Aberdeen Harbour Expansion Project

Construction Environmental Management Document

AHEP-DRA-APP-0001 Rev 9
21 October 2019

DRAGADOS

Contents

Chapter 11
Marine Mammal Mitigation Plan

Revision Log

Revision Number	Date	Location of Revision	Revision Details
Rev 5	23/05/2018	Throughout plan	Removal of references to JDN
		Table 11.1	Removal of individuals names
		Section 11.5	Minor text addition on potential effects.
		Section 11.6.5	Section previously lower in document, moved to 11.6.5 to improve flow of report.
		Section 11.6 and 11.7	Section rearranged to improve flow of text.
		Section 11.8	Removal of contractor specific PAM base requirements and section streamlined. Specific methodology will be agreed with stakeholders when contractors appointed.
		Section 11.9	2017 dates of trial blasting removed
		Section 11.9.1	Contractor specific methodology removed
		Section 11.9.2	Update to section
		Throughout plan	Changes as Dragados now implementing mitigation including MMO, PAM and Underwater Nosie Monitoring
		Appendices	Addition of Appendix A and C1, Appendix E and F
Rev 6	21/01/2019	Document substantially rewritten from Rev 5	
Rev 7	06/02/2019	Review of appendices and section references throughout the document	
Rev 8	10/10/19	Amalgamation of method statements “Drilling & Blasting Methodology – Environmental Controls Marine mammals” and “Environmental Mitigation – South Breakwater and Shore Blasting.”	
		Updated throughout taking into consideration comments from SNH and MSLOT sent on the 10th & 25th June 2019	
Rev 9	21/10/2019	Updated with the charge weight increase proposal	

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11 Marine Mammal Mitigation Plan

11.1 Introduction

This Marine Mammal Mitigation Plan (MMMP) has been prepared to ensure construction risks to marine mammals associated with the proposed Aberdeen Harbour Expansion Project (AHEP) are appropriately managed.

The MMMP includes all mitigation measures that have been identified for marine mammals as outlined in Chapter 15 and Chapter 26 of the AHEP Environmental Statement (ES)[1] as well as measures agreed between Aberdeen Harbour Board (AHB) and Scottish Natural Heritage (SNH), Marine Scotland (MS) and Transport Scotland (TS) during the consultation on the Environmental Statement (ES).

The need to minimise the production of underwater noise is paramount in the harbour design and construction. Dragados have removed all marine impact piling operations included within the ES Design Envelope. Dragados will work with the dredging and blasting contractors to minimise blasting and drilling use. The MMMP sets out a programme of measures to control activities that can generate loud noise and to protect marine mammals. It provides for monitoring data to be supplied to Marine Scotland and SNH.

All marine operations and land blasting operations that can propagate noise in the marine environment will adhere to the MMMP.

For ease of reference, the commitments and timescales in relation to marine mammal monitoring and reports issued are included in 11.8.6 of this plan.

11.2 Roles and Responsibilities

The following individuals are responsible for ensuring that the requirements of this Marine Mammal Mitigation Plan are implemented at the AHEP site.

Table 11.1: Roles and Responsibilities Table

Job Title	Responsibilities
Dragados Environmental Clerk of Works (ECoW)	Delivery of toolbox talks to staff regarding watching for marine mammals, work with an experienced Marine Mammal Observer (MMO) to train staff to undertake Marine Mammal watches and audit watches. Maintain JNCC Noise Registry.
Dragados Environmental Manager (EM)	Work with Dragados Marine Co-ordinator to ensure the appropriate MMO/Passive Acoustic Monitoring (PAM)/Underwater Noise Measurements/C-PODS actions are taking place.
Dragados Marine Co-ordinator	Coordination of all dredging and blasting activities and ensuring mitigation is in place including double bubble curtain, MMO and PAM. Liaise with superintendents, engineers, captains and/ or crew, drilling and blasting operators.

[1] Aberdeen Harbour Expansion Project (November 2015). Volume 2: Environmental Statement, Chapter 15: Marine Mammals.

Job Title	Responsibilities
Marine Mammal Observer	Carry out dedicated watches prior to drilling, blasting and deposit activities. Complete watch logs and reports based on observations.
Blast Master	Notify MMO and PAM operator to begin watches 1 hour before blast. Make final check with lead PAM/MMO that there are no marine mammals in the mitigation zone before blast.
MMO	Record watches to verify that the mitigation zones are free from marine mammals before blasting and other UWN generating activities.
PAM Operator	Record watches to verify that the mitigation zones are free from marine mammals before blasting.
UWN Operator	Record UWN inside and outside the bubble curtains during blasting.

11.3 Key Sensitivities

The ES identified bottlenose dolphin, harbour porpoise and grey seal as the key marine mammal species requiring the use of mitigation measures during construction work. In general, the ES found that impacts relating to construction of the AHEP are anticipated to be localised and temporary on very high value receptors and significance of effect is largely considered to be minor or moderate adverse.

The Moray Firth Special Area of Conservation (SAC) in north-east Scotland supports the only known resident population of bottlenose dolphin *Tursiops truncatus* in the North Sea. As a coastal and wide-ranging species, this population is distributed along the east coast, with a number of hotspots existing within this range. The bottlenose dolphins present around Aberdeen are known to be part of the resident population associated with the Moray Firth SAC, and use Aberdeen Harbour as key foraging habitat.

Potential impacts from anthropogenic noise due to construction of the harbour upon marine mammals is a key environmental risk. Anthropogenic noise is a generic term that refers to any man-made sound or vibration which intrudes into the natural environment and which can mask a biologically useful sound (a ‘signal’), disturb the natural behaviour of the animals, impair hearing or cause injury. Such anthropogenic noise sources include drilling, blasting, dredging, shipping, rock breaking and piling. The potential effects depend on the intensity and duration of the sound source.

11.4 Legislation and Guidance

Under Section 107 of the Marine Scotland Act 2010, it is an offence to kill, injure or take a live seal (intentionally or recklessly).

Under the terms of the Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations, in Scottish inshore waters (within 12 nm of the coast), European

Protected Species are afforded extra protection. For dolphins, porpoises and whales, it is an offence to deliberately or recklessly:

- capture, injure or kill such an animal;
- harass an animal or group of animals;
- disturb an animal while it is occupying a structure or place used for shelter or protection;
- disturb an animal while it is rearing or otherwise caring for its young;
- obstruct access to a breeding site or resting place, or otherwise deny the animal use of the breeding site or resting place;
- disturb 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;
- disturb 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;
- disturb an animal while it is migrating or hibernating; and
- disturb any dolphin, porpoise or whale (cetacean).

Dragados holds European Protected Species Licence MS EPS 27/2017/0 (EPS Licence) from Marine Scotland. It authorises Dragados to disturb harbour porpoise, bottlenose dolphin, white-beaked dolphin, risso's dolphin and minke whale at Nigg Bay due to the activities described in the 'Supplementary Information' documentation supporting the licence application. In October 2018, Dragados applied for a variation to the licence in respect of the use of an acoustic deterrent device (ADD) to scare seals. MS EPS 06/2018/1

The Environmental Manager will update the 'Supplementary Information' to reflect changes in the construction programme and will apply for further variations to the EPS licence if necessary prior to any activities producing underwater noise commencing on site.

Within this document, the term 'marine mammal' is generally used in a broad sense referring to cetaceans and seals.

11.4.1 Guidelines

As required under Section 3.2.5(k) of Construction Marine Licence 05965/16/0 for the AHEP project, Dragados will adhere to the following relevant Joint Nature Conservation Committee (JNCC) guidelines (except where amendments have been approved by the licensing authority):

- JNCC guidelines for minimising the risk of injury to marine mammals from using piling (JNCC, 2010b);

- JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC, 2010c); and
- JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, August 2017)[2]

Other relevant guidelines for the project include:

- The protection of Marine European Protected Species from injury and disturbance – Guidance for Scottish Inshore Waters (Marine Scotland, 2014)

11.4.2 Aberdeen Harbour Dolphin Code

Under CEMD Chapter 17, Vessel Management Plan, adherence to the Aberdeen Harbour Dolphin Code is required for all AHEP vessels. Copies of the Code will be available on vessels associated with AHEP construction. The Code states:

- When dolphins are nearby, maintain a steady course and the slowest safe speed you can;
- When entering or leaving the harbour stay well away from the breakwaters to avoid startling or boxing-in animals behind them;
- If it is safe and practicable to do so, avoid directly approaching the animals;
- Avoid turning engines on and off if dolphins are present; and
- Never allow anyone to swim with, touch or feed dolphins.

The ECoW gives regular toolbox talks to make skippers aware of the code. Checks are made to ensure all skippers adhere to the Code.

11.5 Cross references

The contractor appointed to undertake PAM and UWN monitoring will submit a method statement and details of the equipment to be used to MS-LOT for approval before the equipment is deployed, if methodology is different to already approved methodology.

When reading and implementing the Marine Mammal Mitigation Plan, cross reference should be made to the following plans that form part of the CEMD where mitigation measures are described:

- Chapter 7, Dredging and Dredge Spoil Disposal Monitoring Plan – particularly for information on the dredging works and procedures to be followed during dredging operations.
- Chapter 8, Fish Species Protection Plan – particularly for information on handling fish carcasses recovered during blasting operations.

[2] JNCC (August 2017) JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys. http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_aug2017.pdf Accessed 05/03/2018

- Chapter 14, Piling Management Plan – particularly for information on the planned land-based rotary pile driving operations.
- Chapter 17 Vessel Management Plan – particularly for information on the handling of vessels in Nigg Bay including communication and exclusion areas.

11.6 Project Aspects with Potential to Affect Marine Mammals

Construction activities including piling, shot-hole drilling, blasting, dredging and shipping can produce noise at sound pressure levels harmful to marine mammals. High intensity impulsive sources (e.g. impact piling and blasting) are known to be more harmful than less intensive continuous sources (e.g. shipping, dredging and drilling).

Prolonged use of ADDs to deter seals can be harmful to marine mammals.

Other potential impacts on marine mammals are those caused by collisions with marine vessels or impacts from accidental releases of pollutants.

11.6.1 Piling

There is no requirement to use marine impact piling in AHEP Construction.

Details of land based rotary piling are included in CEMD Chapter 14, Piling Management Plan.

11.6.2 Drilling

Construction of the AHEP requires drilling in the marine environment (i.e. using equipment mounted on vessels) and in the terrestrial environment (using land-based drilling rigs).

Along the shore, particularly on the south side on Nigg Bay, some of the shot-hole locations, although situated below Mean High Water Springs (MHWS) will be drilled using land-based drilling equipment from working platforms of ‘made-up’ ground.

The process of drilling shot-holes to allow the explosive charges to be set below the seabed so that blasting can fracture the rock is described in CEMD Chapter 7, Dredging and Dredge Spoil Disposal Management and Monitoring Plan. Marine drilling is described in Section 7.3.1 and land-based drilling is described in Section 7.3.5.

Underwater noise from marine drilling was measured in October 2018. MS-LOT has agreed that PAM is not required before shot-hole drilling, and that the MMO mitigation zone for drilling is 100m.

11.6.3 Blasting

AHEP involves marine blasting works using shot-holes drilled in the marine environment, and land blasting works using shot-holes drilled from temporary working platforms. The working principles of the blasting works are provided in the CEMD Chapter 7, Dredging and Dredge Spoil Disposal Management Monitoring Plan

Explosives will be used below the seabed to fracture rock to allow the backhoe dredger to remove it for reuse in the South Breakwater core or other areas where rock placement is required, e.g. as general fill material, or will be taken offsite for reuse.

Figure 11.6 shows the areas of rock to be blasted, and the rock that has already been removed by dredging or ripping at the time of writing.

Blasting is restricted to daylight hours unless in exceptional circumstances, e.g. for Health & Safety reasons or where poor weather develops. Charges will not be set unless there is a high confidence that they can be detonated in daylight hours. Any blasting outside daylight hours due to such exceptional circumstances will be reported in writing to MS-LOT within 48 hours.

The minimum amount of blasting will be undertaken using the smallest practicable charge. The mitigations described in Section 11.7 provide checks and balances to ensure that marine mammals are not exposed to noise levels above the 183 dB re 1µPa (peak) equivalent to 170 dB re 1µPa (RMS) assessed in the ES, outside the bubble curtain or at 400 m if the bubble curtain is positioned less than 400 m from the blast location.

In 2018, the maximum charge weight used was 20 kg. For blasting in 2020/2021, an incremental increase in charge weight is proposed. This is described in more detail in Section 11.7.7

Blasting will not occur during weather that is outside the operating limits of the vessels involved (typically 0.5m wave height) or when the sea-state prevents verification that the mitigation zone if free from marine mammals (typically Beaufort sea state greater than 3) unless agreed otherwise with MS-LOT.

If adverse effects on marine mammals are observed by the MMOs, MS-LOT will be notified immediately.

11.6.4 Dredging

AHEP involves dredging overburden and blasted rock from the seabed. The working principles of dredging are described in the CEMD Chapter 7, Dredging and Dredge Spoil Disposal Management and Monitoring Plan, Section 7.2.

11.6.5 Mechanical Rock Breakers

AHEP will remove rock to create trenches close to the northern and southern breakwaters where concrete blocks will be placed to create a barrier for breakwater material to rest against. In some cases rock may be removed by blasting and in other

situations by deploying mechanical equipment such as a drum cutter, a mechanical ripper, a hydraulic rock breaker or a crane-deployed 'Trepano' rock-breaker.

Underwater noise measurement is undertaken during the first use of each type of mechanical rock-breaking equipment in Nigg Bay, and the results provided to MS-LOT. In 2018 and 2019 noise levels were measured from a mechanical 'ripper'. The ripper noise report was issued to MSLOT & SNH in 2019 and after review of comments from SNH, MS-LOT concluded that the noise arising from ripping is unlikely to disturb animals within the impact zone and no further underwater noise monitoring is required for this activity. Furthermore, this activity does not need to have MMO/PAM mitigation.

A 100m mitigation zone has been established for the Trepano on the basis of UWN noise measurements completed in 2019.

11.6.6 Breakwater Construction

Breakwater construction will, at times, be a 24 hour a day operation involving several different activities including the placement of rock from HGVs directly onto the seabed, rock movement by bulldozer and the installation of accropodes There is a risk that some marine mammal species may come close to the breakwater operations during construction, particularly seals, due to their inquisitive nature and desire to haul out.

11.6.7 Acoustic Deterrent Device

In 2018, the presence of grey seals in the mitigation zone in Nigg Bay frequently prevented blasting works. SNH suggested the use of an ADD to scare seals from the mitigation zone before blasting activities. Marine Scotland varied EPS Licence 06/2018/1 on 15 October 2018 to permit the use of the ADD from a vessel at anchor within Nigg Bay for two periods of 20 minutes before a blast.

11.6.8 Shipping

CEMD Chapter 17, Vessel Management Plan, contains measures to prevent vessel collisions that could impact marine mammals, including the requirement that vessels adhere to the Aberdeen Harbour Dolphin Code. Since 'corkscrew' type injuries on seals have been attributed to seals predating on other seals, injury to seals due to vessels' dynamic positioning systems harming is no longer considered a credible risk.

11.6.9 Accidental Release of Pollutants

CEMD Chapter 15, Pollution Prevention Plan and Chapter 17, Vessel Management Plan describe measures developed to control the storage, movement and treatment of fuel and oil on and around the site, which will reduce the risk of accidental spills to the marine environment and potential harm to marine mammals. All vessels will carry spill kits and competent staff members to deploy them should the need arise.

11.7 Mitigation Measures / Commitments

Discussions with SNH and Marine Scotland highlighted the use of the existing Harbour area by marine mammals and how they could be impacted by noisy activities including blasting operations as a key issue which requires monitoring. Bottlenose dolphins are frequent visitors to this area. Dragados will work with organisations such as WDC and RSPB Dolphinwatch to see how data collected in the wider area may be used to augment the data collected by the mouth of the existing Aberdeen Harbour and within Nigg Bay. Analysis of the existing data sets managed by these organisations may be a useful reference when analysing changes in marine mammal behaviour around AHEP.

Dragados' ECoW performs routine marine mammal observation watches at the Harbour Mouth and records the behaviour of the animals observed and any changes to their behaviour due to the construction activity.

In 2018 and 2019, underwater noise measurement was used to assess the noise attenuation from potential sources of underwater noise, including: dredging, marine drilling, land drilling, mechanical rock breakers and blasting. Underwater noise measurement was also undertaken to characterise the effectiveness of the DBC at reducing underwater noise from blasting.

11.7.1 C-PODs

In April 2018, Dragados installed two buoyed continuous porpoise detectors (C-PODS) at Nigg Bay to monitor the presence and absence of bottlenose dolphins and harbour porpoise. The C-PODS were positioned in the same locations used as those for the EIA baseline data collection to allow for comparison of results before and during construction.

After the buoyed moorings were removed in May 2018, they were replaced with acoustic release moorings in August 2018. Both moorings broke free in October 2018. The C-PODS were recovered and deployed again in December 2018. During January 2019, it was noted that the North C-POD had become dislodged during heavy weather and was later recovered in April 2019. The North C-POD became dislodged again in August 2019. All data from the recovered C-PODs were downloaded and report issued to MS-LOT.

The C-POD specification and deployment procedure is detailed in Appendix C.

11.7.2 Double Bubble Curtain

In order to reduce the sound exposure to marine mammals during blasting, a bubble curtain will be deployed, consisting of a porous hose that is weighted down onto the seabed and connected to air compressors. Compressed air fed into the hoses rises to the surface to form a 'wall' of bubbles that has the effect of deflecting or absorbing noise inside the curtain and reducing the noise levels measured outside the curtain.

To maximise the attenuation of noise at AHEP, a double bubble curtain (DBC) will be deployed during blast events. This comprises two separate bubble curtain hoses laid approximately 15m apart.

The hoses will be lowered to the seabed from reels using a small vessel. They will be positioned on the seabed in one of the configurations presented below using GPS.

Depending on where blasting is undertaken, Dragados have identified three configurations in which the DBC can be installed to block 'direct line of sight' noise propagation between the blast location and open water. These are shown in Figure 11.1

- The configuration illustrated by the blue line is suitable for marine blasting in the north of Nigg Bay. This was the configuration adopted for all blasting in 2018. The hoses run from the compressor area at the South Breakwater (SBW) across the mouth of the bay to the North Breakwater (NBW) and continue outside the line of the NBW, so that line of sight propagation of noise from the bay is cut off by the DBC and the breakwater.

- The configuration illustrated by the solid (inner) green line is suitable for blasting at the southern trenches. The two hoses run from the compressor area at the South Breakwater and round the rocks at the South Breakwater in an arc, so that noise inside the loop of the DBC is contained.

- The configuration illustrated by the dashed (outer) green line is suitable for more general blasting at the Southern Shore of the bay, including the southern tranches. The two hoses from the compressor area enter the sea south of the SBW and go round the rocks by the SBW in an arc, crossing the mouth of Nigg Bay and ending outside the NBW.

The final positions for the DBC will depend on the practicality of deployment, the location of the blasting activities and the results of underwater noise testing when the DBC is in use.

The DBC compressors will be operated by a trained person. Operation of the DBC before and during blasting is described in 11.7.2

15 minutes before the blast, the DBC is turned on and the functioning of the DBC is visually checked from a vantage point and the DBC operator confirms to the Blast master and MMO/PAM lead that it is operating effectively.

After the blast, the DBC operator will check that the generators and hoses are prepared for re-starting when next needed and will switch the DBC off.

Dragados Marine Co-ordinator records DBC operations and details will be kept of works or adjustments to the bubble curtain.

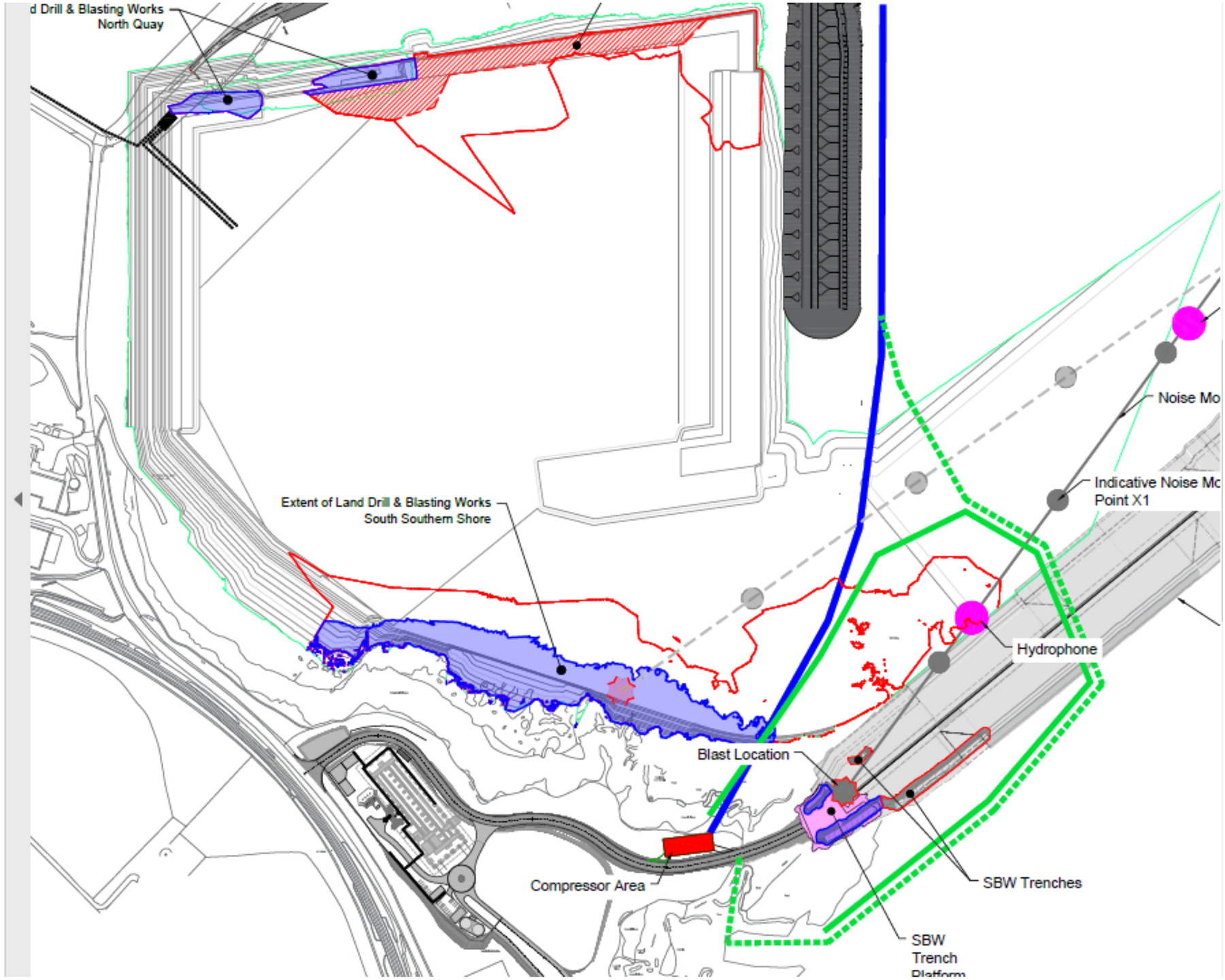

Figure 11.1: Configurations of the bubble curtain

11.7.3 Marine Mammal Observers (MMOs)

Before commencing activities that generate high levels of underwater noise, trained and experienced MMOs will be used to identify whether any marine mammals are present within the applicable mitigation zone.

The 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical survey[3]' (August 2017) defines experienced, dedicated and non-dedicated MMOs as follows:

- Experienced MMO: Should have a minimum of 20 weeks' experience of implementing JNCC guidelines in UK waters obtained within the previous ten years, preferably within the previous five. Furthermore, they will be experienced at identifying UK marine mammal species (visually and/ or acoustically depending on the role) and be familiar with their behaviour.
- Dedicated MMO: A trained MMO who is employed for the sole purpose of undertaking visual observations to detect marine mammals and advising on and monitoring the implementation of the guidelines.
- Non-dedicated MMO: A trained MMO who may undertake other roles on the vessel when not conducting a mitigation role. This person can be a member of the rig's or vessel's crew providing they do not undertake other roles during mitigation periods.

AHEP requires MMOs to have a level of experience appropriate for the work in hand. Any deviation in MMO experience from the above will be agreed with MS-LOT and SNH, by providing CV's for individuals for review and comment.

For deposit of dredged material at sea, MMO watches of a 500m mitigation zone around the dredger or barge are carried out by a trained non-dedicated MMO on the vessel for 20 minutes before starting to deposit material. A continuous MMO watch must be maintained during the deposit operations and if marine mammals are observed within 500m, deposit operations must cease until the area has been clear of marine mammals for at least 20 minutes.

For breakwater construction work, a trained non-dedicated MMO from the work crew will carry out an MMO watch to a distance of 50m from the seaward end of the breakwater for 1 or 2 minutes to ensure the area is free of marine mammals before rock is placed on the seabed or accropodes are installed. If animals (most likely seals) are observed in the area, rock placement or accropode installation will be halted until the marine mammal has voluntarily left the area. During breakwater construction, the ECoW will check on a weekly basis that the watch is being performed correctly.

For shot-hole drilling, MMO watches of a 100 m mitigation zone (direct line of sight) are carried out by a JNCC-trained, non-dedicated MMO for 20 minutes before starting the first of a series of drill holes, and the watch is repeated if there is a break of more than 20 minutes between the drilling of shot-holes. If any marine

[3] JNCC (August 2010). JNCC Guidelines for Minimising the Risk of Injury to Marine Mammals from using Explosives. Accessed at http://jncc.defra.gov.uk/pdf/JNCC_Guidelines_Explosives%20Guidelines_August%202010.pdf .

mammals are observed the MMO will notify the Drill Master, and drilling will be postponed until the mammals move out of the exclusion zone. Once the MMO is satisfied that area is clear of marine mammals then drilling can commence.

Before drum cutter operations (and at first use of other mechanical rock-breakers before a practical mitigation zone is established based on UWN measurement), watches of a 500m mitigation zone are carried out by a JNCC-trained, non-dedicated MMO for at least 20 minutes. If marine mammals are identified in the mitigation zone, operations will not commence until marine mammals have left the area.

For blasting work, dedicated experienced MMOs will be employed. AHEP requires these MMOs to have attended a relevant JNCC course and, ideally, have at least 2 years' experience as MMO including work on similar projects (or in the North Sea). The experienced MMOs should:

- Be suitably equipped and trained to be able to identify the marine mammal species likely to be in the 1km mitigation zone;
- Concentrate their efforts before, during and after a 'noisy' activity;
- Be familiar with using Marine Mammal Reporting forms; and
- Have direct access to the person who is controlling the construction operation and is authorised to stop or change activities if necessary.

For blasting, two dedicated experienced MMOs, one located on the North Headland and one on the South Headland, will observe a 1km mitigation zone from the blast for 1 hour before the scheduled blast time (See Figure 11.2. These locations are approximately 18m above sea level). Both will maintain radio contact with the lead PAM operator who will in turn be in contact with the blast master. If any marine mammals are observed in the mitigation zone, the blast will be postponed, until the MMOs have confirmed that:

- If blasting in the northern part of the bay:
    - no seals have been observed inside the bubble curtain
    - no other marine mammals have been observed in the 1km exclusion zone for the last 30 minutes.
- If blasting in the southern area (both for southern part of the bay and the SBW trenches):
    - no seals are either within the double bubble curtain or closer than 500m away from the blasting point, whichever is greater.
    - no other marine mammals have been observed in the 1km exclusion zone for the last 30 minutes.

The procedure for carrying out MMO and PAM watches is provided in Section 11.7.5. After a blast has occurred, the MMO will continue to watch for the time stated in the applicable Method Statement to record any information on behaviour of animals that enter into the mitigation zone, unless restricted by daylight in which

a post blast watch requirement can be relaxed in agreement with previous discussions with MS-LOT.

Figure 11.2: MMO Observation Locations on North and South Headlands (height of each vantage point is approximately 18m above sea level)

If concurrent activities require MMO watches, the ECoW will review the work plan and ensure that the nominated MMO for each activity is aware of the other and that the MMOs are in contact with each other and working together to highlight sightings of marine mammals.

In addition to MMO watches during noise generating activities, the ECOW will dedicate at least 20 hours per month (equivalent to one hour for each working day) to carrying out watches for marine mammals. Sightings and observed behaviour will be recorded recording using the standard forms used during noise generating activities.

All sightings will be recorded on MMO recording forms.

11.7.4 Passive Acoustic Monitoring (PAM)

Passive Acoustic Monitoring (PAM) system will be used in combination with MMOs to ensure the 1km mitigation zone for blasting operations is clear of marine mammals. PAM will detect vocalising marine mammals within the mitigation zone that are not visible to MMOs.

JNCC state that the PAM operative is expected to be a sub-contracted professional whose sole role to operate the PAM system. For AHEP, the PAM operators will be experienced specialists dedicated to the task of operating the PAM equipment.

The PAM monitoring stations and detection coverage for are detailed in Figure 11.3

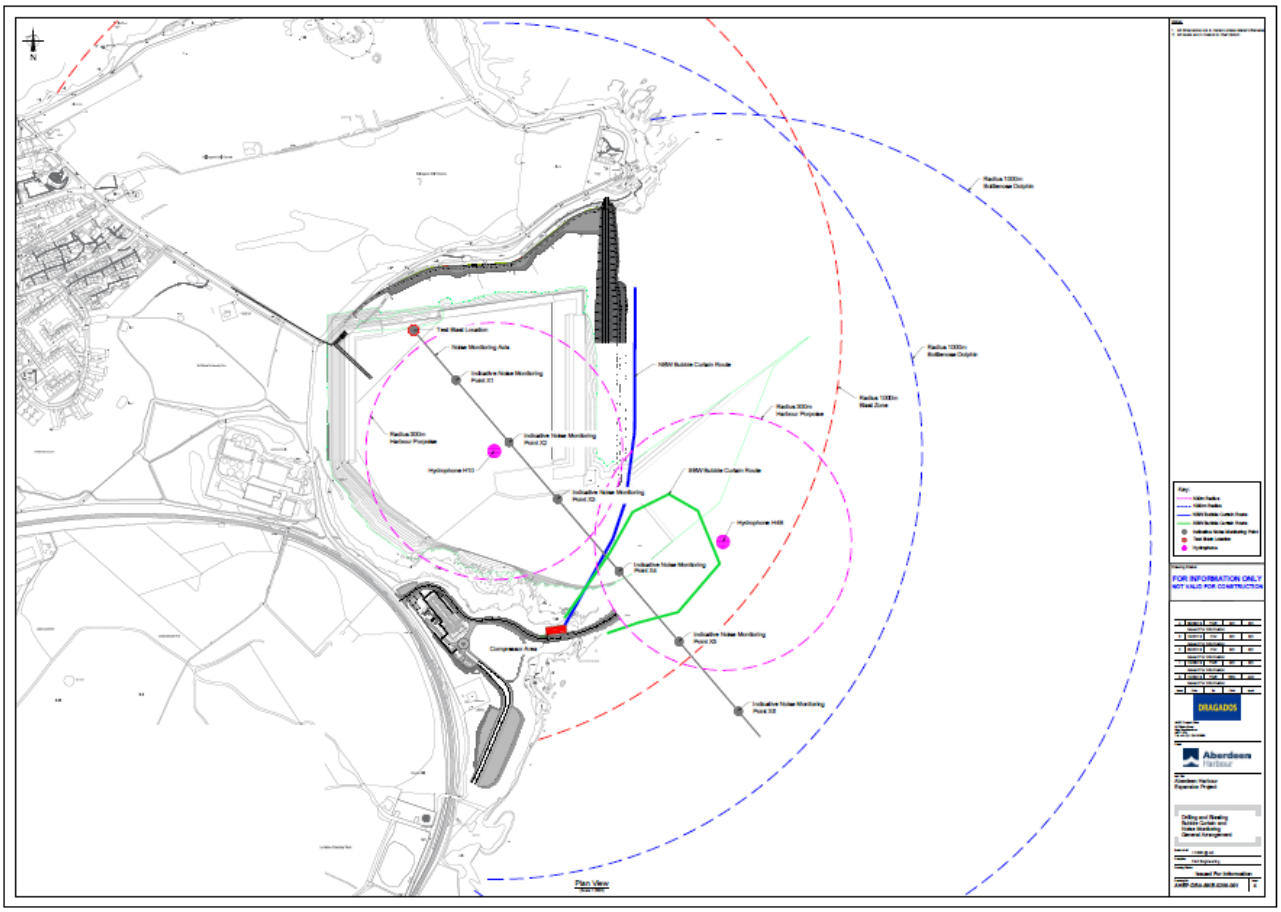

Figure 11.3 PAM Monitoring Locations during Blasting

Figure 11.4 details the PAM monitoring location for blasting in the southern shore area.

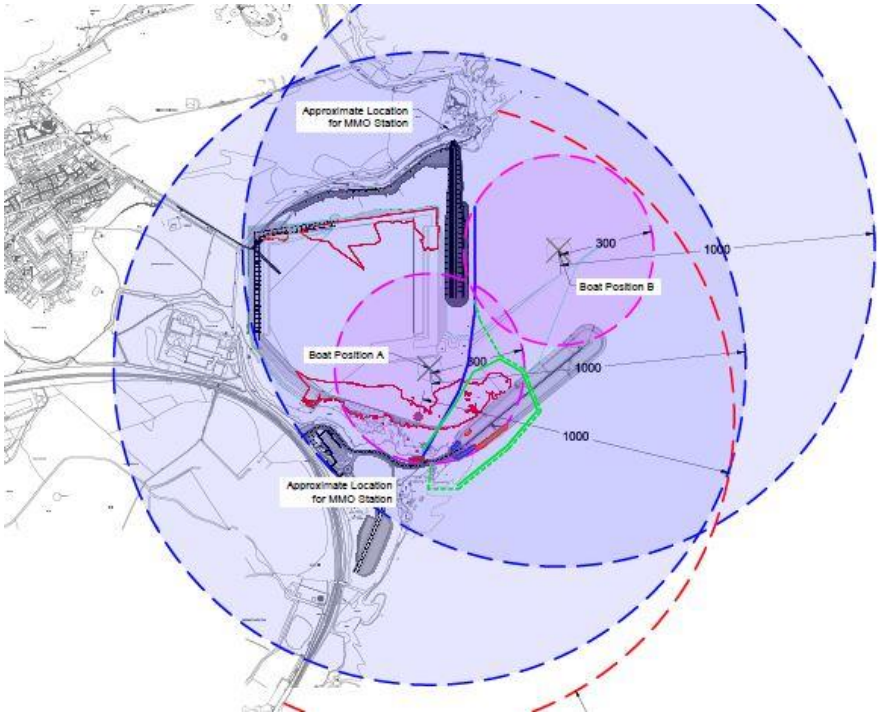

Figure 11.4 PAM Monitoring locations on southern shore

Three vessels will be used when required. The vessels will be statically positioned during the mitigation periods. Boat A (inner) will be positioned at the inner harbour/entrance channel. Boat B (outer north) will be positioned at the north of the outer bay. Boat C (outer south) will be positioned at the south of the outer bay when line of sight to the basting works require it. After the south breakwater has progressed and line of sight is reduced, two vessels will be used for PAM as displayed in figure 11.4. The positions and mobility of the vessels may be adjusted after consultation with MS-LOT.

PAM and UWN hydrophones will be deployed for one hour prior to a blast. The procedure for carrying out MMO and PAM watches is provided in Section 11.7.3.

11.7.5 Procedure for MMO and PAM watches prior to blasting

Prior to each blast, the following procedure will be followed:

1. One hour prior to the blast, the Blast master will alert the Lead MMO/PAM operator, MMO and the Bubble Curtain Operator of the intention to blast at a given time.

2. The Lead MMO/PAM operator will remain in constant communication with the acoustic technicians, MMOs, Blast master and the Bubble Curtain operator, via VHF Channel 13. The lead MMO/PAM operator will be responsible for mitigation controls across the site and will instruct the blast master to delay operations until the acoustic mitigation team is satisfied that

all marine mammals are out of the exclusion zones and that mitigation protocols have been adhered to.

3. One hour before the scheduled blast the MMO and PAM operators will undertake marine mammal monitoring within 1 km (direct line of sight) of the blast. The MMOs will be positioned on the north and south headlands, which are at approximately 18m above sea level. (Figure 11.2). If marine mammals are observed in the mitigation zones the blast will be postponed, until both PAM and the MMOs have confirmed the following:

   For blasting in the north of the bay:

   - No seals have been observed in the bubble curtain mitigation zone; and
   - No other marine mammals have been observed in the 1 km mitigation zone for 30 minutes.

   For blasting in the south of the bay and South Breakwater trenches:

   - No seals are either within the DBC or within 500 m of the blasting location, whichever is greater.
   - No other marine mammals have been observed in the 1 km mitigation zone for 30 minutes.

4. The Lead MMO confirms to the Blast Master that blasting can commence.
5. If seals are observed within the mitigation zones during this 30 minute observation period and no other marine mammals are present, the ADD will be activated for a maximum 20 minute period and will only be attempted twice within any one blasting operation (see Section 11.7.6). If this is not effective then use of the ADD will be ceased for that blasting operation. Blasting will not go ahead if seals remain in the mitigation zone.
6. 15 minutes before the blast commences the bubble curtain is switched on, and the operator confirms to the Blast Master and MMO/PAM lead that it is operating effectively.
7. The Project ECoW will also carry out checks for rafting birds in the vicinity of the blasting area and advise the Blast Master that the area is clear. The detonator charge used for fish scare will also scare any birds away in the immediate area. The movement of small vessels on the project also scares rafting birds off the water.
8. 1 minute before each blast a small explosive device (for instance the ‘Shockstar MS’ containing 720mg of explosives) will be detonated one minute prior the start-up of the double bubble curtain to deter fish.
9. Drill platform / dredger is moved to safe distance from the blast area.
10. Blast master will visually check the area of blasting, to make sure no ships come near or that there is no one within the vicinity of the blast exclusion zone.

11. If there is a vessel approaching, or other activity occurs in or near the area of blasting, the procedure is suspended, until the vessel (or other activities) has left the area.

12. Blast master will make final check with MMO/PAM operator that no marine mammals are present in the exclusion zone.

13. Directly before the blast the Drill & Blast pontoon will signal the load horn using the blasting signal (increasing intervals).

14. The PAM operators on boats B and C as displayed in Figure 11.5 will move into position for simultaneous PAM and UWN monitoring as detailed in Figure 11.4.

15. Blasting takes place.

16. Immediately after blasting, the Drill & Blast pontoon will signal the "no more danger" signal (one long signal).

17. The Bubble curtain will be switched off and any fish kill or unusual activities will be recorded. As per the requirements of the current approved CEMD 2017, checks for any dead or injured salmon or other fish during marine construction activities will be carried out; this will form part of the environmental induction and toolbox talks.

18. All large fish carcases which can be collected safely will be stored in an air tight container. The fish health inspectorate will be contacted immediately on collection of salmonid carcasses to arrange their collection and delivery to the MS-Fish Pathology Unit for sampling to determine cause of death. In the event that five or more fish carcasses (or injured, or moribund fish) are reported during one 24 hour period within 50m of a construction zone, the Ecological Clerk of Works (ECoW) will notify MS-LOT, Dee District Salmon Fishery Board and the Environmental Manager via phone and email. Within 24 hours of the fifth reported carcass, consultation will be sought with the Environmental Manager and MS-LOT to determine any temporary mitigation requirements. If deemed necessary, temporary mitigation will be implemented as soon as it is safe to do so. Any dead marine mammal carcass will be delivered to SAMSS team and reported to the Marine Scotland/SNH within 24 hours.

19. The number of dead or injured fish noted pre-blasting and post-blasting recorded, along with any pictures, will be provided to MS-LOT in the blasting report.

20. The Drill and Blast pontoon will be manoeuvred back into position ready for the next phase of drilling. The waste from the Nobel detonation cords are collected on board and drilling can be resumed.

21. The MMO will continue to watch for 20 minutes after blasting has occurred to record any information on behaviour of animals that enter into the mitigation zone after blasting.

22. PAM will continue monitoring for 20 minutes after blasting to determine how quickly marine mammals move back into the 1km mitigation zone.

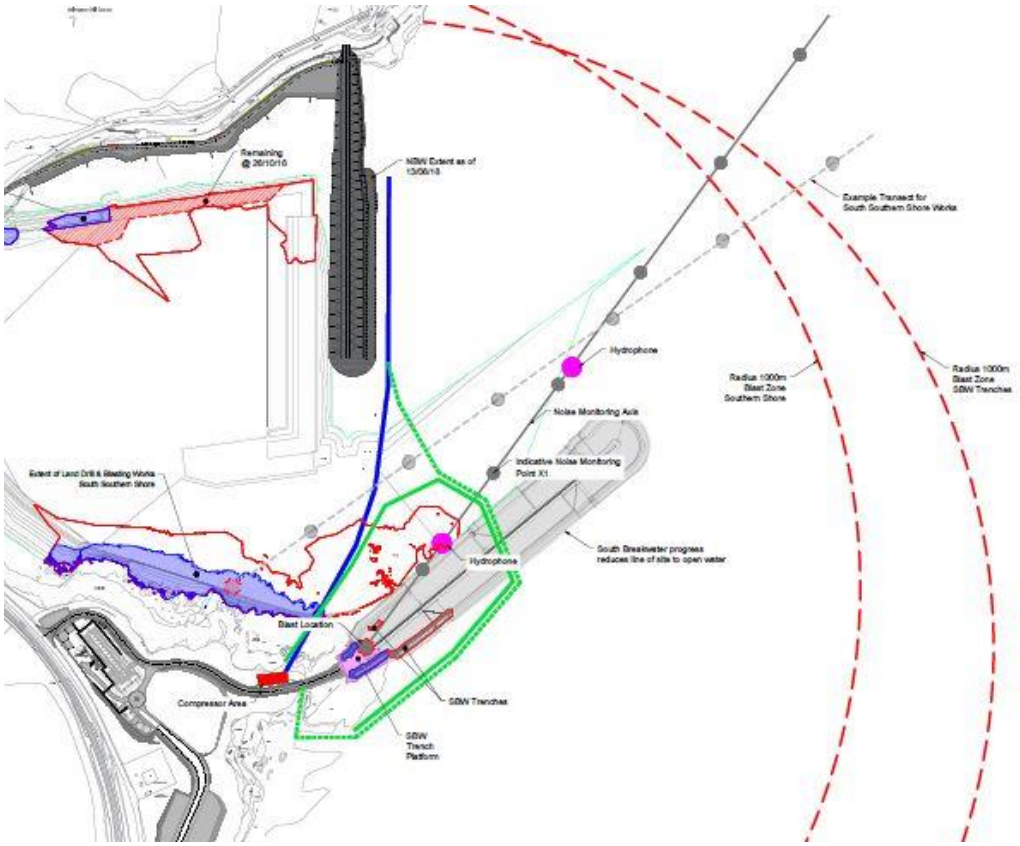

Figure 11.5 Map presenting planned locations for double bubble curtains and noise monitoring equipment for southern trenches and southern shore work.

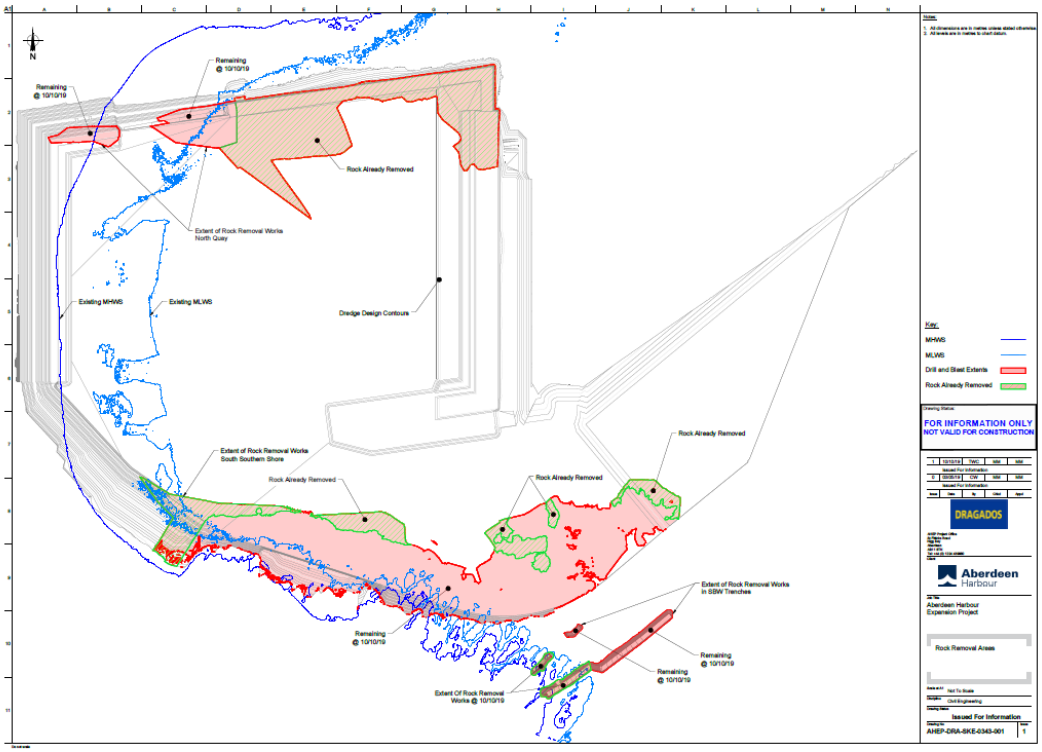

Figure 11.6 Areas where rock removal has taken place (green) and is due to take place (red).

11.7.6 Acoustic Deterrent Device (ADD)

If seals are observed in the mitigation zone during the MMO and PAM watch before blasting and no other marine mammals within 1km, an acoustic deterrent device (ADD) may be activated to encourage seals to swim out of the mitigation zone.

In 2018, the ADD was used, but it proved ineffective at deterring large bull seals from the mitigation zone.

If used, the ADD located on an anchored vessel at a distance of 100m from any seal activity will be switched on for 20 minutes following a soft start procedure, followed by 20 minutes off. During this time, the MMOs will monitor the behaviour of the seals and advise if they have moved out of the mitigation zone. If they have not moved the ADD will be reactivated for a further 20 minutes. If the ADD is not successful and seals remain in the mitigation zone, the blasting operation will be postponed. The ADD will not be attempted more than twice for any blasting operation. Vessels must not harass or approach the seals in an attempt to herd the seals out of the area. If the ADD is successful, after confirmation by the MMOs and PAM that no marine mammals are within mitigation zone, the bubble curtain will be switched on and blasting preparations will resume.

11.7.7 Underwater Noise (UWN) Monitoring

Underwater noise levels will be monitored during blasting activities. The underwater noise measurements in Nigg Bay are undertaken following the 'Good Practice Guide for Underwater Noise Measurement[4]' with regard to in-situ underwater noise measurement, data processing and reporting the measurements using appropriate metrics.

Our current proposal for incremental increase in charge weight has been designed to demonstrate the project's precautionary approach towards ensuring that marine mammals are not exposed to noise levels above the 183 dB re 1µPa (peak) equivalent to 170 dB re 1µPa (RMS) assessed in the ES, outside the bubble curtain or at 400 m if the bubble curtain is positioned less than 400 m from the blast location.

This plan has considered the conclusions from the calibrated blast noise propagation model, based on noise levels measured in the 2018 blasting campaign, and the conclusions of the recently prepared EIAR.

The blasting incremental regime is divided in two phases;

Phase 1 starts with a charge weight of 20 kg, and then the charge weight is increased to 30kg and then 40kg. During phase 1, six blasts will be undertaken for each charge weight before increasing to the next.

Phase 2 then starts and the charge weight increments are reduced to 5kg. The number of repetitions with each charge weight remains six blasts before increasing to the next charge weight. The Maximum charge weight is 80kg.

The increments are summarized below:

Phase 1 blasting regime: 20, 30, 40 kg

Phase 2 blasting regime: 45, 50, 55, 60, 65, 70, 75, and 80 kg

After each detonation, if the peak level measured is below the noise threshold (183 dB Peak/170 dB RMS), then the charge weight will be increased to the next increment. All noise measurements will be reported on the same day of the blasting to MS-LOT.

Additional considerations:

A Precautionary Control Limit (PCL) has been defined by AHEP to minimize chances of reaching the noise threshold. PCL is set as 178 dB Peak/167dB RMS (5dB below peak level threshold (183dB)) and 3dB below RMS threshold (170dB) respectively). The following actions will take place in respect of the PCL.

[4] National Measurement Office, Marine Scotland, The Crown Estate, Robinson, S.P., Lepper, P. A. and Hazelwood, R.A., NPL Good Practice Guide No. 133, ISSN: 1368-6550, 2014.

1 - If any noise measurement reaches the PCL (but remains below the noise threshold), all remaining planned blasts for that charge weight will be undertaken. Two scenarios are then contemplated:

1.1 - If the noise measured for the remaining blasts with that same charge weight are all below the PCL, the charge weight will continue to be gradually incremented but reducing the weight of the planned increments by half (i.e. 5kg instead of 10kg and so on).

1.2 - If the sound level measured for any of the remaining blasts for that same charge weight is again over the PCL, the charge weight will not be incremented further.

2 - If any noise measurement reaches or exceeds the noise threshold (183 dB Peak/170 dB RMS), the charge weight will be reduced by 5kg and the blasting plan will continue but all planned increments will be reduced by half (i.e. 2.5kg instead of 5kg). The following scenarios are then considered:

2.1 - If all following blasts are below the PCL, the charge weight will continue to be gradually increased with reduced increments as described above.

2.2 - If any of the following blasts reaches the PCL, the charge weight will not be increased further.

2.3 - If any of the following blasts reaches the threshold, the charge weight will be further reduced by 5kg and will remain fixed for all remaining blasts.

During each blast, underwater noise will be measured using two hydrophones positioned along a transect between the blast location and the open sea. One hydrophone is inside the DBC and the other is outside it. The peak noise level from each blast will be provided to MS-LOT on the day of the blast, and a report of calibrated noise levels will be sent to MS-LOT within a week.

If the daily peak noise level for any charge increment is above the benchmark, MS-LOT and Scottish Natural Heritage (SNH) will be notified on the day of the blast and the above PCL steps would be followed.

The positions for deployment of hydrophones for underwater noise monitoring change according to the location of the blast and the line of sight transect to the open sea. The UWN monitoring locations for marine blasting in the north and south of Nigg Bay are shown in Figure 11.4

This information can be seen summarised in the tables below:

Noise level measured below PCL
Noise level measured over PCL but below RMS/Peak threshold
Noise level measured equal or higher than RMS/Peak threshold

Scenario 1 - No exceedances

Charge size (Kgs.)	20.0	30.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0
Blast number	1	7	13	19	25	31	37	43	49	55	61
	2	8	14	20	26	32	38	44	50	56	62
	3	9	15	21	27	33	39	45	51	57	63
	4	10	16	22	28	34	40	46	52	58	64
	5	11	17	23	29	35	41	47	53	59	65
	6	12	18	24	30	36	42	48	54	60	66

Scenario 1.1 - One measurement over PCL

Charge size (Kgs.)	20.0	30.0	40.0	45.0	50.0	52.5	55.0	57.5	60.0	62.5	65.0	67.5	70.0	72.5	75.0	77.5	80.0
Blast number	1	7	13	19	25	31	37	43	49	55	61	67	73	79	85	91	97
	2	8	14	20	26	32	38	44	50	56	62	68	74	80	86	92	98
	3	9	15	21	27	33	39	45	51	57	63	69	75	81	87	93	99
	4	10	16	22	28	34	40	46	52	58	64	70	76	82	88	94	100
	5	11	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102

Scenario 1.2. - Two measurements over PCL

Charge size (Kgs.)	20.0	30.0	40.0	45.0	50.0	55.0	55.0	55.0	55.0	55.0	55.0
Blast number	1	7	13	19	25	31	37	43	49	55	61
	2	8	14	20	26	32	38	44	50	56	62
	3	9	15	21	27	33	39	45	51	57	63
	4	10	16	22	28	34	40	46	52	58	64

Scenario 2.1 - One exceedance, then always below PCL

Charge size (Kgs.)	20.0	30.0	40.0	45.0	50.0	55	60.0	55	57.5	60.0	62.5	65	67.5	70.0	72.6	75.0	77.5	80.0
Blast number	1	7	13	19	25	31	37	43	49	55	61	67	73	79	85	91	97	103
	2	8	14	20	26	32	38	44	50	56	62	68	74	80	86	92	98	104
	3	9	15	21	27	33	39	45	51	57	63	69	75	81	87	93	99	105
	4	10	16	22	28	34	40	46	52	58	64	70	76	82	88	94	100	106
	5	11	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108

Scenario 2.2 - One exceedance, one subsequent measurement over PCL

Charge size (Kgs.)	20.0	30.0	40.0	45.0	50.0	55	60.0	55	55	55	55
Blast number	1	7	13	19	25	31	37	43	49	55	61
	2	8	14	20	26	32	38	44	50	56	62
	3	9	15	21	27	33	39	45	51	57	63
	4	10	16	22	28	34	40	46	52	58	64
	5	11	17	23	29	35	41	47	53	59	65
	6	12	18	24	30	36	42	48	54	60	66

Scenario 2.3 - One threshold exceedance, one subsequent measurement over threshold

Charge size (Kgs.)	20.0	30.0	40.0	45.0	50.0	55	60.0	55	50	50	50
Blast number	1	7	13	19	25	31	37	43	49	55	61
	2	8	14	20	26	32	38	44	50	56	62
	3	9	15	21	27	33	39	45	51	57	63
	4	10	16	22	28	34	40	46	52	58	64
	5	11	17	23	29	35	41	47	53	59	65
	6	12	18	24	30	36	42	48	54	60	66

11.8 Reporting

Dragados will submit periodic reports to MS-LOT and SNH .

Whilst activities with the potential to create underwater noise which are likely to disturb marine mammals are ongoing on site, Dragados will produce reports on the operation of the mitigation package used for blasting (MMO and PAM) and reports of the UWN monitoring to demonstrate DBC efficiency during blasting.

11.8.1 C-POD Reports

Dragados has submitted reports of C-POD data to MS-LOT in 2018 and 2019.

Dragados will submit quarterly reports of C-POD data while they are operational and an annual summary report. These reports will summarise the deployment methodology, any problems encountered and the monitoring results from the C-POD deployment.

Dragados will submit a final report once construction is complete, which will compare C-POD detections against those recorded during the AHEP ES C-POD surveys.

11.8.2 MMO and PAM Reports

The MMO and PAM contractor appointed by Dragados during blasting works will record all observations of marine mammals on standard forms or their electronic equivalents (see Appendix A) and submit the sheets weekly to the ECoW.

During blasting, Dragados ECoW or EM will collate a monthly report of MMO and PAM activities containing

- Date and location of the operations, including distances between blasting points and double bubble curtain.
- Start and end time of the observation
- Marine mammals identified
- A comparison between detections of marine mammals made by MMOs and PAM registers (to monitor the PAM effectiveness).
- Details concerning the behaviour of the animals observed, including any use of the ADD and the effect this had on the behaviour of seals during and after use of the ADD.
- Details of any occasions when activity was delayed or stopped due to presence of marine mammals
- Weather conditions and visibility
- Details of any problems encountered including exceptional circumstances where blasting has occurred in the hours of darkness

- A look-ahead to activities planned in the next month and any specific mitigations proposed
- Any recommendations for amendment of the MMMP.

The monthly report and the MMO and PAM logs will be submitted to JNCC, SNH and WDC.

11.8.3 UWN Monitoring Reports

Dragados will carry out UWN monitoring of the DBC until MS-LOT is satisfied that its effectiveness has been sufficiently demonstrated and it is reasonable to expect noise levels outside the DBC to remain below the benchmark.

Dragados will require the UWN measurement contractor to provide an 'initial indication of sound pressure levels inside and outside the DBC within 24 hours of the blast. If the 'initial indication' exceeds the benchmark, Dragados Environmental manager will notify MS-LOT and SNH within 24 hours of the blast.

Dragados will require the UWN measurement contractor to provide Dragados' appointed UWN expert with UWN measurement data within 24 hours of each blast. DUK's UWN expert is to report calibrated UWN to Dragados within 72 hours of the blast. When received, the calibrated UWN data report will be provided to MS-LOT.

During blasting, Dragados will provide a monthly summary report of UWN measurements to S-LOT and SNH.

11.8.4 UK Noise Registry

The UK Marine Noise Registry (MNR) developed and maintained by JNCC on behalf of Defra and the Devolved Administrations (DAs) is a database that records the spatial and temporal distribution of impulsive noise generating activities in UK seas in order that they can be analysed to determine whether the activities compromise the achievement of Good Environmental Status (GES) under the Marine Strategy Framework Directive.

Dragados has, and will continue to, submit data on planned activities to the UK Noise Registry. Dragados will also submit records of the actual activities undertaken. According to the MNR guidance, the use of explosives is a 'noisy' underwater activity that shall be recorded in the MNR.

Information required to be recorded in the MNR when explosives are used is listed in Table 11.2.

Table 11.2: Information required in the Marine Noise Registry

Proposed activity form	Close-out report

• Earliest start date (DD/MM/YYYY)
• Latest end date (DD/MM/YYYY)
• Expected duration of activity
  ○ Location
  ○ Latitude/longitude point (decimal degrees)
  ○ Latitude/longitude polygon (decimal degrees)
  ○ Quadrant/block
• Source properties:
  ○ SPL, dB re 1µPa (peak) @1m SEL, dB re 1µPa2 s (per pulse) @1m
  ○ Piling: maximum hammer energy (KJ)
  ○ Explosives: mass of TNT equivalent (kg)
	• Source properties:
	  ○ SPL, dB re 1µPa (peak) @1m
	  ○ SEL, dB re 1µPa2 s (per pulse) @1m
	  ○ Piling: maximum hammer energy (KJ)
	  ○ Explosives: mass of TNT equivalent (kg)
	• Actual location of activity
	  ○ Latitude/longitude point (decimal degrees)
	  ○ Quadrant/Block
	• Actual dates on which activity took place in correspondence with the location

Dragados ECoW will work with its sub-contractors to collate data for input into the MNR when required.

Dragados will submit a Close-out Report for the licensable marine activities that produced loud, low to medium frequency (10Hz-10kHz) impulsive noise in the online MNR at the close-out report due date and no later than 12 weeks from the completion of the licensable marine activity.

11.8.5 Data Analysis and Close-out Report

Dragados will seek to identify an academic (e.g. post-doc) to analyse the AHEP data relating to marine mammals, including:

- The data collected from the C-PODS will be compared with the data collected for the EIA baseline.
- The MMO observation sheets from AHEP will be analysed in a similar manner to the JNCC MMO Seismic Survey/Explosive information.
- The data from PAM reports will be analysed together with the MMO data.

The data will be analysed with a view to compiling a final close-out report within 6 months of the completion of construction.

11.8.6 Report summary

Report	Frequency	Reported by
C-POD Data		

C-POD report	Quarterly	Environmental team to MS-LOT and SNH
C-POD Annual Summary	Annual	Environmental team to MS-LOT and SNH
C-POD Final Report	End of construction	Environmental team to MS-LOT and SNH
Blasting Mitigations		
PAM Monitoring Trial Report	2 weeks prior to commencement of blasting	PAM contractor to MS-LOT
MS Monthly report and ADD use / seal behaviour	Monthly	Environmental team to MS-LOT and SNH
MMO logs	Monthly	Environmental team to MS-LOT, JNCC, SNH and WDC
UWN calibrated data report	Within 72 hours of blast	Environmental team to MS-LOT
UWN monitoring reports of calibrated data	Monthly (unless benchmark exceeded)	Environmental team to MS-LOT and SNH until agreed otherwise
Notifications		
Non-compliance (Anything that deviates from agreed methodology including any dead marine mammal)	Within 48 hours	Environmental team to MS-LOT
Exceedance of noise benchmark	Early indication within 24 hours Accurate level within 72 hours	Environmental team to MS-LOT
Close-out reports		

UWN Summary Report.	At the close-out report due date and no later than 12 weeks from the completion of the licensable marine activity.	Submitted via online Marine Noise Registry Copy will also be submitted to MS-LOT.
Close-out Report	Within 6 months of the completion of construction	Independent academic to MS-LOT, SNH and JNCC

Appendix A

Marine Mammal Observation Sheet

A1 Appendix A – JNCC Recording Forms

MARINE MAMMAL RECORDING FORM - COVER PAGE

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Country**	**Location**	**Ship/ platform name**
Client **Dragados**	**Contractor**	**Survey type** ☐ site ☐ VSP ☐ 2D ☐ WAZ ☐ 3D ☐ piling ☐ 4D ☐ explosives ☐ OBC ☐ other ☐ 4C	
Start date	**End date**		

Number of source vessels	**Type of source** (e.g. airguns)	**Number of airguns** (only if airguns used)	**Source volume** (cu. in.)
Source depth (metres)	**Frequency** (range in which peak energy is emitted, in Hz)	**Intensity** (primary peak-to-peak amplitude in dB re. 1µPa or bar metres)	**Shot point interval** (metres)
Method of soft start ☐ increase number of guns ☐ increase frequency (where permitted) ☐ increase pressure (where permitted) ☐ increase number and frequency ☐ increase number and pressure ☐ other			

Visual monitoring equipment used (e.g. binoculars, big eyes, etc.)	**Magnification of optical equipment** (e.g. binoculars)	**Height of eye above water surface** (metres)	**How was distance of animals estimated?** ☐ by eye ☐ with laser rangefinder ☐ with rangefinder stick/ callipers ☐ with reticle binoculars ☐ by relating to object at known distance ☐ other
Number of dedicated MMOs	**Training of MMOs** ☐ JNCC approved MMO training course for UK waters ☐ PSO training course for the Gulf of Mexico ☐ MMO training course for Irish waters ☐ MMO training course for New Zealand waters ☐ other ☐ none		

Was PAM used? ☐ yes ☐ no	**Number of PAM operators**
Description of PAM equipment	

Range of PAM hydrophones from airguns (metres)	**Bearing of PAM hydrophones from airguns** (relative to direction of travel)	**Depth of PAM hydrophones** (metres)

MARINE MAMMAL RECORDING FORM - OPERATIONS

Regulatory reference number .....……..... **Ship/ platform name** .....
(e.g. DECC no., BOEM permit no., OCS lease no., etc.)

Complete this form every time the airguns are used, including overnight, whether for shooting a line or for testing or for any purpose.
Times should be in UTC, using the 24 hour clock.

Date	**Reason for firing** l = line t = test x = test followed immediately by line	**Time soft start/ ramp-up began**	**Time of full power**	**Time of start of line**	**Time of end of line**	**Time of reduced output** (if relevant)	**Time airguns/ source stopped**	**Time pre-shooting search began**	**Time search ended**	**Time PAM began**	**Time PAM ended**	**Depth range** (during pre-shooting search) s = <200m d = >200m b = both	**Was it day or night in period prior to firing?** d = day n = night w = dawn k = dusk	**Was any mitigating action required?** (yes/ no)

MARINE MAMMAL RECORDING FORM - EFFORT

Regulatory reference number .....…….. **Ship/ platform name** .....
(e.g. DECC no., BOEM permit no., OCS lease no., etc.)

Record the following for all watches, even if no marine mammals are seen.
START A NEW LINE IF SOURCE ACTIVITY OR WEATHER CHANGES. ENTER DATA AT LEAST EVERY HOUR.

Date	**Visual watch or PAM** (v/ p)	**Observer's/ operator's name(s)**	**Time of start of section of watch** (UTC, 24hr clock)	**Time of end of section of watch** (UTC, 24hr clock)	**Source activity** (f/ s/ r/ n/ v)	**Start position** (latitude and longitude)	**Depth at start** (m)	**End position** (latitude and longitude)	**Depth at end** (m)	**Speed of vessel** (knots)	**Wind dir'n**	**Wind force** (B'fort scale)	**Sea state** (g/ s/ c/ r)	**Swell** (o/ m/ l)	**Vis.** (visual watch only) (p/ m/ g)	**Sun glare** (visual watch only) (n/ wf/ sf/ vf/ wb/ sb/ vb)	**Precip.** (n/ l/ m/ h/ s)

Visual watch or PAM: v = visual watch; p = PAM
Source activity: f = full power; s = soft start; r = reduced power (not soft start); n = not active; v = variable (e.g. tests)
Sea state: g = glassy (like mirror); s = slight (no/ few white caps); c = choppy (many white caps); r = rough (big waves, foam, spray)
Swell: o = low (< 2 m); m = medium (2-4 m); l = large (> 4 m)
Visibility: p = poor (< 1 km); m = moderate (1-5 km); g = good (> 5 km)
Sun glare: n = none; wf = weak forward; sf = strong forward; vf = variable forward; wb = weak behind; sb = strong behind; vb = variable behind
Precipitation: n = none; l = light rain; m = moderate rain; h = heavy rain; s = snow

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number (start at 1 for first sighting of survey)**	**Acoustic detection number (start at 500 for first detection of survey)**
Date		**Time at start of encounter** (UTC, 24hr clock)	**Time at end of encounter** (UTC, 24hr clock)

Were animals detected visually and/ or acoustically?

- visual
- acoustic
- both

How were the animals first detected?

- visually detected by observer keeping a continuous watch
- visually spotted incidentally by observer or someone else
- acoustically detected by PAM
- both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth (metres)**

Species/ species group	**Description** (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)
Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken** yes no

Behaviour (visual sightings only)

Direction of travel (relative to ship)

- towards ship
- away from ship
- parallel to ship in same direction as ship
- parallel to opposite direction to ship
- crossing perpendicular ahead of ship
- variable
- milling
- stationary
- other
- unknown

Direction of travel (compass points)

- N
- NE
- E
- SE
- S
- SW
- W
- NW
- variable
- stationary
- unknown

Airgun (or other source) activity when animals first detected full power not firing soft start reduced power (other than soft start)	**Airgun (or other source) activity when animals last detected** full power not firing soft start reduced power (other than soft start)	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
		Closest distance of animals from airguns (or other source) (metres)	**Time of closest approach** (UTC, 24hr clock)

If seen during soft start give (during soft start (metres): **First distance** **Closest distance** **Last distance**	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned) none required delay start of firing shut-down of active source power-down of active source power-down then shut-down of active source	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)

Appendix B

Underwater Noise Measurements

B2 Annex B Summary of Guidance Notes for Underwater Noise Measurement

(Reproduced from NPL Good Practice Guide No 133)

B2.1 Summary: Acoustic Metrics

The most appropriate metrics for use with **pulsed sounds** are:

- Single pulse Sound Exposure Level (SEL)
- Cumulative Sound Exposure Level (SEL) (for a series of pulses);
- Peak sound pressure level;
- Peak-to-peak sound pressure level.

It may also be useful to calculate the peak compressional sound pressure level and peak rarefactional sound pressure level, the pulse duration, and the pulse repetition frequency.

The metric most suitable for **continuous sounds** (including ambient noise) is:

- Sound Pressure Level (SPL).

Note that by convention, this is a time-averaged quantity and is most commonly understood as an RMS value. The averaging time used in the calculation of the values of SPL must be stated.

Where continuous sounds also contain transient or pulsed sounds from specific events, the metrics used for pulsed sounds should be used to describe these specific events.

B2.2 Summary: Measuring Instrumentation

Ensure measuring system performance is fit for purpose. Key performance parameters include:

- Sensitivity
- frequency response
- directivity
- system self-noise
- dynamic range

The performance of any commercial off-the-shelf systems should be validated

The measuring system should be calibrated over the full frequency range of interest

Ensure appropriate quality assurance procedures are applied to the measurement

Data storage should ideally be lossless format and include all necessary metadata and calibration information

B2.3 Summary: Deployments

Ensure deployment configuration is appropriate for measurement requirements with hydrophones deployed at appropriate depths

Ensure deployment related parasitic signals are minimised, including those originating from:

- Flow noise
- Cable strum
- Surface heave
- Vessel/platform noise
- Mechanical noise
- Electrical noise

Record all auxiliary data and metadata

Ensure steps are taken to protect recorders and data from loss

B2.4 Summary: Ambient noise measurement

Ensure that the objectives of the measurements are clear and that the monitoring and deployment configuration is appropriate for those objectives

Ensure that the temporal sampling regime is appropriate for the objectives, and that the duration and duty cycle are appropriately chosen

Ensure that the spatial sampling regime is appropriate for the objectives, and that the locations of monitoring stations are appropriately chosen

Ensure that the instrumentation is correctly specified for the application (for example, in terms of frequency range, dynamic range and self-noise)

Ensure the deployment minimises measurement artefacts and parasitic signals

Document and justify choice of data analysis methodology in terms of:

- Metrics – arithmetic mean and median are recommended

- Averaging procedure – choice of snapshot time
- Statistical representation of data – representing dispersion of data by use of analysis such as box-plots, and cumulative distributions.

Record all relevant auxiliary data and metadata including data which may correlate with acoustic data (ship traffic data, weather data, etc.)

B2.5 Summary: Radiated noise measurement

Ensure that the objectives of the measurements are clear and that the measurement configuration is appropriate for those objectives

Ensure that the source output metrics are appropriate for the objectives, and that the measurement configuration enables the chosen metrics to be derived

If a source level is calculated, ensure that an appropriate propagation model is used which accounts for the relevant physical propagation phenomena

Ensure that the measurements satisfy the requirements of the objectives such that:

- the instrumentation is correctly specified for the application in terms of frequency range, dynamic range and self-noise
- spatial sampling is appropriate to ensure far-field conditions and (if required) to provide an empirical check on propagation
- the temporal sampling captures any variation in acoustic output using a fixed (static) recording position
- the deployment minimises measurement artefacts and parasitic signals contaminating noise sources are minimised (or eliminated)

B2.6 Summary: Propagation modelling

Ensure that the choice of model is appropriate for the application

Ensure that the propagation model used accounts for the physical propagation phenomena relevant to the scenario, including the following potential influencing factors

- range-dependent bathymetry including dependence on varying water depth and the frequency cut-off for the channel;
- sound speed including the sound speed profile (especially for deeper water);
- frequency dependence, including absorption in the water;

- seabed properties, including propagation within the seabed;
- interaction with the sea surface, including the effect of surface roughness.

Preferably, use a model that has been benchmarked against historical experimental data or by comparison with other propagation models, or check consistency with range-dependent measured data from current experimental work (for example, when measuring radiated noise).

B2.7 Summary: Uncertainties

- All measurements require an estimate of uncertainty in order to be useful.
- Uncertainties may be categorised into two classes
  - Type A: a measure of the repeatability of the measurement (derived from the statistical dispersion of repeated measurements);
  - Type B: a measure of uncertainty due to any the systematic bias.

There are a number of potential sources of uncertainty:

- calibration of instrumentation;
- position of source and receiver;
- spurious signals introduced by the deployment
- validity of any assumptions made;
- environmental parameters (for use in a propagation model).

Ensure that the measurements satisfy the requirements of the objectives such that:

- the instrumentation is correctly specified for the application in terms of frequency range, dynamic range and self-noise
- spatial sampling is appropriate to ensure far-field conditions and (if required) to provide an empirical check on propagation
- the temporal sampling captures any variation in acoustic output using a fixed (static) recording position
- the deployment minimises measurement artefacts and parasitic signals
- contaminating noise sources are minimised (or eliminated)

B2.8 Summary: Propagation modelling

Ensure that the choice of model is appropriate for the application

Ensure that the propagation model used accounts for the physical propagation phenomena relevant to the scenario, including the following potential influencing factors:

- range-dependent bathymetry including dependence on varying water depth and the frequency cut-off for the channel;

- sound speed including the sound speed profile (especially for deeper water);
- frequency dependence, including absorption in the water;
- seabed properties, including propagation within the seabed;
- interaction with the sea surface, including the effect of surface roughness.

Preferably, use a model that has been benchmarked against historical experimental data or by comparison with other propagation models, or check consistency with range-dependent measured data from current experimental work (for example, when measuring radiated noise).

Appendix C

C-POD Specifications

C1 C-POD Specification

Contents

C1 C-POD Deployment Procedure

As part of the Marine Mammal Mitigation Plan (Section 11.7.1), Dragados has committed to the deployment of C-PODs to monitor the presence and absence of bottlenose dolphins and harbour porpoise in and around the AHEP construction site. The following provides an outline of a proposed C-POD deployment.

C1.1 Proposed Deployment Locations

In order to provide comparability between the EIA baseline and construction phase observations, it is proposed to reuse the original monitoring stations locations for the C-POD deployment (Figure 1 1).

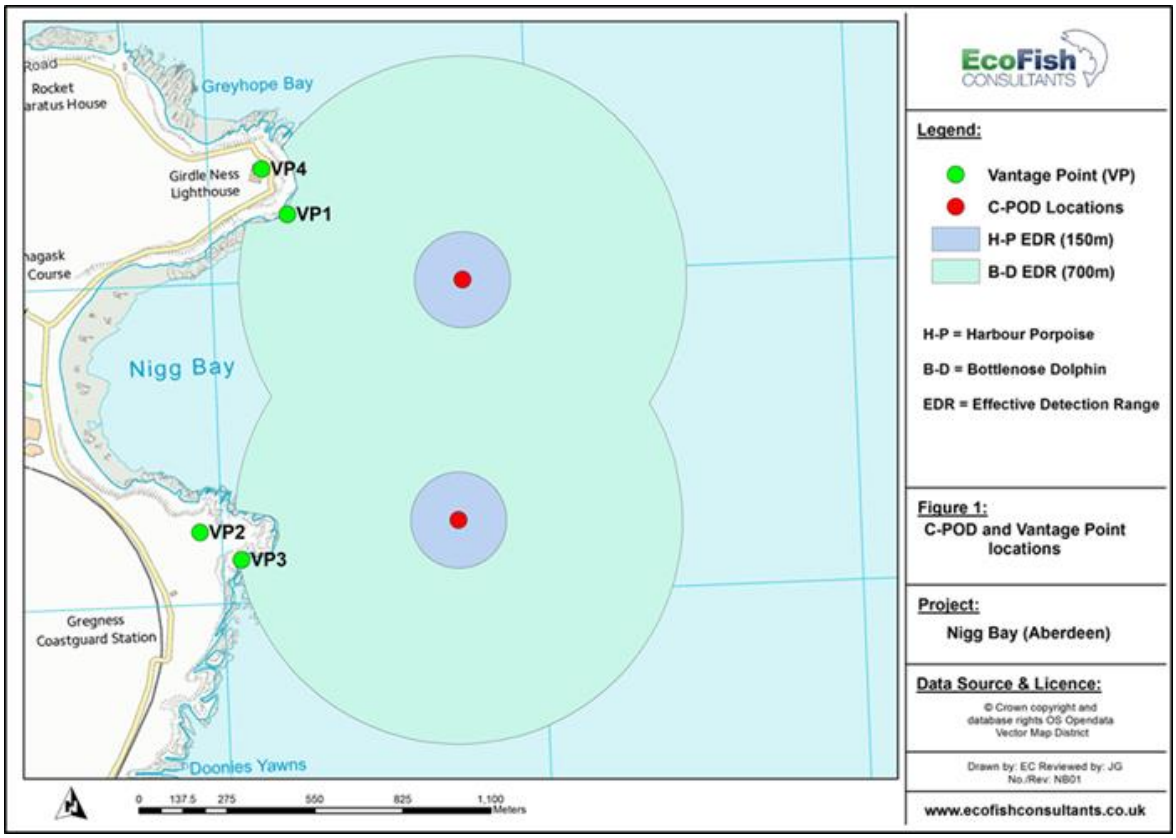

Figure 1: AHEP C-POD deployment locations and Effective Detection Radius (EDR) for EIA baseline survey.

The exact locations are:

- Northern C-POD – 57°08.215'N 002°02.200'W
- Southern C-POD – 57°07.811'N 002°02.211'W

The C-PODS will be deployed in late April/May 2018 and operate until marine construction works are completed.

C1.2 Deployment Methodology

The C-PODs contain a hydrophone, amplifier, electronic filters, a processor, battery and memory. The mooring consists of a buoy with radar reflectors and lantern, steel combination riser with galvanised eyes, rated shackles and an anchor weight.

Initially, maintenance visits will be carried out once a month. This will be changed to one visit every other month, once Dragados are satisfied the devices are working to their optimum ability. During maintenance, all survey data will be downloaded and the C-POD furnished with new batteries and memory card.

Figure 2: C-POD attached to a mooring line and deployed at AHEP.

C1.3 C-POD Data Acquisition, Processing and Analysis

C-PODs continuously monitor the 20-160 kHz frequency range of odontocete (toothed whales) to detect echolocation clicks demonstrating visits to the survey area, and the collection of presence-absence data over the survey period. These devices are able to distinguish between the high-frequency clicks from harbour porpoise and the mid frequency clicks from dolphin, but are unable to distinguish between the clicks from different dolphin species.

C-PODs use digital waveform characterisation to select all clicks similar to cetacean clicks and logs the time, centre frequency, sound pressure level, duration and bandwidth of each click. The desktop software 'cpod.exe' then processes the click data using the KERNO classifier to identify click trains and their likely sources.

The identification of source works very well for porpoise trains, but is less precise for dolphin click trains, and a secondary encounter classifier called GENENC, which uses a longer classification time window to improve the detection performance, is usually to improve the classification of these.

The detection range of static loggers is generally expressed as the 'EDR' or Effective Detection Radius. It is proposed that the EDRs for the construction phase monitoring are maintained at the same radii as for the EIA baseline, i.e. 150 m for porpoise and 700 m for bottlenose dolphin (approximately one third of the known maximum detection ranges for each species) (Figure 1)

Some of the options under consideration by Dragados for long-term static deployments for underwater noise monitoring include alternative technologies for sound processing that provide classification algorithms for click train auto detection. This could provide some economies for the deployment, and may also provide benefits when interpreting detection positive minutes (DPM) against construction activity noise.

C1.4 Reporting

During the first 3 months of C-POD monitoring, a report of operations and results were undertaken on a monthly basis. Due to confidence that the C-PODS are running efficiently and as agreed with MSLOT, reporting will now be undertaken every quarter, with a yearly report to summarise.

These reports should summarise the methodology, any problems encountered and results from the C-POD deployment. The final report will compare C-POD detections against those recorded during the AHEP ES C-POD surveys. Reports will be provided to MSLOT and SNH within 2 months of the data download.

Appendix D

Appendix D

D1 Marine Data Analysis

Dragados have committed to undertaking various monitoring of marine mammals alongside underwater noise monitoring. It is intended that at least the following datasets will be synthesised in the final report.

- C-POD detections
- MMO observations
- PAM observations
- Underwater noise measurements

Given the volume of data likely to be generated it may be that in-depth analysis can be undertaken such as a research project for an MSC or some other form of academic research. This will be explored further by Dragados and via the proposed Steering Group.

This document will continue to be developed as the plans for data analysis become clearer over the duration of the construction of AHEP.

D1.1 Data Analysis Steering Group

Dragados propose that a regular meeting is convened with MSLOT, MS Science, SNH, WDC, AHB and Dragados to help steer the data analysis and the final reporting of the data sets. The first meeting of this group will be arranged by the Dragados EM in 2020.

D1.2 Proposed Data Analysis

Under Water Noise Monitoring

All underwater nose monitoring undertaken at AHEP (detailed in section 11) will be pulled into one final report.

The report will consider the predicted noise levels described in the AHB EIA and further information submitted in support of the HRO and ML applications. The report will describe any differences between the predicted noise levels and those recorded and detail lessons learnt for future applications.

Marine Mammal Observations and Passive Acoustic Monitoring

It is proposed that marine mammal observations, both visual and acoustic are analysed in a similar manner to those undertaken for seismic surveys and other 'noisy' activities. This will include, should the data sets allow, reporting on detection rates (during different construction activities and when no activities are ongoing), any detection rate trends over the entire construction programme, any behavioural information that can be gained in terms of response to construction activities, the effectiveness and adherence to the CEMD and any lessons learnt.

C-PODS

Data analysis will be undertaken as per the C-POD data analysis outlined in Appendix C of the C-POD Deployment procedure. This methodology will be similar to that of the data analysis for the harbour porpoise and bottlenose dolphin detection hours undertaken in the AHEP Environmental Statement. This is to ensure that the data can be comparable so as to assess the differences in the detection hours recorded prior to and following the start of the construction works at AHEP.