away from anthropogenic activities. This would also avoid potential disturbance of salmon during their migration back to their natal rivers.

Since it will be impossible to avoid all possible disturbance of protected species occurring in the vicinity of the proposed LSO site owing to their conflicting temporal sensitivities, the following set of mitigation measures are recommended for consideration during survey and construction works.

- The noise associated with the chosen construction techniques should be considered carefully and noisy activities such as pile driving that have the potential to cause physical damage to marine life occurring in close proximity should be avoided or minimised as far as is possible.

- The noisiest activities should be timed to coincide with the periods of lowest biological sensitivity wherever possible.

- Where loud and irregular or impulsive noises are a necessary component of the works, a soft start where the noise is built up gradually is recommended. This gives marine life the opportunity to move away from the area before the noise reaches a level that could cause physical damage. Alternatively, Acoustic Mitigation Devices (AMD) could be used to drive away sensitive marine life before works begin.

- Where loud and irregular or impulsive noises are a necessary component of the works the use of sound dampening devices, such as bubble curtains and cofferdams should be investigated.

- Avoiding noisy activities during bad / stormy weather, when bird species in particular, are more sensitive to disturbance (because of the higher energy requirements needed to search for food etc) is strongly encouraged.

- Marine mammal and / or seabird observers should be deployed to keep watch for protected species and ensure a suitable distance is maintained between them and any survey / construction vessels on site. Where protected species, particularly those with limited capacity for avoidance (e.g. flightless eider duck), or a known inquisitive nature (e.g. basking shark) get close to survey / construction works, these should be stopped (where safe to do so) until the species move away to a safe distance.

- Passive Acoustic Monitoring Systems (PAMS) could also be considered as an additional means of detecting cetaceans in the area.

Information Required to Address Uncertainties

Impact Characterisation

- Distance of LSO into the Moray Firth (location of discharge point)
- Nature of interceptors and Sustainable Drainage Systems (SuDS), and specifically their efficacy in the removal of de-icer from the surface water run-off
- Composition of the de-icers used
- Predicted extent of change in water quality, turbidity and de-icer concentrations
- Construction methodologies and associated noise (source level of sound and frequency)
- Noise propagation model (consult with MS-LOT)
- Define interaction with designated sandbank features

Benthic Habitat Survey

- Survey required to address uncertainties in the benthic habitats that could be removed or altered by the proposed development as well as those occurring in the immediate vicinity of the discharge point that could be subject to potentially damaging levels of pollutants (e.g. de-icer)

Commercial Fisheries Assessment

- Face to face meetings / telephone calls with local fishermen to characterise their use of the area
- Request that surveyors make a note of any signs of fishing activity occurring in the area during investigative works

Marine Mammals and Seabirds

- Request that surveyors make a note of any marine mammal, basking shark, otter or seabird sightings. MMOs to also collect data on sightings where they are employed

Otters

- A dedicated otter survey to look for signs of otter holts and resting up sites on the shore is required to determine their use of the area.

Atlantic Salmon

- Request tracking data from Findhorn and Spey salmon currently being collected by the Atlantic Salmon Trust (AST)

Introduction

WYG were commissioned by Defence Infrastructure Organisation (DIO) to undertake an Ecological Appraisal (EA) of the site known as RAF Lossiemouth, Moray. The EA undertaken by WYG covered the construction and extension of buildings, runways and aircraft hangars on the existing RAF Lossiemouth site as well as a proposed contractor's compound and an LDP drainage site. During the course of the EA it was determined that the LDP drainage site needed to be extended to incorporate a long sea outfall pipe, and it is this part of the development that forms the focus of this review.

Site Location

RAF Lossiemouth is located in Moray, in the north-east of Scotland. The proposed long sea outfall, will extend from the Moray Golf Course, on the southern shore of the Moray Firth out to between 600 m and 1000 m (Figure 1).

Proposed Development

RAF Lossiemouth is one of two RAF Quick Reaction Alert (QRA) stations which protect UK airspace and is the base for three Typhoon combat aircraft squadrons and an RAF Regiment squadron. RAF Lossiemouth is due to be developed through the construction and extension of existing infrastructure and it will be necessary as part of this development to upgrade the associated waste management and drainage system. At the present time, effluent from three wastewater package plants and surface water runoff are discharged into the Covesea burn, an open waterway which runs through the Moray Golf Course. As part of the proposed development, two waste water packages are being made redundant and a new wastewater treatment works (WwTw) is being developed. Effluent from the remaining wastewater package plant and the WwTw will drain into the propose Long Sea Outfall (LSO) system along with surface water runoff, which is known to contain de-icer from the aircraft.

Surface water is, and will continue to be, directed through interceptors and some of the proposed developments also incorporate Sustainable Drainage Systems (SuDS), which collectively serve as a preliminary treatment phase. The surface water and effluent will then run into an attenuation tank, sized to capture first flush flows, or the first 5 mm of rainfall. As surface water run-off from the furthest catchment will take the longest to get to the tank, more than 5 mm will be captured from all but the closest areas. The attenuation tank has been designed to allow for rainfall events larger than those known to occur once in every 5 years, dependent on intensity. Short high intensity rainfall events may breach the attenuation tank and would then over-flow to the Covesea Burn. However, these events should be rare and any overflowing discharges will be heavily diluted by the excessive rainfall.

Downstream of the attenuation tank, the LSO is to be fitted with a flow control, limiting flows to 95 litres per second. Flow control is necessary to manage head losses (energy lost in the system through friction) downstream of the tank. Excessive head losses can compromise the performance of the LSO. It has been estimated that there could be in excess of 3 m^3 per second travelling through the LSO, hence the attenuation tank has been included in the design to capture and control excessive flows.

Figure 1. Chart showing the location of the proposed developments at RAF Lossiemouth, including the approximate position of the long sea outfall.

The resulting discharges will be released offshore via the LSO which will run between 600 m and 1000 m offshore from the Moray Golf Course (Figure 2). The discharge will need to comply with bathing water standards and the developers drainage team are working with Scottish Environment Protection Agency (SEPA) to ensure compliance. The proposed pipe alignment follows the existing LSO at the southern end of the site, the Covesea Burn position and avoids areas of protruding rock offshore. The pipe will be 600 mm in diameter, matching the dimensions of the existing LSO. The distance that the pipe will need to run into the Moray Firth (the location of the discharge point) will be informed by the results of topographic, geotechnical and hydrographic surveys and the discharge point will be designed to ensure adequate dilution of the discharges. It is likely that the proposed LSO will be buried as far out as the Lowest Astronomical Tide (LAT) mark and beyond this, the pipe will sit on top of the seabed, weighted down with precast concrete anchors. This mirrors the construction of the existing LSO and should minimise the need for noisy construction (e.g. pile driving) offshore.

Scope of the Review

An assessment of the environmental impacts anticipated to be associated with this development was carried out by WYG in 2018 (WYG, 2019). At that time however, the need for a long sea outfall had not been identified and since no other component of the development encroaches on the marine environment, marine ecology was not included in the initial EA. The objective therefore of this report is to fill this gap in the EA and to undertake a preliminary review of the likely impacts of the installation of the LSO on marine life and to identify any additional survey or investigative work that may be required. Since the proposed location of the outfall lies within the Moray Firth SAC and the proposed Moray Firth SPA, these will form the main focus of the review. Any likely impacts to the designated sites that cannot be scoped out will be subject to an Appropriate Assessment (AA). This review also incorporates the full suite of marine life in the vicinity of the development including inshore fisheries and aquaculture developments.

Sand dunes and geological sites are not included in this assessment but these will be dealt with separately by WYG.

Note that scientific names are provided at the first mention of each species and common names (where appropriate) are then used throughout the rest of the report for ease of reading

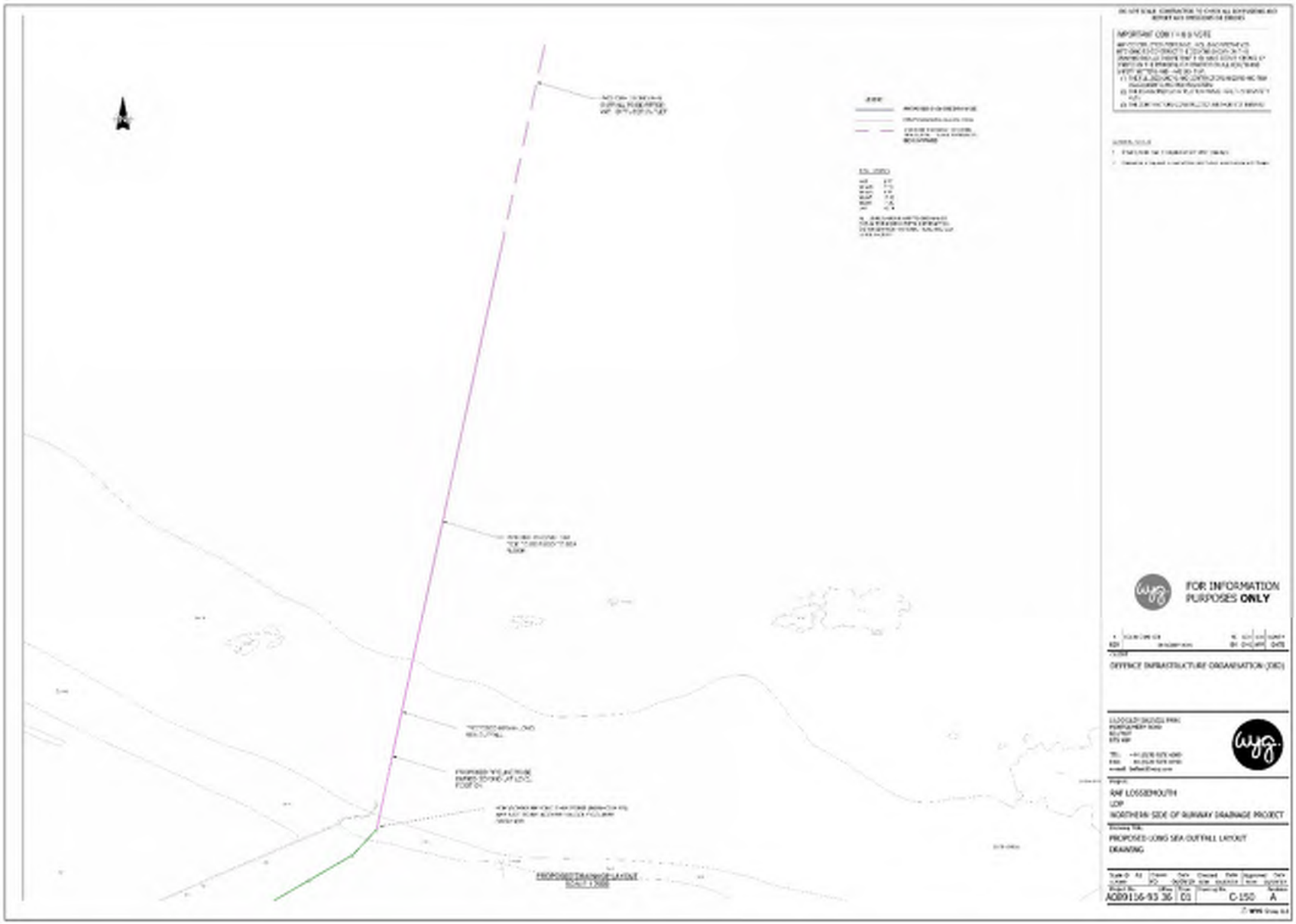

Figure 2. Chart showing the proposed drainage solution for the RAF Lossiemouth Development, including the long sea outfall (marked in pink).

Policy and Legislative Background

Policy Background

Convention on Biological Diversity

The Convention on Biological Diversity (CBD) was adopted at the Earth Summit in Rio de Janeiro, Brazil in June 1992, and entered into force in December 1993. CBD was the first global treaty to provide a legal framework for biodiversity conservation and established the following three main goals:

- the conservation of biological diversity,
- the sustainable use of its components,
- the fair and equitable sharing of the benefits arising from the use of genetic resources.

In October 2010, at the 10th Conference of the Parties to the CBD in Nagoya, Japan, a new 'Strategic Plan for Biodiversity 2011–2020' was adopted along with its 20 'Aichi targets'. The latter set out 20 challenging targets under 5 strategic goals to stimulate "*effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication....*'.

All public bodies have a responsibility to seek to achieve this target.

European Union Biodiversity Strategy

The European Union adopted its own new EU Biodiversity Strategy (EUBS) in May 2011 to halt the loss of biodiversity and ecosystem services in the EU by 2020 as a contribution to meeting the goals of the CBD Strategic plan and Aichi targets. The EUBS includes a new vision: "*By 2050, European Union biodiversity and the ecosystem services it provides – its natural capital – are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided*".

The UK Post-2010 Biodiversity Framework

Within the UK, delivery of the CBD and the EUBS is now guided by the UK Post-2010 Biodiversity Framework. This framework is overseen by the Environment Departments of all four governments in the UK working together through the Four Countries Biodiversity Group. The framework demonstrates how the work of the four countries and the UK contributes to achieving the 'Aichi targets', and identifies the activities required to complement the individual country biodiversity strategies.

Scottish Biodiversity Strategy

The Scottish Biodiversity Strategy comprises of 'Scotland's Biodiversity: It's in Your Hands' which was published in 2004 and set out a 25-year strategy for the conservation and enhancement of biodiversity in Scotland, and the '2020 Challenge for Scotland's Biodiversity - a strategy for the conservation and enhancement of biodiversity in Scotland' which was published in June 2013. The latter is Scotland's response to the Aichi Biodiversity Targets, outlined in the CBD and EUBS. The Strategy has the aim 'to conserve biodiversity for the health, enjoyment and wellbeing of the people of Scotland, now and in the future.' It sets out a vision for 2030 as well as objectives and desired outcomes leading us there.

Local Biodiversity Action Plan

Local Biodiversity Action Plans (LBAPs) identify habitat and species conservation priorities at a local level (typically County by County) and are usually drawn up by a consortium of local Government organisations and conservation charities. Although they are no-longer managed at a national level, many are still reviewed and updated at a local level.

The North East Scotland Biodiversity Partnership (The Partnership) combines the efforts of the local authority areas of Moray, Aberdeenshire and Aberdeen City and is managed by the James Hutton Institute, an independent research body. The Partnership has produced five 3-year North East Scotland Local Biodiversity Plans (NE LBAPs) to date, with the most recent covering 2014-2017. The NE LBAPs do not list specific habitats and species of importance, rather focussing on conserving all relevant UK Priority Habitats and Species. The current aims of the partnership are:

- To work towards the protection and enhancement of the biodiversity of the North East through the development of effective, local working partnerships.
- To develop and encourage local action for species and habitats identified as national targets emerging from the Scottish Biodiversity Strategy.
- To identify targets for biodiversity conservation appropriate to the area, incorporating issues of local importance and reflecting the values of local people.
- To raise awareness and build capacity within local communities and to encourage and motivate them to take action to protect and enhance biodiversity by demonstrating that they can make a difference.
- To provide a focal point for information exchange to assist those working in biodiversity conservation throughout the region.
- It should be noted that the existence of a SAP or HAP does not always infer an elevated level of importance for those features. These plans may be designed to encourage an increase in these habitats/species, rather than to protect a county-scarce feature (for example).

The Green Book

The recently published Green Book is guidance issued by HM Treasury on how to appraise policies, programmes and projects. It provides guidance on the design and use of monitoring and evaluation before, during and after implementation. It applies to all proposals that concern public spending, changes to regulation and changes to the use of public assets and resources, (e.g. policy and programme development, all public spending proposals, legislator proposals, appraisal of project portfolios, major projects, use of public assets etc.). It is therefore relevant to the MOD and other public sector bodies. Section 6.5 of the Green Book outlines a number of trigger questions for determining whether further Natural Capital assessments are necessary, which (in addition to questions relevant to wider environmental disciplines) includes the question:

- ‘Is the option likely to effect directly or indirectly…wildlife or wild vegetation, which are indicators of biodiversity?’

Ultimately, this places a duty on MoD/DIO to consider Natural Capital, including Biodiversity. No Net Loss of biodiversity and Net Gain are principles at the forefront of environmental policy placed on public bodies. These aim to halt the loss of biodiversity and maximise improvements.

Scottish Planning Policy

The project is being undertaken through permitted development; however, in the interests of maintaining biodiversity, reference has been made to specific text within Scottish Planning Policy.

National Planning Framework 3'4. A natural, resilient place "*A planned approach to development helps to strike the right balance between safeguarding assets which are irreplaceable, and facilitating change in a sustainable way. We must work with, not against, our environment to maintain and further strengthen its contribution to society*".

Scotland's National Marine Plan

The Scottish Government adopted its National Marine Plan in early 2015 (SG 2015). The purpose of the plan is to provide an overarching framework for marine activity in Scottish waters, with a view to enabling the sustainable development and use of the marine area in a way that protects and enhances the marine environment whilst promoting both existing and emerging industries. This is underpinned by a set of core general policies which apply across all existing and future development and use of the marine environment, and sectoral specific policies.

With respect to Defence, the National Marine Plan emphasises that the Royal Navy, the Army and Royal Air Force need to use Scotland's seas for defence purposes, and in this respect they require the following;

- The ability to deploy and develop a flexible and broad range of capabilities
- The exclusive use of certain areas during particular times of the year
- The use of exemptions in planning law for the purposes of national security
- To retain the statutory right to close areas in internal waters and create by-laws for complete closures and exclusions

Nevertheless, developments required for Defence need to be considered in terms of the general policies set-out in the Marine Plan and crucially for this review, need to be undertaken within environmental limits (SG 2015).

Moray Local Development Plan

The Moray Local Development Plan outlines the vision of Moray Council and Scottish Government to develop the district in an environmentally and economically sustainable manner. The plan sets out the policies for assessing planning applications and details where development is expected to take place over the next 5 years. The policies contained within the Moray LDP that are of most relevance to the long sea outfall in relation to ecology and nature conservation are summarised below:

Policy E1 – Natura 2000 Sites and National Nature Conservation Sites

The aim of this policy is to protect designated sites of national and international conservation value. Moray hosts a diversity of habitats and species which contribute to the high-quality environment and these sites are to be protected from inappropriate development. Appropriate Assessment or EIA are required for developments which are likely to have a significant environmental impact.

Natura 2000 Designations

In exceptional circumstances, proposals that could affect the integrity of a Natura site may be approved where:

a) There are no alternative solutions
b) There are imperative reasons of over-riding public interest including those of a social or economic nature

c) If compensatory measures are provided to ensure that the overall coherence of the Nature network is protected

Natura sites include Special Areas of Conservation (SAC), Special Protection Areas (SPA) and RAMSAR sites.

National Designations
Development proposals which affect a National Park, Site of Scientific Interest (SSSI) or National Nature Reserves will only be permitted where:

a) The objectives of designation and the overall integrity of the area will not be compromised
b) Any significant adverse effects on the qualities for which the site has been designated are clearly outweighed by social, environmental or economic benefits of national importance

Policy E2 – Local Nature Conservation Sites and Biodiversity
This policy aims to protect sites and species of local nature conservation value. Developments which are likely to have a significant adverse effect on Local Nature Reserves, protected species or wildlife sites, or that conflict with Local Biodiversity Action Plans, will be refused unless it can be demonstrated that:

a) Local public benefits clearly outweigh the nature conservation value of the site
b) There is a specific locational requirement for the development

Development proposals should protect and where appropriate, create natural and semi-natural habitats. Developers are required to demonstrate that they have considered potential habitat improvements in their design and sought to include links with green and blue networks where possible.

Policy E3 – Protected Species
Proposals which may have an adverse effect on a European Protected Species (EPS) will not be approved unless:

a) There is no satisfactory alternative
b) The development is required to preserve public health/safety or for other overriding reasons of public interest including those of a social or economic nature

Proposals which would have an adverse effect on a nationally protected species of bird (defined in the Wildlife and Countryside Act 1981) will not be approved unless the following conditions are met:

a) There is no other satisfactory solution
b) The development is necessary to preserve public health or public safety
c) The development will not be detrimental to the conservation status of the species concerned

A licence from SNH as well as planning permission may be required. Where protected species may be affected, a species survey should accompany the application to demonstrate how any offence under the relevant legislation will be avoided.

Policy E8 – Coastal Protection Zones
The objective of this policy is to protect and enhance the Moray Coast for its landscape, nature conservation, recreation and tourism benefits. Development proposals within the Coastal Protection Zone (CPZ), as identified on the proposals map, must not impact upon the objectives of the CPZ or the Water Framework Directive (WFD) and will be refused unless:

a) There is existing use
b) It is an appropriate extension or change of use to existing buildings or replacement of existing buildings
c) For low intensity recreational or tourist use e.g. golf courses
d) For uses directly related to agriculture, forestry and fishing

In addition, proposals must not affect the ecological, geomorphological or landscape importance of the area. Development will not be permitted on any parts of the coast that are identified as being at risk of flooding or erosion.

Policy EP2 Biodiversity (consultation process complete)

EU Biodiversity Strategy
The EU 2020 Biodiversity Target aims to achieve 'no net loss' and restoring at least 15% of degraded ecosystems. This necessitated member states to produce national Biodiversity Strategies.

(v) Biodiversity - Create a variety of high quality multi-functional green/blue spaces and networks that connect people and nature that include trees, hedges and planting to enhance biodiversity and support habitats/wildlife and comply with policy EP2 Biodiversity and Geodiversity and EP5 Open Space.

A plan detailing how different elements of the development will contribute to supporting biodiversity must be included in the design statement submitted with the planning application. Integrate green and blue infrastructure such as swales, permeable paving, SUDS ponds, green roofs and walls and grass/wildflower verges into streets, parking areas and plots to sustainably address drainage and flooding issues and enhance biodiversity from the outset of the development. Developments must safeguard and connect into wildlife corridors/ green networks and prevent fragmentation of existing habitats.

All development proposals must retain, protect and enhance features of biological interest and provide for their appropriate management. Developments must safeguard and connect into wildlife corridors, green/blue networks and prevent fragmentation of existing habitats. Development should integrate measures to enhance biodiversity as part of multi-functional spaces/ routes.

Where development results in the loss of natural habitats of ecological and amenity value, compensatory habitat creation will be required on an alternative site in Moray.

Legislative and Licencing Requirements

Permitted Development

This development is being carried out under permitted development as detailed in the Town and Country Planning (General Permitted Development) (Scotland) Order 1992 (GDPO). For a Part 14 (Aviation) development such as this one, the GPDO normally precludes the requirement for planning permission and Environmental Impact Assessment (EIA) unless the development is in, or partly in, a sensitive area (for example an SAC) and likely to have a significant impact on it, or where the development fails to meet the specifications detailed in Part 14. The Moray Council are currently seeking screening opinions to determine whether or not an EIA is required for the LSO component of the RAF Lossiemouth development. If the council decide an EIA is required, permitted development rights will be withdrawn and a planning application must be submitted and accompanied by an EIA report.

Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a systematic procedure that must be followed for certain categories of development before they can be granted planning permission or, where applicable or authorised through other consenting processes. Its purpose is to assess a development's potential significant environmental effects (positive or negative) and determine how these can be reduced or enhanced depending upon their nature. This helps to ensure that the predicted effects of a development are properly understood by statutory consultees, other interested parties including the public, and the relevant determining authority, before a decision is made on the planning application.

Directive 2014/52/EU was enacted on 14 April 2014 and amends all previous Directives on EIA. For planning applications submitted under the Town and Country Planning (Scotland) Act 1997 (as amended), Directive 2014/52/EU was transposed into Scottish law by the EIA Regulations on 16 May 2017.

The main stages in the EIA process are:

- Scoping to determine those matters to be addressed by the EIA and the contents of the ER (as proposed in this Scoping Report),
- Data review, involving compiling and reviewing available data and/or undertaking of baseline surveys to generate site-specific data,
- Assessment and design iteration, whereby the potential significant effects of the development during its construction, operation and decommissioning are assessed and the conclusions fed back into the design in order to avoid, prevent, reduce and, where possible, offset any significant adverse effects on the environment,
- Assessment of the construction methodology for, and final design of the development,
- Identifying any residual effects and any further mitigation requirements, and
- Preparing the ER documenting the EIA process and its conclusions.

Habitat Regulations Assessment

Under the Habitats Regulations (Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)), all competent authorities must consider whether any plan or project will have a 'likely significant effect' on a Natura site. The process of a Habitat Regulations Assessment (HRA) is iterative and involves an initial 'Screening' stage followed by an Appropriate Assessment (AA) if proposals are deemed likely to have a significant (adverse) impact on an SAC, SPA or RAMSAR site, known collectively as Natura 2000 sites, or on a European Protected Species (EPS). The HRA process also applies to proposed SACs and SPAs since it is the Scottish Government's policy to protect such sites as if they had been formally designated. This policy is set out in paragraphs 207 to 210 of the Scottish Planning Policy.

European Protected Species Licence

European Protected Species (EPS) are animals and plants (species listed in Annex IV of the Habitats Directive) that are afforded protection under The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and the Conservation of Offshore Marine Habitats and Species Regulations 2017. All cetacean species (whales, dolphins and porpoise) and Otter are EPS. If any activity is likely to cause disturbance or injury to an EPS, a licence is required to undertake the activity legally.

Under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), Regulation 39 (1) makes it an offence to:

a) deliberately or recklessly to capture, injure, or kill a wild animal of a European protected species,
b) deliberately or recklessly –
i) *to harass a wild animal or group of wild animals of a European protected species*,

ii) *to disturb such an animal while it is occupying a structure or place which it uses for shelter or protection,*
iii) *to disturb such an animal while it is rearing or otherwise caring for its young,*
iv) *to obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place,*
v) *to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs,*
vi) *to disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young, or*
vii) *to disturb such an animal while it is migrating or hibernating*.

Due to the differing lifestyles of cetaceans and how little we know about them, the law gives them further protection through an additional disturbance offence.

Regulation 39(2) provides that it is an offence to;

a) deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)

Considerations to exempt from the requirement of these species protection provisions are available in certain specified circumstances, provided that:

- there is a licensable purpose,
- there are no satisfactory alternatives, and
- the actions authorised will not be detrimental to the maintenance of the population of the species concerned at favourable conservation status in their natural range.

<u>An application for a licence will fail unless all of the three tests are satisfied.</u>

Basking Shark Licence

Basking Shark, *Cetorhinus maximus*, are protected through The Wildlife and Countryside Act 1981 (as amended) and if an activity is likely to cause disturbance or injury to this species, a licence is required to undertake the activity legally[1].

Noise Registry

Under the Marine Strategy Regulations (2010), there is a requirement to monitor loud, low to mid frequency (10 Hz to 10 kHz) impulsive noise. Activities likely to produce this type of noise include impact pile driving, geophysical surveys (seismic, sub bottom profiling and multibeam echosounders), explosives and some acoustic deterrent devices. Where a noisy activity is being undertaken, a Proposed Activity form must be completed in the Marine Noise Registry[2], which collects estimated location and date range data on noisy activities. The Marine Noise Registry also collects the actual location and date data (after the activity has been completed). This data should be provided as a Close-out Report in the Marine Noise Registry following completion of the activity, note that any licensee with a marine licence granted subject to conditions specific to the Marine Noise Registry will need to complete the appropriate data submission to fulfill the Marine Noise Registry. Indicating any noise generating activity and the sound frequency in hertz.

[1] https://www2.gov.scot/Resource/0053/00535828.pdf

[2] https://mnr.jncc.gov.uk/.

Controlled Activity Regulations

Activities likely to cause diffuse pollution are regulated by the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (more commonly known as the Controlled Activity Regulations (CAR)). In order to allow for proportionate regulation based on the risk an activity poses to the water environment, there are three types of CAR authorisation:

General Binding Rules (GBRs)

GBRs represent a set of mandatory rules which cover specific low risk activities. Activities complying with the rules do not require an application to be made to SEPA, as compliance with a GBR is considered to be compliance with an authorisation. Since the operator is not required to apply to SEPA, there are no associated charges.

Registrations

These allow for the registration of small-scale activities that individually pose low environmental risk but, cumulatively, can result in greater environmental risk. Operators must apply to SEPA to register these activities. A registration will include details of the scale of the activity and its location, and there will be a number of conditions of registration that must be complied with. There is an application fee for registrations, though subsistence (annual) charges do not apply.

Licences

These allow for site-specific conditions to be set to protect the water environment from activities that pose a higher risk. Licences can cover linked activities on a number of sites over a wide area, as well as single or multiple activities on a single site. Application fees apply to all licences, and subsistence (annual) charges may apply. SEPA has simple licences and complex licences for activities, for which different charges apply.

A key feature of CAR licences, unlike GBRs and registrations, is that they require the applicant to nominate a 'responsible person' (i.e. an individual/partnership/company) to be held accountable for securing compliance with the terms of the licence.

Methodologies

Desk Review

A desk based review was carried out to obtain existing information on marine ecological receptors that occur within the proposed development site and its zone of influence. Since the zone of influence has yet to be determined, the search included records for the whole of the outer Moray Firth but focussed on the proposed site of the development.

Receptors that were researched included the following;

- Statutory and non-statutory sites of nature conservation interest,
- Protected/notable species
- Intertidal and marine habitats
- Inshore fisheries and aquaculture developments

The following databases were queried for records of receptors relevant to this development;

- Marine Scotland National Plan Interactive (NMPI)
- North East Scotland Biological Records Centre (NESBReC)
- Scottish Natural Heritage website (SNHi)
- GEMs database
- Defra's Multi-agency website (MAGIC)
- MEDIN Database
- National Biodiversity Network (NBN) Atlas

In addition, Google scholar searches were undertaken to further research specific receptors and other commercial developments (e.g. the Moray Wind Farm) were also investigated as sources of relevant ecological data.

Site descriptions and management plans were obtained for each of the designated sites identified through the relevant authority websites and through direct consultations with the relevant authorities. Sites designated for geological features have not been included in this review but are dealt with in a separated geological assessment.

The following organisations were also contacted directly in the search for relevant datasets and to provide best available advice on receptor sensitivities and appropriate mitigation proposals;

- Scottish Natural Heritage
- Findhorn, Nairn and Lossie Trust
- Moray Firth and North Coast Inshore Fishing Group

Preliminary Impact Assessment

At this time, there is insufficient information upon which to base a complete assessment of the impacts of the proposed development. Technical investigations that will inform the design of the outfall are ongoing and the precise discharge location and proposed methods of construction have yet to be determined. However, in accordance with best practice (CIEEM 2018), efforts have been made to determine the receptor-impact interactions most likely to lead to adverse effects, such that they can be considered during the design of the construction programme and managed during technical investigations.

The most likely sources of impact have been identified based on our understanding of the project in general terms, and the typical construction techniques that are likely to be employed. Activities that are likely to lead to a significant adverse effect, should they be undertaken in this area, have been identified in the hope that they may be avoided. Additional survey work that is considered necessary and / or desirable in order to reduce uncertainties around the possible ecological impacts of the proposed development have also been identified.

Subtidal Habitats

The Moray Firth seabed has a generally smooth topography, with a gradual deepening to the east. However, the Inner Moray Firth has a narrow channel running northeast - southwest, which is a continuation of the Beauly and Ness valleys. The outer Moray Firth has large sandbanks (if defined as mounds rising up from the seafloor) but the only large (named) sandbanks in the area are the Guillam Bank in the Moray Firth and Riff Bank in the Inner Moray Firth.

The sediments in the Moray Firth are predominantly sands that are glacial in origin, reworked by hydrodynamic processes (Figure 3). Locally, muds accumulate in deeper waters and there are also patches of coarser, mixed sediments as well as areas of rock.

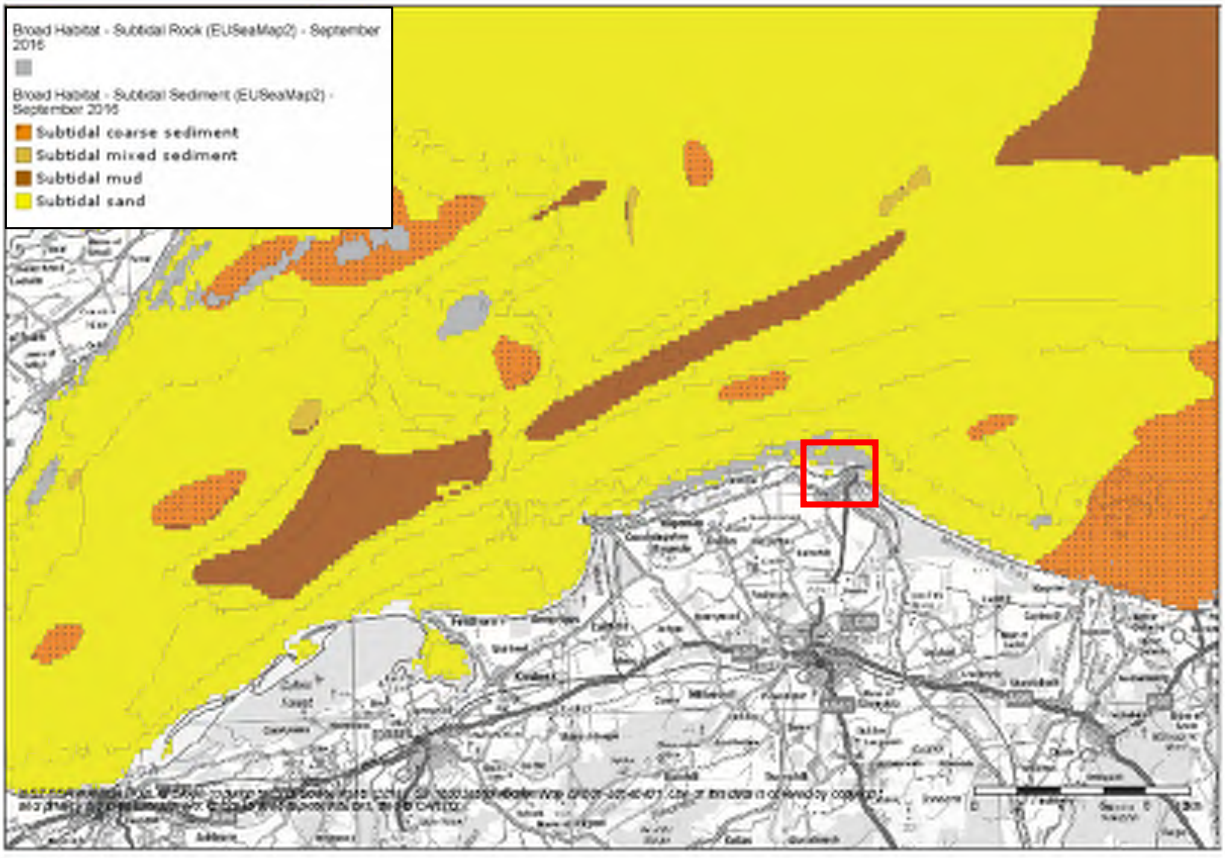

Figure 3. Chart showing the distribution of Subtidal Sediments and Subtidal Rock (EU SeaMap2) ©EMODnet within the Moray Firth. A red square denotes the approximate location of the proposed long sea outfall development.

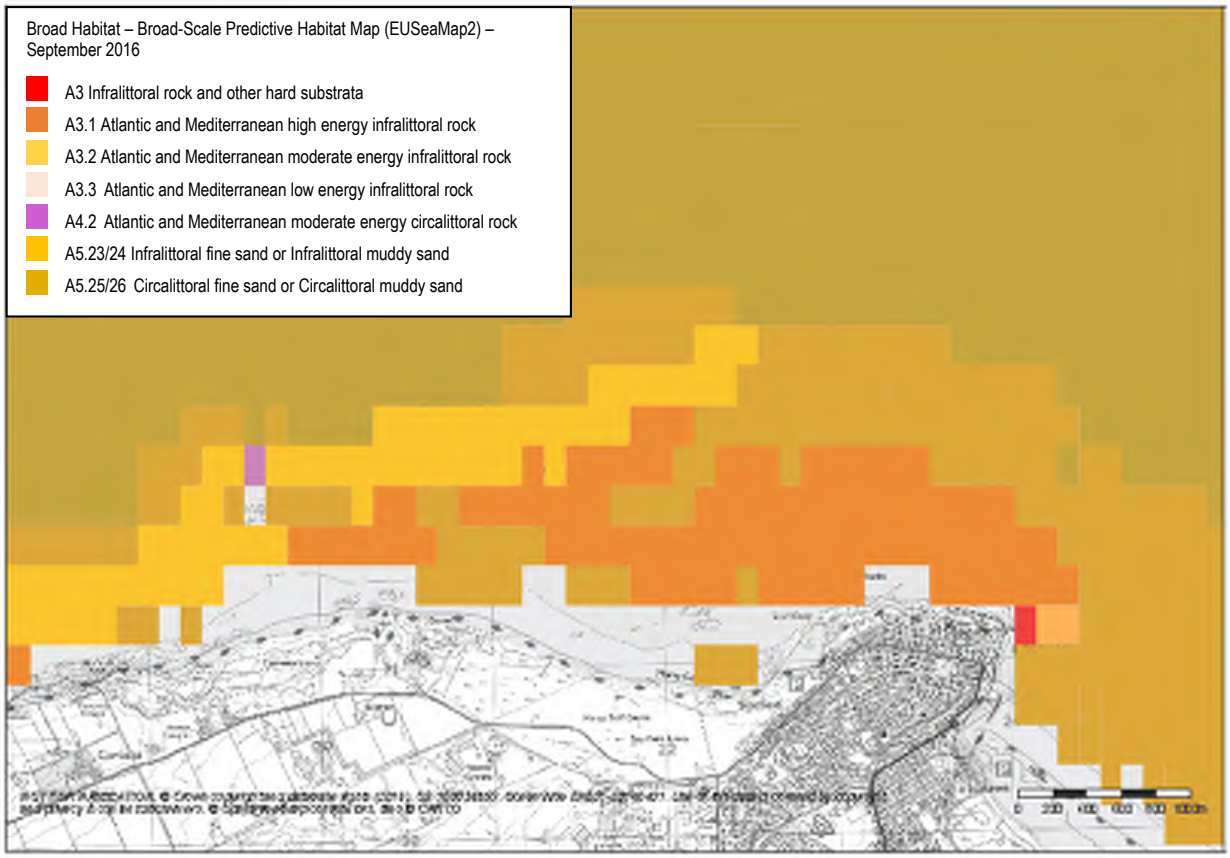

Figure 4. Chart showing the distribution of predicted broad scale habitats EU SeaMap2 ©EMODnet within the vicinity of the proposed long sea outfall development.

Examination of more detailed predictive habitat modelling undertaken across the area (Figure 4) provides further evidence that the area is likely to be characterised by fine and muddy sands interspersed with areas of rock. The sedimentary habitats in this area are known to support a variety of polychaete and bivalve species, as well as sand eels in some areas. Sand eels have been identified as a Priority Marine Feature (PMF) and a priority species on the Scottish Biodiversity List in recognition for the vital role they play in supporting higher levels of the marine food web. Although the other sand dwelling species present in this area are themselves of little importance from a conservation perspective, they too are an important food source for higher levels of the food web, including important populations of overwintering seabirds. Where these sedimentary habitats are permanently covered by shallow sea water, typically at depths of less than 20 m below chart datum (but sometimes including channels or other areas greater than 20 m deep), they fall under the Annex I habitat description "1110 *Sandbanks which are slightly covered by sea water all the time"* and indeed these inshore sedimentary habitats are a designated feature of the Moray Firth (discussed in more detail in proceeding sections of this report). Rock habitats can also be a feature of conservation significance where they form rocky reefs, or where they support mussel beds, both of which fall within the Annex I classification 1170 Reefs.

There have been a number of broad scale ecological surveys undertaken within the Moray Firth SAC with a view to characterising the benthic habitats. In 2004, SNH commissioned Envision Mapping Ltd to carry out surveys to characterise benthic biotopes within the 30 m depth contour of the SAC, focussing on the sedimentary habitats. A total of 228 video samples and 67 grab samples were collected across the site and a sub-set of these were used in combination with acoustic data to create a continuous modelled map of benthic habitats, although it should be noted that the southern shores of the Moray Firth were incompletely sampled due to bad weather. This work was further developed in 2016 through the

analysis of video footage and seabed still images collected from a further 30 sites, beyond the 30 m contour and the re-analysis of data collected in 2004 (Moore 2016).

The biotopes identified across the Moray Firth described by Moore (2016) are shown in Figure 5 and the same biotopes are overlaid on the modelled benthic substrates as described by Foster-Smith et al. (2009) in Figure 6. The sites sampled closest to Lossiemouth, and along much of the southern coast were found to be characteristic of the biotope SS.SSa.IMuSa – Infralittoral Muddy Sand (Connor et al. 2004). The agreement between the 2009 and 2016 habitats is not very high, but it is likely that this is an artefact of the very minimal sampling (one video transect between Findhorn and Burghead) from the southern Moray Firth included in the 2009 habitat model and the subsequent reliance of the model on acoustic data (Foster-Smith et al. 2009). The 2016 biotopes have since been verified and further refined (Moore 2019), although the extent of the latest mapping of the Moray Firth does not quite extend as far east as the Lossiemouth site.

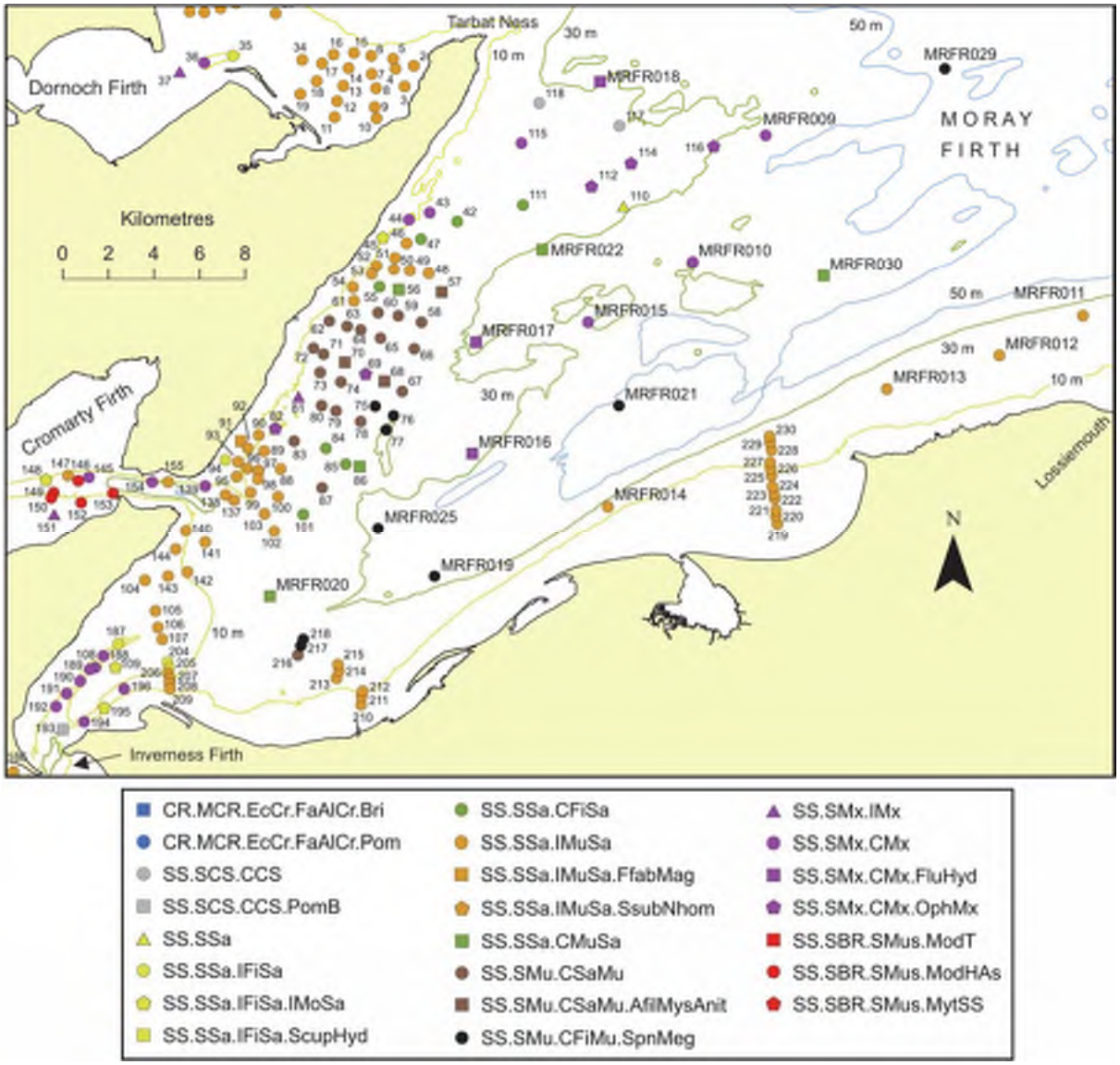

Figure 5. Distribution of biotopes in the central Moray Firth as described by Moore (2016).

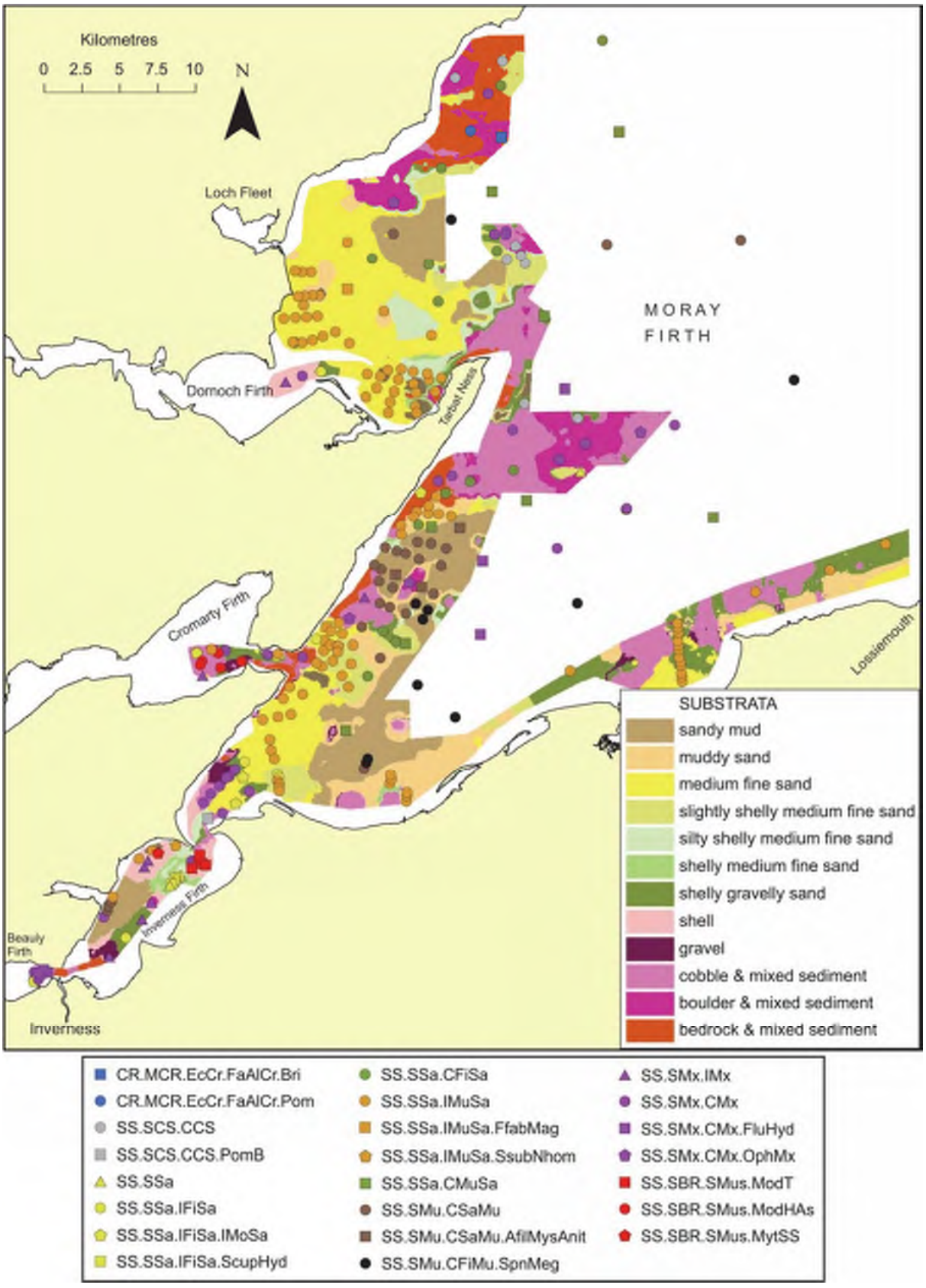

Figure 6. Distribution of biotopes in the central Moray Firth as described by Moore (2016), together with the modelled distribution of benthic substrata as described by Foster-Smith et al. (2009).

The predominant biotope thought to characterise the proposed development sites, SS.SSa.IMuSa – Infralittoral Muddy Sand describes a habitat of non-cohesive muddy sand (with 5% to 20% silt/clay) in the infralittoral zone, extending from the extreme lower shore down to a more stable circalittoral zone at about 15-20 m (Connor et al. 2004). The habitat supports a variety of animal-dominated communities, particularly polychaetes (*Magelona mirabilis, Spiophanes bombyx* and *Chaetozone setosa*), bivalves (*Fabulina fibula* and *Chamelea gallina*) and the sea potato *Echinocardium cordatum*. These communities are important prey sources for a variety of seabirds and therefore regardless of their protected status, have an important ecological role in supporting the qualifying waterfowl features of the pSPA.

Although rock habitats have been noted in this area, they do not appear in the benthic habitat modelling or sample analysis, indicating that the rocky features are perhaps quite localised and smaller in size than the habitat modelling units. It will be necessary to map these rock features to inform the design and location of the outfall and also to ensure that no protected reef habitats have been missed.

Intertidal Habitats

The intertidal habitats are dominated by sand where the RAF Lossiemouth site meets the Moray Firth, although parts of the upper shoreline were found to be dominated by coarser substrata, comprised mostly of pebbles (WYG 2019). Although visually relatively featureless, sand flats and mud flats are ecologically very important habitats for supporting higher predator populations. These habitats typically support a range of polychaetes, bivalves and crustaceans which are fed on by mobile epifauna, flat fish and waterfowl.

Plate 1. Photographs of the shoreline at the proposed long sea outfall development site at Lossiemouth, taken from the WYG Environmental Appraisal Target Notes (WYG 2019).

Designated Sites

The proposed long sea outfall at RAF Lossiemouth lies within the Moray Firth Special Area for Conservation (SAC) which was designated in 2005 for the protection of the Annex II species *Tursiops truncatus*, (bottlenose dolphin) as well as the Annex I Habitat, "Sandbanks which are slightly covered by seawater at all times" which can include gravelly and clean sands; muddy sands; eelgrass (*Zostera marina*) beds and / or maerl beds (composed of free-living Corallinaceae). It also lies within the Moray Firth proposed Special Protection Area (pSPA) selected to provide protection to important wintering grounds used for feeding, moulting and roosting by waterfowl, as well as for important foraging areas to the north, for breeding European shag *Phalacrocorax aristotelis.* The site also lies closely adjacent to a number of other protected sites of ecological significance as summarised in Figure 7 and Table 1.

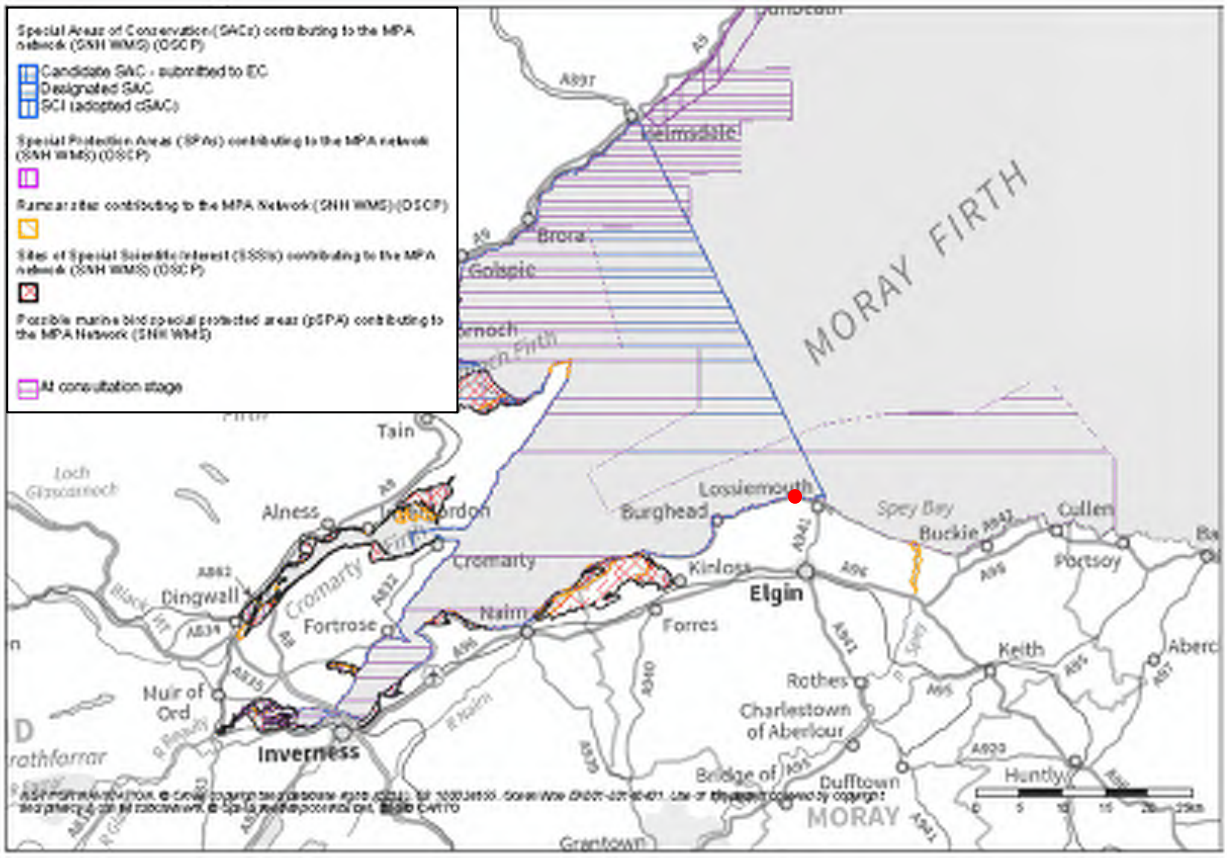

Figure 7. Chart showing the distribution of designated sites relative to the proposed long sea outfall development site (red spot) at Lossiemouth in the Moray Firth, Scotland.

Table 1. Summary of statutory designated sites that encompass marine features and their relative proximity to the proposed long sea outfall development site.

Designation	Site Name	Distance & Direction	Summary of Features
Special Area of Conservation (SAC)	Moray Firth	Within the site boundary	• Bottlenose dolphin *Tursiops truncatus* • Sandbanks which are slightly covered by sea water all the time
Proposed Special Protection Area (pSPA)	Moray Firth	Within the site boundary	• Overwintering waterfowl • Breeding European Shag *Phalacrocorax aristotelis*
Special Protection Area (SPA)	Moray and Nairn Coast	12km south-east and 14km south-west	• Non-breeding bar-tailed godwit *Limosa lapponica*, dunlin *Calidris alpina alpina*, and greylag goose, *Anser anser* • Breeding osprey *Pandion haliaetus*
Ramsar Wetland of International Importance	Moray and Nairn Coast	12km south-east and 14km south-west	• Non-breeding greylag goose, *Anser anser*, pink-footed goose *Anser brachyrhynchus* and redshank *Tringa tetanus* • Intertidal mudflats/sandflats and marine habitat (including marine mammals)
Special Area of Conservation (SAC)	River Spey	>30km South East	• Freshwater pearl mussel, *Margaritifera margaritifera,* Sea lamprey, *Petromyzon marinus,* Atlantic salmon, *Salmo salar and* Otter, *Lutra lutra*

Moray Firth SAC

The Moray Firth supports the only known resident population of bottlenose dolphin *Tursiops truncatus* in the North Sea and is one of only two UK sites where the species is a primary qualifying feature. The population is estimated to be around 130 individuals (Wilson et al. 1999). Dolphins are present all year round, and, while they range widely in the Moray Firth, they appear to favour particular areas of the Inner Firth, the southern Moray Firth coastline and the mouth of the Cromarty Firth, and are usually found within 10 km of land. Bottlenose dolphins can produce a calf every 4-5 years and they typically live for between 30 and 50 years (SNH 2018). Calves can be born at any time of the year but are most common between March and September. March to September is also the time of the dolphin's peak abundance in the Moray Firth, further demonstrating the importance of this area to the dolphins.

The conservation objective for the bottlenose dolphins is:

> To avoid deterioration of the habitats of the qualifying species (Bottlenose dolphin *Tursiops truncatus*) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and
>
> To ensure for the qualifying species that the following are established then maintained in the long term:
>
> - Population of the species as a viable component of the site
> - Distribution of the species within site
> - Distribution and extent of habitats supporting the species
> - Structure, function and supporting processes of habitats supporting the species
> - No significant disturbance of the species

Since there is a high likelihood of bottlenose dolphins occurring in the inshore waters near Lossiemouth, it will be imperative to investigate the potential for interactions between them and the proposed long sea outfall development.

Although not the primary reason for site selection, 'sandbanks which are slightly covered by sea water all the time' are also a designated feature of the Moray Firth SAC. This habitat consists of sandy sediments that are permanently covered by shallow sea water, typically at depths of less than 20 m below chart datum (but sometimes including channels or other areas greater than 20 m deep that are connected with the main sandbank feature). The habitat comprises distinct banks (i.e. elongated, rounded or irregular 'mound' shapes) which may arise from horizontal or sloping plains of sandy sediment. Where the areas of horizontal or sloping sandy habitat are closely associated with the banks, they are included within the Annex I type.

The distribution of sandbank features across the Moray Firth was modelled as part of a study commissioned by SNH (Miller et al. 2017), the results of which are shown in Figure 8. Miller et al. (2017) modelled the presence of the qualifying feature using sedimentary data from a variety of sources and they concluded that the banks were composed mostly of muddy sands with smaller banks of mixed, gravelly and clean sands in the area adjacent to the proposed LSO. These sandbank habitats are considered to be important spawning grounds and nursery areas for juvenile fish species. They are also known to support large populations of sandeels as well as a variety of burrowing worms, crustaceans and bivalve molluscs, all of which are an important food source for fish, seabirds and marine mammals (SNH 2018).

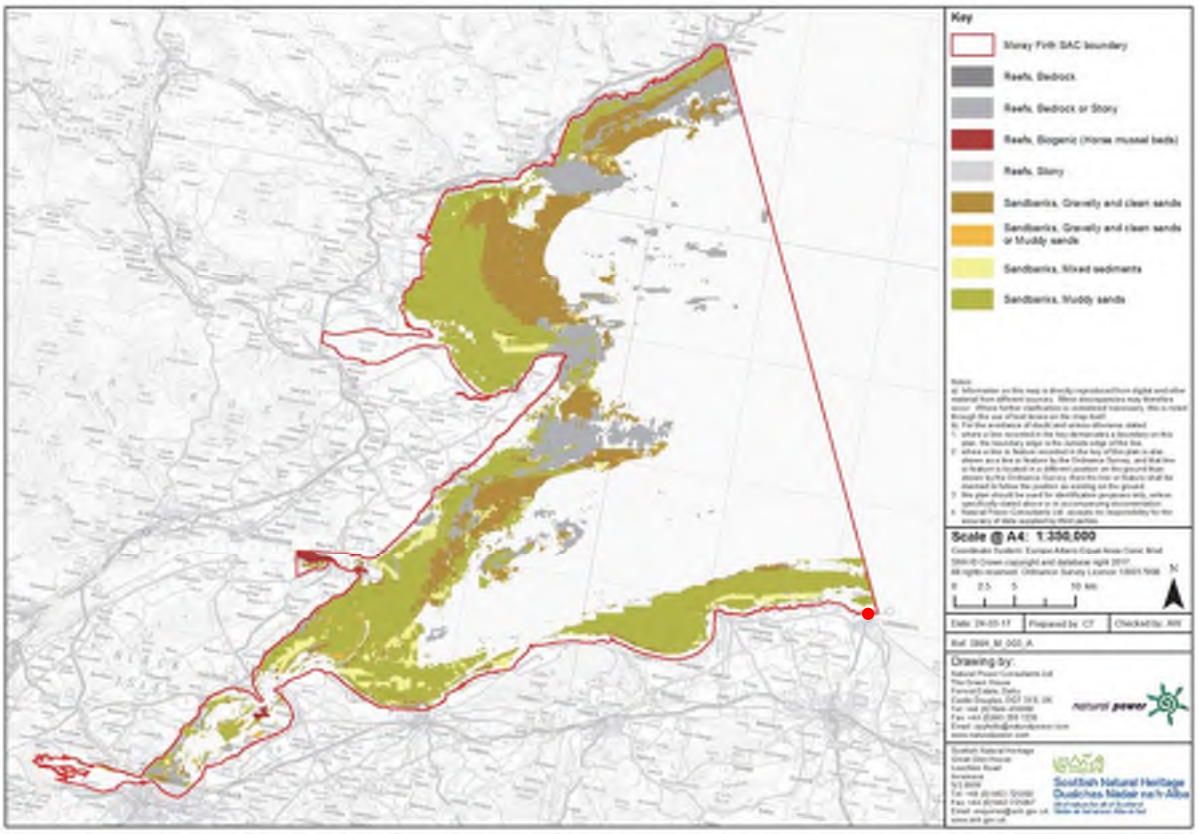

Figure 8. Chart showing the distribution of reef and sandbank habitats relative to the proposed long sea outfall development site (red spot) at Lossiemouth in the Moray Firth, Scotland. Figure reproduced from Miller et al. (2017).

The conservation objective for the designated sandbank features is:

To avoid deterioration of the qualifying habitat (Sandbanks which are slightly covered by sea water all the time) thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

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

- Extent of the habitat on site
- Distribution of the habitat within site
- Structure and function of the habitat
- Processes supporting the habitat
- Distribution of typical species of the habitat
- Viability of typical species as components of the habitat
- No significant disturbance of typical species of the habitat

The proximity of the qualifying sandbank features mean that it will be imperative to investigate the potential for interactions between this feature and the proposed long sea outfall development.

Moray Firth pSPA

The Moray Firth has been selected to provide protection to important wintering grounds used for feeding, moulting and roosting by waterfowl, many of which migrate to Scotland every year to overwinter or to stop off at as one of their staging posts while on migration. The inshore area to the north of the Moray Firth is also selected as an important foraging area for breeding European shag, *Phalacrocorax aristotelis*. The species which are known to use the areas closest to the proposed development site are summarised in Table 4.

Note that neither the European Shag nor the Greater scaup, *Aythya marila*, are present in the area of interest and are not considered further in this review.

Table 4. Summary the qualifying bird species included in the Moray Firth proposed Special Area for Protection (pSPA) that are known to occur in the vicinity of the proposed long sea outfall, and could feasibly be influenced by the development (SNH 2016a).

Common Names	Scientific Names	Protected Status	Use of Area
Red-throated Diver & Great Northern Diver	*Gavia stellata* *Gavia immer*	Annex 1 species Annex 1 species	Over wintering around the coast in shallow waters Feed on a variety of fish species
Slavonian Grebe	*Podiceps auritus*	Annex 1 species	Over wintering around the coast in shallow waters Feed on small fish, amphipods and other crustaceans
Common Eider	*Somateria mollissima*	Migratory species	Present all year, concentrated along the southern coast between Nairn and Lossiemouth Feed on molluscs and small crustaceans
Long-tailed Duck	*Clangula hyemalis*	Migratory species	Over wintering, out to 40 m depths Feed on molluscs and small crustaceans
Common Scoter	*Melanitta nigra*	Migratory species	Over wintering Feed on molluscs and small crustaceans
Velvet Scoter	*Melanitta fusca*	Migratory species	Over wintering Feed on molluscs and small crustaceans
Common Goldeneye	*Bucephala clangula*	Migratory species	Over wintering Feed mainly on invertebrates such as molluscs, worms and crustaceans but will take also small fish.
Red-breasted Merganser	*Mergus serrator*	Migratory species	Over wintering Feed on a variety of fish species

The conservation objective of the pSPA is:

> To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, subject to natural change, thus ensuring that the integrity of the site is maintained in the long-term and it continues to make an appropriate contribution to achieving the aims of the Birds Directive for each of the qualifying species.
>
> And this is to be achieved through the following objectives:
>
> a) Avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term;
>
> b) To maintain the habitats and food resources of the qualifying features in favourable condition.

For the purposes of Habitats Regulations Appraisal (HRA) consideration of the conservation objectives will be required for plans / projects inside and outside the site.

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Moray and Nairn Coast SPA & Ramsar

The Moray and Nairn Coast SPA & Ramsar sites are co-located on the south coast of the Moray Firth in north-east Scotland. The sites comprise the intertidal flats, saltmarsh and sand dunes of Findhorn Bay and Culbin Bar, and the alluvial deposits and associated woodland of the Lower River Spey and Spey Bay. The area is considered to be of outstanding nature conservation and scientific importance for coastal and riverine habitats and supports a range of wetland birds throughout the year. In summer, it supports nesting Osprey *Pandion haliaetus*, whilst in winter it supports large numbers of Iceland/Greenland Pink-footed Goose *Anser brachyrhynchus*, Icelandic Greylag Goose *Anser anser* and other waterbirds, especially ducks, sea-ducks and waders. The geese feed away from the SPA on surrounding agricultural land during the day. The sea-ducks feed, loaf and roost over inundated intertidal areas within the site, but also away from the SPA in the open waters of the Moray Firth. The site supports several nationally scarce aquatic plants, invertebrates, and mammals and regularly supports migrating waterbirds and various species of wintering waders.

River Spey SAC

The River Spey is designated for the protection of Atlantic salmon *Salmo salar*, an anadromous fish which spends most of its life at sea, but returns to spawn in the same stretch of river or stream in which it hatched. The Spey supports one of the largest salmon populations in Scotland, with little evidence of modification by non-native stocks. Adults spawn throughout virtually the whole length of the river, and good quality nursery habitat is found in abundance in the main river and numerous tributaries. Salmon in the Spey system are little affected by artificial barriers to migration, and the waters in the catchment are largely unpolluted (the river is oligotrophic throughout its length). For a system of its size, the Spey is also relatively free from flow modifications such as abstractions, diversions and impoundments. The salmon population includes fish of all ages including migrating smolts and returning adults.

Non-Statutory Designated Sites

In addition to the statutory designated sites listed in Table 1, a number of non-statutory designated sites of ecological importance have been identified. These include sites listed in the Study of Environmentally Sensitive Areas (SESA) as well as the Moray Basin, Firths and Bays Important Bird Area (IBA). All of these sites have been identified as being important for populations of wintering and passage wildfowl and are encompassed by the SPA and pSPA listed in Table 1, therefore the interests of these sites are considered to be inextricably linked with those of the statutory designated sites and they will not be considered further in this review.

Protected Species

Cetaceans

Scottish inshore waters are internationally important for a number of cetacean species and at least 23 species of whales, dolphins and porpoises are known to occur in Scottish waters (SG 2014). The Minke whale, *Balaenoptera acutorostrata*, bottlenose dolphin, *Tursiops truncatus*, and the harbour porpoise, *Phocoena phocoena*, have all been sighted regularly between Burghead and Covesea (https://seawatchfoundation.org.uk/legacy_tools/region.php?output_region=3) peaking in numbers between July and September. The Moray Firth SAC is also one of only two sites designated for the protection of bottlenose dolphins, further highlighting the importance of this area for cetaceans.

There are sporadic records of other cetacean species occurring in the Moray Firth (Robinson et al. 2007 and references therein), including the following:

- Humpback whales, *Megaptera novaengliae*
- Sperm whale, *Physeter microcephalus*
- Fin whale, *Balaenoptera physalus*
- Sei whale, *Balaenoptera borealis*
- Northern bottlenose whale, *Hyperoodon ampullatus*
- Sowerby's beaked whale, *Mesoplodon bidens*
- Pilot whales, *Globicephala melas*
- Killer whales, *Orcinus orca*
- Risso's dolphins, *Grampus griseus*
- Atlantic whitesided dolphins, *Lagenorhynchus acutus*
- White-beaked dolphin, *Lagenorhynchus albirostris*
- Striped dolphin, *Stenella coeruleoalba*
- Common dolphin, *Delphinus delphis*

The majority of these records are from deeper waters, some distance offshore from the proposed development site but the sensitivity of pelagic and visiting cetaceans would still need to be considered alongside the resident and regular cetacean visitors because of their high sensitivity to anthropogenic activities and the high conservation status afforded to them.

All cetacean species are classed a European Protected Species (EPS) and are listed in Annex IV(a) of the Habitats Directive. They have also been identified as Priority Marine Features (PMFs) in Scotland. In addition, the harbour porpoise is included in the OAPAR List of Threatened and/or Declining Species and Habitats.

Minke Whale, *Balaenoptera acutorostrata*

The minke whale is the second smallest baleen whale, but still reaches between 8 and 10 m in length at sexual maturity. The minke whale is a cosmopolitan and opportunistic species whose distribution closely follows concentrations of prey, and drivers of prey abundance such as phytoplankton (Tetley et al. 2008). In Scotland, minke whales feed primarily on sandeels, *Ammodytes* spp., sprat, *Sprattus sprattus* and herring, *Clupea harengus* and there is evidence that they make use of bird-associated foraging (Robinson and Tetley 2007). Here, the whales exploit concentrations of small fish compacted together at the water's surface by flocks of feeding seabirds from above and by schooling predatory fish below. In the Moray

Firth, they are thought primarily to feed on sandeels concentrated by schools of predatory mackerel, *Scomber scombrus* (Robinson and Tetley 2007).

Minke whales typically live for 30–50 years; in some cases they may live for up to 60 years. In the North Atlantic, conception typically takes place from December to May peaking in February, and birthing typically takes place from October to March, peaking in December. The gestation period for minke wales is 10 months and the calves generally nurse for 5 -10 months. Minke whales are most frequently sighted in the Moray Firth towards the end of summer, suggesting they are in the area to feed rather than to breed.

As with most Mysticetes, the auditory system for the minke whale is not well understood. However, magnetic resonance imaging points to evidence that the minke whale has fat deposits in their jaws intended for sound reception, much like Odontocetes.

Bottlenose Dolphin, *Tursiops truncatus*

The Moray Firth in north-east Scotland supports the only known resident population of bottlenose dolphin *Tursiops truncatus* in the North Sea. The population is estimated to be approximately 130 individuals (Hammond and Thompson 1991; Wilson et al. 1999). Dolphins are present all year round, and, while they range widely in the Moray Firth, they appear to favour particular areas of the Inner Firth, the southern Moray Firth coastline and the mouth of the Cromarty Firth and are usually found within 10 km of land (Wilson et al. 1999; Mendes et al. 2002; Bailey and Thompson 2006; Robinson et al. 2007; Fernandez-Betelu et al. 2019). Bottlenose dolphins can produce a calf every 4-5 years and they typically live for between 30 and 50 years (SNH 2018). Calves can be born at any time of the year but are most common between March and September. March to September is also the time of the dolphin's peak abundance in the Moray Firth, demonstrating the importance of this area to the dolphins.

Bottlenose dolphins are social animals typically living in groups of between 2 and 25 individuals, but they can also form much larger groups of 45 to 60 individuals. The smaller groups are like an extended family with individuals remaining together over a number of years. Calves remain with their mothers for 3 to 10 years. Adult males may join the group for a short while, and then go off to live in bachelor herds. Bottlenose dolphins eat a wide range of fish including herring, cod, mackerel and salmon. They tend to feed singly or in small groups and are also known to work together to herd fish into a tight ball close to the surface to aid feeding. Atlantic salmon are thought to be an important food source for the resident bottlenose dolphins in the Moray Firth (Bailey and Thompson 2006; Fernandez-Betelu et al. 2019).

Dolphins have a complex communication system with a well-developed auditory memory. They can learn through observations and comprehend a simple language. As well as being used in communication, sounds provide dolphins with information about their environment and are used for the remote detection of prey (David 2006). Dolphins produce loud bursts of echolocatory clicks (15-130 kHz) that are designed to function at relatively close range (rarely beyond a few kilometres) as well as pure tone whistles which are thought to maintain group cohesion over larger distances.

Harbour Porpoise, *Phocoena phocoena*

The harbour porpoise is generally found in estuaries and shallow coastal bays. In the Moray Firth, single animals, pairs and groups of 5 - 10 are most often seen. They can be active and fast moving, but are frequently shy and do not normally approach boats. Harbour porpoises are permanent residents in the Moray Firth, moving from inshore to deeper feeding grounds where their diet includes mackerel, herring, sprats and squid. A single calf, measuring around 2.5 feet in length, is born in the summer months after

a pregnancy lasting eleven months. Porpoises can be highly vocal and demonstrative, although you will never see them leaping out of the water or bow ride with a boat in the manner of dolphins. They may gambol alongside a slow moving vessel in small groups before cutting away at a sharp angle. There is some evidence of conflicts between porpoises and bottlenose dolphins in the Moray Firth, but the cause and frequency of these are unknown.

Other Marine Mammals

Seals

The main legislation that protects seals in Scottish waters is the Marine (Scotland) Act 2010. This Act also provides for Scottish Ministers to designate Seal Conservation Areas. In addition, the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) prohibits certain methods of catching or killing seals and The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014 provides seals with further protection in Scottish waters, making it an offence to intentionally or recklessly harass seals at significant haul-out sites. Both the harbour seal, *Phoca vitulina*, and the grey seal, *Halichoerus grypus*, have also been identified as PMFs in Scotland (Wilding et al. 2016).

It is an offence to intentionally or recklessly kill, injure or take a seal at any time of year, except:

- to alleviate suffering, and / or
- where Marine Scotland has issued a licence to do so.

Permitted methods of killing or taking seals are detailed in licences and licence holders must report returns information regularly.

The Moray Firth is home to approximately 900 harbour seals and up to 1,300 grey seals visit in the summer. The sandbanks off Findhorn are used by harbour seals to haul out and rest, and this is the closest designated seal site to the proposed development (Figure 9). The issue of seal management and protection is a complex one in the Moray Firth since a declining harbour seal population coexists with a declining salmon population. Both harbour and grey seals are known to predate on salmon and because of this, there is a long history of shooting seals in Scotland, especially in areas where they are perceived as impacting on economically important salmon fisheries. In light of this, the Moray Firth Seal Management Plan (MFSMP) was developed in 2005. The MFSMP began as a pilot scheme developed to coordinate the management of the declining harbour seal and salmon populations in this area by achieving the following aims:

- Manage seal and salmon fishery conflicts within the Moray Firth to have minimal impact on wildlife and tourism,
- Restore and maintain the 'favourable conservation status' of harbour seals and salmon in their SACs,
- Reduce the impact of shooting on the harbour seal population, through licensing and targeting key areas where there may be conflicts,
- Reduce the impact of seal predation, especially on spring salmon stocks,
- Develop non-lethal methods, such as seal scarers, to reduce the number of seal salmon interactions, particularly within rivers, and
- Monitor and research the status of seal populations, salmon stocks and interactions between them.

Since the inception of the MFSMP, seal numbers have stabilised and have started to rise again. The management plan structure has been considered a success and it has been used as a template for developing the management of seals on other parts of the coast. Despite this, harbour seal counts have continued to drop. In august 2014, a total of 693 harbour seals were counted in the area surveyed annually, between Findhorn and Helmsdale, compared with 858 in 2013 and 1,033 in 2012. It is the

Scottish Mammal Research Unit's (SMRU's) lowest count to date and is 25% lower than the mean count (909) between 2002 and 2013. (Duck and Morris 2015).

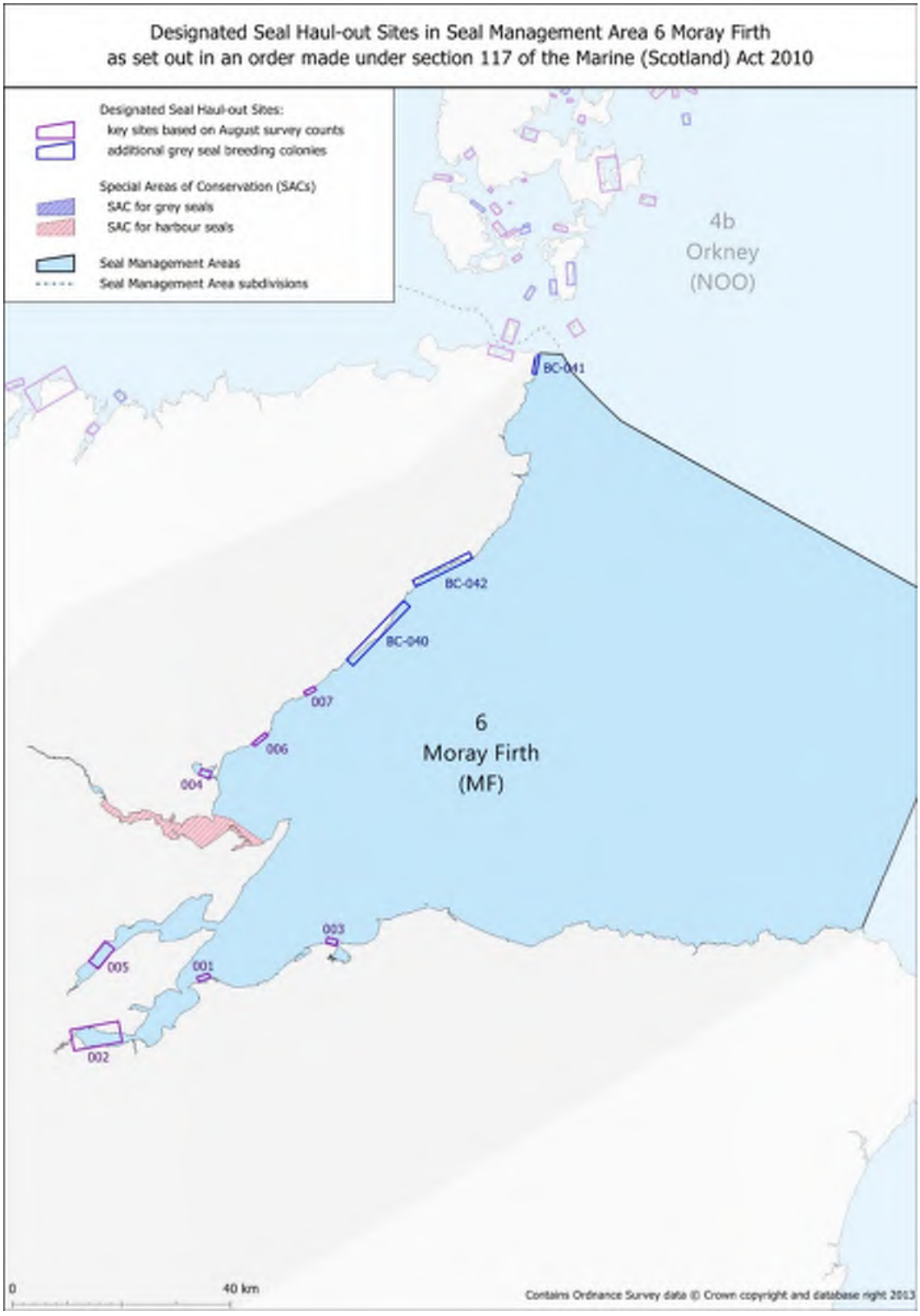


Figure 9. Chart showing the location of designated seal haul out sites and Special Areas of Conservation (SACs) designated for the protection of seals within the Moray Firth Seal Management Area (MFSMA). NB there is no grey seal SAC in this region, the figure legend is common to charts of all SMAs.

European Otter, *Lutra lutra*

The European otter, *Lutra lutra*, was lost from most of England and Wales between the 1950s and the 1970s, which has been attributed persecution, habitat loss and, more recently, the impact of toxic organochlorine insecticides. The otter survived in Scotland's cleanest bodies of water in the north and west and is now flourishing across Scotland and the rest of the UK, reflecting a significant change in the way we manage our aquatic environment. The Scottish otter population is estimated to comprise around 8,000 individuals and an unusually high proportion of these (50% or more) are coastal dwelling individuals, which feed almost exclusively in the sea.

The European otter is protected by various international conventions, including the European Union's Habitats and Species Directive and it is therefore classed as a European Protected Species (EPS). The otter is listed in Appendix 1 of the Convention on International Trade in Endangered Species (CITES), prohibiting all trade in individuals from the wild. In the UK, the otter is further protected under the Wildlife and Countryside Act.

It is an offence to deliberately or recklessly:

- capture, injure or kill an otter
- harass an otter or group of otters
- disturb an otter in a holt or any other structure or place it uses for shelter or protection
- disturb an otter while it is rearing or otherwise caring for its young
- obstruct access to a holt or other structure or place otters use for shelter or protection, or otherwise deny the animal use of that place
- disturb an otter in a manner or in circumstances likely to significantly affect the local distribution or abundance of the species
- disturb an otter in a manner or in circumstances likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young

It is also an offence to:

- damage or destroy a breeding site or resting place of such an animal (whether or not deliberately or recklessly)
- keep, transport, sell or exchange, or offer for sale or exchange any wild otter (or any part or derivative of one) obtained after 10 June 1994

Otter shelters are legally protected whether or not an otter is present.

Developers would need to apply to SNH for an EPS licence to allow proposed development works that might affect otters, to proceed legally.

The otter is carnivorous and eats almost exclusively live prey, such as trout (*Salmo trutta*), young salmon (*Salmo salar*) and other fish, crustaceans, eels, frogs, water birds and insects. It is however, an opportunistic feeder, taking whatever prey is available, and otters that live along coastlines feed mainly on crabs and catshark (*Scyliorhinus* spp.).

A female otter reaches sexual maturity between 18 months and 2 years of age, although most breeding begins between 2 and 3 years. Mating takes place in the water, and can occur throughout the year; there is no fixed breeding season. After a gestation period of 60-64 days, 2-4 pups are born. These are covered in fur, but have their eyes closed for the first 5 weeks. After 10 weeks they are able to swim, but will remain with their mother for up to a year. The male plays little, if any, role in rearing the young. Mortality

can be high amongst young otters, often due to starvation when they move off into areas where there are well-defended territories of adults.

Habitats suitable for commuting otters were identified during the Phase I surveys of the LDP drainage site, including the drainage ditch itself and the beach (WYG 2019) although no actual evidence of otters was found. These areas are heavily disturbed by the public (including dog walkers) and so are unlikely to support suitable resting-up sites or Holts. The presence of these habitats cannot however, be ruled out without further dedicated survey work. That otters are a designated feature of the Spey Bay SAC indicates that there is a stronghold in the general region and it will therefore be necessary to be mindful of their likely presence and sensitivity during investigative works and construction.

Sharks and Rays

All species of sharks and rays are on the OSPAR list of Threatened and Declining Species due to their removal as both target and non-target species and most species found in UK waters are fall under the International Union for the Conservation of Nature (IUCN) class of 'Near Threatened' to 'Critically Endangered'. The only shark species which is not classed as threatened in the seas around the UK is the Small-spotted catshark, *Scyliorhinus canicula*. The following eight species have also been identified as Priority Marine Features (PMFs) in Scotland:

- Basking shark – *Cetorhinus maximus*
- Spiny dogfish – *Squalus acanthias*
- Porbeagle shark – *Lamna nasus*
- Portuguese dogfish – *Centroscymnus coelolepis*
- Leafscale gulper shark – *Centrophorus squamosus*
- Common skate – *Dipturus batis* complex
- Blue shark – *Prionace glauca*
- Sandy ray – *Leucoraja circularis*

Many of the PMF shark and ray species are limited to deeper offshore waters in the far west and north of Scotland, but the spiny dogfish, porbeagle, blue shark, common skate and sandy ray could feasibly occur within the vicinity of the proposed development and Basking shark are observed on a comparatively relatively regular basis in the inshore waters of the Moray Firth.

Basking Shark, *Cetorhinus maximus*

The basking shark is the second largest fish in the world and the largest in British waters, growing up to 9.8 m in length. They are known to migrate over large distances in both offshore and coastal waters at depths from the surface to over 750 m. Basking shark are typically associated with tidal fronts on the continental shelf and shelf edge where they feed on plankton. They have been recorded from around the whole Scottish coast, with sightings peaking in the summer months especially at a number of hot spots on the west coast. Despite being a species typically associated with the west coast of Scotland, Basking shark are known to be occasional visitors to the Moray Firth (Figure 10) with sightings near Lossiemouth as recently as the 20th September this year (https://www.northern-scot.co.uk/news/shark-spotted-between-burghead-and-findhorn-183504/). Increases in sea water temperatures are thought to be related to sightings being observed further north than in previous decades, with occasional records now around Shetland and Orkney north to the Norwegian coast and in the northern North Sea (Bloomfield and Solandt 2008; Solandt and Ricks 2009).

In the past basking sharks were subject to a targeted fishery in Scottish waters and whilst this no longer exists and they are protected in British waters they are still fished elsewhere. They have suffered 50-80%

population declines in recent years. Numbers remain low and they are classed as globally Vulnerable on the IUCN Red List.

Developers would need to apply to Marine Scotland for a Basking Shark licence to allow proposed development works that might affect Basking Shark, to proceed legally.

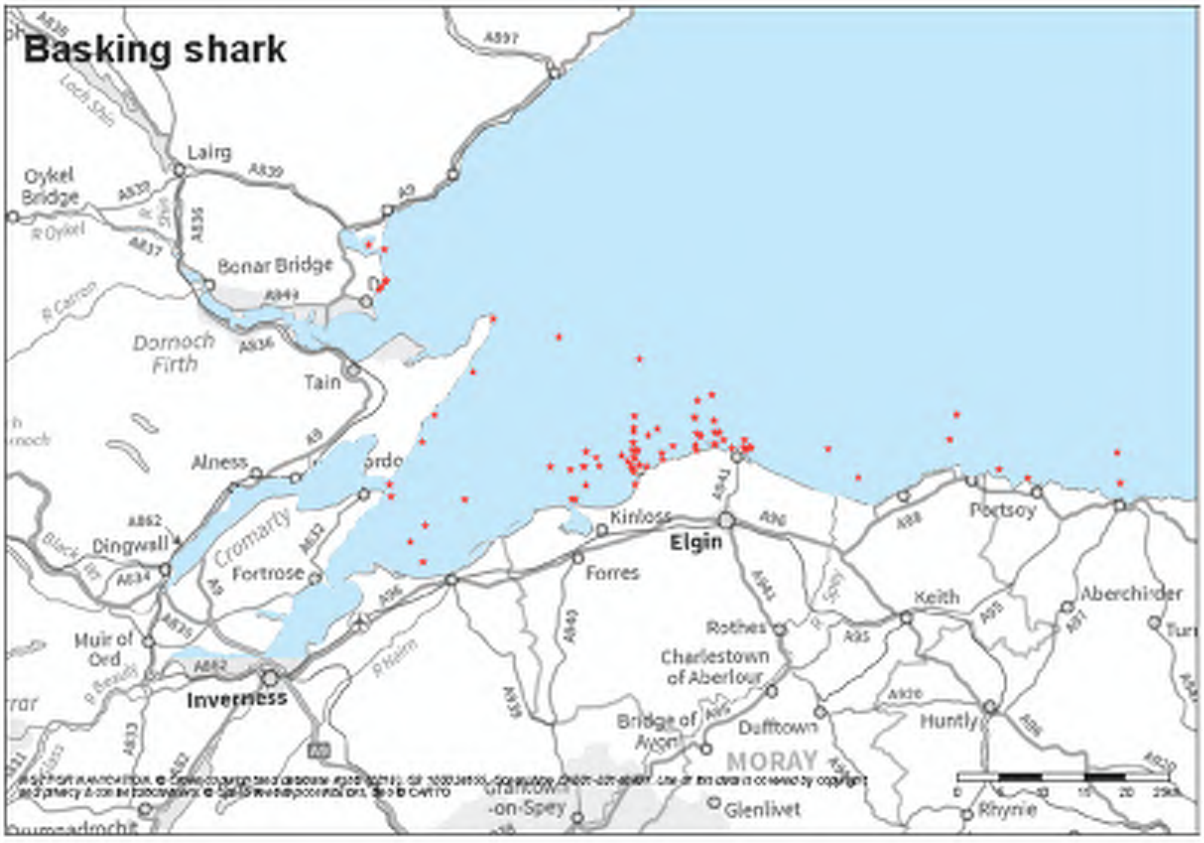


Figure 10. Chart showing Basking Shark, *Cetorhinus maximus,* sightings and distribution in the Moray Firth. Data downloaded from Marine Scotland's MAPS NMPi, 01.10.2019 © SNH WMS.

Porbeagle shark – *Lamna nasus*

The porbeagle shark can reach 3.5 m in length and is usually found mid-water between 200-700 m, although they have occasionally been observed in shallower water, close inshore. It is widely distributed around Scotland although considered rare, and is currently listed on the IUCN Red List as Critically Endangered in the north-east Atlantic and Vulnerable internationally. It is fished for human consumption and fishmeal production and is highly susceptible to overfishing. In 2010 an EU-wide zero TAC was introduced, but the shark can still be landed as by-catch in certain fisheries.

Blue shark – *Prionace glauca*

The blue shark can grow up to 3.8 m in length and, as part of their annual migration, can be found in Scotland during the summer months, especially off the west coast. Blue shark occur at all depths down to 600 m and so could feasibly occur close to the proposed development site. Indeed, according to the Scottish Marine Animal Stranding Scheme (SMASS) an adult female blue shark was found stranded between Roseisle and Burghead on the 18th November 2017, indicating that this species does occur in the general area, although it is likely only to be an occasional visitor.

The blue shark is widely fished either as bycatch or by targeted fisheries. The North Atlantic stock status is unclear due to unreliable catch data but there appears to have been a declining trend in recent years.

Local legislation to protect it is likely to have only limited impact as they are highly migratory. The blue shark is currently listed as Near Threatened on the IUCN Red List.

Spiny dogfish – *Squalus acanthias*

The spiny dogfish, or spurdog, is a small dogfish reaching 1.6 m in length and is one of the most abundant shark species in the world. It is widely distributed in Scottish waters and is found just above the sea bed, typically at depths of 10-200 m, although it can be found as deep as 900 m. Most populations are at serious risk from overfishing and the species is classed as Vulnerable internationally and Critically Endangered in the north-east Atlantic, where populations are depleted, on the IUCN Red List. Both directed fishing and accidental bycatch pose threats. The spiny dogfish is found in much higher abundances on the west coast of Scotland but is known to occur in the Moray Firth and the area is considered to be a low-intensity nursery ground for this species (Ellis et al. 2012).

Common skate – *Dipturus batis* complex

The common skate can grow up to 3 m in length, and is found at depths down to 600 m. It has been recorded from all coasts around Scotland. The common skate was once abundant in north-west Europe but there have been significant declines around the UK over the last century due to overfishing. The waters around the Isle of Mull and Firth of Lorn retain a relatively healthy population but nevertheless, this species is classed as Critically Endangered on the IUCN Red List and it is prohibited to land any catch in the EU. The Moray Firth is not considered to be a nursery or spawning ground for this species (Ellis et al. 2012) but this does not preclude its presence and more general use of the area.

Sandy ray – *Leucoraja circularis*

The sandy ray can reach 120 cm in length and occurs at depths from 70-275 m. It is an offshore species typically found on sandy or muddy sea beds to the northwest of Scotland but can occur elsewhere around the coast. The status of the species is unknown and while there is not a target fishery it is often taken as bycatch, leading to declines in its numbers. The sandy ray is listed as Vulnerable on the IUCN Red List.

Fish

Atlantic salmon, *Salmo salar*

The Atlantic salmon, *Salmo salar* is listed in Annex II (freshwater only) and IV of the Habitats Directive. They are a Priority Species under the UK Post-2010 Biodiversity Framework and have been identified as Priority Marine Feature (PMF) in Scotland (Wilding et al. 2016). This species is also managed in Scotland through the Conservation of Salmon (Scotland) Regulations 2016, a system under which the killing of Atlantic salmon in inland waters is managed on an annual basis by categorising the conservation status of their stocks.

In general terms the Regulations:

- prohibit the retention of salmon caught in coastal waters
- permit the killing of salmon within inland waters where stocks are above a defined conservation limit
- require mandatory catch and release of salmon in areas which fall below their defined conservation limit following the assessment of salmon stocks

Eleven rivers feed into the Moray Firth, including some of the most famous salmon rivers in Scotland. The River Spey, which lies approximately 30 km to the east of the proposed development site, has been designated a Special Area of Conservation (SAC) as it supports one of the largest salmon populations in

Scotland. The River Findhorn, which lies approximately 20 km west of the proposed development site is also a salmon river. The River Lossie is the closest Salmon River to the proposed development (approximately 500 m east, as the crow flies). The presence of three salmon rivers in the vicinity of the proposed development site means that there is a high likelihood of salmon using or passing through the area, particularly during the summer months before they return to their natal rivers to lay their eggs. Although the river Lossie is not designated as an SAC for salmon, it has been categorised as High Risk (Grade 3), meaning that the local population are considered to be particularly vulnerable. The salmon population in the Moray Firth is also thought to be very significant in supporting the resident bottlenose dolphin population, further highlighting their importance in the local ecosystem.

The Atlantic salmon is an anadromous species which spends most of its life at sea, returning to spawn in the same stretch of river or stream in which it hatched. Salmon typically travel upstream to spawn from November to February. The juveniles will stay in freshwater for between two and six years, after which they migrate back to the sea, usually around spring time (Hendry and Cragg-Hine 2003). Salmon migration can only take place within specific flow windows and hence barriers to migrations, both natural and artificial, represent a significant threat to salmon populations. In rivers, salmon may encounter barriers in the form of fords, dams, weirs, culverts, rapids or waterfalls and their interaction with these barriers has been relatively well studied (Hendry and Cragg-Hine 2003). The impact of small-scale and offshore barriers however, is largely unknown, although it is thought that even minor barriers could have a significant impact on the condition of salmon and therefore have the potential to impact reproductive success.

Atlantic salmon are predators, feeding on small fish including capelin and sandeels, and crustaceans including Euphausiid shrimps and Amphipods. Adult salmon do not feed when they migrate back up their natal rivers, making their marine diet all the more important. Atlantic salmon migrate over thousands of kilometres and can lose up to 40% of their body weight over the course of a single migration (Belding 1934). Salmon are also predated upon themselves, by marine mammals including seal, dolphins and otters.

Sandeels

The term "Sandeel" encompasses a number of different small fish species, all in the Sand Lance family. They are distinctively slender with a pointed snout, giving them an eel-like shape. Between April and September they swim in large shoals close to the seabed and will burrow into the sand to escape predators. In the winter months, they bury themselves up to 50 cm in the sand. They are an incredibly important part of the marine ecosystem and are a favourite food of Harbour Porpoises, Minke Whale, Seals, Terns, Pollack and Mackerel (Tollit and Thompson 1996). Sand Eels including *Ammodytes marinus* and *Ammodytes tobianus* have been identified as Priority Marne Features (PMFs) in Scotland and the Lesser Sand Eel (*A. tobianus*) is a Priority Species under the UK Post-2010 Biodiversity Framework.

Sandeels are likely to occur in the designated sandbank features of the Moray Firth but may also occur in other sandy areas. Sandeels have a demonstrated preference for the sloping edges of sandbanks (Greenstreet et al. 2010) but perhaps more critical in determining their distribution is the composition of the sediments. Holland et al. (2005) undertook a detailed study into the sediment preferences of A. marinas, demonstrating a strong preference for seabed habitats containing a high proportion of medium and coarse sand (particle size ≥ 0.25 to < 2 mm) and low silt content. Sandeels are rare in sediments where the silt content (particle size < 0.63 µm) is greater than around 4 % and absent where the silt content is greater than 10 % (Wright et al. 2000; Holland et al. 2005). Given that the area has previously been characterised as muddy sands it is perhaps unlikely that the area supports and important sandeel population, but this cannot be ruled out entirely at this stage.

River and Sea Lamprey

Lampreys belong to an ancient order of vertebrates, the Agnatha or 'jawless fish'. There are three species that occur in the UK, of which two, the river and sea lamprey, utilise the marine environment. Both the river and sea lamprey are listed on Schedule 3 of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Both species spawn in fresh water in spring or early summer, followed by a larval phase (ammocoetes) spent in suitable silt beds in streams and rivers. All individuals die after spawning (Maitland 2003). Ammocoetes have been recorded consistently, albeit in very low numbers, from the River Lossie (Laughton 2011; Laughton 2017) demonstrating that lamprey are present in the general area. Sea lamprey, *Petromyzon marinus*, are a primary feature of the Spey River SAC and river lamprey, *Lampetra fluviatilis*, have also been recorded in the rivers Spey and Conon.

Ammocoetes can spend several years in riverine silt beds, feeding on organic detritus and eventually transforming into adults from late summer onwards. The transformation into the adult stage is characterised by the development of functional eyes and the mouth changes into a fully formed sucker (Maitland 2003). After transformation, river and sea lampreys migrate to sea, where they use their suckers to attach to other fish. After several years in the marine environment the adults return to fresh water to spawn (Maitland 2003).

The distribution of sea lamprey is largely dictated by their host (Waldman et al. 2008). At sea, lamprey feed on a variety of marine mammals and fish, including shad, herring, pollock, salmon, cod, haddock, swordfish and basking sharks (Maitland 2003; Silva et al. 2014). Homing behaviour is not apparent in this species and, unlike salmonids and shads, lampreys do not have specific river populations (Waldman et al. 2008). The rarity of capture in coastal and estuarine waters suggests that marine lampreys are solitary hunters, widely dispersed at sea. It is also possible that they feed in deeper offshore waters as they have been caught at considerable depths (Maitland 2003).

In contrast to sea lamprey, river lamprey are generally found in coastal waters, estuaries and accessible rivers. In estuaries, they feed on a variety of fish, particularly on small fish including juvenile herring, *Clupea harengus*, sprat, *Sprattus sprattus*, and flounder, *Platichthys flesus* (Maitland 2003). River lamprey typically spend one or two years living in estuaries. They then feeding in the autumn and move upstream into medium to large rivers, usually migrating into fresh water between October and December (Maitland 2003).

European Eel, *Anguilla anguilla*,

The European eel, *Anguilla Anguilla*, stock has been assessed as being critical with very low recruitment (ICES 2017). In 2007 an EU Regulation (EU 1100/2007)[3] was established with the objective to protect, recover and sustainably use, the stock. The European eel is also listed as Critically Endangered on the IUCN Red list and is a UK Biodiversity Action Plan species.

The vulnerability of the European eel stems in part from its complex life history and the fact that it is fished at all life stages throughout its distribution. The European eel is a catadromous migratory species which has five life stages, Leptocephalus (larvae), Glass eel, Elver, Yellow eel and Silver eel. The European eel is thought to spawn in the Sargasso Sea. The newly hatched larvae use oceanic currents to cross the Atlantic Ocean towards the European continental shelf and once there, metamorphose into glass eels (Malcolm et al. 2010). All juvenile eels found in the shallower waters off Scotland are therefore likely to be glass eels, with larval eels occurring only to the west of the continental shelf (Tesch 2003). Glass eels generally migrate into fresh water in their first year after arrival, although some remain in coastal waters

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007R1100&from=EN

until they mature, and others move back and forth between coastal, estuarine and freshwaters throughout their lives (Malcolm et al. 2010). After living and growing in these various environments for up to 60 years, adult eels (also known as yellow eels) turn silver and start their migration back to the Sargasso Sea to spawn and, presumably, to die (Malcolm et al. 2010).

The migratory behaviour of eels in Scottish coastal waters is poorly understood and migration seasons for both adults and juveniles are probably quite protracted. Tesch (2003), notes that eels typically arrive off Shetland and the Western Isles in September, Orkney and Caithness in November, and areas off the rest of eastern mainland Scotland in December. The first eels may, however, arrive as early as August and continuous glass eel arrival is likely to occur for several months after the mid-winter peak and perhaps even through the whole year, albeit in lower numbers (Malcolm et al. 2010).

It has been suggested that glass eels destined for Scottish rivers remain in coastal regions until April or May before river temperatures rise sufficiently for them to enter fresh water. The bulk of the return of silver eel migration is thought to extend from September to January (Malcolm et al. 2010). European eel have been regularly noted, albeit in low abundances in the River Lossie juvenile fish surveys (Laughton 2011; Laughton 2017).

Seabirds

Divers and Grebes

Three species of diver and grebe have been identified as qualifying species for the Moray Firth pSPA, the red throated diver, *Gavia stellata*, the great northern diver, *Gavia immer* and the Slavonian Grebe, *Podiceps auritus*. All three species are listed in Annex I of the Birds Directive (EC Directive on the conservation of wild birds (amended) - 2009/147/EC) and are Schedule 1 species under The Wildlife and Countryside Act.

Red Throated Diver

The red throated diver, *Gavia stellata,* is circumpolar and holarctic in distribution and the British population of 1,200 -1,500 pairs breed mostly in Orkney and Shetland (ap Rheinallt et al. 2007). Adults arrive at their breeding lochs from late March and leave by early September. Outside the breeding season the birds move offshore and disperse. The British population increases dramatically by early October, to approximately 17,000 birds, and abundances are thought to peak on the Moray Firth in January (SNH 2016a). Charts showing the distribution of red throated diver within the Moray Firth pSPA are included in Annex I of this report.

Great Northern Diver

Great northern diver, *Gavia immer*, breed in Greenland, Iceland, Alaska, North America and Canada and very occasionally in Northern Scotland. They breed on small pools and lochs, moving to the coast in winter, where they feed on fish. Great northern divers start to appear in the UK around August and peak in abundance in February on the Moray Firth (SNH 2016a). They then return to their breeding grounds in April. Great northern diver have been observed flocking at times of migrations (ap Rheinallt et al. 2007) and so may be present in higher densities in the spring and autumn. Charts showing the distribution of great northern diver within the Moray Firth pSPA are included in Annex I of this report.

Slavonian Grebe

Like the divers, the Slavonian grebe, *Podiceps auritus*, is found over-wintering on the Moray Firth between September and April (SNH 2016a) after which they return to their breeding grounds in Iceland, northern Norway and Scotland. Charts showing the distribution of Slavonian grebe within the Moray Firth pSPA are included in Annex I of this report.

Geese, Ducks and Swans

Six duck species have been identified as qualifying species for the Moray Firth pSPA and all are listed as regularly occurring migratory species in the Birds Directive (EC Directive on the conservation of wild birds (amended) - 2009/147/EC). Charts showing the distribution of qualifying duck species within the Moray Firth pSPA are included in Annex I of this report. The species are as follows:

Common Eider

Unlike all of the other qualifying bird species of the Moray Firth pSPA, the common eider, *Somateria mollisima*, is present all year round (SNH 2016a). Eider ducks nest on the ground in secluded places away from human disturbances. This can include moorland at considerable altitudes (up to 200m above sea level) as well as small islands (ap Rheinallt et al. 2007). The largest breeding colony of eiders can be found at the Sands of Forvie (Aberdeenshire) (Parkin and Knox 2010) and there is an established link with this site and the populations inhabiting the Moray Firth (Milne 1965). Between July and September the whole adult population of eiders undergoes a moult migration. Eiders undergo a double moult during which they are flightless for a period of time and hence very susceptible to predation and disturbance pressures (Milne 1965). Flocks of moulting eider have been observed in the Moray Firth off the coast at Hopeman (Milne 1965) and their presence close to the proposed development is very possible.

Outside of the breeding season eiders remain close to the shore and often aggregate in feeding or roosting flocks of hundreds, sometimes thousands, of birds. Most feeding in water less than 10m deep, primarily on marine mollusc and especially blue mussels. At night, eiders roost in offshore flocks, returning in to the coast at first light to feed.

Long Tailed Duck

Long-tailed duck, *Clangula hyemalis*, wintering in Britain are believed to originate from northern Fennoscandia and north-west Russia, with the bulk of these wintering in the Moray Firth (ap Rheinallt et al. 2007). Within the Moray Firth long-tailed duck have been most frequently recorded in Spey Bay and along the south coast of the Moray Firth (Annex I) in waters up to 40 m deep (SNH 2016a).

Common Scoter

The common or back scoter, *Melanitta nigra*, can be found in large wintering aggregations on the Moray firth between October and March (Parkin and Knox 2010). The propensity of the common scoter to aggregate in large numbers makes it vulnerable to pollution events like oil spills since very large numbers of birds can be impacted in a comparatively small spatial area. Common scoter were less widely distributed than other seaduck in the Moray Firth. They were generally concentrated close inshore between Burghead and Nairn, around the mouth of the inner Dornoch Firth, in Spey Bay and on the Riff Bank (SNH 2016a, Annex I).

Velvet Scoter

The velvet scoter wintering on Scottish coasts are thought to originate from Norway, Finland and possibly Northern Russia. They migrate to the east coast of Britain to moult and winter in large numbers. The velvet scoter, *Melanitta fusca*, has a very similar distribution to the common scoter although it is far less numerous (SNH 2016a). Nevertheless, the peak estimate of 1,488 birds on the Moray Firth, make this the largest concentration of velvet scoter in Scotland and the UK.

Common Goldeneye

The common goldeneye, *Bucephala clangula*, is a common and widespread passage migrant and winter visitor in Scotland. The wintering population originates largely from Scandinavia although there are

breeding populations in Scotland (ap Rheinallt et al. 2007). Common goldeneye breed in tree holes beside freshwater lakes and rivers, moving south to winter in fresh and salt water (Parkin and Knox 2010). Within the Moray Firth pSPA, goldeneye were mainly distributed either in the most southerly and shallow parts of the Inverness Firth, in the Dornoch Firth or occasionally on the southern shore in the Culbin/ Findhorn area.

Red Breasted Merganser

The red breasted merganser, *Mergus serrator*, belongs to the sawbill family, so called because of their long, serrated bills, used for catching fish such as salmon and trout. Red breasted merganser are most commonly seen around the UK's coastline in winter, forming flocks of several hundred. Within the Moray Firth pSPA red-breasted mergansers occurred at a number of localities along the southern shore and in the inner firth, but a large aggregation was present only in the Beauly Firth.

In addition to the aforementioned seabird species wintering waders are widely distributed throughout the inner Moray Firth and there are also protected sites for geese. However, no major concentrations of waders are thought to occur in the immediate vicinity of the proposed development and the Moray and Nairn Coast SAC and Ramsar sites are thought to be at a sufficient distance (12-14 km) from the proposed development to avoid any adverse effects from a development of this scale. However, should the noise and water quality modelling indicate that physical impacts could extend this far, the sensitivity of these receptors will need to be revisited.

Commercial Fisheries

Aquaculture and Shellfish Fisheries

There are no known active aquaculture sites for finfish or shellfish, or any protected shellfish waters in the vicinity of the proposed long sea outfall, with the nearest sites occurring in the Cromarty and Dornoch Firths (Figure 11). Therefore aquaculture and shellfish harvesting are not considered further in this review.

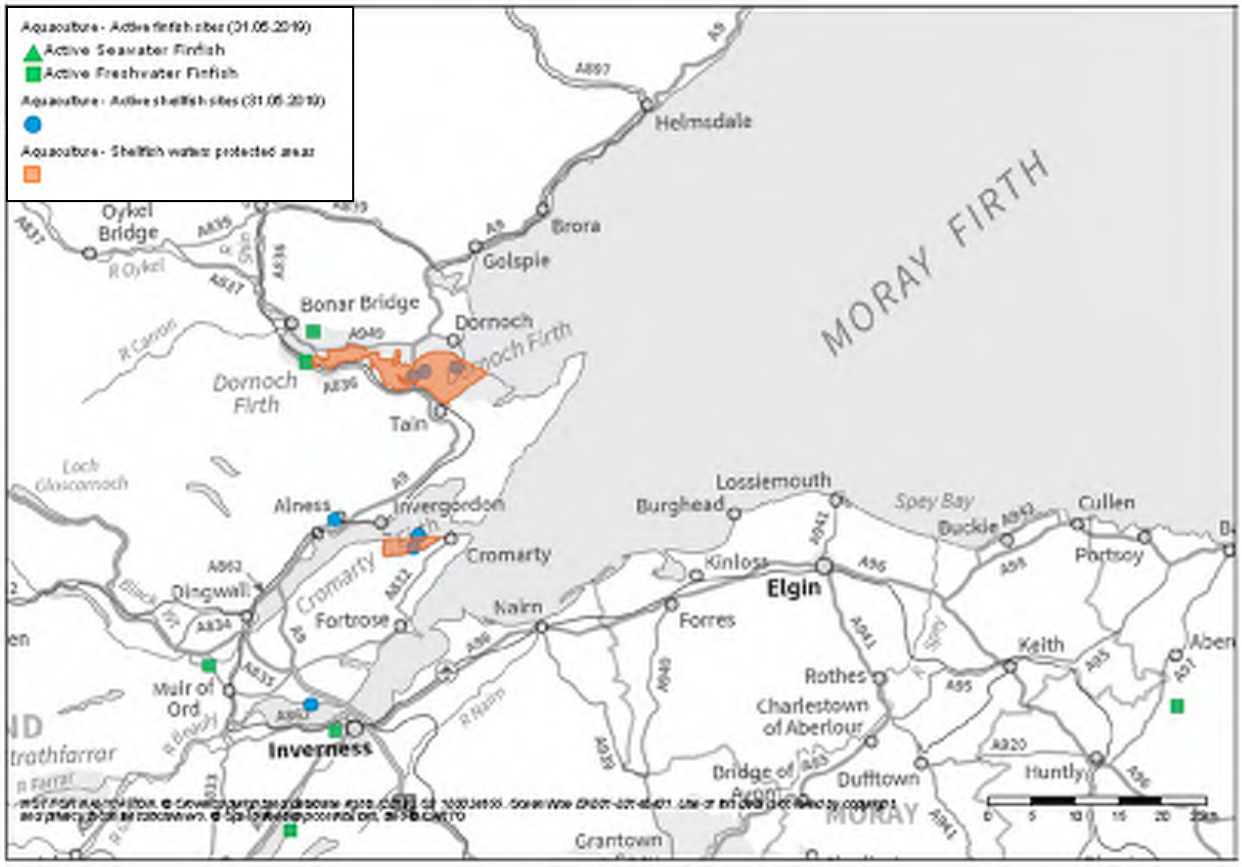


Figure 11. Chart showing the location of active finfish and shellfish aquaculture sites as well as protected shellfish waters in the Moray Firth. Data downloaded from Marine Scotland's MAPS NMPi, 10.07.2019.

There are shellfish protected waters in the mouth of the Cromarty Firth, and the Dornoch Firth which support a number of shellfish aquaculture sites. There are both over 40 km away from the proposed long seas outfall development and it would therefore be inconceivable that they would be influenced in any way by the development.

Inshore Fisheries

The most important commercial species in the Moray Firth, in terms of value, are squid, lobster, brown crab, *Nephrops*, velvet crab and king scallop (Lake 2011). The south side of the Moray Firth also supports and economically important hand line fishery for mackerel. Although Lossiemouth has a long history of commercial fishing spanning back to the opening of Elgin and Lossiemouth harbour in 1837, the harbour has since been re-named Lossiemouth Marina, reflecting the fact that it is currently used almost exclusively by leisure craft. The closest commercial fishing port to the proposed long sea outfall

development is therefore Burghead Harbour which still supports a number of small inshore fishing vessels. No high resolution fisheries data was identified for this area and although a number of local fishermen were contacted directly, none offered a view of the proposed development or provided information about their use of the area in the vicinity. Given the nature of the seabed in Covesea, it is likely that the fine muddy sediments support *Nephrops* and that the rocky outcrops are used by lobster and crab and some creeling has been observed in this area during some of the ground investigation surveys. Nevertheless, the extent to which these resources are targeted by the inshore fleet is as yet unknown.

Assessment of Likely Impacts

Summary of Physical Impacts

The proposed LSO has been designed to address concerns regarding the current drainage system in place at the RAF Lossiemouth site. At the present time, effluent from three wastewater package plants and surface water runoff are discharged into the Covesea burn, an open waterway which runs through the Moray Golf Course. As part of the proposed development, two waste water packages are being made redundant and a new wastewater treatment works (WwTw) is being developed. Effluent from the remaining wastewater package plant and the WwTw will drain into the proposed LSO system along with surface water runoff, which is known to contain de-icer from the aircraft.

Surface water is, and will continue to be, directed through interceptors and some of the proposed developments also incorporate Sustainable Drainage Systems (SuDS), which collectively serve as a preliminary treatment phase. The surface water and effluent will then run into an attenuation tank, sized to capture first flush flows, or the first 5 mm of rainfall. As surface water run-off from the furthest catchment will take the longest to get to the tank, more than 5 mm will be captured from all but the closest areas. The attenuation tank has been designed to allow for rainfall events larger than those known to occur once in every 5 years, dependent on intensity. Short high intensity rainfall events may breach the attenuation tank and would then over-flow to the Covesea Burn. However, these events should be rare and any overflowing discharges will be heavily diluted by the excessive rainfall.

Downstream of the attenuation tank, the LSO is to be fitted with a flow control, limiting flows to 95 litres per second. Flow control is necessary to manage head losses (energy lost in the system through friction) downstream of the tank. Excessive head losses can compromise the performance of the LSO. It has been estimated that there could be in excess of 3 m^3 per second travelling through the LSO, hence the attenuation tank has been included in the design to capture and control excessive flows.

The resulting discharges will be released offshore via the LSO which will run between 600 m and 1000 m offshore from the Moray Golf Course. The discharge will need to comply with bathing water standards and the developers drainage team are working with SEPA to ensure compliance. The proposed pipe alignment follows the existing LSO at the southern end of the site, the Covesea Burn position and avoids areas of protruding rock offshore. The pipe will be 600 mm in diameter, matching the dimensions of the existing LSO. The distance that the pipe will need to run into the Moray Firth (the location of the discharge point) will be informed by the results of topographic, geotechnical and hydrographic surveys and the discharge point will be designed to ensure adequate dilution of the discharges. It is likely that the proposed LSO will be buried as far out as the Lowest Astronomical Tide (LAT) mark and beyond this, the pipe will sit on top of the seabed, weighted down with precast concrete anchors. This mirrors the construction of the existing LSO and should minimise the need for noisy construction (e.g. pile driving) offshore.

The anticipated impacts associated with this development can therefore be summarised in Table 5.

Table 5. Summary of the likely impacts associated with the proposed long sea outfall development at Lossiemouth.

Stage	Source of Impact	Notes
Investigative Survey Work	Noise / vibration disturbance	Particularly relating to percussion drilling during geotechnical surveys
	Increased turbidity / disturbance of sediments	Minimal sediment will be released during drilling since cores are to be retained for analysis
	Introduction of INNS	Potentially damaging non-native species could feasibly be introduced during the course of the survey work through ships hulls, ballast water release or the deployment of survey equipment
Pipeline Construction	Removal of habitat (within the footprint of the outfall pipe)	Although the precise location is as yet undetermined it is unlikely that the outfall pipeline will be placed within a designated sandbank feature but there will nevertheless be some removal of habitat
	Increased turbidity / disturbance of sediments	All pipeline laying techniques will result in some degree of sediment disturbance which will in turn result in an increase in turbidity levels. This impact will be temporary and short-lived
	Noise / vibration disturbance	All pipeline laying techniques will result in some noise disturbance although this again will be temporary. The precise nature of the noise disturbance cannot be determined at this time as construction methods have yet to be chosen
	Introduction of INNS	Potentially damaging non-native species could feasibly be introduced during the course of the construction work through ships hulls, ballast water release or the deployment of construction equipment
Operation of the Outfall	Reduction in salinity, and water quality (including the release of de-icer), close to the outfall point	There will be an area around the outfall where salinities will be reduced and water quality will also be reduced. The reduction in salinity and water quality will decrease with distance from the outfall as the water becomes mixed and diluted. Hydrographic surveys and modelling are due to be undertaken imminently to determine the extent of this impact
	Increased turbidity / sedimentation	The precise composition of the discharges are as yet unknown but it is likely that they will contain some particulate matter. It is therefore likely that there will be some localised sedimentation and / or changes in turbidity
	Occasional pollution events	It is unclear at this time what the likelihood is of occasional pollution events, if for example contaminants other than de-icer are spilt and make their way into the drainage water

One of the key environmental considerations associated with the development of a new outfall pipe is the composition of the discharges that will be released into the environment. In this case, the composition of the discharges will not be significantly different from those currently being released into the Moray Firth through the Covesea burn, and, as far as we are aware, they not causing any adverse effects on the ecosystem. Nevertheless, surface water to be released through the LSO is known to contain de-icer used on the runways and aircraft, the primary compound of which, is ethylene glycol which can be toxic (Dobson 2000). The installation of the LSO means that ethylene glycol will be released into a different area of the seabed than the existing drainage system. Furthermore, there is an existing LSO, which will remain operational, that also releases ethylene glycol into the Moray Firth so there is potential for the two outfalls to have cumulative effects, depending on the positioning and proximity of the discharge point.

Sills and Blakeslee (1992) reviewed the monitoring of ethylene glycol at airports in the US and differing levels of the compound had been recorded in the run-off, ranging from 70 to 19,000 mg / l. At the top end, these concentrations appear high, but even at these levels the compound would not be considered toxic for most aquatic organisms (Table 6) and considerably lower concentrations would be anticipated with dilution from rainfall alongside the natural biodegradation of the compound.

Caution should be exercised however, since tests using de-icer containing ethylene glycol have generally showed greater toxicity to aquatic organisms than the pure compound, indicating that there are other toxic components in de-icer formulations, which can vary dramatically from one product to the next (Dobson 2000). Laboratory tests exposing aquatic organisms to stream water receiving runoff from airports have demonstrated toxic effects and death. Field studies in the vicinity of an airport have also reported toxic signs consistent with ethylene glycol poisoning (oxalate crystal formation), fish kills, and reduced biodiversity (Dobson 2000).

It will be important therefore to fully understand the composition of de-icers used by the RAF and to review the sensitivity of marine life to its other constituents.

Table 6. Acute toxicity of ethylene glycol to aquatic organisms (Dobson 2000).

Organism	End Point	Concentration mg/l
Cyanobacterium, Microcystis aeruginosa	Toxic threshold (cell multiplication)	2,000
Green algae, Selenastrum capricornutum	96-h EC50	6,500 – 13,000
Water flea, Daphnia magna	24-h LC50	>10,000
Brown shrimp, Crangon crangon	96-h LC50	~ 50,000
Crayfish, *Procambarus* spp.	96-h LC50	91,430
Rainbow trout, Oncorhynchus mykiss	96-h LC50	17,800 – 45,600

Receptor Sensitivity

Sedimentary and Rock Habitats (not designated)

The sedimentary and rock habitats and the fauna inhabiting them are not thought to be sensitive to noise, but turbidity, changes in water quality (most notably the release of de-icer), sedimentation, habitats loss / alteration and the introduction of non-native species all have the potential to cause adverse impacts. Many of the invertebrates inhabiting the sedimentary habitats in this area will be important in supporting higher levels of the food web, including salmon, seabirds and ultimately marine mammals. It will be important to consider these potential impacts once more is known about the extent and nature of the construction works, and what will be left on / in the seabed. It should be born in mind though that this is a relatively small-scale development within a habitat that is widely distributed along the southern shore of the Moray Firth. It is therefore very unlikely that the largely temporary impacts associated with this development will give rise to any ecologically significant effects.

Sandbanks slightly covered by seawater at all times

Like the non-designated sedimentary habitats in this area, sandbanks are not considered to be sensitive to noise disturbance but could be impacted by changes to the seabed and water quality as summarised in Table 7.

Table 7 Sensitivity and Vulnerability of the Moray Firth SAC 'Sandbanks which are slightly covered by sea water all the time' to activities most closely aligned with the proposed long sea outfall development (SNH 2006).

Activity	Sensitivity of Sandbanks
Coastal Development (Civil Engineering)	The construction and maintenance of structures, both within and adjacent to the sea have the potential to cause direct loss and / or disturbance of sandbank habitats and communities as tidal currents, and therefore coastal processes, may be affected. For example coastal structures such as linear coastal defences or erosion control measures (e.g. gabions) can affect local sediment suspension and deposition patterns and therefore have the potential to cause deterioration of sandbank habitat through smothering. Installation, replacement and maintenance of undersea cables or pipes have the potential to cause direct loss or disturbance of sandbank habitats as well as local deterioration of associated habitats and communities.
Discharge of commercial effluent	Commercial effluent has the potential to cause deterioration of sandbank habitats and communities. This would be through the effects of pollution and / or nutrient enrichment, which may cause subsequent changes in community structure.
Discharge of sewage	Sewage effluent (whether treated or untreated) has the potential to cause deterioration of sandbank habitats and communities. This would be through the effects of pollution and / or nutrient enrichment, which may cause subsequent changes in community structure.
Military Activity & Civil Aviation (Discharges & run-off)	Run-off of fuel or de-icing chemicals from airfields has the potential to cause deterioration of the plant and animal communities associated with the sandbank habitat.

Based on our current understanding of the proposed development, the outfall will not be located within a designated sandbank feature but it will be imperative to determine through hydrographic modelling whether there is likely to be any interaction between the designated features and the material released from the outfall, or any sedimentation associated with construction.

Cetaceans (including Bottlenose Dolphins *Tursiops truncatus*)

Cetaceans are not likely to be impacted by turbidity or small-scale changes to sediment type, but the noise associated with construction and to a lesser extent the investigative survey work, could impact on cetaceans using this area. It is also possible that the discharges themselves could have an impact on cetaceans, although this is considered very unlikely assuming that the discharges conform to bathing water standards (Nautilus 2001; Law et al. 2012). The sensitivity and vulnerability of the bottlenose dolphins to anthropogenic activities has been assessed by Scottish Natural Heritage (SNH 2006) and their sensitivity to activities most closely aligned with the proposed development are summarised in Table 8.

Table 8 Sensitivity and Vulnerability of the Moray Firth SAC 'Bottlenose dolphins *Tursiops truncatus*' to activities most closely aligned with the proposed long sea outfall development (SNH 2006).

Activity	Sensitivity of Bottlenose Dolphin
Coastal Development (Civil Engineering)	The construction and maintenance of structures, both within and adjacent to the sea have the potential to cause disturbance to dolphin populations, especially if undertaken at critical times of the year. Excessive underwater noise has the potential to cause disturbance to dolphin populations through: interference with communication, navigation and foraging; or disruption of social bonds. Sudden loud noise or harassment may elicit a stress response in the dolphins. Increased / prolonged periods of turbidity resulting from civil engineering activities may affect availability of prey species or the dolphins' ability to catch them. Impoverishment of seabed communities may lead to degradation of food chains.
Discharge of commercial effluent	Commercial effluent has the potential to cause deterioration of dolphin populations through impairment of their reproductive or immune systems, carcinogenic effects, increased risk of disease, or through toxic impacts on prey species. This would be through the effects of toxic effluents and / or nutrient enrichment, which may cause subsequent changes in community structure.
Discharge of sewage	Sewage effluent (whether treated or untreated) has the potential to cause deterioration of dolphin populations, particularly in areas frequented by this species, through increased risk of disease or through adverse impacts on prey species. This could be through the effects of toxic effluents or chemicals used in the treatment process, pathogens and / or nutrient enrichment, which may cause subsequent changes in community structure.
Military Activity & Civil Aviation (Discharges & run-off)	Jettison of aircraft fuel and run-off of fuel or de-icing chemicals from airfields have the potential to cause deterioration of dolphins by causing direct carcinogenic effects or having toxic impacts on their prey.
Scientific research	Boat-based scientific research activities have the potential to cause disturbance or deterioration through underwater noise or collision with dolphins, particularly if boats spend long periods of time in the vicinity of dolphins or where craft actively follow the animals. Disturbance may also result from sonar systems, navigational depth sounders, and other fish-finding devices. Dolphins are a European Protected Species, as well as a qualifying interest within this SAC. Researchers may require a licence; advice should be sought from SNH accordingly if there is any doubt as to this requirement.

Cetaceans are highly dependent on sound for communication, to gain information about the environment and to find food. This makes them particularly sensitive to increases in anthropogenic noise, as it has the potential to disrupt feeding, confuse cetaceans and under the most extreme circumstances, can cause physical damage to their hearing apparatus (Bailey et al. 2010). The sensitivity of cetaceans to activities such as pile driving and seismic surveys are well known (David 2006; Bailey et al. 2010; Barham 2017).

Measurements taken at a wind farm site, 25 km away from the Moray Firth SAC found that pile driving activities associated with the development were loud enough to cause auditory injury to a bottlenose dolphin within 100 m and that behavioural modifications could be expected up to 50 km from the source (Bailey et al. 2010). In light of the potential for injury, it is standard practice to have a Marine Mammal Observer (MMO) on-board vessels undertaking pile driving and other highly noisy activities, such that they may be stopped if the presence of a cetacean is detected. The effect of noise from other survey and construction activities on cetaceans however are less well known.

Table 9 presents a summary of some recent underwater noise modelling undertaken for a site on the northern tip of Anglesey off the North Wales Coast (Barham 2017). Although the absolute values may not be directly applicable to the Moray Firth, they do give a good indication of the relative sensitivity of cetaceans to the planned survey activities and construction works typically associated with pipe laying. It should be noted that the noise sources included in the model for large vessels are of a similar magnitude to those from cutter section dredgers and hence will far exceed the anticipate noise created by the small inshore survey vessels that will be used in the investigative surveys planned for this site.

Table 9. Summary of the predicted impact ranges of marine activities on cetaceans (Barham 2017). PTS = Permanent Threshold Shift (equivalent to a permanent loss of hearing), Avoidance = behavioural Avoidance (e.g. moving away from the noise). All ranges are given in meters and represent averages calculated from responses modelled in different directions. NB these distances are based on noise propagation models for a site in Ireland and do not relate to the Moray Firth specifically. They are included here to provide indicative effect responses that could be anticipated in response to the survey and construction work associated with the proposed long sea outfall at Lossiemouth.

	Impact Range (m)				
	Low Freq. Cetaceans (e.g. baleen whales)	Mid Freq. Cetaceans (e.g. bottlenose dolphin)		Harbour Porpoise	
	PTS	PTS	Avoidance	PTS	Avoidance
Medium Vessel	<1	<1	<1	<1	10
Large Vessel	<1	<1	<1	<1	60
Rotary Drilling (242kW)	<1	<1	7	<1	9
Rotary Drilling (570kW)	<1	<1	16	<1	18
Percussive Drilling	15	3	427	2	340
Cutter Suction Dredging	3	<1	105	<1	91
Pile Driving	207	31	503	3	440
Rock Cutting	2	<1	70	<1	15

Seals

Like cetaceans, seals, or pinnipeds, can be sensitive to anthropogenic noise. Noise from shipping, anti-predator acoustic devices and recreational activities, both at sea and on land, can cause disturbance at haul-out sites and particularly loud noises, including those associated with pile driving and seismic surveys can cause auditory injuries (Thompson et al. 2013). Table 10 presents a summary of some recent underwater noise modelling undertaken for a site on the northern tip of Anglesey off the North Wales Coast (Barham 2017). Although the absolute values may not be directly applicable to the Moray Firth, they do give a good indication of the relative sensitivity of pinnipeds to the planned survey activities and construction works typically associated with pipe laying. It should be noted that the noise sources included in the model for large vessels are of a similar magnitude to those from cutter section dredgers and hence will far exceed the anticipate noise created by the small inshore survey vessels that will be used in the investigative surveys planned for this site.

Table 10. Summary of the predicted impact ranges of marine activities on pinnipeds (Barham 2017). PTS = Permanent Threshold Shift (equivalent to a permanent loss of hearing), Avoidance = behavioural Avoidance (e.g. moving away from the noise). All ranges are given in meters and represent averages calculated from responses modelled in different directions. NB these distances are based on noise propagation models for a site in Ireland and do not relate to the Moray Firth specifically. They are included here to provide indicative effect responses that could be anticipated in response to the survey and construction work associated with the proposed long sea outfall at Lossiemouth.

	Pinnipeds (in water)	
	PTS	Avoidance
Medium Vessel	<1	<1
Large Vessel	<1	<1
Rotary Drilling (242kW)	1	117
Rotary Drilling (570kW)	1	210
Percussive Drilling	37	2,950
Cutter Suction Dredging	5	457
Pile Driving	387	2,350
Rock Cutting	4	293

Seals are not considered to be sensitive to changes in water quality and turbidity at the anticipated levels and they are not particularly vulnerable to introduced non-native species.

Otters

There have been very few studies into the sensitivity of otters to noise but Voigt et al. (2019) calculated their hearing range (in air) at 80 dB to be 200 Hz to 32 kHz, indicating that this species can hear a narrower spectra of sounds than pinnipeds. Historically, there has been a general assumption that anthropogenic noise is detrimental to otter populations arising primarily because of their widespread decline in heavily populated parts of England. However, the persistence of a breeding otter population under Shetland's ferry terminal and the recovery of otters in noisy cities like Glasgow, provides strong evidence that anthropogenic noise in not adversely impacting this species (Chanin 2003). Like pinnipeds and cetaceans there will be a level of noise that will damage the hearing of otters and hence their presence during noisy construction works should be monitored.

Otters are not thought to be particularly sensitive to changes in turbidity but the deterioration of water quality and more specifically the introduction of de-icer could be damaging. Data relating to the toxicity of organic compounds is sparse, and in some instances contradictory, but the use of Deildrin, an organochloride used in insecticides until 1970, is widely implicated in the decline of otter populations throughout the UK and so the interaction between otters and the LSO discharges need to be considered carefully once likely concentrations are known. That said ethylene glycol does not bio-accumulate (Dobson 2000) and it is unlikely that the levels anticipated in the discharges would be toxic to an animal the size of an otter (see Table 6 for examples of toxicity levels).

The only introduced non-native species likely to impact otter populations in the Moray Firth is the American Mink but this is not a species that could be accidentally introduced through any of the planned survey or construction works.

Sharks & Rays

Sharks, like bony fishes, possess an inner ear and a lateral line, which are sensitive to underwater vibrations and sounds. Compared to marine mammals, sharks have a very narrow hearing range but are known to be particularly sensitive to very low frequencies. This hearing range overlaps with most of the anthropogenic sound produced by seismic airgun arrays, dredging, pile driving and shipping and there is some evidence that basking shark, in particular, are attracted to pulsing noises. Therefore, like cetaceans, pinnipeds and otters, it will be important to monitor for the presence of sharks during noisy survey and construction works and to ensure that a safe distance is maintained between them and the boats propellers.

Skates and rays are not generally considered sensitive to anthropogenic noise because they don't have a swim bladder but sudden loud noises of low frequency have been shown to elicit an avoidance response in most fish (Neal and Pizolla 2006). Noise rarely has a physiological effect on fish so skates and rays are not considered as sensitive to noise.

Skates and rays are unlikely to be influenced by local changes in water quality and would be able to quickly and easily avoid the discharge point.

Salmon

The main threats to post-smolt marine survival rates are thought to be:

- Change in sea surface temperature,
- Sea lice (salmon farming),
- Commercial fishing, and
- Seals

However, the relationship between changes in the marine environment and post-smolt survival are not well understood. Changes in water flow and increased turbidity could represent a barrier to salmon migration whilst it has been postulated that high levels of suspended sediments can physically choke the fish and / or disrupt feeding (Barrett et al. 1992).

A recent study undertaken by Harding et al. (2016) examined the sensitivity of Atlantic salmon to pile driving noise. During the study, no startle response was observed in relation to individual hammer strikes and no clear behaviour change could be attributed to the pile driving noise. This is in keeping with the findings of other studies (Knudsen et al. 1992; Bagočius 2015) which all indicate that salmon have limited sensitivity to anthropogenic noise.

The pipeline itself could feasibly represent a physical barrier to migration, or increase the energy required to make the migration, where the fish need to swim over the pipeline in potentially stronger water currents. However, the size and construction of the proposed LSO mirrors that of the existing LSO, which as far as we are aware has not had any negative effects on the local Salmon population. The diameter of the pipe itself is only 600 mm although the size and composition of the concrete blocks that will weigh down the pipeline are as yet unknown. It is unlikely thought the pipeline would represent a complete barrier to Salmon movements at any point along its length.

Sandeels

Sandeels are not known to be particularly sensitive to noise but they do have very specific habitat requirements and hence changes to seabed sediments could impact on the habitat suitability for these important prey species. Sand eels are most likely to be associated with the designated sandbank features and therefore assuming the impact of the proposed long sea outfall does not extend out to these features, then it is unlikely that a development of this scale would have an ecologically significant effect on this species.

The specific sensitivity of sandeels to ethylene glycol and other compounds that could be found in de-icer is unknown but it is likely that they would be in the same order as those identified for other fish species (Table 6) and hence it is unlikely that the discharges will be toxic. Nevertheless, this will need to be considered more carefully once the results of dispersion modelling are known.

Other fish species

Lamprey and eel could be sensitive to changes in water quality and the introduction of pollutants, and the European eel, which has a swim bladder may exhibit some sensitivity to the noise associated with construction. However, these species only occur very sporadically in the vicinity of the proposed outfall and they are highly mobile so it is likely that they could avoid any water quality changes associated with the LSO discharge, and any noise disturbance, therefore ecologically significant effects are considered highly unlikely.

Seabirds

Although it will be necessary to consider the impacts of the development on these important over-wintering bird populations, and the prey upon which they depend, it should be noted that outfalls have been excluded from the management advice because they have been assessed as being unlikely to have a significant impact on these qualifying populations (Table 11). Furthermore, it is of note that although the Moray Firth pSPA itself has been designated to protect breeding Shag, these populations occur at the northern limit of the pSPA and so are far enough away from the proposed outfall development not to be impacted by either the survey or construction activities.

Seabirds are sensitive to anthropogenic noise and although there remain many uncertainties to the vulnerability of individual species (Schwemmer et al. 2011), they could feasibly be disturbed by some of the noisier investigative surveys and the construction works associated with this development. The protected seabirds occurring in this area are over-wintering. That is, they are using the area to feed and roost and therefore temporary disturbances are less likely to become ecologically significant since breeding and / or chick rearing is not being disrupted. The site is also closely adjacent to Lossie Marina and RAF Lossiemouth meaning that the birds in this area are likely to be habituated to a relatively high level of noise which makes them a lot less vulnerable to disturbance from noisy construction activities. One possible exception to this however, is the common eider duck, *Somataria mollissima*, which undertakes an unusual double moulting during which its flight feathers are all dropped simultaneously, leaving it flightless for a number of weeks. It will therefore be particularly important to ensure that noise

disturbance is avoided during this sensitive period or that impacts on these vulnerable birds are mitigated through the use of bird observers and the avoidance of particularly loud and irregular noises.

Table 11. Overview of activities with potential to affect the qualifying features of the Moray Firth pSPA as detailed in the management advice for the site (SNH 2016b).

Activities considered likely to affect the qualifying features	Activities not considered likely to affect the qualifying features (other than insignificantly)*
Fishing - mobile gear • Mechanical and hydraulic benthic dredging • Benthic trawls • Pelagic trawls and seines Fishing – static gear • Drift nets • Bottom set nets (incl. fyke nets) • Harvesting – intertidal shellfish, bait and blue mussel fishery) Navigational and maintenance dredging • Existing maintenance dredging • Dredge spoil disposal • Capital dredging Ports and harbours • New development -Cromarty,Inverness, Ardersier, Avoch, Balintore, Brora, Buckie, Burghead, Cullen, Findochty, Fortrose, Golspie, Helmsdale, Hopeman, Lossiemouth, Nairn, Portgordon, Portmahomack, Portnockie, Rosemarkie and Sandend • Ship-to-ship transfer Recreational users • Jet-skiing • Wildfowling • Angling, boating, wildlife tours & kayaking (increase in activities) • Renewables • Wave (lease area) • Wind (consented)	Anchorages & moorings Fishing – static gear • Creels (including lobster, crabs and Nephrops) Fishing – mobile gear • Line fishing (including jigging) Infrastructure – cables, pipelines, outfalls • Power interconnectors • Gas and oil pipelines • Outfalls

* Only the specific examples of activities listed in the table have been excluded, rather than the broad activity types. New plans or projects will still need to be considered by the relevant competent authority

The University of Hull have developed a bird mitigation toolkit (Cutts et al. 2013) which provides a useful summary of the likely impacts of different activities on seabirds (Table 12). It is of note that their findings suggest that individuals walking on mudlflats are likely to have as much if not more of a disturbance on seabirds that piling and other construction activities, and this in part is a reflection of seabirds ability to habituate to noisy activities and also their sensitivity to visual disturbance. Nevertheless, as with ceteceans and other marine mammals irregular piling noise is likely to result in a disturbance response and efforts should be made to minimise the noise of construction, particularly during sensitive moulting periods.

Table 12. Summary of the general waterbird response to disturbances from a range of activities including construction work (reproduced from Cutts et al. 2013).

Disturbance	Response
Personnel and plant on mudflat	High (and should be restricted at all times)
Third party on mudflat	High (but difficult to restrict)
Personnel and plant on seaward toe and face	High to Moderate
Intermittent plant and personnel on crest	High to Moderate
Third party on bank	High to Moderate
Irregular piling noise (above 70db)	High to Moderate
Long-term plant and personnel on crest	Moderate
Regular piling noise (above 70 db)	Moderate
Irregular noise (50db- 70 db)	Moderate
Regular noise (50 db – 70 db)	Moderate to Low
Occasional movement of crane	Moderate to Low
Noise below 50db	Low
Long-term plant only on crest	Low
Activity behind flood bank (inland)	Low

High Noise Level Effects
Noise disturbance is typified by regular responses to stimuli with birds moving away from the works to areas which are less disturbed (within noise tolerances). Most birds will show a degree of response to noise stimuli. Birds that remain in the affected area may not forage efficiently and if there are additional pressures on the birds (cold weather, extreme heat etc.) then this may impact upon the survival of individual birds or their ability to breed. For auditory disturbance to qualify as a high level, it must constitute a sudden noise event of over 60dB (at the bird, not at source) or a more prolonged noise of over 72dB.

Moderate Noise Level Effects
Moderate noise disturbance is typified as high level noise which has occurred over long periods so that birds become habituated to it or lower level noise which causes some disturbance to birds. This encompasses occasional noise events above 55dB, regular noise 60-72dB and long-term regular noise above 72dB, where birds have become habituated. There is cross-over in moderate and high level noise thresholds although the lower band can be assumed unless the species is particularly sensitive.

Low Noise Level Effects
Low level noise is classed as that which is unlikely to cause response in birds using a fronting intertidal area. As such noises of less than 55dB at the bird are included in this category. These effects are likely to be masked by background inputs in all but the least disturbed areas and thus would not disturb the birds close by. Noise between 55-72dB in some highly disturbed areas e.g. industrial or urban areas and adjacent to roads, may feature a low level of disturbance provided the noise level was regular as birds will to often habituate to a constant noise level.

Based on long term observations of waterbirds (primarily Mallard and Redshank) Cutts et al. (2013) have compiled a noise decay matrix to help determine the distance at which noise is likely to illicit a response and when those responses are likely to require mitigation (Table 13). This can be used to inform discussions and decisions around the most appropriate construction methods to employ for the proposed development and to determine the need to mitigate against noise disturbance on seabirds.

Table 13. Overview of standard distance decay rates of noise and the likely resulting response on waterbirds where acceptable 'dose' levels are shaded green with dark green unlikely to have any affect whilst the pale green might occasionally induce a low level behavioural response such as a heads-up; yellow to orange shading is where a response is likely but mitigation may be effective in reducing the disturbance risk; pale red where mitigation is necessary and might be of value, but with a remaining risk of effect; dark red where a flight response is almost certain to occur and would be increasingly difficult to mitigate through (reproduced from Cutts et al. 2013).

Metres from Source	dB(A)										
0.67	120	110	100	95	90	85	80	75	70	65	60
1.33	114	104	94	89	84	79	74	69	64	59	54
2.67	108	98	88	83	78	73	68	63	58	53	48
5.33	102	92	82	77	72	67	62	57	52	47	42
10.67	96	86	76	71	66	61	56	51	46	41	36
20.67	90	80	70	65	60	55	50	45	40	35	30
42.67	84	74	64	59	54	49	44	39	34	29	24
85.33	78	68	58	53	48	43	38	33	28	23	
170.67	72	62	52	47	42	37	32	27	22		
341.33	66	56	46	41	36	31	26	21			
682.66	60	50	40	35	30	25	20				
1365.32	54	44	34	49	24						

Vessel movements and other visual disturbance can elicit avoidance behaviour in many seabirds. Great northern diver, red-throated diver, Slavonian grebe, common scoter, velvet scoter, and red-breasted merganser are considered to have a medium sensitivity to visual disturbance created by vessel movement. All species display avoidance behaviour with flight responses varying between species. Long-tailed duck, shag, eider and goldeneye are considered to have low sensitivity to visual disturbance created by vessel movement with some level of habituation occurring. For eider however, during periods of flightless moults their ability to avoid vessel movement will be reduced.

All qualifying seabird features rely on underwater visibility to capture prey and/or forage on the sea bed. Divers and grebe exhibit a low sensitivity to this pressure. Information on potential impacts of water clarity changes on sea duck, however, is sparse.

Management and Mitigation of Disturbance

A more comprehensive suite of management and mitigation options will be devised once more details of the construction methods and nature of the discharges are known, and additional survey works have been completed. In the meantime, since site investigation works could cause temporary disturbances to some of the marine life in this area, and as construction works are currently in the early planning phase, the proceeding sections of this report are designed to highlight the short-term mitigation requirements as well as to highlight some aspects of the construction works that require particular consideration with respect to marine resources.

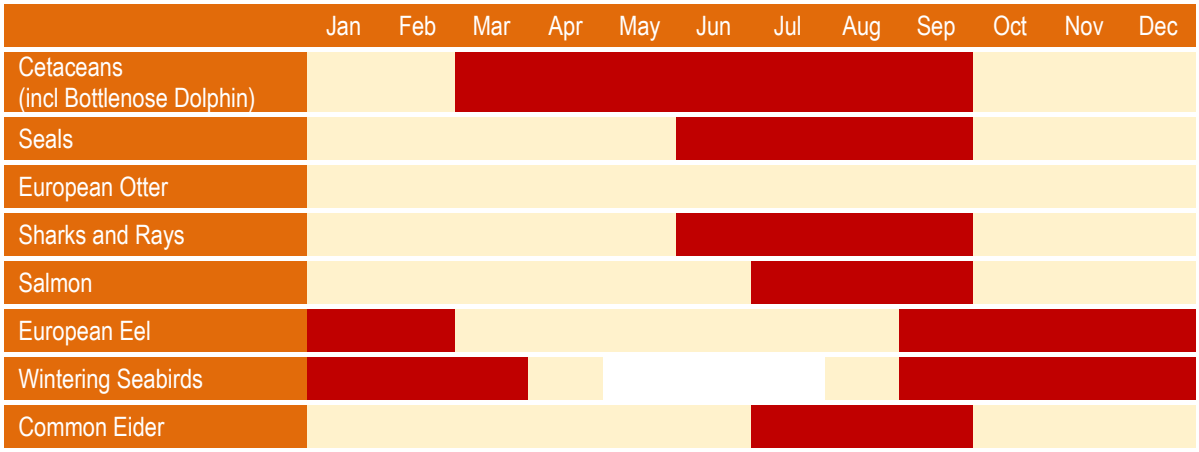
Temporal Sensitivity

A large number and range of sensitive receptors have been identified within the proposed development site that could potentially be influenced by the proposed LSO and associated works. It is therefore useful to consider their respective temporal sensitivity as a means of identifying the best timing for noisy construction and survey activities as well as those periods where mitigation will be necessary. Table 14 summarises the temporal sensitivity of key ecological receptors that are likely to have some sensitivity to the investigative works and construction associated with the proposed LSO development. Receptors that are considered only to be sensitive to the permanent habitat changes and / or discharges from the outfall are not included here, since their temporal sensitivity is not relevant to the management of these activities.

Based on the information summarised in Table 14, the optimal timing for the construction works would be the spring, between March and May. During this time, bottlenose dolphin are likely to be in the area but won't yet have reached their peak summer abundances, and most other sensitive receptors will be largely absent or present only in small numbers. It is also comparatively simple to mitigate against the noise disturbance on bottlenose dolphins using a Marine Mammal Observer (MMO).

If possible, it would be best to avoid construction work between July and September when eider ducks may be present in their flightless moulting phase, as they have a very limited capacity to move away from anthropogenic activities. This would also avoid potential disturbance of salmon during their migration back to their natal rivers.

Table 14. Summary of the temporal sensitivity of key ecological receptors, or groups of receptors where the constituent species use of the area and temporal sensitivity is consistent, where red indicates a period of high sensitivity, yellow indicates some sensitivity and white indicates no sensitivity (the receptor is absent from the area).



Mitigation of Noise and Visual Disturbances

Noise and visual disturbances associated with the investigative survey works and construction need to be considered for a number of different receptors, and throughout most of the year. At this site it will be impossible to time the construction works to avoid all possible disturbance of protected species occurring here because of their conflicting temporal sensitivities (Table 14). That said, all of the protected species thought to be sensitive to noise and / or visual disturbance at this site are highly mobile and are unlikely to be present in the immediate vicinity of the development in high abundances.

- The noise associated with the chosen construction techniques should be considered carefully and noisy activities such as pile driving that have the potential to cause physical damage to marine life occurring in close proximity should be avoided or minimised as far as is possible.

- The noisiest activities should be timed to coincide with the periods of lowest biological sensitivity wherever possible.

- Where loud and irregular or impulsive noises are a necessary component of the works, a soft start where the noise is built up gradually is recommended. This gives marine life the opportunity to move away from the area before the noise reaches a level that could cause physical damage. Alternatively, Acoustic Mitigation Devices (AMD) could be used to drive away sensitive marine life before works begin.

- Where loud and irregular or impulsive noises are a necessary component of the works the use of sound dampening devices, such as bubble curtains and cofferdams should be investigated.

- Avoiding noisy activities during bad / stormy weather, when bird species in particular, are more sensitive to disturbance (because of the higher energy requirements needed to search for food etc) is strongly encouraged.

- Marine mammal and / or seabird observers should be deployed to keep watch for protected species and ensure a suitable distance is maintained between them and any survey / construction vessels on site. Where protected species, particularly those with limited capacity for avoidance (e.g. flightless eider duck), or a known inquisitive nature (e.g. basking shark) get close to survey / construction works, these should be stopped (where safe to do so) until the species move away to a safe distance.

- Passive Acoustic Monitoring Systems (PAMS) could also be considered as an additional means of detecting cetaceans in the area.

Information Required to Address Uncertainties

Impact Characterisation

At the time that this review was undertaken, the precise length of the long sea outfall and the location of the discharge point were yet to be determined. Furthermore, the extent of water quality and turbidity changes had not been modelled. Hydrographic surveys and modelling are currently underway and the results of this work, along with the geotechnical ground investigations will be essential in further characterising the impacts that are likely to be associated with the development. Finalising the design of the drainage system and obtaining a more complete understanding of the interceptors and Sustainable Drainage Systems (SuDS), including the potential for isolated pollution events, will also be critical in taking this impact assessment forward. This is of particular relevance to the assessment of potential interactions with the designated sandbank features and once this information becomes available, it will need to be mapped against the designated features to clearly demonstrate the likelihood of an interaction.

Understanding the precise composition of the de-icers used and the likely concentrations of compounds being released into the Moray Firth through the LSO will be essential in order to fully characterise the likely ecological impacts of this development.

Source level of sound and frequency will be needed for the EPS licence application and noise propagation modelling is likely to be required for the Habitats Regulation Assessment (SNH personal comms). It may therefore be prudent to collect ambient noise data, if this is not already available for the Moray Firth, to inform the noise propagation model and improve its accuracy. Marine Scotland Licensing Operations Team (MS-LOT) should be consulted in this regard as they have particular expertise in this field and may be able to undertake or at least support the modelling work.

Cumulative Impacts

In order to fully assess the impacts that could be caused by the proposed LSO it will be essential to consider the cumulative impact of this proposal and the existing LSO, particularly in relation to the concentrations of aircraft de-icer and the potential for the pipelines to disrupt Salmon migration.

Benthic Habitat Survey

Although the subtidal benthic habitats of the Moray Firth have been modelled to produce continuous maps, the data upon which the models are based is relatively scarce, particularly within the vicinity of the proposed development. The models predict that the seafloor in this area is characterised by fine muddy sands but there is also evidence of some rock outcropping which has the potential to fall under the Annex I Reef classification, either as rocky reef or as a biogenic reef if it supports reef fauna such as mussels. We would therefore recommend that a survey is undertaken to provide a greater degree of confidence in the habitats that are currently present, and that may be removed during construction, paying particular attention to the rock habitats. The benthic survey should extend across the footprint of the predicted sedimentary and water quality changes to ensure the seabed in this area does not support any further protected or highly sensitive species or habitats that could be significantly impacted by the proposed development.

Commercial Fisheries Assessment

Some high-level fisheries information was obtained for the Moray Firth but no detailed information regarding the area in the immediate vicinity of the proposed development was identified. Although contact was made with the chairman of the North East Coast Regional Inshore Fishing Group (NECRIFG), he was reluctant to engage beyond supplying the email addresses of a number of local fishermen, who did not respond to emails requesting information and / or discussion regarding the proposed development. Fishermen typically work long and unsociable hours and will usually respond far better to face-to-face interactions, or telephone calls, when this is not possible. We would therefore recommend that a visit is made to the local harbours and / or a meeting is organised to discuss the use of the inshore area by local fishermen. Understanding how the area is used by local fishermen will make it a lot easier to identify any potential interactions with the planned works and to hopefully mitigate against any loss of earnings and associated compensation claims. In the interim, it would be useful if all survey contractors could be briefed to note any signs of fishing activity occurring in the area, for example the presence of fishing vessels, or marked pots.

Marine Mammals and Seabirds

The marine mammal and seabird populations in the Moray Firth are fairly well documented and given the large areas that they use, and the frequency with which they use them, we would not recommend any additional survey work for the characterisation of these populations. It would however be useful if all survey contractors could be briefed to note any sightings of marine mammals, sharks and seabirds and we would anticipate that where MMO's are required for the survey work that they will also be collecting sightings data, which can be used to supplement this review and future impact assessment work.

Otters

A dedicated otter survey to look for signs of otter holts and resting up sites on the shore is required to determine their use of the area.

Atlantic Salmon

The use of the area by Atlantic salmon is poorly understood. However, acoustic tracking surveys are very expensive and time consuming and are not considered proportionate to the scale of this development and the likelihood of a significant effect. That said, the Atlantic Salmon Trust (AST) are currently carrying out an acoustic tracking study on salmon in the Moray Firth, tagging and tracking fish from the Findhorn and Spey, and the first year's results should be available in November 2019. We would therefore recommend that contact is made with AST (initial email sent 31.07.2019) and that results are reviewed as soon as they become available https://atlanticsalmontrust.org/wp-content/uploads/2018/04/MSP-Jan-19-SP.pdf.

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List of Abbreviations

AA	Appropriate Assessment
AMD	Acoustic Mitigation Device
BAP	Biodiversity Action Plan
CAR	Controlled Activity Regulations
CPZ	Coastal Protection Zone
DASHH	The Archive for Marine Species and Habitats Data
DIO	Defence Infrastructure Organisation
EIA	Environmental Impact Assessment
EPS	European Protected Species
GES	Good Environmental Status
HRA	Habitats Regulation Assessment
IUCN	International Union for Conservation of Nature's
LDP	Local Development Plan
MPA	Marine Protected Area
MS-LOT	Marine Scotland Licensing Operations Team
PAMS	Passive Acoustic Monitoring System
PMF	Priority Marine Feature
QRA	Quick Reaction Alert
RAF	Royal Air Force
SAC	Special Area of Conservation under the EC Directive 92/43/ EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna.
SEPA	Scottish Environment Protection Agency
SMASS	Scottish Marine Animal Stranding Scheme
SMRU	Scottish Marine Mammal Research Unit

SNH	Scottish Natural Heritage
SPA	Special Protection Area under EC Directive 79/409/ EEC on the Conservation of Birds
WFD	Water Framework Directive

Glossary of Terms

Ammocoetes	The larval stage of a lamprey
Anadromous	Fish that live in marine water and migrate up rivers to breed (e.g. Salmon). Opposite of catadromous.
Appropriate Assessment	The assessment that is required by Habitat Regulations (Conservation (Natural Habitats, &c.) Regulations 1994 to determine the potential effect of a project or plan on a Special Protected Area or Special Area of Conservation with respect to their qualifying interests
Benthic	A description for animals, plants and habitats associated with seabed. All plants and animals that live in, on or near the seabed are referred to as benthos
Best Environmental Practice	The most appropriate combination of environmental control measures and strategies
Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they form part; this includes diversity within species, between species and of ecosystems
Biomass	Biomass is the biological material derived from a living organism. Fish stock biomass refers to the total estimated weight of a stock or species of fish (in ICES advice this is often called Total Stock Biomass or TSB)
Birds Directive	EU Directive 2009/147/EC on the conservation of wild birds
Catadromous	Fish that live in fresh water and migrate to the sea to breed (e.g. the European eel). Opposite of anadromous.
Diadromous	Fish that spend portions of their life cycles in fresh water and other portions in salt water. Include both anadromous and catadromous fish.
EIA Regulations	The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Good Environmental Status	Defined in the Marine Strategy Framework Directive as the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive.

Habitats Directive	EU Directive 92/43/ EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna, as amended
Habitats Regulations	Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)
Marine Strategy Framework Directive	EU Directive 2008/56/ EC on establishing a framework for community action in the field of marine environmental policy, known as the Marine Strategy Framework Directive.
Natura 2000 Site	EU-wide network of nature conservation sites (Special Areas of Conservation and Special Protection Areas) established under EC Directive 92/43/ EEC on the Conservation of Natural habitats and of Wild Flora and fauna and EC Directive 79/409/ EEC on the Conservation of Birds.
Priority Marine Features	Species and habitats which have been identified as being of conservation importance to Scotland. Most are a subset of species and habitats identified on national, UK or international lists.
Scottish Offshore Waters	Term used generally to refer to waters off Scotland more than 12 nautical miles from baselines (i.e. the area stretching from 12 nautical miles out to limits of UK jurisdiction i.e. 200 nautical miles).
Scottish Territorial Waters	Defined under the Territorial Sea Act 1987 as the waters stretching from baselines out to a maximum of 12 nautical miles, or the median line between adjacent countries.
Water Framework Directive	EU Directive 2000/60/ EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

Annex I. Distribution of Waterfowl Species across the Moray Firth pSPA (SNH 2016a).

NB. Only charts of species present in the areas adjacent to Lossiemouth i.e. that could feasibly be impacted by the proposed development have been included here.

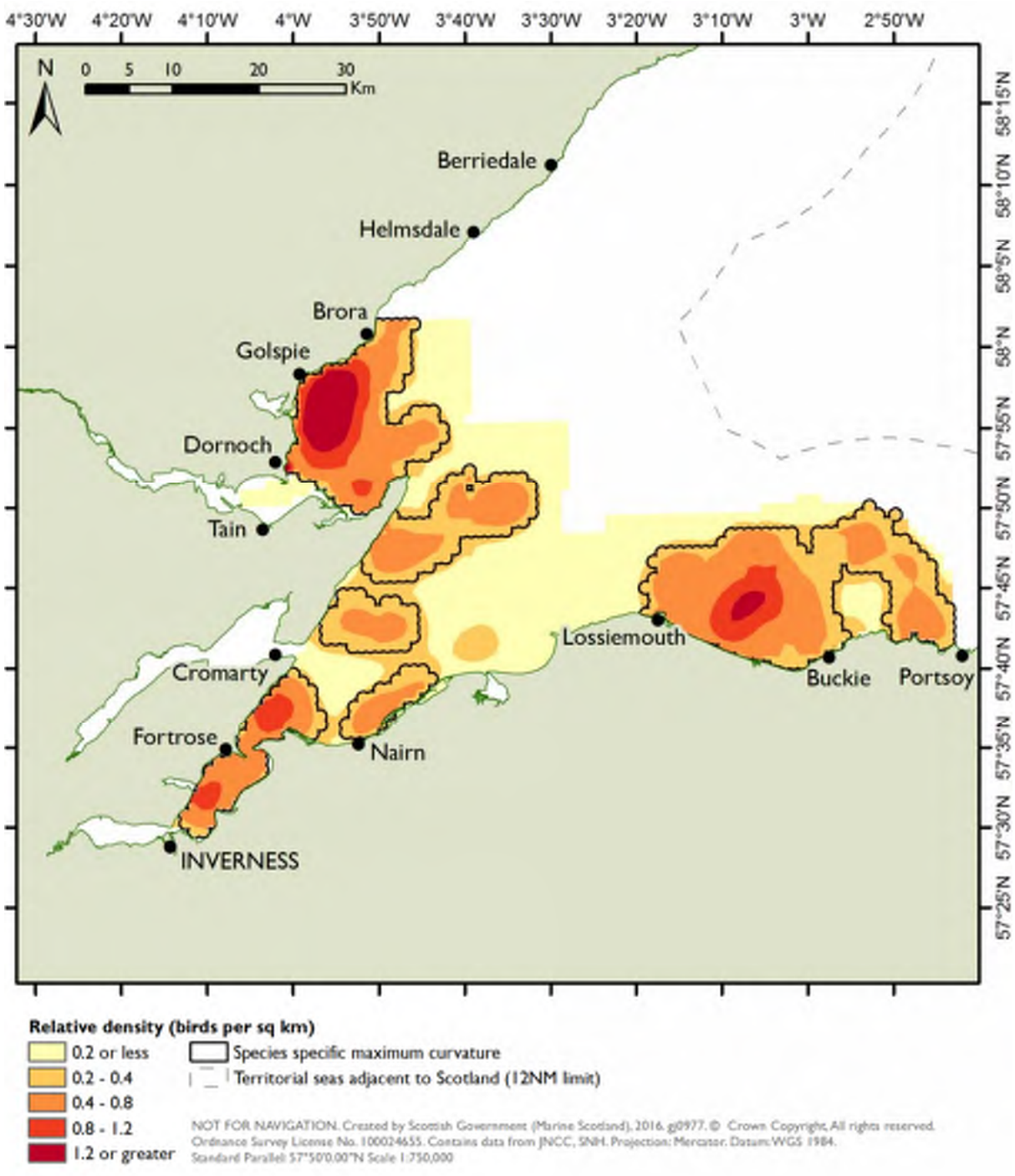

Figure I.1. The distribution of diver species (red-throated diver and great northern divers) in the Moray Firth pSPA.

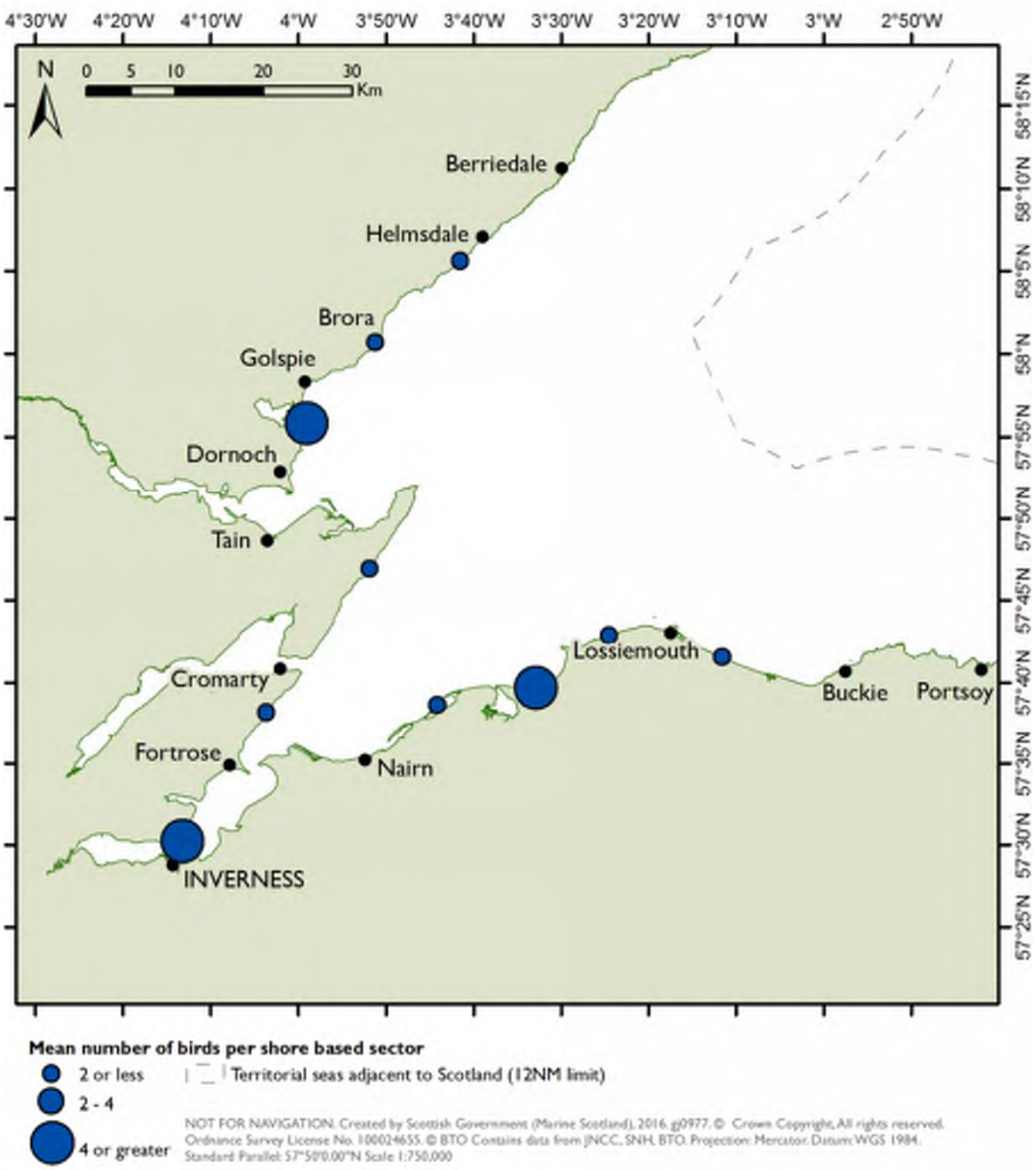

Figure I.2. The distribution of Slavonian grebe in the Moray Firth pSPA. Point symbols represent the relative number of Slavonian grebe in each RSPB count sector.

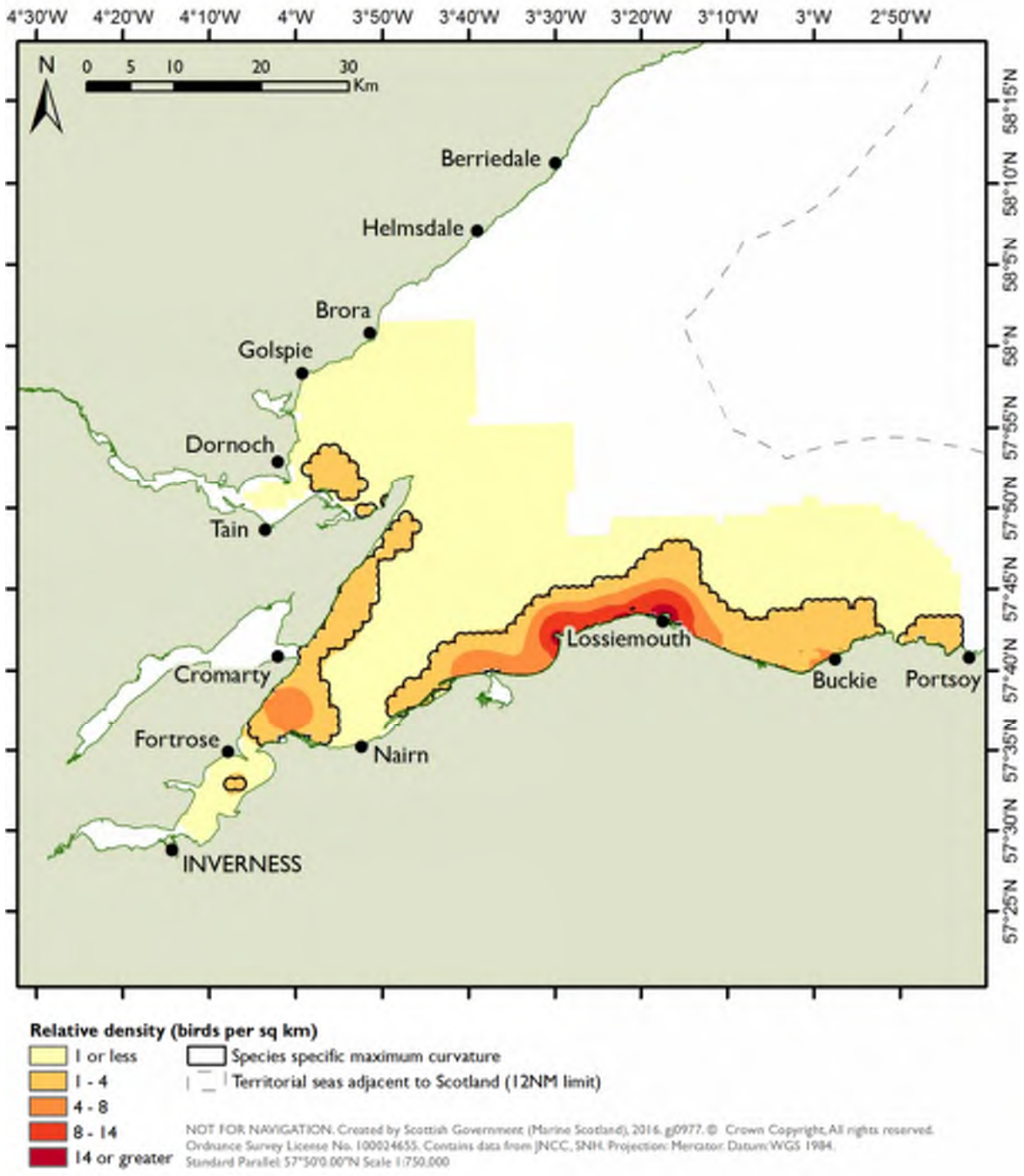

Figure I.3. The distribution of common eider in the Moray Firth pSPA.

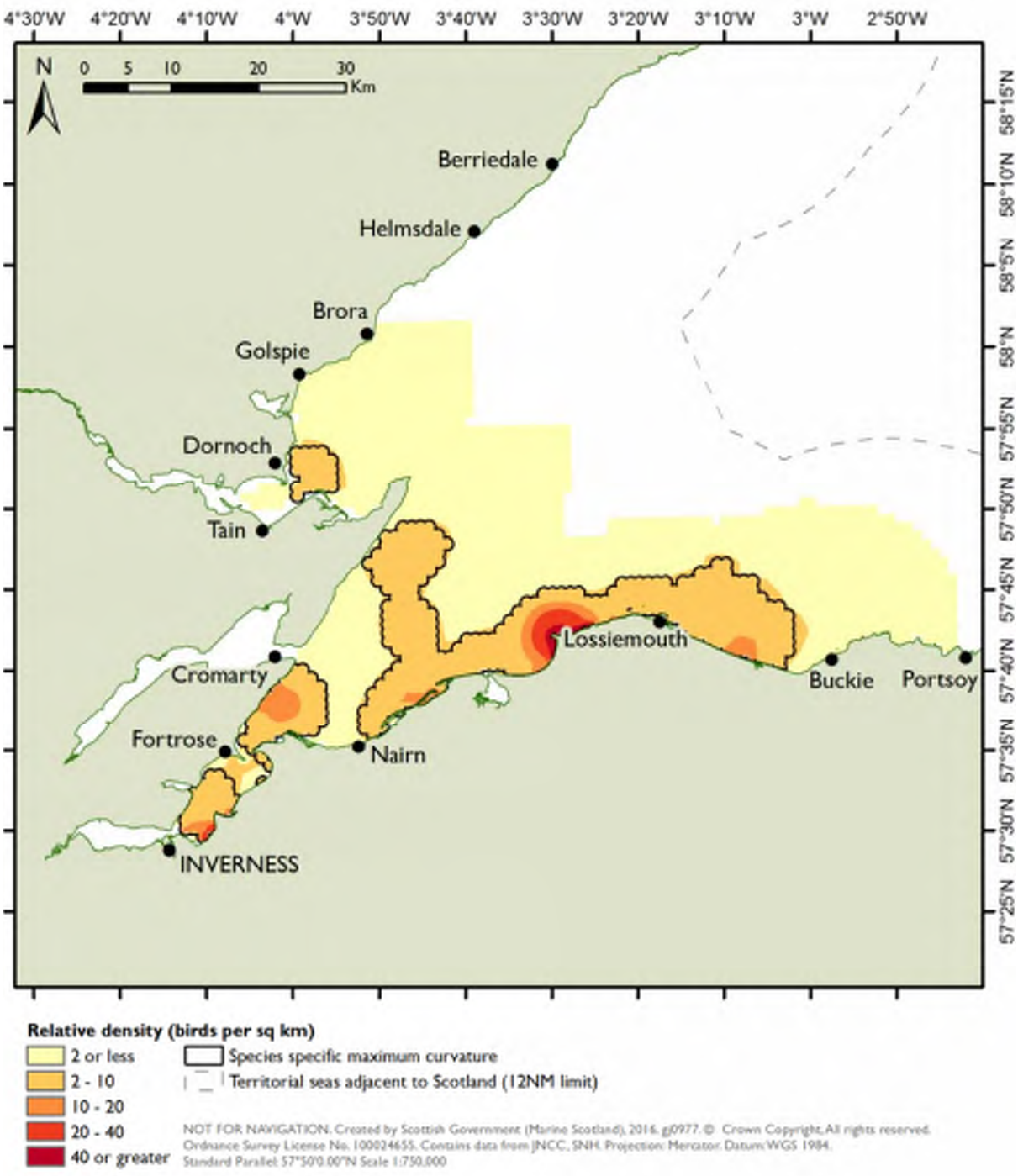

Figure I.4. The distribution of long-tailed duck in the Moray Firth pSPA.

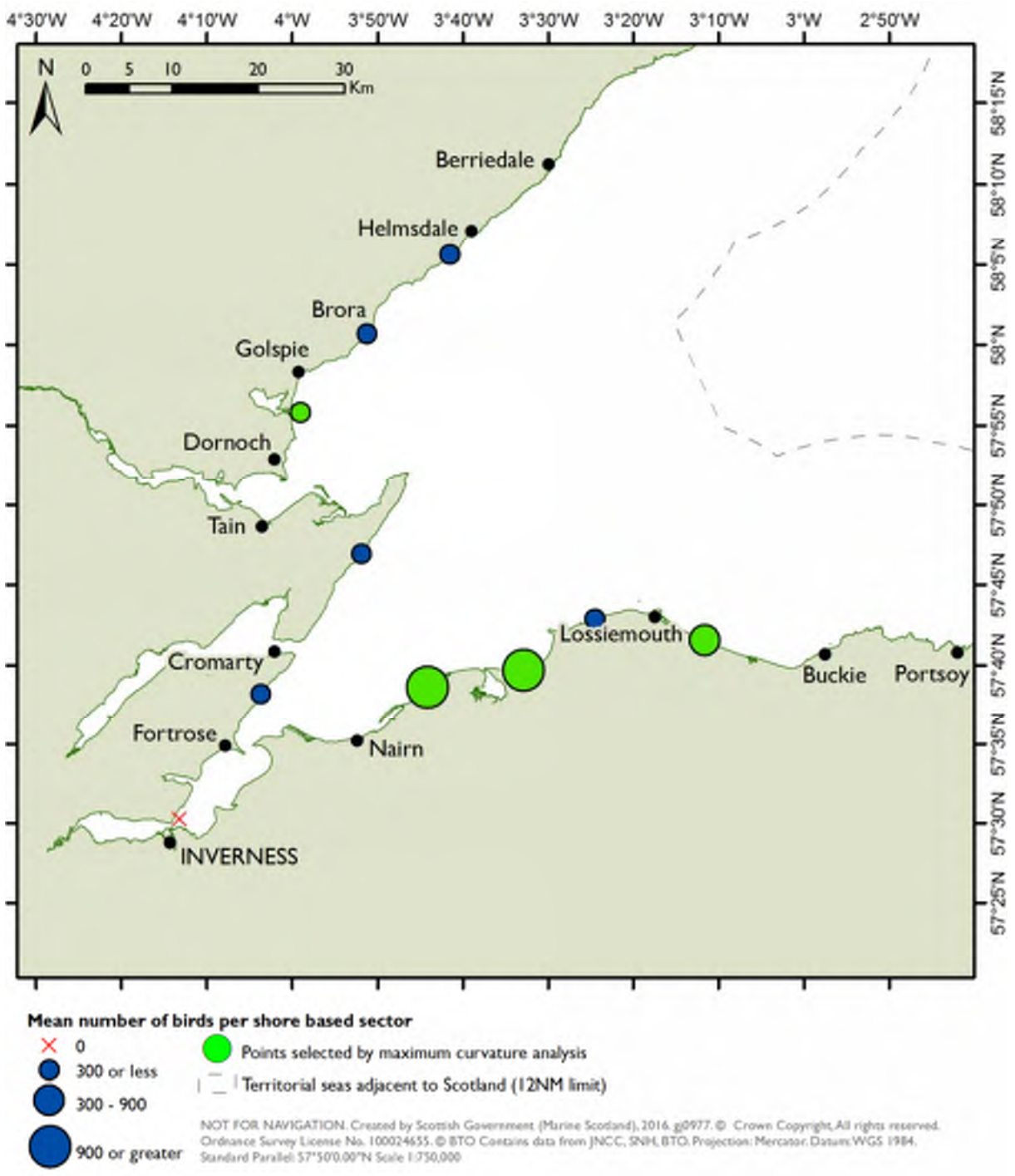

Figure I.5. The distribution of common scoter in the Moray Firth pSPA. Point symbols represent the relative number of common scoter in each RSPB count sector. Count sectors with the highest relative count that warranted inclusion within the proposed boundary were identified by maximum curvature.

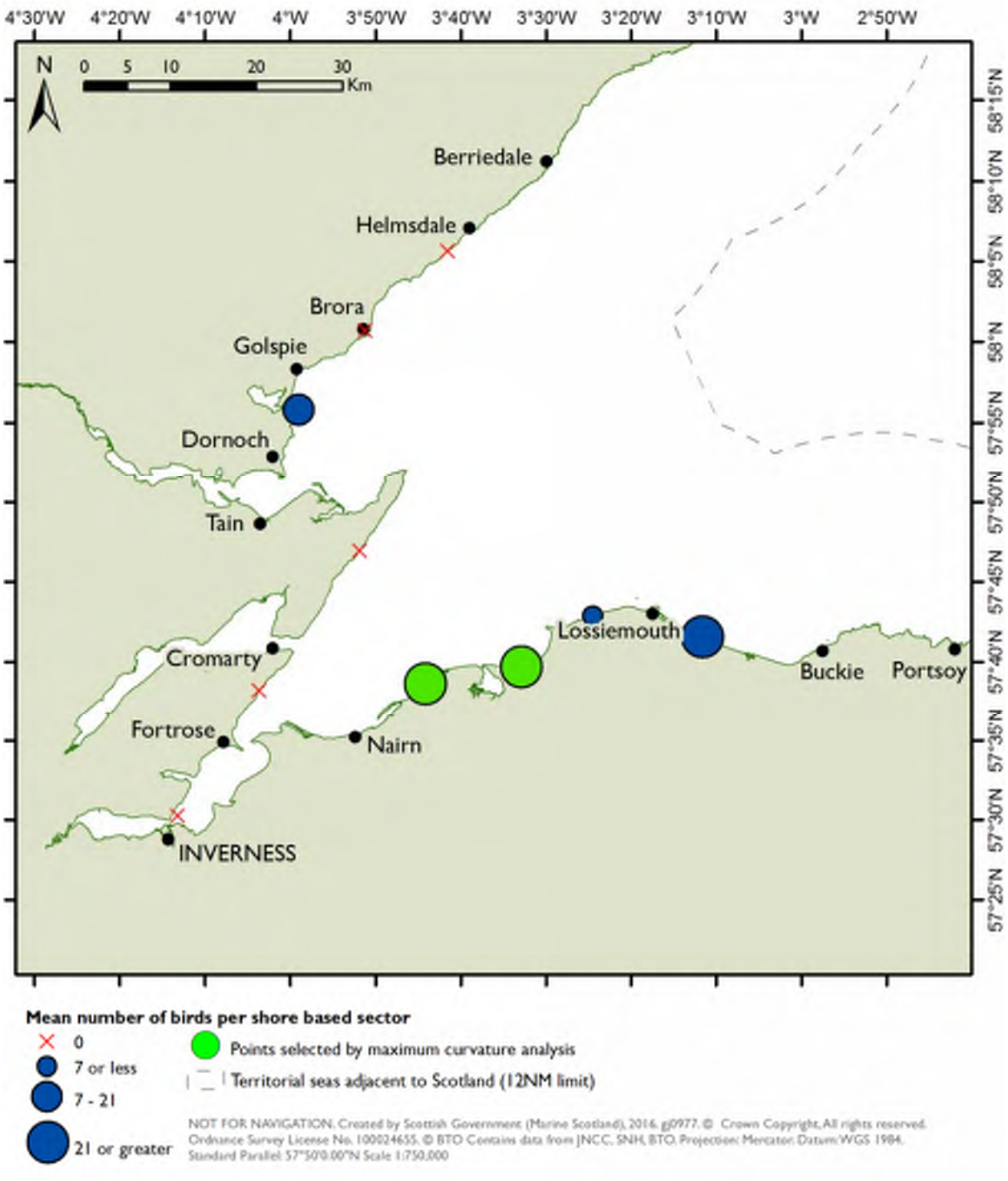

Figure I.6. The distribution of velvet scoter in the Moray Firth pSPA. Point symbols represent the relative number of common scoter in each RSPB count sector. Count sectors with the highest relative count that warranted inclusion within the proposed boundary were identified by maximum curvature.

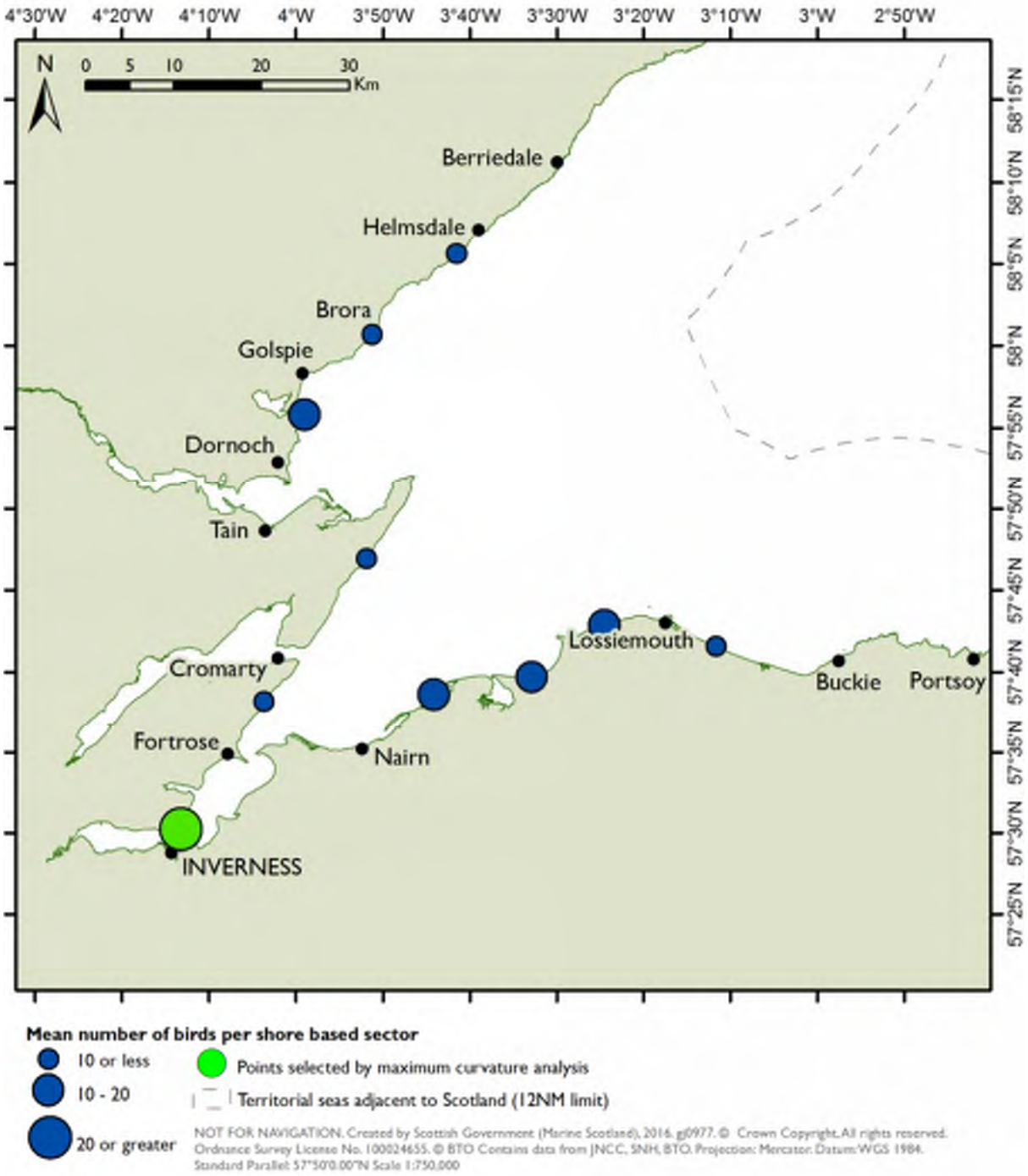

Figure I.7. The distribution of common goldeneye in the Moray Firth pSPA. Point symbols represent the relative number of common scoter in each RSPB count sector. Count sectors with the highest relative count that warranted inclusion within the proposed boundary were identified by maximum curvature.

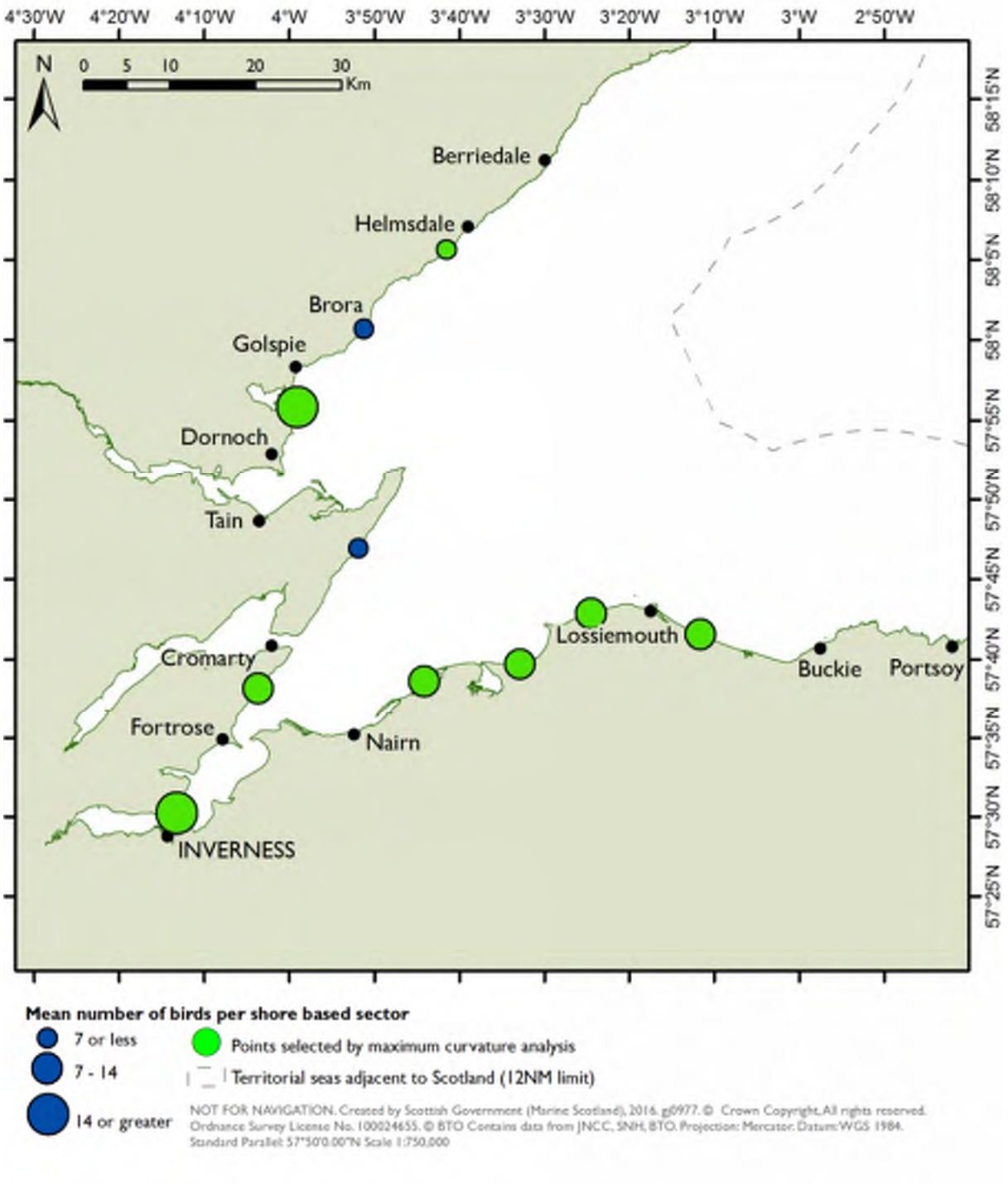

Figure I.8. The distribution of red breasted merganser in the Moray Firth pSPA. Point symbols represent the relative number of common scoter in each RSPB count sector. Count sectors with the highest relative count that warranted inclusion within the proposed boundary were identified by maximum curvature.