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# Seagreen Preconstruction Marine Mammal Monitoring Plan

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## Table of Contents

1. Introduction .....	4
2. Seagreen Project: summary of marine mammal sensitivities .....	6
3. Differences in sensitivities between 2012 Seagreen assessment and 2018 Optimised Seagreen Project assessment.....	9
4. Seagreen MMMP .....	9
4.1 Overview of Methodology .....	11
4.2 Existing baseline.....	12
4.3 Survey equipment.....	12
4.4 Survey design .....	13
4.5 Data analysis .....	13
4.6 Reporting.....	13
4.7 Other relevant monitoring work – Digital Aerial Surveys for ornithology monitoring.....	13
4.8 Strategically led regional studies .....	14
5. References .....	15

## 1. Introduction

Seagreen has committed to undertake marine mammal monitoring surveys to support the delivery of the Seagreen Alpha and Seagreen Bravo offshore wind farms (OWFs) and the Offshore Transmission Asset (OTA) (the 'Seagreen Project') to better understand the effect of construction activities associated with the Development on marine mammal populations in the vicinity of the Development, and to validate assumptions made within the ES and RIAA. The wind farm projects and associated OTA were awarded development consent in October 2014.

This document describes Seagreen's approach to marine mammal monitoring in relation to the development and as such forms the pre-construction element of the Marine Mammal Monitoring Plan (MMMP) developed as part of the Project Environmental Monitoring Programme (PEMP) required to discharge the relevant conditions as set out in Table 1.1.

*Table 1.1. Consent conditions requiring marine mammal monitoring.*

Reference	Condition Summary	Discharge Status
<i>S36 Consent Alpha and Bravo</i>		
Condition 26b PEMP	The PEMP must cover, but not be limited to the following matters:  b. The participation by the Company in surveys to be carried out in relation to marine mammals as set out in the Marine Mammal Monitoring Programme ("MMMP");	<b>Pre-construction:</b>  The Seagreen pre-construction MMMP is currently in the process of being delivered. Seagreen will seek confirmation from MS-LOT on discharge of the pre-construction element of Condition 26.b monitoring requirements once the first year of monitoring has been completed in 2020.
		<b>Construction:</b>  Seagreen will seek confirmation from MS-LOT on discharge of the construction element of Condition 26.b monitoring requirements at the appropriate time. Final detailed monitoring design for the construction MMMP (Construction MMMP) will be confirmed based on the findings from the MMMP pre-construction monitoring and will consider the final foundation design and construction approach.
		<b>Post-construction:</b>  Seagreen will seek confirmation from MS-LOT on discharge of the post-construction element of Condition 26.b monitoring requirements at the appropriate time.

Reference	Condition Summary	Discharge Status
Condition 27 FTRAG	The Company must participate in any Forth and Tay Regional Advisory Group (“FTRAG”) established by the Scottish Ministers for the purpose of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, ornithology, diadromous fish, <b>marine mammals</b> and commercial fish.	Seagreen are represented on the Marine Mammal Subgroup of the FTRAG. A pre-construction Marine Mammal Monitoring Strategy document describing the proposed approach has been submitted to the FTRAG Marine Mammal Subgroup. Seagreen will seek confirmation on acceptance of the MMMP from the FTRAG subgroup at the forthcoming meeting in July 2019.  Following this meeting, Seagreen will seek confirmation from MS-LOT that condition 27 has been discharged.
Condition 28 SSMEG	The Company must participate in any Scottish Strategic Marine Environment Group (“SSMEG”) established by the Scottish Ministers for the purposes of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, ornithology, diadromous fish, marine mammals and commercial fish.	SSMEG has not been established. The condition does not apply.
<b>Marine Licence – Transmission Asset</b>		
Condition 3.2.1.1.b PEMP	The PEMP must cover, but not be limited to the following matters:  b) The participation by the Company in surveys to be carried out in relation to marine mammals as set out in the MMMP	<b>Pre-construction:</b>  The Seagreen pre-construction MMMP is currently in the process of being delivered. Seagreen will seek confirmation from MS-LOT on discharge of the pre-construction element of Condition 3.2.1.1.b monitoring requirements once the first year of monitoring has been completed in 2020.
		<b>Construction:</b>  Seagreen will seek confirmation from MS-LOT on discharge of the construction element of Condition 3.2.1.1.b monitoring requirements at the appropriate time. Final detailed monitoring design for the construction MMMP (CMMMP) will be confirmed based on the findings from the MMMP pre-construction monitoring and will consider the final foundation design and construction approach.
		<b>Post-construction:</b>  Seagreen will seek confirmation from MS-LOT on discharge of the post-construction element of Condition 26.b monitoring requirements at the appropriate time.

Reference	Condition Summary	Discharge Status
Condition 3.2.2.18 FTRAG	The Licensee must participate in any FTRAG established by the Licensing Authority for the purpose of advising the Licensing Authority on research, monitoring and mitigation programmes for, but not limited to, diadromous fish, marine mammals and commercial fish.	Seagreen are represented on the Marine Mammal Subgroup of the FTRAG. A pre-construction Marine Mammal Monitoring Strategy has been submitted to the FTRAG Marine Mammal Subgroup. Seagreen will seek confirmation on acceptance of the MMMP from the FTRAG subgroup at the forthcoming meeting in July 2019. Following this meeting, Seagreen will seek confirmation from MS-LOT that condition 3.2.2.18 has been discharged.
Condition 3.2.2.19 SSMEG	The Licensee must participate in any SSMEG established by the Licensing Authority for the purpose of advising the Licensing Authority on research, monitoring and mitigation programmes for, but not limited to, diadromous fish, marine mammals and commercial fish.	SSMEG has not been established. The condition does not apply.

The monitoring approach presented within this MMMP has been developed with reference to the key sensitivities identified in the marine mammal Environmental Impact Assessment (EIA) for the Seagreen project (Seagreen, 2012; Ch.13) and the 2013 Habitats Regulation Assessments (HRA) (Seagreen, 2013) based on the 2012 Seagreen Project design parameters. This document builds upon a previous discussion document “Seagreen marine mammal monitoring strategy” (Seagreen report LD00009-CST-OF-RPT-0013) which was developed in January 2019 and provided a detailed consideration of the sensitivities identified in the EIA and HRA and the proposed approach for marine mammal monitoring. This document was subsequently consulted upon with Scottish Natural Heritage (SNH), Marine Scotland Science (MSS) and MS-LOT and the resulting agreed approach is described within this MMMP. A summary of the marine mammal sensitivities follows in section 0 of this document.

In September 2018 Seagreen submitted new consent applications for optimised wind farm projects within the same project area. This was based on a design envelope reflecting updated wind turbine and foundation technologies. Section 3 of this document provides a short discussion of the differences in sensitivities between the 2012 Seagreen assessment and the 2018 Optimised Seagreen Project assessment.

The document concludes with Section 4 which provides a description of the approach to the Seagreen MMMP for the 2014 consented project.

## 2. Seagreen Project: summary of marine mammal sensitivities

Chapter 13 (Marine Mammals) of the 2012 Offshore Environmental Statement (ES) for the Seagreen Project assessed the potential for impacts on bottlenose dolphin, harbour porpoise, minke whale, white-beaked dolphin, harbour seal and grey seal. No significant impacts were predicted on any species as a result of any activities during the construction, operation or decommissioning of either Project Alpha, or Project Bravo in isolation, or Project Alpha and Project Bravo combined.

Key potential impacts identified during the assessment were the potential effects of underwater noise from pile driving; auditory injury (in the form of permanent threshold shift (PTS)) on harbour porpoise, minke whale and grey and harbour seal, as well as behavioural disturbance in all species commonly occurring in the area, including bottlenose dolphins. It was recognised that monitoring of the occurrence or consequence of any PTS would be extremely difficult and that the effects of behavioural disturbance would need to be considered in terms of the population level consequences of any localised disturbance. Ch.13 (Marine Mammals) of the 2012 Offshore ES included a commitment to develop a marine mammal monitoring strategy to inform understanding of potential behavioural disturbance.

The assessment of the potential for PTS led to a requirement to develop a Piling Strategy to mitigate the underwater noise impacts arising from piling activity, specifically to reduce the risks of exposure leading to injury. The Piling Strategy must include full details of the proposed method and anticipated duration of pile driving at all locations, the details of soft start procedures and maximum hammer energy and details of monitoring and mitigation to be employed during pile driving. The development of a Piling Strategy is required under condition 11 of the 2014 Section 36 consent for Project Alpha and Project Bravo offshore OWFs and condition 3.2.2.5 of the OTA Marine Licence, in the event that piled foundations are to be used. The development of the Piling Strategy will not be considered in detail in this document – this will be addressed separately at such time when the final Project Design is available. The Piling Strategy will be submitted to the Scottish Ministers for approval, no later than 6 months prior to the Commencement of the Development.

The following sections provide a summary of the key marine mammal sensitivities identified within the EIA for the Seagreen project and the primary drivers for monitoring set out in this MMMP to address the consent requirements stated in Table 1.1.

#### **2.1.1 Bottlenose dolphins**

Bottlenose dolphins are the primary qualifying feature of the Moray Firth SAC. The dolphins range widely beyond the SAC along the east coast of Scotland. Underwater noise modelling indicates that the noise emitted from pile-driving for wind turbine and substation foundations could extend beyond the wind farm footprints and reach the coastal waters used by dolphins.

Therefore the following questions were selected as the primary drivers for monitoring:

- Do elevated noise levels as a result of pile driving reach the coastal strip used by bottlenose dolphins? Are they at levels where a behavioural response may be expected? This will attempt to validate the noise modelling that was carried out to inform the assessment.
- Is there any detectable change in bottlenose dolphin occurrence in this area, in response to this elevated noise? This would attempt to validate assumptions made with respect to the level of individual responses to noise.

#### **2.1.2 Harbour seals**

Similar to the case for bottlenose dolphins above, harbour seals as a qualifying feature of the Firth of Tay and Eden Estuary SAC range beyond the SAC and may forage in, or transit through, the areas affected by noise from pile driving at the wind farm site.

However, since the publication of the Seagreen 2012 Offshore ES and the Marine Scotland 2014 Appropriate Assessment, the harbour seal population in the region has continued to decline, and the occurrence of harbour seals in the area expected to be affected by any construction activities is now extremely low. This was demonstrated by the recent 2018 application for the Optimised Seagreen Project (Seagreen Optimised Project EIA Report, Ch.10 Marine Mammals) which predicted an impact to <1 harbour seal from piling noise (driven by the change in harbour seal baseline, rather than any difference in project effects). It is therefore not considered possible or appropriate to focus any monitoring effort on harbour seals.

### 2.1.3 Grey seals

Similar to the case for bottlenose dolphins and harbour seals above, grey seals, as a qualifying feature of the Isle of May SAC and the Berwickshire & North Northumberland Coast SACs, range beyond these SACs and may forage in, or transit through, the areas affected by noise from any pile driving during wind farm construction. The SNCBs and MSS advised that for the purposes of HRA, the reference population for grey seals should be the east coast management unit, which includes the relevant populations in each of these SACs.

If required, foundation pile driving, as modelled, is the noisiest and most disturbing activity for foundation installation during construction. In their advice, the SNCBs confirmed that other impacts such as indirect effects on prey, or disturbance to seals from boat movements, cable-laying or rock-dumping are unlikely to result in population-level effects. Advice from the SNCBs and MSS in relation to the assessment presented in the 2012 Offshore ES was that depending on the wind farm / piling scenarios modelled, the zones of predicted impacts could overlap with areas that grey seals may use. However, these noise impacts to individuals, along with effects on prey species and/or disturbance to seals arising from other construction activities, will not significantly affect the grey seal population of the east coast management unit. The SAC populations and the population overall are robust and currently increasing and will not suffer any long-term impacts from wind farm construction.

Given these comments, and the fact that grey seals are very wide ranging and highly mobile, it is considered that monitoring focused on understanding the potential effects of pile driving on grey seals is neither appropriate nor achievable.

### 2.1.4 Other cetacean species

As noted above, the 2012 Offshore ES also assessed impacts on other cetacean species likely to be present at the Seagreen site; harbour porpoise, minke whale and white beaked dolphins were sighted during the Seagreen baseline characterisation surveys and are known to be present from a range of other data sources. However, the predicted level of impact on these species was not considered a concern and there were no HRA considerations for any of these species.

It is important to note that the agreed approach detailed below in Section 4 was developed in consideration of the ability to also detect other vocalising cetaceans and to validate assumptions made in the assessment with respect to these species. It is also important to note that a large, intensive, strategic regional monitoring programme is currently underway in the Moray Firth which is focused on developing



our understanding of the impacts of offshore wind farm construction on harbour porpoises. Therefore, it was not considered appropriate or necessary to replicate these efforts in the Forth and Tay.

### **3. Differences in sensitivities between 2012 Offshore ES and 2018 Optimised Seagreen Project assessment**

As set out above, in September 2018, Seagreen submitted consent applications for an optimised project design, based on developments in wind turbine and foundation technology since the original project consents decision in 2014. The EIA Report completed in support of the applications included an assessment of potential impacts on marine mammals. This focussed on impacts due to underwater noise from piling. Seagreen has committed to taking forward either the originally consented project or the optimised project, but not both. At the time of writing the optimised project application is in determination with Marine Scotland.

This MMMP addresses the requirements of the 2014 consents. To inform the development of the MMMP for the 2014 consents, it is important to consider the outcome of the 2018 Optimised project assessment, to ensure that any new information is able to be included. This section highlights the principal differences between the 2012 Seagreen assessment and the 2018 Optimised Seagreen Project assessment, which relate to the following points:

- The continuing decline in the harbour seal population resulting in much lower magnitude of impact for the species in 2018 compared to 2012;
- The change to NOAA thresholds and weightings for PTS resulting in larger PTS weighted SELcum impact ranges for minke whales in the optimised Project.

The former makes no material difference to the priorities for monitoring, as agreed with Marine Scotland and SNCBs. The latter point will need consideration under the development of the Piling Strategy, if this is required, but is not appropriate or possible to address through the MMMP.

There are no material differences in relation to predicted bottlenose dolphin impacts, which remain not significant in the 2018 Optimised Project assessment, in relation to piling noise. However, if used for foundation installation during construction, noise from piling with the potential to disturb is still predicted to reach the coastal areas used by the species.

### **4. Seagreen MMMP**

This section presents the approach to the MMMP for the Seagreen project. Based on the sensitivities detailed in Seagreen's strategy document (LF000009-CST-OF-RPT-0013) and summarised above in Section 0, the following construction monitoring objectives were determined:

- Validate the assumptions made in the impact assessment with respect to the baseline levels of pre-construction presence for the key cetacean species identified (bottlenose dolphin, harbour porpoise, white beaked dolphin, minke whale).
- Validate underwater noise propagation modelling carried out to inform the EIA and HRA by monitoring noise levels at various ranges from the construction activity.

- Confirm whether elevated noise levels as a result of offshore construction activity reach the coastal strip regularly used by bottlenose dolphins.
- Confirm whether noise levels in this area elevated to the extent that behavioural responses may be expected.
- Determine whether there is any detectable change in bottlenose dolphin occurrence in this area as a result of construction activity. This would attempt to validate assumptions made with respect to the level of individual responses to noise, and;
- Determine if there is any change in other cetacean activity across the monitored area in relation to noise generated.

The approach to pre-construction monitoring has been developed on the assumption that pile driving to install foundations will form part of the final construction design and baseline data collection has been progressed on this basis. However, construction monitoring will be dependent on the final foundation design and the construction approach.

#### 4.1 Consultation on marine mammal monitoring

A summary of the process by which the pre-construction MMMP has been agreed and approved is presented in Table 4.1. Agreement has been reached primarily via discussions with MSS, MS-LOT and SNH.

*Table 4.1. Summary of key consultation meetings and agreements for marine mammal monitoring.*

Date	Summary of discussion and agreements	Reference
25/01/2019	Pre-construction Marine Mammal Monitoring Strategy document issued to MS-LOT and stakeholders (MSS,SNH) for consultation.	Report LF000009-CST-OF-REP-0013
30/01/2019	Stakeholders respond to the pre-construction Marine Mammal Monitoring Strategy document	Email from SNH to Seagreen and MS-LOT
05/02/2019	Meeting to discuss the proposed pre-construction Marine Mammal Monitoring Strategy. Proposed Strategy agreed by stakeholders	Minutes LF000009-CST-OF-MOM-0011
18/03/2019	Pre-construction Marine Mammal Monitoring Strategy issued to FTRAG Marine Mammals subgroup for consultation	Email from Seagreen to FTRAG MM subgroup
27/03/2019	Pre-construction Marine Mammal Monitoring Strategy formally issued to FTRAG MM subgroup for formal agreement	Email from MSLOT to Seagreen confirming acceptance of Marine Mammal Monitoring Strategy.

## 4.2 Overview of Methodology

An existing long term acoustic monitoring programme is in place on the east coast of Scotland, the Marine Scotland Science East Coast Marine Mammal Acoustic Study (ECOMMAS). It was agreed with Marine Scotland Science, Scottish Natural Heritage and MS-LOT to co-ordinate with ongoing data collection, to augment this existing programme to realise the full advantage of having a long term existing baseline of cetacean activity across the region and to collect additional data to support the requirements of the Seagreen MMMP.

The ECOMMAS monitoring stations record noise levels and detections of echolocating cetaceans, such as dolphins and porpoises. On review, the configuration of existing monitoring stations is not considered optimal in relation to coverage of the coastal area closest to the Seagreen site. Therefore, the addition of 5 extra monitoring stations between the Stonehaven and Arbroath stations, in a transect from the coast to the Seagreen site was agreed with stakeholders and subsequently implemented. This is shown in Figure 4.1. The initial deployment of cetacean detection devices (CPODs) was undertaken in March 2019, in collaboration with Marine Scotland Science. The survey design includes a monitoring station in the shallow, coastal area known to be used by bottlenose dolphins. It also provides a gradient survey design extending to the wind farm site for determining any changes in detections of other cetaceans in relation to construction activities, as well as monitoring noise at a variety of ranges from construction activity. In addition, the Seagreen augmentation of the array provides the advantage of monitoring further offshore in deeper areas where ECOMMAS has not previously covered.

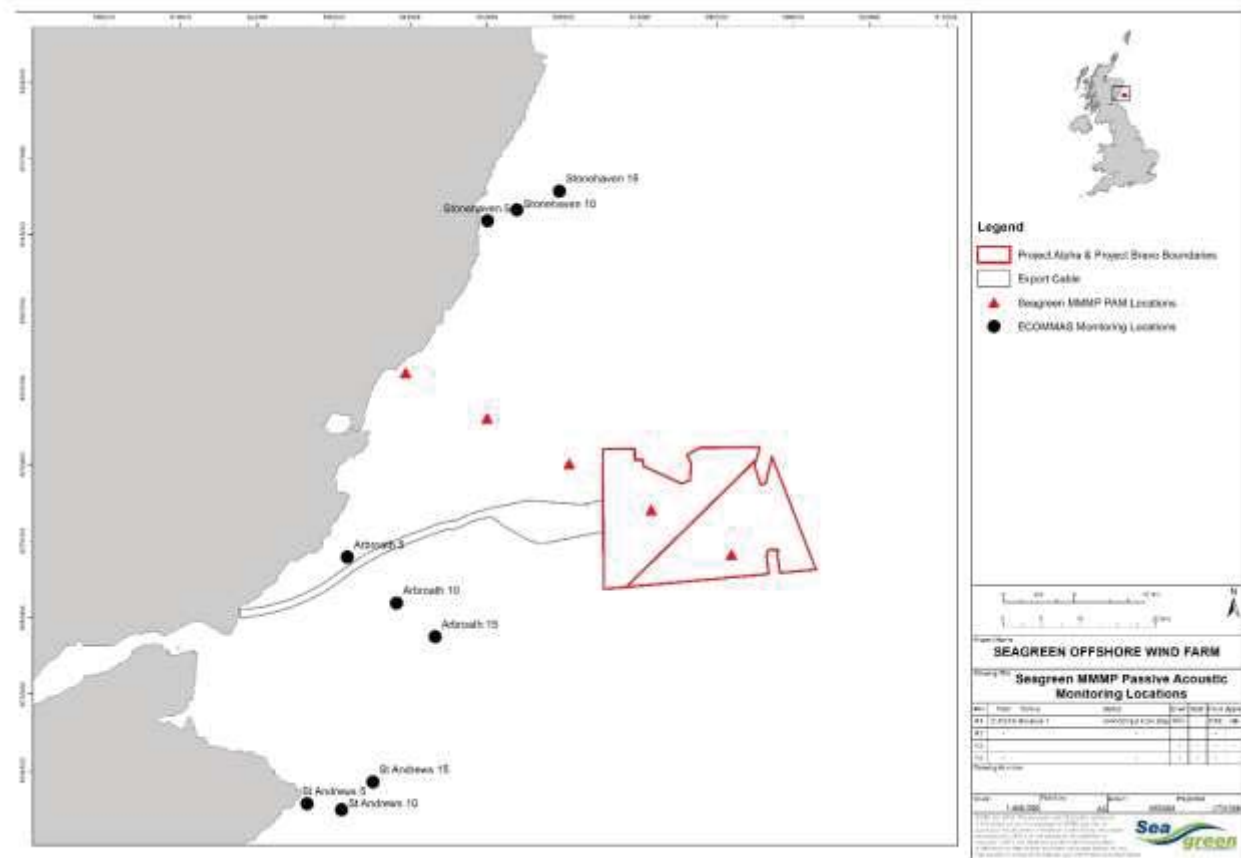


Figure 4.1. The positions of the Seagreen MMMP passive acoustic monitoring stations relative to the existing ECOMMAS monitoring stations.

### 4.3 Existing baseline

The ECOMMAS programme has been collecting data on the occurrence of dolphins and porpoises and on ambient noise levels across the east coast of Scotland since 2013, and therefore a long time series of baseline data on small cetacean occurrence and ambient noise in the region is available.

### 4.4 Survey equipment

Moored CPODs (manufactured by Chelonia Ltd) were deployed at each of the five Seagreen monitoring stations in March 2019 using seabed moorings that were optimised for deployments at these sites, and licenced for scientific use by Marine Scotland and consented by the Crown Estate. Broadband noise recorders (Loggerhead LS1X from Loggerhead Instruments) will also be added to the Seagreen monitoring stations in the summer of 2019, to collect baseline data on ambient noise as well as potentially collecting recordings of dolphin clicks and whistles to aid in species identification.

The final design of the PAM array for construction monitoring will be based upon findings from the MMMP pre-construction monitoring and findings from the ECOMMAS. It is anticipated that ongoing data collection and analysis will permit consultation upon this design in the summer of 2020 and will also include

consideration of the project final design and installation methodologies. The construction monitoring phase of the work would ideally require a co-ordinated programme that integrates a number of studies across the Moray Firth and Forth and Tay development areas with the ECOMMAS.

#### **4.5 Survey design**

During the preconstruction phase, sampling will occur year-round at the five Seagreen monitoring sites shown in Figure 4.1. Only ECOMMAS sites off the coast at Arbroath and Helmsdale collect data year round with sampling occurring between March and October of each year at all other ECOMMAS sites. Based upon these data, and an understanding of the final Project Design, additional sampling periods and locations may be required for the construction period. The requirement for post-construction monitoring will be agreed with MS-LOT and consultees on the basis of the results from the construction monitoring.

Deployments will be made for approximately 4 months at a time, requiring three deployment/recovery cycles in each year.

#### **4.6 Data analysis**

Data will be downloaded using the manufacturer's software, which is also used to identify clicks trains and categorise these as either porpoise or dolphin echolocation clicks. Data will then be processed using established routines and summarised to provide an indication of whether click trains were detected in each minute or hour of the day. Spatial and temporal variation in occurrence will then be expressed in terms of detection positive hours per unit of time, or distributions of waiting times. Recently developed techniques for distinguishing between dolphin species will also be applied to the data (Palmer et al. 2017). The recorded noise data will also be processed for the detection of minke whale vocalisations (Risch et al. 2019).

Once a full year of baseline data collection is completed, the data will be analysed using statistical modelling to explore patterns in dolphin and porpoise occurrence in relation to a range of environmental covariates, using a Generalised Additive Modelling framework utilising General Estimating Equations (for an example of this approach applied to PAM data see Malinka et al. (2018)). This framework can be easily expanded to include construction activity as additional explanatory covariate(s) with additional data collected throughout the construction period.

#### **4.7 Reporting**

Short interim update reports will be provided to MS-LOT after each deployment/retrieval trip to update on the deployment and retrieval activities. A baseline report will be provided to MS-LOT in Q3 2020 after a full year of baseline cetacean occurrence and ambient noise data collection. This report will provide analysis and interpretation of patterns in cetacean occurrence across the period of data collection and in relation to the previous ECOMMAS baseline.

#### **4.8 Other relevant monitoring work – digital aerial surveys for ornithology monitoring**

A programme of monthly digital aerial surveys for ornithology monitoring is also being undertaken across the wind farm site and an agreed buffer between March 2019 and March 2020. These surveys have also

been aligned with surveys being undertaken by other Forth and Tay wind farm developers and the resulting dataset will provide a regional baseline on bird abundance and distribution, against which to test for significant displacement and barrier effects once the OWFs are operational. For further details on this programme, see the Seagreen Ornithology Monitoring Strategy (LF000009-CST-OF-REP-0016).

Although these surveys are primarily for monitoring ornithological interests, detections of marine mammal species, locations and sightings rates will be processed and presented in survey reports. These data may provide a useful pre-construction validation of the baseline abundance and distribution of marine mammals with respect to the species present and any seasonal variation in abundance and distribution.

Digital aerial surveys during construction may also be considered, based on the construction programme, for a key period (notably chick rearing, over May to July), however, over the longer-term perspective for aerial survey monitoring it is not proposed to carry these out throughout the construction phase.

Digital aerial surveys may be included in the monitoring plan for the operational phase of the wind farm and may be useful in informing the extent of any changes in marine mammal abundance over the intervening period. However, the statistical power of these data to detect such a change over and above natural levels of variation may be limited.

#### **4.9 Strategically led regional studies**

The proposals provided above are specific to the Seagreen project and associated potential impacts. However, should other regional studies be progressed within the timeframe of the Seagreen project, e.g. through the FTRAG Marine Mammal Subgroup (FTRAG-MM), Seagreen would be willing to engage in discussions of appropriate measures, to further the understanding of cumulative impacts. In the event that other Forth and Tay offshore wind farm project developers are implementing similar augmentation of the ECOMMAS programme, it would make sense to ensure that data collection and analysis and interpretation was carried out in an integrated and co-ordinated way through FTRAG-MM.

## 5. References

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Palmer, K., K. Brookes, and L. Rendell. 2017. Categorizing click trains to increase taxonomic precision in echolocation click loggers. *The Journal of the Acoustical Society of America* **142**.

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