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Supplementary Environmental Information Report



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CONTROL SHEET

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1 INTRODUCTION

1.1 Background

Scapa Deep Water Quay ('the Proposed Development') is a major strategic port infrastructure project proposed by Orkney Islands Council Harbour Authority ('the Applicant') within Scapa Flow, Orkney. The Proposed SDWQ is designed to deliver a deep-water berth capable of accommodating floating offshore wind (FOW) assembly, integration, operations, and maintenance (O&M) activities, alongside heavy-lift capacity for large-scale turbines and foundations. Additionally, the quay will support wider marine industries and future energy transition initiatives. The chosen location features naturally deep, sheltered water contiguous with sufficient land for laydown, ensuring safe navigation and minimal dredging requirements. These combined attributes establish Scapa Flow as one of the few sites in the United Kingdom capable of hosting marine energy operations at this scale.

In September 2023, applications for a marine licence under the Marine (Scotland) Act 2010 and planning permission under the Town and Country Planning (Scotland) Act 1997 were submitted for determination. The competent authorities for these applications are the Scottish Government's Marine Directorate – Licensing Operations Team (MD-LOT) and the Orkney Islands Council (OIC) Planning Department.

An Environmental Impact Assessment Report (EIAR) supported both submissions. This assessment complied with the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 ('the Land-Use EIA Regulations') and the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 ('the Marine EIA Regulations').

Since the initial submission, regulators have formally requested statutory Additional Information four times under the respective EIA regulations. This document constitutes the formal response to the fourth and latest request.

This Supplemental Environmental Information (SEI) Report has been prepared to support the concurrent applications for Planning Permission and Marine Licensing. It serves three primary functions:

- **Consultee Responses**: To address specific queries and clarification points raised by statutory and non-statutory consultees following the initial application submissions.
- **Design Evolution**: To introduce and evaluate the environmental implications of design modifications made to the 2023 and 2024 baseline scheme.
- **Data Updates**: To present critical environmental data and updated scheme assumptions that were either unavailable during the initial drafting or are now required to validate the proposed design changes.

Overall, this SEI Report updates and supplements the original EIAR and previous SEI Reports, ensuring a robust, comprehensive assessment of all likely significant environmental effects.

1.2 Structure of the SEI Report (July 2026)

To ensure consistency, the sections in this SEI Report (July 2026) maintain the same numbering structure as the original EIAR dated July 2023, updated August 2024 and the SEI Report dated June 2025.

1.3 Previously Submitted Reports and Hyperlinks

- Environmental Impact Assessment Report (July 2023). Scapa Deep Water Quay. Volume 1: Environmental Impact Assessment. **Available at:** https://marine.gov.scot/?q=node/24419
  and
  https://planningandwarrant.orkney.gov.uk/online-applications/caseDetails.do?keyVal=RYTOJOMDHCH00&caseType=Application
- EnviroCentre (August 2024). Scapa Deep Water Quay. Additional Information. **Available at:**
- https://marine.gov.scot/?q=node/25697
- EnviroCentre (May 2025). Scapa Deep Water Quay. Supplementary Environmental Information Report – May 2025. **Available at:** https://marine.gov.scot/?q=data/additional-information-2025-scapa-deep-water-quay
- EnviroCentre (September 2025). Scapa Deep Water Quay. Supplementary Environmental Information Report – October 2025. **Available at:** https://marine.gov.scot/?q=node/26879

2 PROPOSED DEVELOPMENT DESCRIPTION

2.1 Project Description

2.1.1 Site Location

The proposed Scapa Deep Water Quay (SDWQ) is located adjacent to the Bay of Deepdale, approximately 8 km south of Kirkwall. It is located on the eastern coastline within Scapa Flow, approximately 4 km south of the existing Scapa Pier.

2.1.2 Main purpose and associated activities

The Proposed SDWQ will provide deep-water berthing facilities to support diverse marine and industrial operations. Upon completion, its primary medium, to long-term function will be the storage of components and the assembly of wind turbines for the floating offshore wind sector. The project includes dedicated berthing for vessels, alongside welfare amenities and parking infrastructure for harbour personnel. Additionally, the SDWQ is designated as a strategic site for the storage and supply of future fuels for the marine industry.

2.1.3 SDWQ design evolution and consent application history

The original Scapa Deep Water Quay (SDWQ) EIAR and Habitats Regulations Appraisal (HRA) were prepared based on the Exemplar Design submitted in July 2023 and subsequently updated in August 2024. Developed by Arch Henderson and Orkney Islands Council Harbour Authority, this initial design served as the baseline solution for the consenting and tender development phases, forming the basis of the original consent applications.

Following these submissions, the project underwent a comprehensive 'mitigation by design' process in collaboration with the preferred construction contractor. This process resulted in two key design modifications that significantly reduce the development's potential environmental impacts. These changes are detailed throughout the project description below and form the basis of this SEI Report, however they are summarised as follows:

- Quay wall construction
  - **Exemplar Design:** piled wall construction
  - **Current Design:** precast concrete caisson construction, providing a considerable reduction in underwater noise.

- Dredging methodology
  - **Exemplar Design:** Dredge and dispose the majority of material at a sea deposit site
  - **Current Design:** Dredge and re-use majority of material in reclamation, providing a significant reduction in dredging programme and vessel movements to disposal site.

While the overall development footprint remains identical to the exemplar design, the proposed dredge pocket has been extended within the development boundary to accommodate the concrete caisson foundations. Upon completion, the marine infrastructure asset will deliver 23.1 hectares (ha) of operational laydown area alongside 3.1 ha of dedicated quayside concrete hardstanding. The exemplar design solution was initially assessed as appropriate at the scheme design stage; however, as stated

within Volume 3: Technical Appendix 2.1 of the EIAR, this design “may vary once final design and build tender procurement is progressed and contractors' individual construction methods are known.”

2.2 Construction

2.2.1 Programme

Table 2-1 outlines the key construction stages, their indicative durations, and the projected timeframes for these works.

Table 2-1: Outline Construction Programme

Works Description	Est. Duration	Est. Works period
Access road construction, haul road, earthworks and A961 re-alignment	60 weeks	December 2027 – February 2029
Caisson fabrication (off-site)	24 weeks	December 2027 – June 2028
Caisson transport	8 weeks	June 2028 – August 2028
Dredging bund construction	32 weeks	December 2027 – July 2028
Dredging	12 weeks	July 2028 – August 2028
Caisson installation	8 weeks	August 2028 – September 2028
Landside earthworks – Overburden removal, rock blasting and excavation	100 weeks	October 2027 – September 2029
Quay finishings	52 weeks	January 2029 – January 2030
Demobilisation	12 weeks	January 2030 – February 2030
Completion	N/A	February 2030

*Completion of the quay wall, including the infilling of caisson cells and backfilling behind the units, is scheduled to continue until February 2029. Depending on the local availability of suitable materials on-island, these activities may require the vessel movements detailed in Table 2-3. The vessel data presented in Table 2-3 represents a conservative, worst-case scenario for caisson infilling operations.

Terrestrial blasting is scheduled for completion within the initial 59 weeks of the landside earthworks programme. However, to accommodate potential variations in ground conditions, a maximum design scenario of up to 100 weeks is assessed. Terrestrial blasting frequency will be limited to two events per week.

2.2.2 Outline design criteria

These design criteria establish a robust framework for the marine assets, verifying structural integrity, stability, and operational safety. Adherence to these parameters ensures long-term durability when subjected to the site-specific hydrodynamic and metocean conditions of the Scottish marine environment.

- **Dredging Requirements**: The operational depths of -15.0m Chart Datum (CD) and -20.0m CD
- **Environmental conditions**: Consideration of climate change and sea-level rise scenarios (A projected sea level rise of 0.9 m by 2100 is considered, based on national climate projections), with tidal lag (normal conditions) and wave conditions (1 in 50-year, 1 in 200-year, 1 in 570-year return periods) integrated into the design.
- **Materials**: Concrete and reinforcement materials must comply with Eurocodes and British Standards, with specifications for exposure classes, cement types, and aggregate properties.

- **Caisson design**: The caissons are designed with a focus on durability, using concrete that is resistant to degradation in marine environments. Concrete properties, cement types, and aggregate characteristics have been carefully specified to ensure a long lifespan.
- **Caisson foundations and fill**: Crushed imported rock is used as the foundation layer, with strict controls on durability and strength. Fill materials inside and behind caissons are selected for high density and internal friction to ensure stability.
- **Scour protection**: Concrete scour protection mattresses and rock armour is installed to mitigate seabed erosion caused by vessel thrusters and propellers near the quay wall.

2.2.3 Site establishment and access

The access road design comprises of an 8 m wide asphalt surfaced roadway, 1.8 m wide hard verge (service strip) and 1.8 m wide remote path (south side), 1.5 m soft verge (north side) and surface water conveyance swales (both sides).

Access will be formed from A961 which is to be realigned as part of the works. This road realignment has its own planning permission and is not part of this application Safe access and egress from the A961 will be achieved with reflective signage and 2-way lights as necessary.

The access road is prioritised as a critical path activity as its completion triggers the commencement of the laydown area, landside cut and fill operations and shall provide access for the construction of the dredge containment bund, allowing dredge operations to commence. The contractor will require temporary service connections to the landside site area early in the programme to facilitate blasting, quarrying and earthworks operations.

The contractor will carry out the topsoil strip, overburden removal and elements of rock cut for the new access road. The contractor will place the subbase and surcharge it to act as a robust haul road during the construction programme. This will take cognisance of Scottish Environment Protection Agency (SEPA) comments on the need to protect Groundwater Dependent Terrestrial Ecosystems at the Project site.

The contractor will install the service trenching, drainage and ducting as the works progress to ensure water is managed effectively, services can be connected, and a safe road is completed prior to temporary traffic using it. Upon completion of the project, the contractor will trim the surcharge and carry out the final surfacing.

2.2.4 Dredging

Prior to the commencement of dredging operations, a containment bund will be constructed around the proposed reclamation area using site won general fill material screened of fines and suitable for placement below water, sourced from the initial landside excavation works and transported from the on-site designated processing areas. The bund shall be constructed up to a level of +4.0m CD using general fill below-water material, placed from the land. The bund shall be located approximately 40m behind the position of the caissons (i.e. within the footprint of the development). Integrated into this bund, a weir box system shall be installed in the northwest corner of the reclamation area. The weir box is an adjustable weir used to dewater the reclamation area, control the water level and the discharge of water/fines at a designated discharge point. All suitable dredged material will be placed in a reclamation area behind the pre-constructed bund, with any unsuitable material disposed at the licenced sea disposal site. The volumes of material to be dredged are presented in Table 2-2

The dredging works extend along the entire quay alignment, including the main quay as well as the small vessel berths to the northern end, and are essential for preparing the seabed for subsequent caisson

installation. The structures will be founded on hard bearing strata, requiring the removal of superficial soils and hard strata from approx. -15m CD down to a maximum depth of -20.5m CD. The dredged area edge slopes depend on the material type, ranging from 1:3 in superficial soils to 1:1 in engineering rock, whilst the dredging berth pockets are required to be operative for elevations of -15m CD and -20m CD.

Dredging works will be executed in a single campaign using a cutter suction dredger (CSD) specifically selected for its capacity to operate efficiently under the anticipated soil, sea and weather conditions at Scapa Flow.

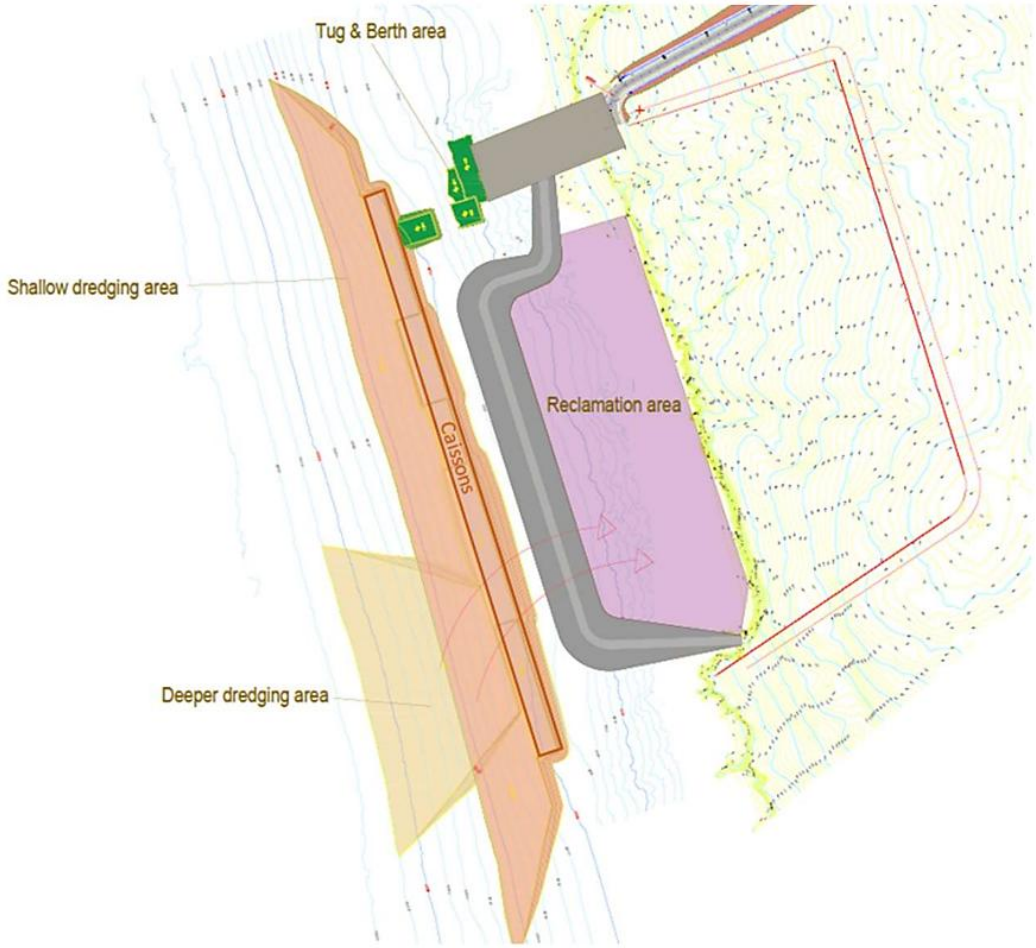


Figure 2-1: Dredging and reclamation areas

The discharging process to the reclamation area shall be carried out through the integration of the dredger pumps with the designated discharge pipeline system where the dredged material will be transported into the reclamation area. This operation will be carried out in parallel with the dredging activities, beginning at the northwest portion of the reclamation.

Turbidity meters will be installed to detect any increase in turbidity outside the reclamation area, the details of which will be included within the supporting Construction Environmental Management Document (CEMD) (see Table 11-1 for further details).

Through the early contractor involvement design stage, it has been identified that a significant reduction in material disposed at sea could be achieved from that which was originally defined in the exemplar design. There is, however, potential for up to 82,000m^3 of glacial till which may be unsuitable for re-use, to be disposed at sea (Table 2-2).

A 4,000m^3 capacity barge(s) will be used to transport material to the licensed offshore deposit site **FI040**. If the maximum volume (82,000m^3) is deposited, there will be 21 round trips to the sea deposit site (42 vessel movements) over 12 a week period, typically this activity will be carried out between the beginning of June to the end of August (currently 2027).

Table 2-2: Proposed Dredge Volumes

Description	Total volume dredged (m^3)	Volume reused on site (m^3)	Volume disposed offshore (m^3)
Hard Dredge	72,653	72,653	0
Soft Dredge	306,754	306,754	0
TOTAL	**379,407**	**379,407**	**0**
Disposal Contingency	*379,407*	*297,407*	*82,000*

2.2.5 Quay wall construction

The quay wall will be formed from reinforced concrete caissons installed on a rock bed foundation, as shown on Figure 2-2. The main quay is composed of nine large reinforced concrete caissons, with a smaller caisson at the south end that ties into the south revetment. At the north end, the small vessel berths are formed by four caissons.

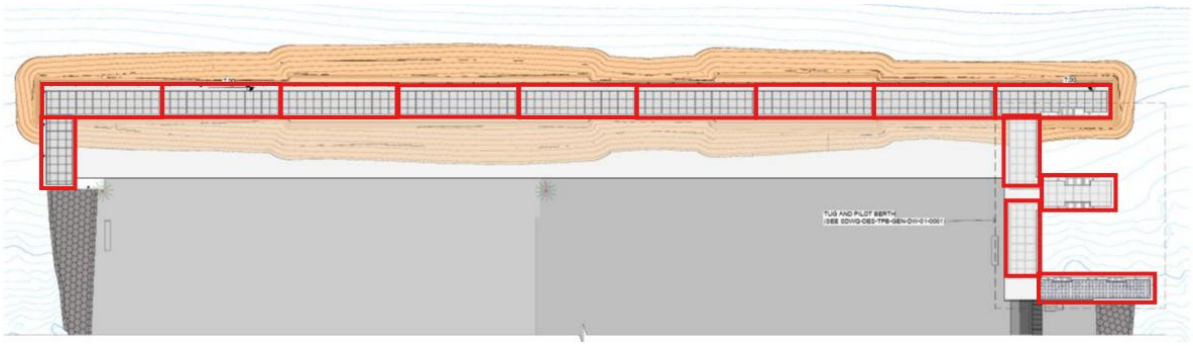


Figure 2-2: Quay Wall General Arrangement

2.2.6 Caisson design criteria

The main quay structure comprises nine large reinforced concrete caissons, complemented by a smaller caisson at the southern return that ties into the adjacent rock armour revetment. A range of caisson cross-sections is incorporated along the quay alignment to accommodate variations in finished dredge depths and underlying geotechnical conditions. The quay cope level is fixed at +7.00 m CD, with dredging in front of the quay generally extending to –15.0 m CD, including a 1 m over-dredge allowance. Near the southern end, a 140 m section includes a deeper dredge pocket reaching –20.5 m CD, also with a 1 m over-dredge allowance. At the northern end, the small vessel berths are formed using a series of smaller caissons. Dredging design accounts for slope requirements based on soil type to ensure foundation levels are established on engineering rock, and the geotechnical performance of the caissons is assessed for sliding, overturning, bearing capacity, and overall stability. Figure 2-3 below outlines a typical cross section for the caisson wall structure.

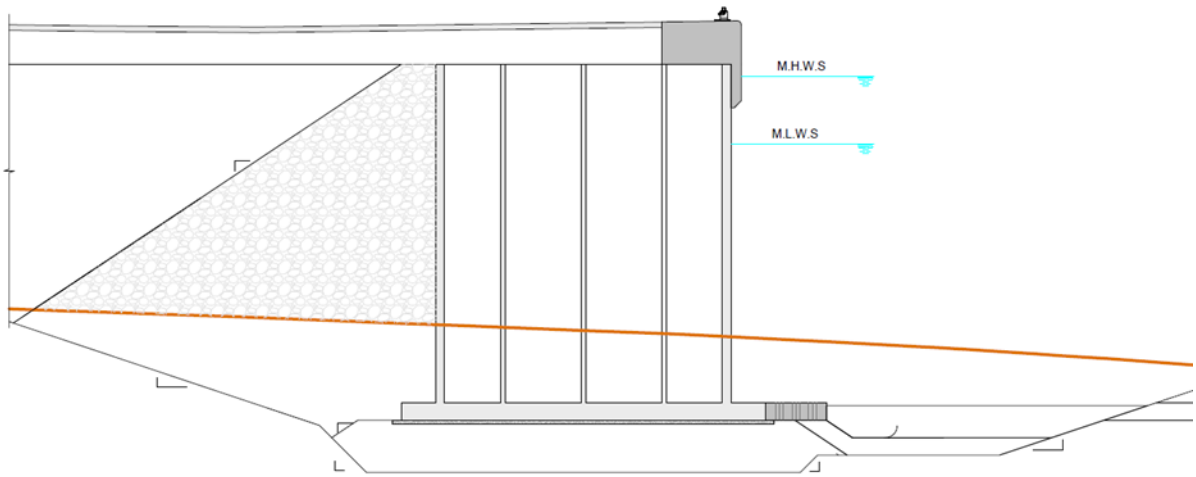


Figure 2-3: Simple cross section of caisson quay wall structure

Each caisson will be ballasted as per design, ensuring naval stability in all phases of transport and installation.

The fourteen caissons will be transported to the site in four shipments (Figure 2-4). The first batch of caissons will be directly installed in their final positions along the quay line from the semisubmersible delivery vessel. The remaining caissons of a batch in subsequent deliveries will be towed to a temporary wet storage area within the Project boundary until its final installation on the quay line.

Caissons will be dry stored during transport from Spain, reducing the risk of transporting non-native species. A Biosecurity Plan will be produced as part of the CEMD (see Table 11-1), which will set out the measures to prevent the introduction of invasive non-native species, in accordance with relevant legislation and best practice



Figure 2-4: Image of caisson loading operation

2.2.7 Caisson unloading at Scapa Flow

The unloading operation at Scapa Flow requires water depths over 27 m due to the draft of the vessel and caissons, and favourable metocean conditions. The caisson deliveries will be unloaded using 3 tugboats of at least 4,000 Horsepower (3,000kW) which will be hired locally, with the operation carried out in one to two good weather days per shipment.

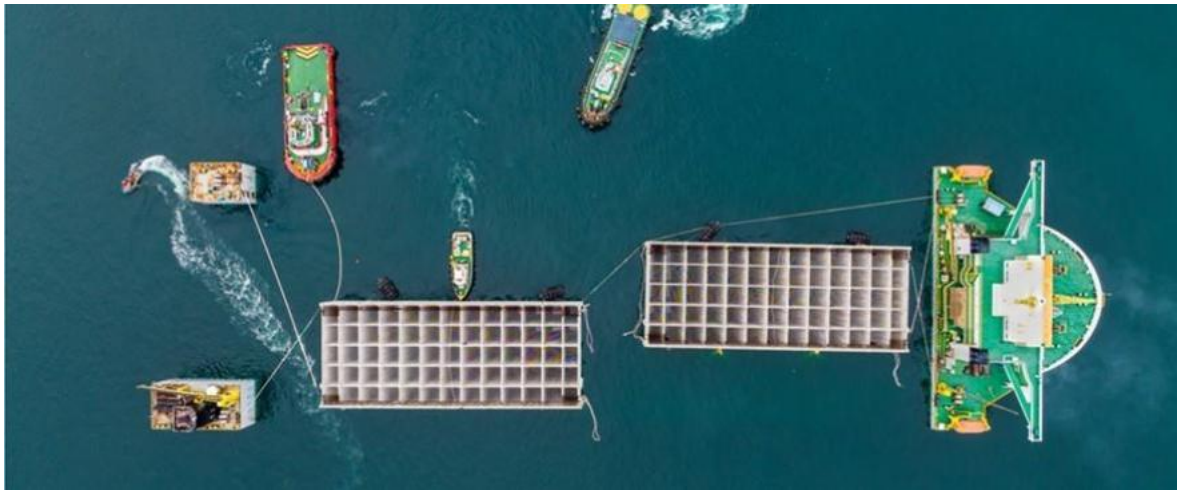


Figure 2-5: Caisson loading onto Semi-submersible vessel

Caissons will be unloaded from the semisubmersible vessel either directly to the quay line or to a nearby storage area, where they will remain until placement. The caissons will be fitted with auxiliary equipment including winches, mooring ropes and anchors, walking platforms, ballast systems, topographic prisms and fenders. After unloading, they will be temporarily secured either by tying them together alongside the partially constructed quay or by anchoring them to the seabed close to the project site. No piling or drilling is required for this operation and underwater noise will be negligible. When weather conditions permit, the caissons will be sunk into their final positions. Alternatively, they may be temporarily set down on the quay-line foundation and later refloated for final installation within tolerance.

2.2.8 Caisson installation

The process to install a caisson is typically performed during daylight hours in around 6-8 hours, given suitable metocean conditions which would typically be as follows: mean wave height (Hm) of 0<0.5m, peak wave period of (Tp)<7s and a wind velocity at 10 meters above sea surface (U10) < 15m/s. Caissons will be towed individually from the semisubmersible vessel or their temporary storage location to the quay line. Typically, one to three tugboats will be sufficient for towing from temporary storage, with the same tugs used to assist the installation operation.

Each caisson will be positioned while sinking, using tugs and winches, until a final controlled touchdown on the prepared foundation. Each caisson has independent and watertight groups of cells. During the operation, each group of cells is filled simultaneously with seawater either using a pump or a valve, with surveyors monitoring the level in each group to ensure that the installation process is performed in a controlled manner.

Ballasting water will be taken from the sea at Scapa Flow after caisson placement. If placement meets tolerance, ballasting continues until filled; otherwise, de-ballasting and repositioning are repeated until successful, usually in one attempt.



Figure 2-6: Caisson control platform and positioning equipment

2.2.9 Landside excavation platform

Mechanical methods will be used to excavate soft soils on land, while rock removal will involve drilling and terrestrial blasting, with no marine blasting planned. The overall landside earthworks programme is scheduled to be ongoing for approximately 100 weeks (Oct 27' to Sept 29' provisionally) with blasting taking place intermittently throughout this period. Due to the nature of the works, the exact timing of the blasts cannot be confirmed and should not be constrained to specific seasons of the year. It is estimated that during the 100 weeks of earthworks, a total of 35 blasts shall be carried out with no more than 2 blasts per week. Initially, the contractor will set up pre-earthworks drainage to manage surface water runoff. After establishing perimeter cut-off V ditches and before starting main land excavation and blasting, a 6m high bund will be built at least 5m from the cliff edge to ensure safety and reduce noise impact on marine life. The bund height shall be achieved by reducing the landside level by 3m and constructing a 3m high bund at the top of the excavation to achieve the overall height of 6m as shown in Figure 2-7.

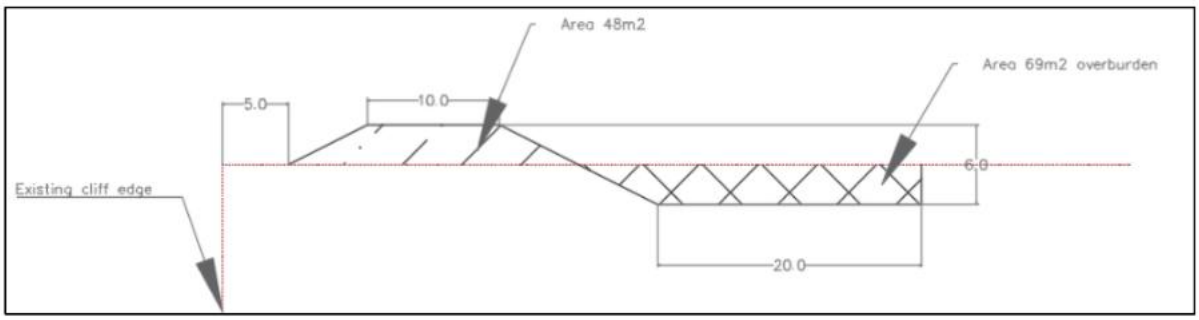


Figure 2-7 Noise bund section

The bund's crest will be 10 m wide to allow equipment movement along its length. It must be in place before any terrestrial blasting begins near the cliff edge, serving as both a noise barrier and a retention wall for sediment runoff. This natural bund will be removed once the rest of the site is excavated to reach the final profile.

Terrestrial blasting will be executed in 70 m strips, moving from the front (west) to the back (east) of the site. The initial bund will be constructed from overburden material taken from the first 20 m of the blasting zone. Each strip will be divided into sections sized for up to two weekly blasts, with operations taking

place simultaneously at both ends of each strip. Processing areas will be located at both ends of the project site to minimise haul distances for blasted materials, and this dual-end approach will also improve fill distribution, allowing fill operations to be supplied from both directions at once.

2.2.10 Reclaimed land (sea filling)

During the dredging campaign, the dredge bund and reclaimed area which it contains shall be completed forming the initial section of land reclamation. Once caissons are installed, filled and backfilled, rock armour revetments shall be constructed at the north and south ends of the quay wall, closing the perimeter. Rock-armoured revetments protect the north and south sides of the site from wave action. These are designed for a 60-year lifespan and to withstand extreme wave conditions (1:200 years). Armour layers consist of 2.5 tonnes (north) and 4.5 tonnes (south) rocks with appropriately sized underlayers and geotextiles. At this stage, general infilling from land will commence using excavated suitable material from the landside development.

The majority of land reclamation material is comprised of dredged material and land-based excavated material (which will be screened on site to remove fines before placement). There is a requirement for imported quarry material to be used at the rear of the concrete caissons to achieve the correct grading and compaction requirements as per the caisson stability design.

Substantial marine area containment will be achieved before land reclamation fill is progressed by construction of the containment bund mentioned above, thus minimising sediment discharge outside the works.

2.2.11 Pollution control

There is the risk of pollution events (oil spills, etc.) during the construction phase of the Project. Adherence to strict Pollution Prevention controls during land reclamation works will mitigate against pollution spills.

In terms of surface water pollution, drainage will be designed, in accordance with best practice and SEPA requirements, to ensure that there are no untreated surface water discharges directly to the surrounding coastal waters. Suitable prevention measures will be in place at all times to prevent the release of pollutants to the water environment, including adjacent coastal waters.

An Outline CEMD has been produced specifically tailored to this project (see Table 11.1). This document will be further developed and enhanced to fully reflect the potential effects and suitable forms of mitigation specific to the chosen contractor’s construction methods and the conditions of all consents.

2.2.12 Construction Vessel Movements

The construction phase will see the following vessel movements as outlined in Table 2-3 below. In total during the entire construction phase (26 months), there will be 112 vessel movements taking place over an eight-month period between June 2028 and February 2029, inclusive.

Table 2-3: Number of Predicted Vessel Movements During Construction

Vessel	Predicted Number of Vessel Movements.	Timescales
Caisson delivery, offloading and installation	20 movements (4 deliveries) using a semi-submersible vessel (3 tugs for offloading, 1 tug for installation) Tugs deployed from nearby Scapa Pier	July 2028 – September 2028
Scour protection	10 trips (20 movements)	August 2028 – September 2028
Caisson infilling	15 trips (30 movements)	August 2028 – February 2029
Dredging	21 trips (42 movements)	June 2028– August 2028
Total	**112**	

Based on baseline vessel movements (as informed by the Navigational Risk Assessment (NRA);see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3 of Appendix A: HRA), this will result in an additional 21.5 vessel movements per month on average (+0.16% from baseline) during winter months (October-March) and an additional 90.4 vessel movements per month on average (+0.5% from baseline) during summer months (April-September).

2.3 Operational Phase

The Project is likely to operate as a marine facility 24 hours per day and 7 days per week, so there is the potential for activity at any time of the day or night. This will include:

- Flatbed lorries: delivering and uplifting from site.
- HGVs: delivering and uplifting from site.
- Light vans: delivering cargo or providing maintenance and servicing to site.
- Road Tankers: delivering bulk goods and liquids to site or removing liquids and waste from site; and
- Forklift trucks: loading and unloading vehicles servicing the site. In addition to the general cargo operations, there will be:
- Minibuses / cars collecting and returning people working one site - these vehicles not allowed in the working area.
- Security staff based within the site and undertaking patrols when appropriate.
- Staff looking after the facility maintenance and assisting with vessel moorings.
- Third Party Stevedore Companies loading and unloading vessels; and
- Coaches and taxis facilitating crew changes on vessels.

The internal roadways and footpaths will be demarcated with designated routes, and barriers will be installed where necessary. There will be a security fence around the working area perimeter to protect it as well as the public, in addition to preventing access to breakwaters, rock armour revetments etc. (access gates will be provided for maintenance). The fence will be constructed in accordance with the requirements of the International Ship and Port Facility Security Code (ISPS).

Table 2-4 provides a summary of the indicative infrastructure likely to be present upon completion of the Project.

Table 2-4: Indicative Operational Infrastructure

Infrastructure Type	Qty	Description
Future Marine Fuels	TBC	Possible storage and supply to vessels of very low or zero carbon fuels. Note this will be subject to further assessments and approval.
Water Tanks	4	As indicated on Figure 2-8 outside of the main working area.
Sub-station	1	Main electric supply point to site as indicated on Figure 2-8 not in main working area.
Main gatehouse / Access building	1	As indicated on Figure 2-8 outside of main working area, may contain admin offices and is the security control for site
Car park, cycle storage and bus stop	-	Vehicle parking spaces and bicycle racks. Bus stop for use by internal bus services (drop off and pick up only)

2.3.1 Quayside Services

The indicative locations of quayside infrastructure services are shown on Figure 2-8.

Quayside services such as potable water and shore power will be incorporated into a service trench that will run around the Project with bunker points to the quayside at regular intervals.

Four water storage tanks with built-in treatment systems (as required) will be installed as indicated in Figure 2-8 to supply potable water to the whole site and vessels. Located near to the water tanks will be a 33kV /11kV/415V substation for whole site supply, including shore power for vessels. Service vehicles will be accessing the Project for crew and maintenance support to these vessels.



Figure 2-8: Proposed SDQW Operational Layout

2.3.2 Vessel Movements

The Project is designed to be flexible so that many types of vessels can berth, subject to draught and length. While the quay is a major strategic facility, its operational profile is characterised by the infrequent arrival of large vessels, likely to be aligned with the integration and deployment schedules of major offshore wind developments. Approximately 80% of vessel activity will take place in the summer months.

There is significant existing vessel activity in the wider area around the proposed Project. There will be increased vessel activity introduced by the Project in the area from the existing shipping route to the site, as detailed by the orange hatched area in Appendix C, Figure 1 (EnviroCentre, 2025a); however, there are currently frequent vessel movements in this area, as shown by the vessel tracks in Appendix C EnviroCentre, 2025a, and in more detail in the NRA submitted with the EIAR (Appendix 2.3 of EnviroCentre, 2025a).

Table 2-5 outlines the annual and seasonal operational vessel activity expected for the Project.

Table 2-5 Annual and seasonal operational vessel activity

	Per year		Per winter season (October – March)		Per summer season (April – September)	
	Vessel number	**Vessel movements (return trips)**	**Vessel number**	**Vessel movements (return trips)**	**Vessel number**	**Vessel movements (return trips)**
Large vessels	28	56	6	12	22	44
Smaller vessels	12	24	2	4	10	20
Pilot boats for large vessels	56	112	11	22	45	90
Total	**96**	**192**	**19**	**38**	**77**	**154**

Based on baseline vessel movements (as informed by the NRA; see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3 of Appendix A, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

2.3.3 Wet storage

There is no planned wet storage of fully constructed turbines at the SDWQ site. Any future proposals for wet storage will be conducted in accordance with the relevant regulations/consents.

2.3.4 Quayside cranes

No fixed or permanent cranage will be installed at the Project site. Instead, lifting operations will be carried out by a combination of cranes fitted to heavy lift vessels and temporary mobile cranes deployed from the quayside. Heavy lifting activities will typically coincide with large vessel movements, so cranes will be operating to similar timeframes as vessel movements.

Crane activity will be dependent on weather conditions, particularly in the winter months, as lifting of large loads is highly susceptible to even light to moderate winds. Based on analysis of 1 in 10-year weather averages in Kirkwall (1979-2010), the time lost to wind in the winter months is >200 hours per month. As such, less than 20% of lifting operations will likely take place in the winter.

There will be approximately 30 operational vessel trips per year (60 vessel movements) that involve a requirement for craneage, with approximately 24 occurring in the summer months and 6 in winter). This equates to 4 vessel trips per month (1 a week) in summer and 1 vessel trip per month (0.25 a week) in winter. As each vessel will be berthed at the Project for approximately 2-5 days, in the summer months cranes are likely to be active between 8 – 20 days per month, and in winter 2 – 5 days per month.

The mobile cranes will typically be up to 250 tonnes capacity (Liebherr LTM1250 or similar). This type of crane has an extendable telescopic boom with a maximum height of 60m in vertical lift. Smaller mobile cranes of 60 and 90 tonnes capacity will be used to support the larger cranes and will find more use during the winter months due to lower boom heights and lower windage. The maximum boom height for Leibherr LTM10-60 is 48m. On-board vessel cranes would be in the region of 70-125m height. The maximum number of cranes in use on site will depend on activities undertaken, but in the summer months, including on-board vessel cranes, could be up to 4 cranes on site, i.e. one on-vessel crane plus 3 mobile cranes. In winter, this number will be far less and is expected to be 2 (smaller) mobile cranes, given that large shipments requiring on-vessel cranes will be planned for summer months. Mobile cranes are slow-moving and generate limited engine noise at ground level.

During the summer months, mobile cranes will typically be stored on site at the Project, and in winter, either stored on site or taken offsite if they are required elsewhere. When not in use, mobile cranes will be lowered with booms retracted and placed horizontally. In this configuration, they are approximately 5m in height. These types of cranes do not normally provide their own lighting, and lifting operations in winter will typically be carried out in daylight hours.

3 EIA METHODOLOGY AND SCOPE

3.1 Purpose of this SEI

An EIAR was submitted to MD-LOT on 18 September 2023 (Reference: 00010511). Additional information was subsequently submitted in September 2024 and validated on 17 October 2024. Following a further request for information from MD-LOT on 15 April 2025, SEI was provided in June 2025. This was followed by a subsequent information submission in September 2025, and a further request for additional information in November 2025.

A parallel planning application, including an EIAR, was validated by OIC Planning Department on 25 September 2023 (Reference: 23/289/NATEIA). OIC Planning issued a request for further information on 22 April 2024, and an amended EIAR containing revised and additional information was submitted on 27 August 2024. Following a subsequent request from OIC Planning on 6 March 2025, SEI was issued in June 2025. A further information submission was made in September 2025, which led to a final request for additional information in November 2025.

This SEI Report has been prepared for the following purposes:

- **To address consultee feedback**: To provide additional information responding directly to points raised by statutory and non-statutory consultees following the submission of the original applications. This details updates and supplements the findings of the Environmental Impact Assessment Report (EIAR) submitted alongside the planning and marine licensing applications.

- **To evaluate design alterations**: To introduce and assess the environmental effects of design modifications introduced since the 2023 marine licensing and planning applications were lodged, ensuring all subsequent design evolutions are fully accounted for.

- **To present updated data**: To provide relevant supplemental data that either was unavailable at the time of the original submissions or is now required to substantiate the assessment of the revised project design.

As detailed in Chapter 2, several design refinements have been introduced since the submission of the Marine Licence and planning applications. These modifications stem from ongoing detailed design engineering, optimisation of construction and operational performance to mitigate potential significant environmental effects, and stakeholders' feedback received during the consultation process.

This SEI Report must be read alongside the amended August 2024 EIAR (and the May 2025 SEI Report) and the Habitats Regulations Appraisal (Appendix A of this document). The proposed design changes do not alter the majority of the amended August 2024 EIAR, which remains valid. Where relevant, this report cross-references specific sections of the August 2024 EIAR that support the current assessment and conclusions.

4 WATER ENVIRONMENT

4.1 Introduction

This SEIR Chapter supplements **Chapter 4: Water Environment** of the **EIAR dated July 2023 and updated in August 2024) and the SEI Reports dated May 2025 and September 2025**. It reviews the established baseline environment and evaluates the potential impacts of construction activities on water quality, tidal water levels, coastal processes, and flood risk.

4.2 Updated Policy Context

There are no updates to policy context.

4.3 Consultee Responses

OIC Marine Planning dated 27 October 2025 responded "*OIC Marine Planning have no comments to make on the September 2025 additional information for the Scapa Deep Water Quay EIA Application 23/289/NATEIA*."

Scottish Environment Protection Agency in their response dated June 2025 **"***Having reviewed the supplementary information we are in a position to remove our holding objection to the proposed development….***"**

Royal Yachting Association Scotland dated 30 October 2025 responded, "*I write to inform you that RYA Scotland has no comment that they wish to make on this application*."

Northern Lighthouse Board in their consultation response to OIC Planning, dated 28 October 2025, noted "…*the evolution of the design introducing caissons, an increase in total dredge volume, that the Navigational Risk Assessment has been completed and a Navigation Management Plan will be in place during the construction works. Northern Lighthouse Board, as before, have no objection to the proposed phased construction works or dredging/ disposal and advise the following;*

Construction Works

- *Orkney Islands Council – Harbour Authority issue Notices to Mariners as needed throughout the project phases informing of the scope and timeframe of the works.*
- *The applicant engage with NLB regarding any temporary and/ or permanent Aids to Navigation required during each phase of the construction and on completion of the project.*
- *On completion of each phase, a copy of the 'as built' plans should be submitted to the UK Hydrographic Office (sdr@ukho.gov.uk) in order that the associated charts and publications can be updated.*

Dredging and Disposal

- *Marine safety information as considered appropriate is issued prior to the commencement of each dredging campaign.*
- *On completion of the dredge works, the final survey data should be submitted to the UK Hydrological Office (sdr@ukho.gov.uk) in order that the associated charts can be updated with the revised water depths."*

4.4 Updated Baseline Conditions

As the footprint of the proposed SDWQ development has not changed significantly there have been no material changes to the environmental baseline conditions detailed in Chapter 4 of the July 2023 EIAR. The baseline remains valid, inclusive of the updates previously submitted as part of the August 2024 EIAR Addendum and the May and September 2025 SEI Report.

4.5 Future Baseline

The future baseline projections, including climate change effects, remain unchanged from those detailed in Chapter 4 of the July 2023 EIAR, as subsequently updated in August 2024 and the May and September 2025 SEI Report.

4.6 Updated Potential Effects

The majority of the proposed SDWQ aligns with the previously assessed exemplar design. Consequently, the potential environmental effects evaluated in Chapter 4 of the EIAR (July 2023, updated August 2024) remain unchanged, with the sole exception of potential water quality impacts arising from dredging activities.

The principal modification to the exemplar design involves a construction methodology variation: replacing the piled quay with gravity-base caisson structures (Chapter 2). To facilitate the placement of these structures, a larger capital dredge volume is required than was originally. However, because the completed development footprint and the marginally extended dredge pockets remain consistent with the exemplar design, any modified potential effects are limited solely to temporary sediment discharge and plume dispersion during dredging activities.

4.6.1 Dredge Plume Dispersion and Impact

Hydrodynamic modelling (Technical Appendix 4.1 of the EIAR [EnviroCentre 2023, updated 2024) indicates that dredging impacts will be localised and short-term. Due to weak tidal currents and the coarse nature of the material, sands and gravels will settle immediately within the dredge footprint. Finer silts and clays will disperse gradually, experiencing a net northward drift during the ebb tide. Total Suspended Solids (TSS) concentrations will remain low, with peak levels restricted to the immediate vicinity of the dredger.

Consequently, prior to mitigation, the magnitude of impact from sediment discharge and dispersion is classified as low within the immediate dredge area and negligible elsewhere. Given the high sensitivity of the receiving coastal waters, this results in a pre-mitigation effect of moderate significance locally and negligible significance across the wider area.

4.6.2 Containment and Mitigation

To mitigate sediment transport and manage water quality, a containment bund will be constructed around the perimeter of the reclamation area prior to the commencement of dredging activities. The bund will be formed using processed, dredger material engineered to a design level of +4.0m Chart Datum (CD). It will be offset 40m landward of the caisson alignment. A weir box system, situated in the north-west corner of the reclamation zone, will regulate internal water levels and manage the settlement and discharge of suspended solids (fines). This configuration ensures that only geotechnically suitable

material is retained within the containment area, while discharging complies with environmental water quality standards.

4.6.3 Dredge Volumes and Disposal

The total proposed dredge volume is 379,407 m³. Through Early Contractor Involvement (ECI), the design has been optimised to minimise the requirement for marine disposal relative to the original design baseline. A volume of approximately 82,000 m³ of geotechnically unsuitable glacial till requires offshore disposal. This material will be transported to the licensed marine disposal site FI040. Assuming a standard barge capacity of 4,000 m³, disposal operations will generate a maximum of 21 round trips (42 discrete vessel movements). This campaign is scheduled to occur over a three-month window between June 2028 and August 2028.

4.6.4 Coastal Flood Risk

In response to correspondence from Peter Woodward (Engineering Services) dated 5th September 2025 (Ref: 679084/MN/001), EnviroCentre acknowledged the comments raised on the potential local inaccuracies of the national Coastal Flood Boundary (CFB) dataset around the Orkney Islands, and specifically within Scapa Flow. EnviroCentre confirmed that the SDWQ design and operational management plan will consider the observed extreme tidal event level of 3.43 metres above Ordnance Datum (mAOD) recorded in St Margaret's Hope during the January 2005 flood event. The operational management plan will consider the risks associated with coastal flooding, including wave overtopping, and detail necessary operational limits and processes.

It was noted that the proposed quay design includes a quay level of 7 m above Chart Datum (mCD), equivalent to 5.35 m above Ordnance Datum (AOD). This represents a freeboard of 1.92 m above the 2005 flood level and 0.99 m freeboard above the equivalent 2100 flood level when accounting for climate change driven sea level rise (+0.93 m).

The Engineering Services consultation response to OIC Planning, dated September 2025 stated "*We are satisfied that future operational management plans will account for what we understand to be more appropriate extreme estimated sea levels (including allowance for future sea level rise) and the associated increased risk of wave overtopping.*

The developer has demonstrated that the risk is understood as per our initial response and the requirement set out under NPF4 Policy 22a. We therefore do no not object to this application."

4.6.5 GWDTE Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

The tufa-forming spring communities will be lost during construction of the laydown area. However, in their consultation response to OIC Planning dated 20th June 2025, the Scottish Environment Protection Agency (SEPA) confirmed that the applicant's proposed mitigation strategy is feasible. This strategy is supported by evidence from a limestone quarry in Cumbria, where tufa deposition successfully re-established over a 10-year period. SEPA noted that the engineered cut faces are an integral component of the development. Consequently, they accept the initial habitat loss as unavoidable and conclude that the proposed habitat creation constitutes acceptable mitigation. SEPA has therefore removed its holding objection to the proposed SDWQ.

4.7 Mitigation Measures

Following a review of the design modifications to the proposed SDWQ, the conclusions of the original EIA Report remain valid. The predicted environmental effects continue to be non-significant; therefore, no additional mitigation measures are required.

4.8 Updated Residual Effects

Following the updated project description, residual effects on the water environment and coastal processes are assessed as negligible. The single exception relates to GWDTEs, where effects are predicted to be minor. This minor effect has been deemed acceptable by SEPA. Consequently, no significant adverse effects on the water environment or coastal processes have been identified under the terms of the EIA Regulations.

4.9 Summary and Conclusions

Based on the updated project description, residual effects on the water environment and coastal processes remain negligible. The single exception relates to GWDTEs; however, this minor effect is deemed acceptable by SEPA. Consequently, no significant adverse effects have been identified under the EIA Regulations. The conclusions of the 2024 EIAR remain fully valid, with no changes to the previously stated significance levels. Overall, the effects of the proposed SDWQ on the water environment and coastal processes continue to be assessed as not significant.

4.10 Statement of Significance

Following a review of the updated project description, the conclusions of the EnviroCentre (2024) EIAR remain valid. There are no changes to the previously reported significance levels. Consequently, the potential effects of the proposed SDWQ on the water environment and coastal processes continue to be assessed as not significant.

5 BIODIVERSITY

5.1 Introduction

This section considers the implications of the amendments to the proposed SDWQ for the assessment findings presented in Chapter 5 of the EnviroCentre 2023, August 2024 EIA Report and SEIR Report dated May 2025, and addresses consultee comments. This section should be read alongside the Habitats Regulations Appraisal Report dated May 2026 (Appendix A).

5.2 Updated Policy Context

There are no updates to policy context.

5.3 Consultee Comments

Orkney Islands Council (OIC) Marine Planning: consultation response dated 27 October 2025, raised no objections and offered no further comments regarding the September 2025 additional environmental information for the Scapa Deep Water Quay application. "…*have no comments to make on the September 2025 additional information for the Scapa Deep Water Quay EIA Application*…"

Maritime and Coastguard Agency (MCA) consultation dated 22 July 2025, stated *"We understand from the Habitats Regulation Assessment (HRA) that there will be "the production of a Vessel Management Plan, for the Construction phases which will detail vessel routes, speeds etc" which is aimed at the avoidance of disturbance impacts for habitats. The MCA would expect that the Vessel Management plan would be carried out in compliance with all maritime safety legislation.*

To address the ongoing safe operation of the marine interface for this project, we would like to point the developers in the direction of the Port and Marine Facilities Safety Code and its Guide to Good Practice – updated April 2025. They will need to liaise and consult with the SHA and develop a robust Safety Management System (SMS) for the project under this code. In this regard, we note in Table 11-1 Schedule of Mitigation under Marine Safety, that "Orkney Islands Council Harbour Authority existing Safety Management System should be updated periodically as harbour operations change" which we welcome.

The MCA therefore has no concerns to raise in response to the additional information provided on the understanding that our previous responses still apply."

The Scottish Fishermen's Federation responded 22 July 2025, stating "*The Scottish Fishermen's Federation Appreciate this opportunity to comment on the 'Scapa Harbour, Kirkwall, Orkney' additional information consultation. Please file a nil return response from the SFF on this particular consultation."*

Additional detailed consultation responses are summarised within Table 5-1.

Table 5-1: Consultee Summary Comments

Consultee	Date	Comment
NatureScot – response to October SEI **Nb these responses have been summarised for brevity.**	07/11/2025	Scapa Flow Special Protection Area (SPA) – Black-throated diver We are unable to conclude no adverse effect on site integrity for the black-throated diver of Scapa Flow SPA. This is based on the potential disturbance and displacement impacts associated with the use of cranes at the proposed development site. The operation of cranes could potentially lead to the disturbance and displacement of a minimum of 19% of the SPA population of black-throated diver… We advise that it is not possible to fully mitigate the potential impacts. Despite some outstanding issues and uncertainties, we are satisfied with some of the suggested mitigation to minimise impacts associated with the construction phase of the proposal, this includes vessel movements, dredging, and airborne noise disturbance, and with the operation vessel movements. However, due to the scale and nature of impacts from operational activities on a significant proportion of the black-throated diver SPA population, we have concluded that adequate mitigation to minimise these impacts on this feature is not feasible.
		Scapa Flow SPA – Great northern diver Due to the lack of assessment for crane operations we cannot conclude no adverse effect on site integrity for this feature. The applicant's information and impact assessment on the construction phase vessel movements is incomplete. An assessment of impacts from crane operations has only been assessed for black-throated diver and whilst we agree that this is the feature that will most likely be impacted by this operation, other qualifying features which are sensitive to towering structures should have been assessed within the HRA, specifically great northern diver and red-throated diver.
		Scapa Flow SPA – Red-throated diver Due to the lack of assessment for crane operations we cannot conclude no adverse effect on site integrity for this feature at this time. An assessment of impacts from crane operations has only been assessed for black-throated diver and whilst we agree that this is the feature that will most likely be impacted by this operation, other qualifying features which are sensitive to towering structures should have been assessed within the HRA, specifically great northern diver and red-throated diver.
		North Orkney SPA Due to the lack of assessment for crane operations… we cannot conclude no adverse effect on site integrity for these features at this time.
		Orkney Mainland Moors SPA Due to the lack of assessment for crane operations for this feature… we cannot conclude no adverse effect on site integrity.
		Sanday Special Area of Conservation (SAC) We conclude LSE for harbour seal but consider that it has not been ascertained that the proposal will not adversely affect the integrity of the Sanday SAC… based on an incomplete in-combination assessment.

		Loch of Stenness SAC Our conclusion is that the proposal will not adversely affect the integrity of the site *provided that* the final Biosecurity Plan should be submitted for approval… prior to construction. This proposal could be progressed with appropriate mitigation. However, because it could affect internationally important natural heritage interests, we object to this proposal unless it is made subject to conditions so that the works are done strictly in accordance with the mitigation detailed in our appraisal.
		In-Combination Assessment The in-combination assessment is still insufficient and lacking in detail considering the scale of the development. The applicant's HRA was unable to conclude if there are any in-combination effects associated with the Quanterness Fish Farm. Therefore, adverse effect… cannot be ruled out.
RSPB – response to October SEI	31/01/2025	RSPB Scotland supports the proposed biodiversity enhancements in principle but argues against using rigid metrics like DEFRA's, advocating instead for a qualitative, expert-led assessment to maximize ecological value for Scotland.
		We have considered the proposal and are concerned that it will result in a loss of approximately 19 hectares (ha) of the Scapa Flow SPA. This results in a loss of habitat, from a combination of harbour pier construction and immediate disturbance to the qualifying species of the SPA set out above.
		At this stage we consider the quality of the information and assessments in both the EIA and HRA to be insufficient to be able to conclude that there would be no adverse effect on site integrity for the qualifying features of Scapa Flow SPA and North Orkney SPA (used by the same species), namely Red-throated diver, Slavonian grebe, Great-northern diver of Scapa Flow SPA. From the information available, the proposed scheme would result in effects on SPA species as result of direct habitat loss and from construction disturbance.
Marine Directorate – request for further information	15/01/2026	Further information is required on the use of cranes, in line with NatureScot advice, including the in-combination assessment and impact assessment for crane use, the impacts of crane use on the black-throated diver, great northern diver and red-throated diver qualifying features of the SPAs.
		Further Information is required, in line with NatureScot advice, on the vessel movements during construction impacting Scapa Flow SPA. This includes, but is not limited to, information on vessels required for scour protection and caisson filling activities during the nonbreeding season of the black-throated diver.
		Further information is required, in line with NatureScot advice, on the plume dispersal modelling to ensure the Conservation Objective, 2c is not undermined for all SPA features.
		Further information is required on the in-combination assessment and cumulative impacts, in line with NatureScot advice, with consideration of the cumulative impacts of both construction and operational vessel movements.

		Further information is required on the in-combination effects for the harbour seal qualifying interest of the Sanday SAC, in line with NatureScot advice
NatureScot revised HRA	March to June 2026	Various meetings and written consultations during the preparation of the Additional Information submission, including letter dated 30th June 2026 providing comments on the draft revised HRA and confirming: 1) they agree with the Applicants conclusion of no AEoSI for North Orkney SPA, Orkney Mainland Moors SPA and Hoy SPA 2) however, with regards to the Scapa Flow SPA, and contrary to the Applicants assessment, they advise 'the development and associated operations will undermine Conservation Objective 2b [The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species] and therefore lead to adverse effect on site integrity for black-throated diver.'

5.4 Updated Baseline Conditions

The application boundary (red line boundary) for the Project remains identical to previous design iterations; consequently, spatial separation distances from all statutory and non-statutory designated sites remain unchanged. Baseline ecological field surveys were conducted in 2023. Because local land management practices have remained uniform since that period, the extent, distribution, and composition of habitats within the site are concluded to remain unchanged and valid for this assessment.

5.5 Future Baseline

In the absence of the SDWQ development, the baseline condition of ecological habitats and features currently present within the Proposed SDWQ boundary would remain largely unchanged.

Within this footprint, terrestrial habitats within a narrow buffer of the cliff top have been enclosed and agriculturally improved. The coastal-fringe fields are managed exclusively for livestock grazing, whereas the inland fields are regularly ploughed, re-seeded, and managed for intensive silage production. Under this "Do-Nothing" scenario, ongoing agricultural land-use is anticipated to persist. Consequently, standard farming practices would continue to exert a localised, attritional pressure on the remaining semi-natural habitats present within the site.

5.6 Updated Potential Effects

5.6.1 Biodiversity Net Gain

In response to the Royal Society for the Protection of Birds (RSPB) consultee comments dated (31 January 2025) regarding Biodiversity Net Gain (BNG) and the Biodiversity Enhancement Management Plan (BEMP), the Applicant clarifies that a viable delivery pathway has been established. With reference to the Supplemental Environmental Information Report (SEIR) (May 2025) Section 5.5.9 (Groundwater Dependent Terrestrial Ecosystems and BNG), the June 2024 Feasibility Assessment confirmed that a 10% net gain is achievable through a combination of onsite and offsite habitat enhancement.

Land directly within the control of the Orkney Islands Council Harbour Authority (OICHA) has been identified for enhancement at Hatston Pier (Grid Reference: HY 43095 12969). To ensure ecological robustness and local continuity, additional offsite restoration is being actively considered at the community-led Quarterness Windfarm, located just 2.4km west of Hatston Pier. Furthermore, in consultation with the Environmental Planner for Orkney Islands Council (OIC), strategic enhancement sites have been identified and earmarked at Papdale East Park (Grid Reference: HY 45863 10498) and Balfour Hospital, Kirkwall (Grid Reference: HY 44458 10109).

As the responsible legal entity, OICHA maintains a firm commitment to delivering biodiversity enhancement across its estate. To provide further resilience to the BNG strategy, OICHA has identified additional pipeline sites. These include redundant local quarries earmarked for ecological restoration, alongside targeted biodiversity enhancement and maintenance reduction schemes within the Grainebank Sustainable Drainage Systems (SuDS) areas (subject to consultation and permissions).

Within the Scottish planning context, biodiversity principles are driven by the National Planning Framework 4 (NPF4) and associated guidance, rather than the mandatory statutory metrics used in England. For the Scapa Deep Water Quay (SDWQ) project, this allows for a bespoke suite of tailored, ambitious onsite and offsite measures. While these local enhancements may not strictly align with English statutory trading metrics, they are optimised to deliver genuine, high-value ecological gains across the wider Orkney context.

The Applicant acknowledges the RSPB's position on the limitations of quantitative metrics within the Scottish planning context. However, Scottish Government Planning Guidance for NPF4 Policy 3 (Section 4.7) explicitly notes that biodiversity assessments *"…may be qualitative or quantitative (for example through use of a metric)…"*. The Applicant has utilised a quantitative 10% metric for this application based on four critical, project-specific requirements:

1. **Objective Accountability & Enforceability:** A 10% metric provides a transparent baseline that translates environmental aspirations into measurable, auditable targets. Unlike purely qualitative approaches, which can be subjective, a numerical target leaves little room for ambiguity when consenting authorities monitor and enforce conditions over the multi-decade management period.

2. **Meeting NPF4 Policy 3(b) Standards:** Under NPF4 Policy 3(b), major infrastructure developments must demonstrate that biodiversity will be left in a *"demonstrably better state"*. A structured calculation provides the most objective proof of a net positive outcome to planning officers, ensuring the application solidly exceeds the threshold of "no net loss."

3. **Contractual and Financial Certainty:** To secure the proposed offsite enhancement locations (including Quarterness Windfarm, Papdale East Park, and Balfour Hospital), OICHA must enter long-term legal and commercial agreements. These contracts and funding mechanisms require exact specifications, such as precise habitat hectarage and target condition scores, which a quantitative framework provides prior to submission.

4. **Efficient Consenting Processes:** Structured metrics break the site down into clear habitat parcels with pre-determined distinctiveness rankings. This framework allows the Orkney Islands Council's Environmental Planner to efficiently audit baseline data, and projected gains, mitigating the risk of application delays associated with reviewing lengthy qualitative narratives.

Rather than viewing these methodologies as mutually exclusive, the Applicant proposes a hybrid approach. The 10% metric establishes a legally binding numerical floor, while concrete terrestrial, inter-tidal, and marine enhancements, including specialised habitat features within the rock armour and engineered adjustments to the quay wall, will be fully detailed by ecological experts via a qualitative, site-specific process within the post-consent BEMP.

This approach is heavily supported by recent field data; ongoing SDWQ intertidal and rocky shore surveys, for example, were conducted on 22–23 May 2025 by an expert team led by Dr Jenni Kakkonen of the Orkney Independent Marine Advisory Group (OIMAG). The findings from these surveys will directly inform the detailed, post-consent BNG plans.

Crucially, OICHA has agreed in principle with OIC Planning that all final BNG commitments will be secured post-consent and enforced via planning conditions, ensuring full regulatory oversight.

5.6.2 Effects on Ornithology - Scapa Flow SPA

The Scapa Flow SPA directly overlaps the proposed Project site. The site is classified under the Birds Directive to protect internationally important populations of rare and vulnerable migratory wild birds. Specifically, it supports breeding red-throated diver and a diverse assemblage of eight non-breeding marine bird species: great northern diver, black-throated diver, Slavonian grebe, European shag, common eider, long-tailed duck, and red-breasted merganser.

Encompassing a total area of 31,819 ha, the SPA is situated within Scapa Flow, an enclosed sea area sheltered by Mainland Orkney to the north; Hoy, Graemsay, South Walls, and Flotta to the west and south; and Burray and South Ronaldsay to the east. The Flow is hydrologically connected to the Pentland Firth in the south via the Sound of Hoxa, and to the Atlantic Ocean in the west via Hoy Sound. The SPA also extends into the nearshore waters east of Orkney, running from South Ronaldsay to Deerness, and includes the sheltered, shallow waters of Holm Sound. It is largely separated from the North Sea to the east by the Churchill Barriers.

It encompasses a range of sheltered and diverse marine habitats sustain a wide range of marine communities. These sheltered habitats provide vital, abundant food resources that support breeding, moulting, and roosting behaviours for the designated seabird and waterbird populations.

The Project site is regularly used by breeding and non-breeding bird species that are qualifying features of overlapping or adjacent SPAs, forming part of wider populations that range over extensive marine and coastal habitats. Species Include:

- Black-throated diver (non-breeding)
- Eider (non-breeding)
- European shag (non-breeding)
- Great northern diver (non-breeding)
- Long-tailed duck (non-breeding)
- Red-breasted merganser (non-breeding)
- Slavonian grebe (non-breeding)
- Red-throated diver (breeding)

Baseline surveys were conducted between November 2020 and March 2024; full details are provided in the Ornithological Technical Report (EnviroCentre, 2025(a), Appendix C: Scapa Deep Water Quay Ornithology Technical Report). A full summary of the occurrence of qualifying species at the project site and the wider Scapa Flow area can be found in section 10.2.1 of the HRA (2026) (Appendix A of this report).

Black Throated Diver

Disturbance of birds due to Vessel disturbance

The project team has provided information on the current typical monthly vessel movements experienced within the eastern area of Scapa Flow. This baseline is derived from the Project NRA (see

Appendix 2.3 of EnviroCentre, 2025a). Baseline vessel activity in Scapa Flow is characterised by a high level of diverse maritime traffic year round, with Automatic Identification System (AIS) data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow, closest to the Project site, current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

Vessel movements during construction

Per Table 2-3 of this SEIR, in total during the entire construction phase (26 months), there will be 112 vessel movements taking place over an eight-month period between June 2028 and February 2029, inclusive. This includes: Caisson deliveries and tug operations; Scour protection trips; Caisson infill trips; and Dredging disposal trips (barge to FI040).

Vessel movements during operation

Per Section 2.3.2 of this SEIR there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Disturbance from vessels

In terms of potential disturbance from vessel movements, the maximum number of vessel movements is 112 over the 26-month construction phase (see Section 2.2.11).

With reference to section 10.3.1.1.1 of the HRA (Appendix A), during construction, vessel activity will cluster around the quay. Consequently, if multiple vessels operate simultaneously, their spatial zones of disturbance will overlap, minimising the overall footprint of impact. The total area affected by vessel disturbance during the construction phase will therefore be minor relative to the wider foraging ranges used by marine birds throughout the year (JNCC, n.d; JNCC, 2003-2013; Orkney Islands Council, n.d; Peters-Grundy et al., 2026). Birds displaced by vessel activity are expected to relocate to extensive areas of comparable habitat within the wider SPA. Furthermore, disturbance and displacement effects are reversible; empirical studies indicate that non-breeding aggregations of common scoter, common eider, long-tailed duck, and white-winged scoter return to pre-disturbance baseline levels within hours of a vessel's departure (Schwemmer et al., 2011).

The only area that will experience a greater increase in vessel activity will be the 167 ha branching east off the established route, to the Project site (although there are baseline vessel movements in this area – as shown in Appendix A: HRA Heat Maps and Noise Contour Maps (Appendix B of that report). Consequently, the introduction of Project construction vessels represents a negligible increase over existing shipping volumes.

The majority of Project construction vessel movements will utilise established shipping channels, specifically the southern entry to Scapa Flow between Flotta and South Ronaldsay, and the western entry between Hoy/Graemsay and Stromness. Both routes currently experience moderate baseline traffic. Consequently, the introduction of Project construction vessels represents a negligible increase over existing shipping volumes.

Over the 26-month construction phase, the proposed SDWQ is projected to increase baseline vessel movements by an average of 0.16% during the winter period (October to March) and 0.50% during the summer period (April to September). These minor increments do not constitute a significant deviation from baseline traffic levels.

The assessment in the HRA evaluates potential mortality using a displacement matrix based on average peak counts (HRA Appendix A). While this approach establishes realistic worst-case scenario, the natural variability in the distribution of black-throated diver within the Scapa Flow SPA must be considered. On any given day during the non-breeding period, localised disturbance is likely to affect fewer individuals than this average peak figure.

Furthermore, while temporary disturbance may occur, its ecological consequences are minimal due to the following factors:

- **Habitat Availability:** Survey data confirms that black-throated divers are widely distributed across the coastal fringes and nearshore areas of Scapa Flow. Birds displaced from the project footprint have immediate access to extensive alternative foraging and resting habitats within the SPA.

- **Intermittent Pressures:** Marine vessel movements do not exert continuous pressure on the population. These activities are intermittent and temporary; any associated disturbance ceases immediately upon the completion of the activity (e.g., once a vessel passes or crane operations stop).

- **Access:** Construction and operational vessels will operate over the winter months i.e. the non-breeding season, and black-throated divers will retain access to the project locality for this period when vessel numbers reduce.

Consequently, any resulting disturbance will be highly localised, short-term, and neither continuous nor sustained.

During the construction phase, vessel movements coinciding with the black-throated diver non-breeding period (August to April, inclusive of their qualifying feature status) are projected to increase by an average of 0.35% over current winter baseline levels. No vessel traffic increases are predicted for the months of March or April. This negligible increment will be temporary, restricted to the 26-month construction period.

Operational phase vessel movements are detailed within Sections 2.3.2 of this SEIR and 10.3.1.2 of the HRA (Appendix A). During the black-throated diver non-breeding period, operational activities are expected to generate an average monthly increase of 13 vessel movements from the proposed SDWQ. This equates to a minor average increase of 0.5% against current monthly baseline traffic levels.

Black-throated diver exhibit a very high sensitivity to disturbance. In previous consultation, NatureScot recommended referencing Guidance Note 8: Guidance to Support Offshore Wind Applications: Marine Ornithology Advice for Assessing the Distributional Responses, Displacement and Barrier Effects on Marine Birds to evaluate potential displacement and barrier effects. Specifically, NatureScot requested a matrix-based modelling approach to quantify potential displacement and mortality rates for black-throated diver resulting from the proposed SDWQ.

This assessment is presented in Appendix A HRA (Appendix D: Mortality Matrix Model). However, inherent limitations exist within this methodology, particularly regarding the compounding of precautionary principles. A report published by the Scottish Offshore Wind Energy Council (SOWEC, 2025) explicitly details these methodological flaws, noting that:

- **Compounded Precaution**: Applying precautionary parameters at multiple individual stages of the impact assessment process compounds conservatism, leading to disproportionately high and potentially excessive predicted outputs.

- **Overestimation of Impacts**: Current guidance methodologies generate conservative impact estimates that are significantly larger than the actual empirical effects likely to occur once a proposed development becomes operational.

- **Lack of Transparency**: The degree of embedded precaution, specifically the margin between modelled estimates and true biological impacts, is not transparent, the probability of these estimated impacts occurring is omitted, and scientific uncertainty is not fully quantified.

- **Inconsistent Evidence Evaluation**: Statutory Nature Conservation Body (SNCB) advised approach lacks transparency and consistency regarding how scientific evidence is appraised and integrated to inform the precautionary approach detailed in in SNCB guidance and advice.

As noted within section 10.4.3.1.1.1 of the HRA (Appendix A), the matrix table for black-throated diver was populated using the mean peak across the three surveyed winters. (7, 11 and 27 – mean peak of 15 birds[1] km buffer), indicating the highly mobile nature of the species within the SPA, and the high variability and ephemeral occurrence of the species in the vicinity of the Project.

This data underscores the species' high mobility within the SPA, as well as its variable, ephemeral occurrence near the proposed project.

Vessel movements during construction and operation are unlikely to create a barrier effect for birds transiting the area. Rather than continuous traffic, vessel activity will be intermittent, averaging significantly less than once per day across both phases. Adopting a precautionary approach, winter activity will decrease further to fewer than two transits per week.

This assessment is supported by baseline data from the 2021/22 surveys. The presence of a small test rig and associated vessels did not entirely displace black-throated divers; birds remained present and were observed transiting the site on 14 out of 24 survey days (58% occupancy). Consequently, project-related vessel traffic is expected to have negligible barrier effects on the species.

The matrix model assessment (Appendix A HRA (Appendix D: Mortality Matrix Model)) applies a precautionary 1% mortality rate to an average seasonal peak count of 15 birds. This calculation yields a predicted loss of 0.135 birds annually, representing approximately 0.2% of the Special Protection Area (SPA) population per year.

Over the 25-year operational lifespan agreed with NatureScot, cumulative precautionary mortality totals 3.375 birds. This constitutes 6% of the SPA population at designation, which equates to the loss of one bird every 7.4 years. This nominal increase is driven by a minor projected rise in vessel movements over current baseline levels: 0.35% during construction and 0.5% during operation.

Mobile cranes

No fixed or permanent cranage will be installed within the Project site boundary. Component lifting will instead be executed using vessel-mounted heavy-lift cranes and temporary, quayside-deployed mobile cranes. Because heavy lifting is tied to large vessel arrivals, the temporal pattern of crane operations will directly mirror vessel movements.

[1] Mean peak count of 15 is calculated using year 1 to 1km (7 birds) and year 2 (11 birds) and 3 (27 birds) out to 2 km.

Lifting activities are highly weather-dependent, particularly regarding wind susceptibility when handling large loads. With reference to the HRA (Appendix A, Section 5.4.4), analysis of 1-in-10-year meteorological data for Kirkwall (1979–2010) indicates that winter wind-related downtime exceeds 200 hours per month. Consequently, less than 20% of total lifting operations are anticipated to occur during the winter period.

The Project will generate approximately 30 operational vessel round-trips per annum (60 individual movements) requiring cranage support. This schedule is seasonally distributed as follows:

- **Summer:** Approximately 24 round-trips, averaging four vessel trips per month (one per week). Given an estimated berth duration of 2 to 5 days per vessel, crane activity will occur across 8 to 20 days per month.

- **Winter:** Approximately 6 round-trips, averaging one vessel trip per month (0.25 per week). Based on the same berth durations, winter crane activity is projected at 2 to 5 days per month.

Primary lifting operations will utilise mobile cranes with a capacity of up to 250 tonnes (Liebherr LTM1250 or equivalent). This crane class features an extendable telescopic boom with a maximum vertical reach of 60 metres above ground level (AGL). To support primary lifting operation, smaller mobile cranes with 60-tonne and 90-tonne capacities will be deployed. These smaller units are well-suited for winter operations due to their lower boom heights and reduced windage profiles; for baseline context, the Liebherr LTM 1060 has a maximum boom reach of 48m AGL. Additionally, vessel-mounted cranes will operate within a maximum height envelope of 70m to 125m.

The landform behind the Project slopes sharply to approximately 20 m higher than the quay level where the cranes will be operating. Against the levels of the land immediately behind this would be 60 m above quay level (within 1 km of the quay). Therefore, the entirety of all cranes will not be viewed against the skyline but against surrounding landform.

The maximum number of active cranes on-site will fluctuate during operation. Peak deployment is anticipated during the summer months, with up to four cranes operating simultaneously across the site. This peak fleet will comprise one vessel-mounted crane and three mobile cranes. Conversely, winter deployment will be significantly reduced to approximately two smaller mobile cranes. This seasonal reduction will be achieved by scheduling all large shipments requiring vessel-mounted cranes exclusively within the summer period.

Mobile cranes are slow-moving vehicles that generate limited engine noise at ground level. During the summer months, these cranes will typically remain stored on-site. In winter, they will either be stored on-site or demobilised if required at other operational locations. To mitigate visual impacts during non-operational periods, mobile cranes will be stowed with booms fully retracted and lowered to a horizontal position, reducing the maximum profile height to approximately 5m. These specific crane models do not feature integral floodlighting, and winter lifting operations will be strictly restricted to daylight hours.

NatureScot advise that divers are particularly sensitive to disturbance and displacement, which also includes visual disturbance and displacement caused by tall, unfamiliar structures in the marine environment (Dierschke et al., 2017). With regards to cranes, there is no evidence available to suggest that quayside cranes cause disturbance and displacement to black-throated diver. The justification for birds being sensitive to towering structures is based on offshore windfarms/turbines and make no mention of coastal developments and/or quayside crane use within such facilities. Importantly, fundamental differences exist between offshore wind farm structures and land-based or quayside cranes:

- **Permanence and Location**: Offshore wind turbines are permanent, highly conspicuous features located within open-water habitats frequently used by divers. Quayside cranes are land-based and situated within an existing industrial context.

- **Movement**: Wind turbines feature continuously moving components (i.e., rotating blades) that may exacerbate disturbance responses, whereas quayside cranes remain entirely static when not in operation.

Following consultation advice from NatureScot, Guidance Note 8: Guidance to Support Offshore Wind Applications has been utilised as a proxy to assess the distributional responses, displacement, and barrier effects of marine birds. While offshore wind farm metrics are not directly transferable to this development, this framework serves as a conservative proxy due to the novelty of the proposed activities and the nearshore distribution of black-throated diver within the project site.

However, Guidance Note 8 metrics are considered inappropriate for evaluating black-throated diver responses to land-based mobile cranes. The visual and mechanical profile of a coastal, shore-bound crane viewed against a terrestrial backdrop is structurally distinct from an isolated, moving marine vessel or an open-water turbine array.

Empirical evidence indicates that black-throated divers exhibit highly localised, low-energy avoidance behaviours rather than wide-scale flight displacement. While literature confirms that divers take evasive action when encountering moving vessels, a study by Jarrett et al. (2018) recorded zero flight responses to marine traffic; instead, individuals overwhelmingly favoured local swimming or diving. This localised response is further corroborated by site-specific baseline data, where no flight responses were recorded across three years of ornithological survey effort.

Consequently, while a minor energetic cost is associated with temporary cessation of foraging or localised avoidance, it does not induce the large-scale flight or barrier effects typically modelled for open-water wind farms. The standard 2 km macro-avoidance zone defined in Guidance Note 8 is derived from birds transiting around large offshore turbine arrays. This behaviour is not comparable to navigating a localised, land-based infrastructure project within a coastal setting.

Black-throated divers are classified as having a very high sensitivity to disturbance and displacement from moving vessels. In the absence of empirical literature regarding diver responses to quayside cranes, vessel-induced disturbance metrics have been adopted as a highly conservative proxy for the assessment.

However, the physical mechanism of disturbance from cranes differs fundamentally from that of mobile vessels at sea. Cranes will operate from fixed locations on the quay or from berthed, stationary vessels. While cranes introduce a tall structure with moving components, their operational movement is slow and confined entirely within strict spatial bounds determined by the mast and jib length.

Additional project-specific evidence indicates that black-throated divers exhibit relatively limited behavioural responses to vessel activity, as mentioned in Section 10.2.1.3.6 of the HRA (Appendix A). During the ornithological surveys, black-throated divers generally exhibited low-level responses to vessel activity. Of the recorded interactions, half of the resulted in birds swimming slowly away, two birds responded by diving, two showed no observable response, and only one bird displayed an alert response. These observations are consistent with Jarrett *et al.* (2021), who found that black-throated divers exposed to ferry traffic in Scapa Flow responded by swimming, diving, or indicated no observable response. The behavioural responses observed and recorded indicate that black-throated divers can move away from the localised disturbance, associated with the Project activities.

There is no published evidence of the effect of cranes on black-throated diver. However, there is anecdotal evidence[2] and data records[3,4] of black-throated divers occurring within and close to harbours during the non-breeding period, including commercial harbours where cranes may be present. Sightings of black-throated divers during the non-breeding period are most frequently reported from bays and sea lochs, and sometimes from reservoirs. These sightings suggest that static vessels, even those with cranes, are not likely to pose a major disturbance impact on individuals of this species foraging close to the Project. Such records are generally uncommon and typically based on observations and photographs submitted by bird recorders and photographers (NBN Atlas, 2026).

NatureScot requested an assessment of black-throated diver disturbance up to 1 km (recommended disturbance buffer for this species; Goodship and Furness, 2022) from cranes during their flightless moult period (mid-September to end of December). It is acknowledged that counts should be taken as a minimum, as they are of birds recorded to 1km from the Vantage Point and not 1 km from the development footprint, but it highlights a more realistic picture of the use of the site by these birds as opposed to peak numbers, which were recorded extremely infrequently during the surveys. To account for the fact that the VP is not 1 km from the Project, the average counts for the 2 km buffer have also been presented. Although peak counts are often required to be used for assessment purposes, a better barometer of importance should be the average peaks across all years of survey. This is 1.5 birds out to 1 km (Table 3 of EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report (EnviroCentre, 2025a)), or 2.6% of the SPA population. During the flightless moult period (mid-September to end of December), again the better barometer is average counts to 1km, which is 2.25 or 4% of the SPA population. It also demonstrates further that this species does utilise other areas of Scapa Flow successfully and that the Flow has sufficient capacity to support this species. The average seasonal peak count out to 2 km of the flightless moult period is 15 birds, which is the same as the seasonal average for the entirety of the survey period.

Due to the highly infrequent use of quayside cranes during the winter months, and specifically within the flightless moult window, any potential disturbance to black-throated diver from vessel and crane activity will be temporary and localized. Disturbance events will be strictly limited to the duration of cargo loading and unloading operations. This pathway is restricted by the low projected vessel traffic volume, which averages just 0.8 vessel movements per week during the winter season. Consequently, for the vast majority of the non-breeding period, black-throated divers will remain undisturbed by project-related vessel and crane operations.

Airborne noise

Airborne noise modelling (see section 10.3.1.1.2 of the HRA (Appendix A) establishes that construction noise levels should be restricted to below 70 dB. A 6 m high bund will be formed at the seaward boundary of the site by retaining the existing land and excavating behind, creating a natural noise screen from terrestrial blasting (and other works) and will only be removed once the site is excavated to the final profile. This physical barrier provides significant acoustic attenuation, dissipating construction noise to less than 35 dB(A) at a distance of 250 m from the source.

An acoustic profile of <35 dB(A) aligns with typical ambient baseline sound levels in rural or coastal environments. Based on empirical thresholds established by the University of Hull (2013), there is no evidence of waterbird disturbance at or below this decibel level. Consequently, due to the high attenuation provided by the terrestrial bunding, the main construction works are predicted to have a negligible acoustic impact on the local waterbird assemblage.

[2] https://www.birdsofpooleharbour.co.uk/sightings/harbour-update-07-01-25/
[3] NBN Atlas - Black-throated diver records
[4] EnviroCentre, 2024b – record of black-throated diver presence in working harbour area (Hatston)

Localised displacement of birds from the immediate vicinity of the active working area is highly likely. However, any displaced individuals are expected to move only as far as the threshold where received noise levels fall below disturbance limits. The wider Scapa Flow SPA possesses ample ecological carrying capacity to accommodate these minor, localised shifts in bird distribution without causing population-level effects.

Conclusion

As previously detailed, empirical evidence from Jarrett et al. (2018) confirms that vessel-induced disturbance does not typically trigger flight responses in black-throated divers. Instead, behavioural reactions are limited to localised swimming or diving, avoiding high-energy flushing events.

The standard 2 km avoidance zone often applied to this species is derived from birds altering flight paths around offshore wind turbine arrays. This open-water avoidance behaviour cannot be directly correlated to the proposed quayside infrastructure. The presence of land-based mobile cranes within a developed coastal setting represents a fundamentally different visual and spatial profile. Crucially, the cranes will operate against a dominant terrestrial landform backdrop that exceeds the height of the structures themselves, significantly reducing their visual silhouette and potential to induce macro-avoidance or barrier effects in transiting birds.

The mortality assessment utilises a displacement matrix approach based on multi-year average seasonal peak counts. While this methodology represents a realistic worst-case scenario, the natural spatial and temporal variability of black-throated diver distribution within the Scapa Flow Special Protection Area (SPA) means that daily disturbance events will likely affect fewer individuals than this statistical mean.

The ecological consequences of any localised displacement are fundamentally limited by habitat availability and target prey distribution. Black-throated divers are widely distributed across the nearshore coastal fringes of Scapa Flow, maintaining extensive access to alternative foraging and roosting habitats throughout the wider SPA. Baseline survey data confirms this widespread distribution, indicating that the localised project area does not support a critical or disproportionate concentration of the regional population.

Project-related vessel movements and quayside crane operations do not represent continuous environmental pressures. These activities are characteristically intermittent and temporary, with any associated disturbance pathways terminating immediately upon the cessation of the operational event (e.g., following a vessel transiting through the nearshore zone or the completion of a cargo loading window).

Because operations are non-continuous, black-throated divers will retain unimpeded access to the project's zone of influence for the vast majority of the non-breeding period. Consequently, the disturbance regime is neither continuous nor sustained, preventing chronic impacts on the species' energetic budgets or population integrity.

The predicted additional mortality of 0.135 birds per year is derived from a conservative displacement matrix framework. This model assumes a macro-displacement rate of 90% applied to the average seasonal peak count of black-throated divers within a 2 km radius of the Project, coupled with a subsequent 1% increase in mortality among those displaced individuals.

Evaluated against a localised reference baseline of 57 individuals, the projected additional mortality of 0.135 birds per year equates to a nominal 0.24% of the Special Protection Area (SPA) citation population annually. However, the Scapa Flow SPA does not function as a closed demographic unit. The overarching biogeographic population utilising this marine area during the non-breeding period is substantially larger. This wider population comprises approximately 200 pairs breeding within Scotland, alongside a influx of wintering individuals originating from the broader boreal North Atlantic region,

including Scandinavia (**NatureScot, 2022**). When evaluated against this expanded biological footprint, the per capita impact of the Project is heavily diluted.

Expressing cumulative mortality as an absolute percentage over time (i.e., 6% of the initial SPA citation population across 25 years) is ecologically misleading. This linear calculation fails to account for continuous density-dependent recruitment and annual recruitment from both the domestic and international breeding populations. While the exact carrying capacity and exchange dynamics between these regional cohorts remain poorly defined in literature, regular population replenishment ensures that localised project-induced losses may not accumulate linearly or cause a net depression of the regional baseline.

The baseline natural mortality within a reference population of 57 adult black-throated divers is calculated at approximately 6.2 individuals per year, applying an established adult annual survival rate of 0.89 ±0.01 (British Trust for Ornithology [BTO, 2026]). This represents a minimum baseline threshold. Should the wintering cohort within the Scapa Flow Special Protection Area (SPA) include a juvenile component, annual natural mortality would increase significantly due to the lower characteristic juvenile survival rate of 0.400.

Extrapolated over the agreed 25-year operational lifespan, and assuming a highly conservative population structure composed exclusively of adults, a minimum of 155 birds associated with the SPA would die through natural mortality pathways. Given an average species lifespan of 12 years, the entire local population will naturally turn over and be replaced more than twice during this 25-year period.

When contextualized against these baseline demographic dynamics, the project's cumulative modelled mortality of 3.375 birds over 25 years represents a negligible perturbation well within the range of natural variation. An incremental loss of less than four individuals over a quarter-century (0.135 birds per year) is highly unlikely to culminate in a long-term population reduction or a sustained modification of species distribution.

Against a background of pronounced interannual fluctuations typical of wintering populations, this nominal project-induced loss is statistically indistinguishable from natural baseline variance. Consequently, an impact of this minor magnitude would be entirely undetectable by any ornithological monitoring program that could realistically be deployed at the site.

Based on the preceding evidence, project-related activities will not create significant barriers to movement, nor will they reduce access to preferred foraging or roosting habitats in a continuous or sustained manner. Any localised distributional adjustments will remain well within the range of natural interannual variability. Furthermore, the projected disturbance footprint is minor relative to the extensive alternative habitat available within the wider Scapa Flow SPA. Crucially, there is no empirical evidence to indicate that the localised marine zones affected by port operations possess disproportionate ecological importance for black-throated diver prey availability.

Any secondary increases in avian energy expenditure or corresponding temporary reductions in body condition will be short-lived and of a negligible magnitude. This low impact level is guaranteed by the abundance of high-quality alternative foraging resources throughout the SPA, which ensures that displaced individuals can rapidly resume foraging elsewhere. Consequently, the project's disturbance pathways will not compromise the energetic budgets, survival rates, or overarching population integrity of the species within the designated site.

Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A) provides details of specific mitigation measures designed to prevent adverse impacts on marine ornithological features, including black-throated diver. Central to this framework is adherence to the protocols established within

a Project Vessel Management Plan (VMP). These embedded mitigation measures require all project-related vessels to operate under the following operational constraints:

- **Speed Restrictions:** Vessels will travel at reduced, non-disruptive speeds to minimise the risk of flushing or collision.
- **Raft Avoidance**: Marine traffic will actively avoid bird rafts on the water, in compliance with the Scottish Marine Wildlife Watching Code (SMWWC).
- **Spatial Controls**: All transits will be restricted to pre-determined, standardized vessel corridors to maintain predictability and minimise the spatial footprint of disturbance.

Based on the findings of the HRA (Appendix A) and impact pathways outlined above, the potential effects of the Project have been rigorously evaluated against the Conservation Objectives for black-throated diver. This assessment incorporates a highly conservative modelling framework, accounting for pronounced natural interannual variability in the spatial distribution of the species within the Scapa Flow Special Protection Area (SPA).

When factoring in the embedded mitigation measures committed to within the Vessel Management Plan (VMP), Construction Environmental Management Document (CEMD) and Operational Environmental Management Plan (OEMP), the **magnitude** of any project-induced disturbance is determined to be **negligible** at the population scale. Consequently, the **significance of the residual effect** is classified as **not significant** in EIA terms.

It is therefore concluded that the predicted disturbance impacts from the Project alone will not result in a population-level decline or sustained distribution change. Accordingly, there is no credible risk of a population depression or disruption to site connectivity, and it can be definitively concluded that the Project **will not adversely affect the integrity** of the Scapa Flow SPA.

However, the comprehensive evidence, species-specific behavioural data, and demographic modelling presented within the HRA report provide a robust, scientifically defensible basis to refine those baseline assumptions. By demonstrating that the **magnitude** of exposure is strictly intermittent and that the residual **significance** is minor, this assessment establishes that the site's over-arching Conservation Objectives will be maintained.

Great northern diver (non-breeding)

Disturbance of birds due to Vessel disturbance:

During the 26-month construction window, the volume of project-related vessel movements will increase by an average of 0.12%[5] over current winter baseline levels (Section 2.2.12). This temporary increase coincides with the non-breeding period for the great northern diver (October to May), for which the species is designated as a qualifying feature.

Operational phase vessel traffic is detailed in Sections 2.3.2 and 10.3.1.2 of the HRA (Appendix A). During the great northern diver non-breeding period (October–May), project operations are projected to add an average of 11 vessel movements per month. This represents a minor average increase of 0.5% over current baseline levels.

A study by Jarrett et al. (2018) demonstrated that great northern divers typically do not fly in response to vessels, instead utilizing swimming or diving as evasive methods. Given the regulated vessel speeds

[5] Note because great northern diver non-breeding period continues into May, this takes into account two additional months of 'summer' movements, which makes this value slightly different to the 0.5% increase in more typical *winter* months (October-March) which is stated elsewhere.

within Scapa Flow and the strict adherence of project vessels to a Vessel Management Plan (VMP), the risk of significant disturbance or collision is considered negligible.

Ornithological surveys undertaken between 2020 and 2022 recorded 49 discrete interactions between great northern divers and vessels. Of these, 24 resulted in no observable reaction, 10 induced a slow swim-away response, 11 caused birds to dive, and three elicited an alert (sitting) posture. Crucially, no vessel movements triggered a flush-flight response. These site-specific observations strongly correlate with Jarrett et al. (2021), who found that at least 95% of diver responses to vessels were limited to no reaction, swimming, or diving, with flush-flight behaviour being exceptionally rare.

Despite evidence from Gittings et al. (2015), great northern divers are generally considered to display a high sensitivity to vessel disturbance (Table 10.11 (of the HRA); Furness et al., 2012). However, the projected increase in vessel traffic along the route is not significant relative to the baseline (see Sections 2.2.12 and 2.3.2 of the SEIR, and 10.2.3.1 and 10.3.1.2 of the HRA (Appendix A). Project-related vessel traffic during both construction and operation is highly unlikely to create a barrier effect for birds moving through the area. Applying a precautionary approach, vessel movements will be intermittent rather than continuous, occurring significantly less than once per day on average across the overall project lifespan, and fewer than twice per week during the winter period.

A Vessel Management Plan (VMP) will be developed for both the construction and operational phases in consultation with NatureScot. The VMP will specify vessel routes, speed restrictions, and operational protocols designed to minimise and, where possible, avoid disturbance impacts. This will include specific mitigation measures to actively identify and avoid high-density aggregations of birds on the water.

The July 2026 HRA states that the matrix model assessment concludes that the Project will result in a precautionary 1% annual increase in mortality (Appendix A: HRA Appendix D Mortality Matrix Model). Based on a mean seasonal peak count of 46 birds, this equates to 0.414 birds annually, or 0.08% of the Special Protection Area (SPA) population, which is considered non-significant. Over an agreed 25-year operational lifespan (consulted with NatureScot), this totals 10.4 birds, representing 2% of the SPA population at designation, or a frequency of one bird every 2.4 years. This minor impact is driven by a respective 0.12% and 0.5% increase over current baseline vessel movements during the construction and operational phases. During the flightless moult period, the mean seasonal peak count is 33 birds, equating to an annual mortality of 0.3 birds (0.06% of the SPA population) and a 25-year total of 7.4 birds (1.5% of the SPA population at designation).

Mobile cranes

As previously noted, mobile crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

Section 10.4.3.1.1.2 of the HRA (Appendix A) details the structural and operational distinctions between offshore wind farm infrastructure and land-based quayside cranes. This comparison provides the necessary technical justification for applying specific sensitivity caveats regarding diver displacement and disturbance, validating the adaptation of offshore wind guidance to the onshore project components.

Great northern divers are considered highly sensitive to vessel-induced disturbance and displacement. In the absence of empirical evidence regarding diver responses to quayside cranes, vessel disturbance is applied as a conservative proxy for this assessment. Notably, cranes will operate from static locations on the quay or from berthed (non-transit) vessels. The disturbance mechanisms of static cranes differ

fundamentally from mobile vessels at sea; while cranes introduce a tall, moving structure, their movements are slow and confined within localised bounds determined by the crane height and jib length. Although no published literature evaluates crane impacts on great northern divers, the frequent presence of the species within active harbours during the overwintering period suggests that stationary structures and berthed vessels are unlikely to cause significant disturbance to individuals foraging near the Project.

Great northern divers exhibit heightened sensitivity during their flightless moult period (February to mid-April; confirmed via NatureScot correspondence) because they cannot execute flush-flight evasive actions. Within a 2 km buffer, the average peak count during this moult period is 33 birds, representing 6.5% of the Special Protection Area (SPA) citation population. However, NatureScot confirmed that it is appropriate to restrict the disturbance and displacement assessment to a 0–500 m zone from the main vantage point. This is based on a standard disturbance threshold of 100–300 m established by Goodship and Furness (2022). The broader distribution data indicates that the species successfully utilises other regions of Scapa Flow, demonstrating that the wider marine area possesses sufficient carrying capacity to accommodate displaced individuals.

During construction, the number of vessel movements relevant to the great northern diver non-breeding period (October-May) will see an average 0.12% increase of vessel movements, over current baseline levels between October and May. Operational phase vessel movements are expected to comprise an average monthly increase of 11 vessel movements over the same period. This constitutes an average increase to the monthly vessel movements of 0.5%. Given the infrequent nature of crane usage during the winter months (2–5 days/month between October-March) and 8-20 days/month in April and May, any disturbance to great northern divers from vessel activity and crane use is expected to result only in temporary disturbance, particularly during the majority of the flightless moult period, with effects that are intermittent during cargo loading and unloading operations. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

Airborne Noise

Airborne noise modelling (see Section 10.3.1.1.2 of Appendix A)) indicates that construction noise levels will remain below the established 70 dB threshold. Consequently, the main terrestrial works are not expected to result in noise disturbance to waterbirds. This assessment is supported by findings from the University of Hull (2013) and the attenuation provided by acoustic bunds surrounding the working area, which ensure that construction sound dissipates to less than 35 dB within 250 m

While localised displacement from the active working area is expected, the wider Scapa Flow SPA possesses the carrying capacity to accommodate these birds at a sufficient distance to prevent adverse noise impacts. Any resulting disturbance will be short-term, restricted to specific construction windows, and fully reversible, with baseline behavioural patterns restored rapidly upon cessation of the activity.

None of these potential disturbance effects will create barriers to movement or reduce access to preferred foraging and roosting habitats. Consequently, there will be no project induced increases in energy expenditure, reductions in body condition, or adverse impacts on winter survival and subsequent migration.

Disturbance distances for great northern diver are 100-350 m (Goodship and Furness, 2022). The peak count of nine birds represents a maximum of 1.8% of the Special Protection Area (SPA) population at citation, while average counts account for 0.4%. The mean peak count of 7.7 birds constitutes 1.5% of the citation baseline. When evaluated against the updated 2017/18 count data (HRA Appendix A, Section 10.2.1.1.2), these metrics correspond to 1.1% and 0.26%, respectively. Furthermore, when compared

against the 2021/22 and 2022/23 HiDef digital aerial survey population estimates, they represent 0.8% and 0.2%, respectively. All of these proportions are considered low.

Section 5.7 and 11 of this SEIR and Section 7 and 10.2.3.4 of the HRA (Appendix A) details mitigation measures to avoid any significant impacts on marine bird species, including great northern diver.

Conclusions

The HRA (Appendix A) assessment concludes that the potential disturbance effects resulting from the Project will not create significant barriers to connectivity or result in a long-term reduction in access to preferred foraging and roosting habitats. Any localised shifts in bird distribution will remain within the range of natural baseline variability, with the spatial extent of the disturbance zone being minor relative to the extensive alternative habitat available within the Scapa Flow SPA. There is no empirical evidence to suggest that the localised areas affected by port operations hold disproportionate importance for prey availability for the great northern diver qualifying feature. Consequently, any project-induced increase in energy expenditure or subsequent reduction in body condition will be short-lived and of a **negligible magnitude**. Given the high carrying capacity of alternative foraging habitats within the SPA and the high probability that displaced individuals will resume foraging elsewhere, the **significance of the effect** is determined to be **negligible and non-significant**. Based on this evidence, and accounting for the embedded mitigation measures committed to by the Project, it is concluded that predicted disturbance impacts from the Project **will not adversely affect the integrity** of the Scapa Flow SPA

Red-throated diver (breeding)

Disturbance of birds due to Vessel disturbance

Although red-throated divers exhibit high sensitivity to vessel disturbance, the projected increase in vessel traffic along the transit route is not significant compared to the baseline environment (see Sections 2.2.12 and 2.3.2 of the SEIR, and 10.2.3.1 and 10.3.1.2 of the HRA (Appendix A). Consequently, vessel movements during both the construction and operational phases are highly unlikely to create a barrier effect for birds traversing the area. Adopting a precautionary approach, vessel traffic will remain intermittent rather than continuous, averaging fewer than one transit per day overall and dropping to fewer than two transits per week during the winter season.

A Vessel Management Plan (VMP) will be developed in consultation with NatureScot to cover both the construction and operational phases. The VMP will specify vessel routing, speed restrictions, and operational parameters designed to minimise, and where possible, avoid, disturbance impacts. This will include specific mitigation measures to actively identify and avoid bird aggregations on the water.

The HRA assessment concludes that the Project will result in a precautionary 1% annual increase in mortality (Appendix A (Appendix D: Mortality Matrix Model)). This conservative estimate is based on a seasonal peak count of three birds, assuming a 1 km disturbance distance. This equates to 0.027 birds annually, representing 0.036% of the Special Protection Area (SPA) population, which is not significant. Over the 25-year operational lifespan agreed with NatureScot, the cumulative predicted mortality is 0.7 birds, equivalent to 0.9% of the SPA population.

Mobile Cranes

Crane activity will be intermittent, seasonal, and synchronized with vessel operations, peaking during the summer months. Onsite movements involve slow-moving, low-noise mobile cranes alongside large on-vessel cranes. Summer operations are estimated at 8–20 days per month, decreasing to 2–5 days per month in winter. Depending on the specific crane model, booms can reach operating heights of 60–125 m, but will be retracted to approximately 5 m during storage. Winter operations will be minimal due

to high wind downtime and daylight-only working constraints, effectively reducing disturbance pressure during sensitive avian wintering periods

Section 10.4.3.1.1.2 of the HRA (Appendix A) delineates the operational differences between offshore wind farm structures and land-based cranes. This comparison justifies the specific sensitivity caveats applied to red-throated diver displacement and disturbance from quayside cranes, thereby qualifying the adaptation of standard offshore wind guidance for this terrestrial context.

During the breeding season, red-throated divers were recorded within 1 km of the Project site during 30.0% of surveys in 2021 and 37.5% in 2022. The 2021 peak count of four birds represents 5.26% of the citation population, assuming a baseline of 76 breeding pairs and that all recorded individuals were unique adults from separate pairs. The 2022 peak count of two birds represents 2.63% of this baseline. These occurrence levels are considered low. Supplementary flight mapping surveys recorded a total of 13 birds in 2021 and 54 birds in 2022, with a seasonal peak count of 19 birds observed in July 2022.

Red-throated divers recorded within 1 km of the Project site primarily utilise the area as a staging zone, characterised by flying in and loafing, with only occasional foraging before moving further into the Flow. This behavioural pattern is supported by foraging suitability modelling, which categorises the Project area within the lowest tier for foraging suitability. Consequently, any localised displacement of red-throated divers within this 1 km zone during crane operations will not result in an adverse effect on the species, as they rely on higher-quality, preferred foraging habitats located more than 1 km away. Total impacts from crane-induced disturbance are therefore considered non-significant.

The evidence citing red-throated diver sensitivity to towering structures in the marine environment relates primarily to offshore wind farms (*Dierschke et al.*, 2017) and does not address quayside cranes in coastal developments. Due to this data gap, vessel disturbance has been applied as a conservative proxy to assess crane impacts. However, cranes will operate exclusively from locations on the quay or from berthed vessels. The disturbance mechanisms of static cranes differ fundamentally from mobile vessels at sea; while cranes introduce a moving structure, their movements are slow and restricted within the bounds of the crane footprint and jib length. Although no published evidence evaluates crane impacts on red-throated divers, the frequent occurrence of the species within active harbours during the breeding season (see Section 10.2.1.2 of the HRA (Appendix A)) suggests that static vessels and associated crane operations do not pose a significant disturbance risk to individuals foraging near the Project.

Flight path mapping data (Ornithological Technical Report (EnviroCentre 2025(a), Appendix C: Scapa Deep Water Quay Ornithology Technical Report)). indicates at least one breeding pair nested on inland moorland lochans to the east. During outward transit flights, these individuals frequently used the marine survey area as their initial alighting destination. Recorded flight altitudes ranged between 20 m and 100 m, with the majority of observations concentrated between 50 m and 100 m. Spatially, most flight registrations occurred over the marine environment rather than inland areas.

Red-throated divers are highly sensitive to disturbance, particularly during the chick-rearing period (June to mid-September; NatureScot, 2022) when unimpeded access to foraging areas is critical. However, disturbance from vessel activity, low-noise mobile cranes, and large on-vessel cranes will be temporary. These intermittent effects are restricted to active cargo loading and unloading operations, and are further constrained by a very low operational vessel frequency of eight vessels per month during the breeding season. Any induced disturbance will be fully reversible upon the cessation of crane operations. Given the species' documented tolerance to stationary vessel presence within active harbours and the implementation of a Vessel Management Plan (VMP) to minimise interactions, no significant or sustained adverse impacts are anticipated.

Airborne noise

Airborne noise modelling indicates that construction noise levels should remain below the 70 dB threshold. Consequently, the main terrestrial works are not expected to cause noise disturbance to waterbirds. This assessment is supported by findings from the University of Hull (2013) and the inclusion of acoustic bunds around the working area, which will attenuate construction sound to less than 35 dB at a distance of 250 m.

While localised avian displacement from the immediate working area is anticipated, the wider Scapa Flow SPA possesses the carrying capacity to accommodate these individuals at a distance sufficient to prevent noise induced impacts. This disturbance will be short-term and restricted to specific construction phases. Furthermore, the impact is temporary and fully reversible, with local baseline conditions expected to recover rapidly upon the cessation of project activities.

None of these potential disturbance effects will create barriers to movement or restrict access to preferred foraging and roosting habitats. Consequently, the Project will not cause elevated energy expenditure, reductions in body condition, or adverse impacts on survival and subsequent migration.

Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A) details mitigation measures to avoid any significant impacts on marine bird species, including red-throated diver.

Conclusions

In conclusion, the potential disturbance effects resulting from the Project will not create barriers to movement, nor will they reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Given that the affected zone represents a small spatial footprint relative to the expansive alternative habitat within the Scapa Flow SPA, any localised distributional changes will remain within the range of natural variability.

There is no evidence indicating that the proposed SDWQ footprint holds disproportionate importance for red-throated diver prey availability. Given the high availability of alternative high-quality habitat and the likelihood that birds will rapidly resume foraging elsewhere, any subsequent increase in energy expenditure or reduction in individual fitness will be short-lived and of **negligible magnitude**. Consequently, the **significance of the residual effect** is determined to be **not significant** (negligible).

Based on this evidence and accounting for the mitigation measures, it is concluded that the predicted disturbance impacts on the red-throated diver qualifying feature **will not result in an Adverse Effect on the Integrity** of the Scapa Flow SPA.

Long-tailed duck (non-breeding)

Disturbance of birds due to Vessel disturbance:

As detailed in Section 10.3.2 of the HRA (Appendix A), project vessels will strictly adhere to established shipping routes. The mapping provided in Ornithological Technical Report (EnviroCentre 2025(a), Appendix C: Scapa Deep Water Quay Ornithology Technical Report) integrates baseline survey data with HiDef aerial survey results, illustrating the proposed transit corridors for both the construction and dredging phases. Additionally, The HRA (Figure 10.3) displays the mean density analysis of long-tailed duck across Scapa Flow, derived from the HiDef survey reports.

The spatial analysis demonstrates that long-tailed duck densities within the designated shipping routes are consistently low. Consequently, the potential for vessel-induced disturbance to this species during construction and dredging operations is considered negligible.

Although long-tailed duck generally exhibit low sensitivity to vessel disturbance, potential vulnerability increases during the pre-migration period when individuals aggregate into larger, concentrated flocks. However, the projected increase in vessel traffic along the transit route to the Project is not significant relative to baseline activity levels (see Sections 2.2.12 and 2.3.2 of the SEIR, and Sections 10.2.3.1 and 10.3.1.2 of the HRA (Appendix A)). Consequently, no significant disturbance impacts are anticipated during this sensitive seasonal window.

A Vessel Management Plan (VMP) will be developed in consultation with NatureScot for both the construction and operational phases. This plan will specify vessel routing, speed restrictions, and operational protocols designed to minimise and, where practicable, avoid disturbance impacts. For long-tailed duck, the VMP will explicitly account for the sensitive pre-migration period spanning March to May. Crucially, the VMP will incorporate targeted mitigation measures to identify and actively avoid bird aggregations on the water.

The HRA concludes that the Project will result in a precautionary annual mortality increase of 1% (Appendix A HRA (Appendix D: Mortality Matrix Model)), based on an average peak count of 387.6 birds. This equates to an estimated loss of 3.5 individuals annually, representing 0.69% of the Special Protection Area (SPA) population, an effect that is deemed not significant. Projected over the 25-year operational period agreed with NatureScot, the cumulative mortality equates to 87.2 individuals, representing 17.3% of the SPA population.

Mobile cranes

Given the infrequent nature of crane usage during winter, any resulting disturbance to long-tailed duck from vessel and crane activity is expected to be temporary. These effects will be intermittent, occurring only during cargo loading and unloading operations. Disturbance is further constrained by the low operational vessel frequency of 0.8 vessels per week during the winter period.

Any induced disturbance will be fully reversible upon the cessation of crane activities. Given the species' documented tolerance to vessel presence and the strict implementation of the Vessel Management Plan (VMP) to minimise interactions, no significant or sustained long-term impacts are anticipated.

Airborne noise

Airborne noise modelling (see Section 10.3.1.1.2 of the HRA) indicates that construction noise levels should remain below the 70 dB threshold. Consequently, the main terrestrial works are not expected to cause noise disturbance to waterbirds. This assessment is supported by findings from the University of Hull (2013) and the inclusion of acoustic bunds around the working area, which will attenuate construction sound to less than 35 dB at a distance of 250 m.

Vessel and construction activities are highly likely to displace individuals from the immediate working area. However, the wider Scapa Flow Special Protection Area (SPA) possesses sufficient ecological capacity to accommodate these displaced birds at a distance that attenuates noise disturbance below impact thresholds. Any resulting displacement will be short-term (restricted to specific construction phases), temporary (ceasing immediately upon completion of the activity), and fully reversible (with baseline distribution rapidly restored following cessation).

None of these potential disturbance effects will create barriers to movement or restrict access to preferred foraging and roosting habitats. Consequently, there will be no significant increase in metabolic energy expenditure, preventing any adverse reduction in the body condition required for winter survival and subsequent migration.

Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A) details mitigation measures to avoid any significant impacts on marine bird species, including long-tailed duck.

Conclusion

It is concluded that the potential disturbance effects resulting from the Project will result in an impact of **negligible magnitude** on bird movements and distribution. These changes will not create significant barriers to movement, nor will they reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any localized distributional changes will remain well within the range of natural baseline variability.

The active disturbance footprint is minor relative to the extensive alternative habitat available within the wider Scapa Flow Special Protection Area (SPA). Furthermore, there is no empirical evidence to indicate that the localized marine zones affected by port operations possess disproportionate ecological importance for long-tailed duck prey availability.

Any secondary increases in avian energy expenditure or subsequent minor reductions in body condition will be short-lived, transient, and of a **negligible magnitude**. Displaced individuals can rapidly resume foraging elsewhere due to the abundance of high-quality alternative resources across the SPA.

When factoring in the embedded mitigation measures committed to by the Project, the residual **significance of the effect** under EIA criteria is determined to be **not significant**. Consequently, when evaluated against the site's Conservation Objectives, the predicted disturbance impacts on the long-tailed duck qualifying feature from the Project alone **will not adversely affect the integrity** of the Scapa Flow SPA.

Eider (non-breeding)

Disturbance of birds due to Vessel disturbance:

Although eider ducks (*Somateria mollissima*) exhibit high sensitivity to vessel disturbance, the projected increase in vessel movements along the transit route is not considered significant relative to the baseline environment (refer to Sections 2.2.12 and 2.3.2 of the SEIR, and Sections 10.2.3.1 and 10.3.1.2 of the HRA (Appendix A)).

To mitigate potential impacts, a Vessel Management Plan (VMP) will be developed for both the construction and operational phases in consultation with NatureScot. The VMP will specify vessel routing and speed restrictions to minimise and, where practicable, avoid disturbance. This will include the implementation of specific protocols to identify and actively avoid key aggregations of birds on the water.

The assessment concludes that the Project will result in a precautionary annual mortality increase of 1% (Appendix A HRA (Appendix D: Mortality Matrix Model)), based on an average peak count of 92 birds. This equates to 0.828 birds per annum, representing 0.041% of the Special Protection Area (SPA) population, which is not considered significant. Over the 25-year operational period agreed with NatureScot, cumulative mortality is projected at 20.7 birds, equivalent to 1% of the SPA baseline population.

Mobile cranes

Eider exhibit high sensitivity to vessel disturbance. In the absence of empirical evidence regarding waterbird disturbance from quayside cranes, vessel disturbance has been applied as a conservative proxy for this assessment. However, cranes operate from static locations on the quay or from berthed (non-transit) vessels, presenting a fundamentally different disturbance mechanism compared to mobile vessels at sea. While cranes introduce a moving, tall structure, their movement is typically slow and confined within specific operational bounds. Although published evidence on crane impacts on eider is limited, the documented presence of this species in operational harbours during the overwintering

period (refer to Section 10.2.1.5.1 of the HRA (Appendix A) indicates that static vessels and quay infrastructure are unlikely to cause significant disturbance to individuals foraging adjacent to the Project.

Given the infrequent nature of crane usage during the winter months, any disturbance to eider from vessel activity and crane operations is predicted to be temporary, intermittent, and restricted to active cargo-handling periods. This exposure is further minimised by a low operational vessel frequency of 0.8 vessels per week during the winter season. Any resulting disturbance will be reversible upon the cessation of crane activities. Consequently, given the species' documented tolerance to static vessel presence and the implementation of a Vessel Management Plan (VMP) to minimise interactions, no significant or sustained adverse impacts are anticipated.

Airborne noise

Based on airborne noise modelling, which recommends a construction noise threshold of 70 dB, the main terrestrial works are not predicted to result in adverse noise disturbance to waterbirds. This conclusion is supported by empirical thresholds established by the University of Hull (2013). Furthermore, the installation of acoustic bunds around the active working areas will attenuate construction noise to less than 35 dB at a distance of 250 m, well below critical disturbance thresholds.

It is anticipated that birds will be displaced from the active working area into the wider Scapa Flow Special Protection Area (SPA), which possesses the carrying capacity to accommodate displaced individuals at a sufficient distance to prevent adverse noise impacts. Any such displacement will be short-term (restricted to specific construction phases), temporary (ceasing immediately upon completion of the activity), and reversible (with baseline distribution restored rapidly following the cessation of works).

None of these potential disturbance pathways will create barriers to movement or restrict access to preferred foraging and roosting habitats. Consequently, the Project will not result in significant energetic expenditure or reductions in body condition that could compromise overwinter survival or subsequent migration success.

Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A) details mitigation measures to avoid any significant impacts on marine bird species, including eider duck.

Conclusion

Based on the assessment framework, the potential disturbance effects arising from the Project will not create significant barriers to connectivity. These effects will not restrict access to preferred foraging and roosting habitats in a continuous or sustained manner.

Any localised changes in eider distribution are predicted to remain within the range of natural baseline variability. Furthermore, the spatial extent of the zone of influence (ZoI) is minor relative to the extensive alternative habitat available within the Scapa Flow SPA. Baseline data indicates no evidence that the specific footprint of port operations holds disproportionate importance for eider prey availability.

Consequently, any localised increase in energy expenditure or subsequent reduction in individual body condition is predicted to be **temporary**. This represents an impact of **negligible magnitude** at the **individual level**, given the high availability of alternative, high-quality foraging habitats and the capacity for displaced birds to resume foraging elsewhere.

When accounting for the embedded and additional mitigation measures committed to by the Applicant, the **residual effects** of the Project alone are deemed to be **not significant** in EIA terms. Specifically, the HRA, concluded beyond reasonable scientific doubt that the predicted disturbance impacts will not lead to an **adverse effect on the integrity** of the Scapa Flow SPA.

Red-breasted merganser (non-breeding)

Disturbance of birds due to Vessel disturbance

Given the sparsity of red-breasted merganser (*Mergus serrator*) within the vicinity of the proposed Project, the magnitude of disturbance to this species is predicted to be low.

Although red-breasted merganser exhibit medium sensitivity to vessel disturbance, the projected increase in vessel movements along the route is not considered significant relative to the baseline (refer to Sections 2.2.12 and 2.3.2 of the SEIR, and Sections 10.2.3.1 and 10.3.1.2 of the HRA (Appendix A)).

To mitigate potential impacts, a Vessel Management Plan (VMP) will be developed for both the construction and operational phases in consultation with NatureScot. The VMP will specify vessel routing and speed restrictions to minimise and, where practicable, avoid disturbance. This will include the implementation of specific protocols to identify and actively avoid key aggregations of birds on the water.

The HRA concludes that the Project will result in a precautionary annual mortality increase of 1% (Appendix A (Appendix D Mortality Matrix Model)), based on an average seasonal peak count of 2.7 birds (Section 10.2.1.6.3 of the HRA Appendix A). This equates to 0.024 birds per annum, representing 0.005% of the SPA population, which is not considered significant. Over the 25-year operational period agreed with NatureScot, cumulative mortality is projected at 0.6 birds, equivalent to 0.1% of the SPA baseline population.

Mobile cranes

Red-breasted merganser are considered to have a moderate sensitivity to vessel disturbance and displacement. In the absence of empirical evidence regarding waterbird disturbance from quayside cranes, vessel disturbance has been applied as a conservative proxy for this assessment. However, cranes operate from static locations on the quay or from berthed (non-moving) vessels, presenting a fundamentally different disturbance mechanism compared to mobile vessels at sea. While cranes introduce a moving, tall structure, their movement is typically slow and confined within specific operational bounds. There is currently no published evidence detailing the specific effects of crane operations on red-breasted merganser.

Given the infrequent nature of crane usage during the winter months, any disturbance to red-breasted merganser from vessel activity and crane operations is predicted to be temporary, intermittent, and restricted to active cargo-handling periods. This exposure is further minimised by a low operational vessel frequency of 0.8 vessels per week during the winter season. Any resulting disturbance will be reversible upon the cessation of crane activities. Consequently, given the species' documented tolerance to static vessel presence and the implementation of a Vessel Management Plan (VMP) to minimise interactions, no significant or sustained adverse impacts are anticipated.

Airborne noise

It is anticipated that birds will be displaced from the active working area into the wider Scapa Flow Special Protection Area (SPA), which possesses the carrying capacity to accommodate displaced individuals at a sufficient distance to prevent adverse noise impacts. Any such displacement will be short-term (restricted to specific construction phases), temporary (ceasing immediately upon completion of the activity), and reversible (with baseline distribution restored rapidly following the cessation of works).

None of these potential disturbance pathways will create barriers to movement or restrict access to preferred foraging and roosting habitats. Consequently, the Project will not result in significant energetic

expenditure or reductions in body condition that could compromise overwinter survival or subsequent migration success.

Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A) details mitigation measures to avoid any significant impacts on marine bird species, including red-breasted merganser.

Conclusion

Based on the findings of the HRA (appendix A)), the potential disturbance effects arising from the Project will not create significant barriers to ecological connectivity. These effects will not restrict access to preferred foraging and roosting habitats in a continuous or sustained manner.

Any localised changes in waterbird distribution are predicted to remain well within the range of natural baseline variability. Furthermore, the spatial extent of the zone of influence (ZoI) is **minor** relative to the extensive alternative, high-quality habitat available within the Scapa Flow SPA. Baseline data indicates no evidence that the specific footprint of port operations holds disproportionate importance for red-breasted merganser prey availability or foraging success.

Consequently, any localized increase in energy expenditure or subsequent reduction in individual body condition is predicted to be **temporary**. This represents an impact of **negligible magnitude** at the **individual level**, given the availability of alternative habitats and the high capacity for displaced birds to resume foraging elsewhere.

When accounting for the embedded and additional mitigation measures committed to by the Applicant, the residual effects of the Project alone are deemed to be **not significant** in EIA terms. Specifically, regarding the HRA, it is concluded beyond reasonable scientific doubt that the predicted disturbance impacts **will not lead to an adverse effect on the integrity** of the Scapa Flow SPA in relation to this qualifying feature.

European Shag (non-breeding)

Disturbance of birds due to Vessel disturbance:

Although European shag (*Gulosus aristotelis*) exhibit medium sensitivity to vessel disturbance, they are considered unlikely to be displaced by vessel movements. Furthermore, the projected increase in vessel traffic along the transit route is not considered significant relative to the baseline environment (refer to Sections 2.2.12 and 2.3.2 of the SEIR, and Sections 10.2.3.1 and 10.3.1.2 of the HRA (Appendix A)

To mitigate potential impacts, a Vessel Management Plan (VMP) will be developed for both the construction and operational phases in consultation with NatureScot. The VMP will specify vessel routing and speed restrictions to minimise and, where practicable, avoid disturbance. This will include the implementation of specific protocols to identify and actively avoid key aggregations of birds on the water.

The HRA (Appendix A) concludes that the Project will result in a precautionary annual mortality increase of 1% (Appendix D: Mortality Matrix Model), based on an average seasonal peak count of 61 birds (Section 10.2.1.7.3 of Appendix A HRA). This equates to 0.549 birds per annum, representing 0.019% of the SPA population, which is not considered significant. Over the 25-year operational period agreed with NatureScot, cumulative mortality is projected at 13.7 birds, equivalent to 0.5% of the SPA baseline population.

Mobile cranes

Given the infrequent nature of crane usage during the winter months, any disturbance to European shag from vessel activity and crane operations is predicted to be temporary, intermittent, and restricted to

active cargo-handling periods. This exposure is further minimised by a low operational vessel frequency of 0.8 vessels per week during the winter season. Any resulting disturbance will be reversible upon the cessation of crane activities. Consequently, given the implementation of a Vessel Management Plan (VMP) to minimise interactions, no significant or sustained adverse impacts are anticipated.

Airborne noise

It is anticipated that birds will be displaced from the active working area into the wider Scapa Flow Special Protection Area (SPA), which possesses the carrying capacity to accommodate displaced individuals at a sufficient distance to prevent adverse noise impacts. Any such displacement will be short-term (restricted to specific construction phases), temporary (ceasing immediately upon completion of the activity), and reversible (with baseline distribution restored rapidly following the cessation of works).

None of these potential disturbance pathways will create barriers to movement or restrict access to preferred foraging and roosting habitats. Consequently, the Project will not result in significant energetic expenditure or reductions in body condition that could compromise overwinter survival or subsequent migration success.

Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A) details mitigation measures to avoid any significant impacts on marine bird species, including European Shag.

Conclusion

Based on the assessment framework, the potential disturbance effects arising from the Project will not create significant barriers to ecological connectivity. These effects will not restrict access to preferred foraging and roosting habitats in a continuous or sustained manner.

Any localised changes in waterbird distribution are predicted to remain well within the range of natural baseline variability. Furthermore, the spatial extent of the zone of influence (ZoI) is minor relative to the extensive alternative, high-quality habitat available within the Scapa Flow SPA. Baseline data indicates no evidence that the specific footprint of port operations holds disproportionate importance for European shag prey availability or foraging success.

Consequently, any localized increase in energy expenditure or subsequent reduction in individual body condition is predicted to be **temporary**. This represents an impact of **negligible magnitude** at the **individual level**, given the vast availability of alternative habitats and the high capacity for displaced birds to resume foraging elsewhere.

When accounting for the embedded and additional **mitigation measures** committed to by the Applicant, the **residual effects** of the Project alone are deemed to be **not significant** in EIA terms. Specifically, regarding the **HRA** framework, it is concluded beyond reasonable scientific doubt that the predicted disturbance impacts will not lead to an **adverse effect on the integrity** of Scapa Flow SPA.

Slavonian grebe (non-breeding)

Disturbance of birds due to Vessel disturbance:

Although Slavonian grebe (*Podiceps auritus*) are considered to have a moderate sensitivity to vessel disturbance, the projected increase in vessel traffic along the route to SDWQ is not considered significant relative to the baseline (refer to Sections 2.2.12 and 2.3.2 of the SEIR, and Sections 10.2.3.1 and 10.3.1.2 of the HRA (Appendix A).

The potential displacement of a peak of 7 birds represents 5.2% of the SPA population; however, the wider Scapa Flow area possesses the carrying capacity to support these individuals.

To mitigate potential impacts, a Vessel Management Plan (VMP) will be developed for both the construction and operational phases in consultation with NatureScot. The VMP will specify vessel routing and speed restrictions to minimise and, where practicable, avoid disturbance. This will include the implementation of specific protocols to identify and actively avoid key aggregations of birds on the water.

The HRA (Appendix A) concludes that the Project will result in a precautionary annual mortality increase of 1% (Appendix A (Appendix D: Mortality Matrix Mode)l), based on an average peak count of 5.67 birds. This equates to 0.05 birds per annum, representing 0.038% of the SPA population, which is not considered significant. Over the 25-year operational period agreed with NatureScot, cumulative mortality is projected at 1.3 birds, equivalent to 0.9% of the SPA baseline population

Mobile cranes

Slavonian grebe are considered to have a very high sensitivity to vessel disturbance and displacement. In the absence of empirical evidence regarding waterbird disturbance from quayside cranes, vessel disturbance has been applied as a conservative proxy for this assessment. However, cranes operate from static locations on the quay or from berthed (non-moving) vessels, presenting a fundamentally different disturbance mechanism compared to mobile vessels at sea. While cranes introduce a moving, tall structure, their movement is typically slow and confined within specific operational bounds. Furthermore, during the inshore surveys undertaken in 2017/18, Slavonian grebes exhibited a strong preference for sheltered, relatively shallow coastal zones. Only seven individuals were recorded across all boat-based surveys, suggesting that Scapa Flow does not represent primary foraging habitat for this species.

Given the infrequent nature of crane usage during the winter months, any disturbance to Slavonian grebe from vessel activity and crane operations is predicted to be temporary, intermittent, and restricted to active cargo-handling periods. This exposure is further minimised by a low operational vessel frequency of 0.8 vessels per week during the winter season. Any resulting disturbance will be reversible upon the cessation of crane activities. Consequently, given the species' minimal presence within the Scapa Flow area and the implementation of a Vessel Management Plan (VMP) to minimise interactions, no significant or sustained adverse impacts are anticipated.

Airborne noise

It is anticipated that birds will be displaced from the active working area into the wider Scapa Flow Special Protection Area (SPA), which possesses the carrying capacity to accommodate displaced individuals at a sufficient distance to prevent adverse noise impacts. Any such displacement will be short-term (restricted to specific construction phases), temporary (ceasing immediately upon completion of the activity), and reversible (with baseline distribution restored rapidly following the cessation of works).

None of these potential disturbance pathways will create barriers to movement or restrict access to preferred foraging and roosting habitats. Consequently, the Project will not result in significant energetic expenditure or reductions in body condition that could compromise overwinter survival or subsequent migration success.

Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A) details mitigation measures to avoid any significant impacts on marine bird species, including Slavonian grebe.

Conclusion

Based on the findings of the HRA (Appendix A), the potential disturbance effects arising from the Project will not create significant barriers to ecological connectivity. These effects will not restrict access to preferred foraging and roosting habitats in a continuous or sustained manner.

Any localised changes in waterbird distribution are predicted to remain well within the range of natural baseline variability. Furthermore, the spatial extent of the zone of influence (ZoI) is minor relative to the extensive alternative, high-quality habitat available within the Scapa Flow SPA. Baseline data indicates no evidence that the specific footprint of port operations holds disproportionate importance for Slavonian grebe prey availability or foraging success.

Consequently, any localised increase in energy expenditure or subsequent reduction in individual body condition is predicted to be **temporary**. This represents an impact of **negligible magnitude** at the **individual level**, given the vast availability of alternative habitats and the high capacity for displaced birds to resume foraging elsewhere.

When accounting for the embedded and additional **mitigation measures** committed to by the Applicant, the **residual effects** of the Project alone are deemed to be **not significant** in EIA terms. Specifically, regarding the HRA, it is concluded beyond reasonable scientific doubt that the predicted disturbance impacts **will not lead to an adverse effect on the integrity** of Scapa Flow SPA in relation to this qualifying feature.

Disturbance to prey species and habitats of prey species (construction only)

As described in NatureScot's Conservation and Management Advice Document for the Scapa Flow SPA (NatureScot, 2022), supporting habitats comprise the characteristics of the seabed and water column essential to the qualifying features. This attribute encompasses wider oceanographic processes, including upwellings, tidal flows, and hydrological movements, that sustain these habitats and influence nutrient cycling and prey distribution.

Hydrodynamic modelling (EnviroCentre 2024,Technical Appendix 4.1 Scapa Flow Deep Water Quay Coastal Hydrodynamic Modelling Study), demonstrates negligible impact on the surrounding water column and seabed, attributable to the low-energy hydrodynamic environment characterising this portion of Scapa Flow. Consequently, impacts on prey species supporting the qualifying features are predicted to be negligible, ensuring that their baseline abundance and spatial distribution remain unaltered.

The dredge material comprises approximately 17% gravel, 60% sand, and 23% silt and clay. Given the weak tidal currents within the vicinity of the proposed dredge pockets, sediment plumes generated by dredging activities will be highly localised and short-term. The magnitude of sediment discharge and dispersion will be low within the active dredge footprint and its immediate surroundings, and negligible beyond this zone. Critically, no project-related sediment transport will occur within the Scapa Flow SPA boundary. Consequently, the supporting habitats for qualifying features beyond the direct development footprint will be maintained.

Engineered drainage designs will ensure that no untreated surface water discharges enter surrounding coastal waters. Additionally, the deployment of silt booms during land reclamation works will mitigate sediment-related pollution risks that could otherwise affect the qualifying features of the SPA and their prey resources. To address potential marine pollution from the pier and associated vessels, strict adherence to Guidance for Pollution Prevention (GPPs) will prevent the release of contaminants into the marine environment. With these mitigation measures implemented, the supporting habitats for qualifying features will be maintained.

For sea disposal of dredged material, no sediment transport will occur within the Scapa Flow SPA boundary, as the designated marine disposal site is located entirely outside the SPA. Consequently, the supporting habitats for the qualifying features beyond the direct development footprint will be maintained.

Great northern diver (non-breeding)

Based on the assessment presented in Sections 10.3.2 and 10.4.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the great northern diver (*Gavia immer*) qualifying feature of the Scapa Flow SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained."

Red-throated diver (breeding)

Based on the assessment presented in Sections 10.3.2 and 10.4.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver (*Gavia stellata*) qualifying feature of the Scapa Flow SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained."

Black-throated diver (non-breeding)

Based on the assessment presented in Sections 10.3.2 and 10.4.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the black-throated diver qualifying feature of the Scapa Flow SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Long-tailed duck (non-breeding)

Based on the assessment presented in Sections 10.3.2 and 10.4.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the long-tailed duck qualifying feature of the Scapa Flow SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Eider (non-breeding)

Based on the assessment presented in Sections 10.3.2 and 10.4.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the eider qualifying feature of the Scapa Flow SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Red-breasted merganser (non-breeding)

Based on the assessment presented in Sections 10.3.2 and 10.4.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low

exposure and localised nature of these changes, the resulting significance of effect on the red-breasted merganser qualifying feature of the Scapa Flow SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

European Shag (non-breeding)

Based on the assessment presented in Sections 10.3.2 and 10.4.3.2 of the HRA (Appendix A)), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the European shag qualifying feature of the Scapa Flow SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Slavonian grebe (non-breeding)

Based on the assessment presented in Sections 10.3.2 and 10.4.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Slavonian grebe qualifying feature of the Scapa Flow SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Accidental release of contaminants or pollutants (all phases)

The following sections present the assessment of effects conclusions for the Scapa Flow SPA qualifying species screened into the assessment. This is based on the Project parameters detailed in Section 10.3.3 of the HRA (Appendix A))

Proposed construction mitigation measures will collectively minimise accidental pollutant release risks. The Construction Environmental Management Document (CEMD), supported by Environmental Clerk of Works (EnvCoW) oversight, ensures all activities follow approved methods to prevent spills, manage materials safely, and maintain compliance with environmental commitments. The Pollution Incident Response Plan provides clear spill-response procedures, emergency contacts, and staff training to guarantee rapid containment. Furthermore, the Pollution Prevention Plan (which extends into the operational phase) outlines specific protocols to manage accidental spillages should they occur.

Turbidity monitoring, silt booms, and controlled dredging protocols help minimise sediment plumes and the mobilisation of contaminated materials, thereby preserving water quality and preventing pollutant dispersal. Rigorous Ballast Water Management procedures govern ballast operations to eliminate the risk of un-permitted discharges. Additionally, best-practice monitoring enables the early detection of any environmental changes, facilitating immediate corrective action. Together, these integrated controls establish a robust environmental management framework that significantly reduces the likelihood, magnitude, and extent of accidental pollutant releases across both the construction and operational phases.

In the unlikely event of a spill, prevailing hydrographic circulation patterns and established best-practice containment measures would restrict residual pollutants to the immediate vicinity of the site. Consequently, any accidental release of contaminants from Project vessels will be strictly controlled, with robust procedures in place to minimise environmental impacts.

An Operational Environmental Management Document (OEMD) will be implemented throughout the operational phase, incorporating industry best practice and strict adherence to the Scottish Environment Protection Agency (SEPA) Guidance for Pollution Prevention (GPPs)

Great northern diver (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.4.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of Scapa Flow SPA with respect to its great northern diver qualifying feature.

Red-throated diver (breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.4.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of Scapa Flow SPA with respect to its great northern diver qualifying feature.

Black-throated diver (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.4.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of Scapa Flow SPA with respect to its Black-throated diver qualifying feature.

Long-tailed duck (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.4.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of Scapa Flow SPA with respect to its Long-tailed duck qualifying feature.

Eider (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.4.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of Scapa Flow SPA with respect to its eider qualifying feature.

Red-breasted merganser (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.4.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of Scapa Flow SPA with respect to its Red-breasted merganser qualifying feature.

European Shag (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.4.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**.

Consequently, it is concluded that these effects **would not adversely affect the integrity** of Scapa Flow SPA with respect to its European shag qualifying feature.

Slavonian grebe (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.4.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of Scapa Flow SPA with respect to its Slavonian grebe qualifying feature.

Ornithological habitat changes (operation and maintenance only)
The Project will result in the loss of 19.1 hectares (ha) of habitat within the Scapa Flow SPA. This loss represents approximately 0.06% of the total designated SPA footprint, which constitutes a negligible proportion of the site. The predicted impact is highly localised, ensuring that the remaining expanse of the SPA will continue to offer extensive foraging, roosting, and commuting habitats sufficient to maintain the conservation status of the qualifying species.

The habitat functions affected relate primarily to marine foraging areas utilised by the qualifying bird species. Given the extensive scale and heterogeneous nature of the SPA, this localised loss is not anticipated to compromise the overall ecological integrity or functioning of the designated site.

Scapa Flow encompasses extensive areas of suitable foraging habitat characterised by comparable prey availability and hydrodynamic conditions. Consequently, the localised area affected does not constitute a unique or limiting foraging resource. Furthermore, the qualifying mobile avian features, specifically divers, grebes, and seaducks, exhibit wide foraging ranges, enabling them to exploit abundant, high-quality habitat throughout the remainder of the SPA and the wider marine environment

Avian flight paths between foraging areas, roosting sites, and open water will not be impeded. The operational footprint of the Project will not create a barrier to movement, thereby preserving the wider ecological connectivity of habitats utilised by the SPA qualifying features.

Great northern diver (non-breeding)

Baseline surveys from 2017/2018 and HiDef surveys from 2021/2022 and 2022/2023 confirm the continued presence, number, and distribution of Great Northern Diver within Scapa Flow. Given the extensive foraging habitat and prey resources available across the wider Scapa Flow SPA, the site has ample carrying capacity to accommodate the individual birds that occasionally utilise the Project site boundary for foraging.

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outside the Project boundary, operational habitat change is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.4.3.4 of the HRA (Appendix A) the **magnitude of change** to the habitat is classified as **negligible**. Given the high sensitivity of the great northern diver qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of Scapa Flow SPA.

Red-throated diver (breeding)

Vantage point and flight surveys undertaken between 2020 and 2022 confirmed that at least one breeding pair of red-throated diver utilised the Project site and its environs for foraging. While the Project

footprint provides suitable foraging habitat, the wider Special Protection Area (SPA) retains sufficient ecological capacity to support this pair.

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outwith the Project boundary, operational habitat change is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.4.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the high sensitivity of the red-throated diver qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project will be **not significant** in EIA terms, and will not result in an **adverse effect on the integrity** of Scapa Flow SPA

Black-throated diver (non-breeding)

Operational activities will result in the intermittent disturbance of 167 hectares (ha) of suitable black-throated diver habitat. This localised impact is concentrated within the marine area branching east from the established shipping route, which will experience an incremental increase in vessel traffic above existing baseline movements (detailed in HRA Appendix A : Heat Maps and HiDef Survey Data). This area of disturbance represents approximately 4.8% of the total utilised suitable habitat within Scapa Flow, defined as all marine waters supporting black-throated diver records located more than 2 km from the coastline (totalling 3,478 ha). As illustrated by the high-density clusters in the Heat Maps and HiDef Survey Data, the distribution of black-throated divers across Scapa Flow is characteristically ephemeral. The presence of multiple alternative high-occupancy areas demonstrates that the wider SPA maintains sufficient carrying capacity to accommodate any temporarily displaced individuals.

Given the highly localised footprint of operational loss and disturbance, combined with the extensive availability of alternative foraging and commuting habitats outside the Project boundary, the overall habitat alteration resulting from the Project is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.4.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the high sensitivity of the black-throated diver qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project alone will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of Scapa Flow SPA.

Long-tailed duck (non-breeding)

While the Project footprint provides suitable foraging habitat for long-tailed duck, the wider SPA possesses sufficient carrying capacity to support these birds without compromising site integrity.

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outwith the Project boundary, operational habitat change is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.4.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the sensitivity of the long-tailed duck qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project alone will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of Scapa Flow SPA.

Eider (non-breeding)

While the Project footprint provides suitable foraging habitat for eider, the wider SPA possesses sufficient carrying capacity to support these birds without compromising site integrity.

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outwith the Project boundary, operational habitat change is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.4.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the sensitivity of eider qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project alone will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of Scapa Flow SPA.

Red-breasted merganser (non-breeding)

The Project will result in the loss of 19.1 ha of the Scapa Flow SPA, representing 0.06% of the total SPA area. Given that nearly all red-breasted merganser records occur within 500 m of the shoreline, this loss equates to 0.4% of the utilised SPA area. While the Project footprint provides suitable foraging habitat, the wider SPA retains sufficient carrying capacity to support these birds.

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outwith the Project boundary, operational habitat change is concluded to be of **negligible magnitude**

Based on the assessments detailed in Section 10.3.4 and Section 10.4.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the sensitivity of red-breasted merganser qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project alone will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of Scapa Flow SPA.

European Shag (non-breeding)

While the Project footprint provides suitable foraging habitat for European shag, findings from the 2017/18 surveys demonstrate a wide-ranging distribution across Scapa Flow. Consequently, the wider SPA possesses the carrying capacity to support these birds, which peaked at 73 individuals.

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outwith the Project boundary, operational habitat change is concluded to be of **negligible magnitude**

Based on the assessments detailed in Section 10.3.4 and Section 10.4.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the high sensitivity of the European shag qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project alone will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of Scapa Flow SPA.

Slavonian grebe (non-breeding)

The Project will result in the loss of 19.1 ha of the Scapa Flow SPA. Given that nearly all Slavonian grebe records occur within 500 m of the shoreline, and none were recorded within the 'Southern Approaches' sector, this footprint equates to 0.4% of the utilised SPA area. Although the Project footprint provides suitable foraging habitat, 2017/18 survey data demonstrate notable winter redistribution across Scapa Flow, indicating that the wider SPA possesses the carrying capacity to support this population (peak of seven birds).

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outwith the Project boundary, operational habitat change is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.4.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the high sensitivity of the Slavonian grebe qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project alone will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of the Scapa Flow SPA.

Cumulative Effects

Projects within and around Orkney have the potential to cause cumulative, in-combination effects on ornithological features that serve as qualifying interests for nearby protected sites. Table 5-2 outlines the specific plans and projects selected for this in-combination assessment.

Table 5-2: Plans and projects considered for cumulative effect assessment of ornithological features

Plan or Project	Development type	Status	Distance from Project
Ayre Offshore Wind Farm	Offshore Wind	Application	36 km
Orbital Westray Tidal Array	Tidal	Pre-Application (Scoping)	27 km
EMEC Fall of Warness	Tidal	Application	24 km
EMEC Billia Croo	Wave	Application	25 km
Mocean– East of Deerness	Wave	Pre-Application	13 km
Orkney–- Caithness	Cable	Under construction	22 km
SHEPD North Coast and Orkney cable route surveys (EPS Licence)	Cable	Consented	30 km
Backaland Pier, Eday	Ports and harbours	Application	28 km
Scammalin Bay (Faray)	Ports and harbours	Consented	33 km
Hatston Pier Expansion	Ports and harbours	Application	9 km
Eynhallow Sound	Aquaculture	Operational	24 km
Bay of Cleat, Westray	Aquaculture	Operational	42 km
Wyre	Aquaculture	Operational	22 km
Puldrite	Aquaculture	Operational	14 km
East of Skelwick Skerry, Westray	Aquaculture	Operational	41 km
Vestness, Westray	Aquaculture	Operational	45 km
Hunda, Scapa Flow	Aquaculture	Operational	6 km
Scarfhall Point, Westray	Aquaculture	Operational	44 km
Lober Salmon Farm, Scapa Flow	Aquaculture	Operational	9 km
East Moclett, North Sound	Aquaculture	Operational	44 km
Bringhead, Scapa Flow	Aquaculture	Operational	17 km
Quanterness	Aquaculture	Operational	10 km
Westerbister	Aquaculture	Operational	550 m
Veantrow Bay, Shapinsay	Aquaculture	Operational	18 km
Chalmers Hope	Aquaculture	Operational	16 km
Toyness	Aquaculture	Operational	10 km
Bay of Cleat (south)	Aquaculture	Operational	42 km
Bay of Ham	Aquaculture	Operational	28 km
Bay of Vady	Aquaculture	Operational	24 km
Kirknoust	Aquaculture	Operational	25 km
Meil Bay	Aquaculture	Operational	9 km

Fara West	Aquaculture	Operational	15 km
Stronsay Harbour	Dredging & disposal	Application	32 km
Hatston, Kirkwall	Dredging & disposal	Application	9 km
Scammalin Bay (Faray)	Dredging & disposal	Consented	33 km

Disturbance of birds from Project activities

Construction and operational vessel activities from other developments create the potential for cumulative effects such as disturbance within the Scapa Flow Special Protection Area (SPA). Specifically, increased vessel transit through the SPA originating from the projects detailed in Table 5-1 may displace or disturb qualifying bird species.

The majority of vessel movements from cumulative plans and projects will utilise established shipping channels entering and exiting Scapa Flow from the south (between Flotta and South Ronaldsay) and the west (between Hoy/Graemsay and Stromness). Both corridors experience moderate baseline traffic; consequently, the addition of a small number of Project vessels represents a negligible departure from existing conditions. Increased vessel activity will be concentrated primarily within a 167-hectare zone branching east from the main channel toward the Project site. No cumulative vessel activity from external developments is anticipated in this specific area, though baseline movements do occur (see Appendix A (Appendix B: Heat Maps and Noise Contour Maps)). Furthermore, existing aquaculture installations operating under recent variations must adhere to seasonal restrictions and designated routing policies in line with site-specific advice for the Scapa Flow Special Protection Area (SPA) (NatureScot, 2022). Adherence to these pathways ensures vessels avoid critical foraging habitats, effectively mitigating potential disturbance to qualifying features.

Construction activities for the Hatston Pier expansion could cause intermittent disturbance and temporary habitat displacement for qualifying features of the Scapa Flow SPA. However, this impact will remain highly localised. It is projected to affect only a minor proportion of the SPA bird populations, which are also capable of foraging in alternative habitats outside the protected site boundaries.

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of:

- 5 red-throated diver (10.6% of the breeding population of North Orkney SPA);
- 31 great-northern diver (10% of the non-breeding population of North Orkney SPA); and
- 10 Slavonian grebe (6% of the non-breeding population of North Orkney SPA)

Individual birds may exploit both the North Orkney SPA and Scapa Flow SPA for foraging at different times, potentially exposing them to intermittent disturbance across separate foraging or roosting habitats. However, Hatston Pier is an established, active commercial port within Kirkwall Bay. Given the extensive alternative habitat available across both SPAs, localised disturbance is highly unlikely to result in an adverse effect on site integrity for any qualifying species. This conclusion applies to the Hatston expansion independently, as well as in combination with the Project.

The **magnitude** of any potential cumulative disturbance to the qualifying features of the Scapa Flow SPA from Project activities is predicted to be **low**, with impacts characterised as **temporary, localised, and fully reversible**. Consequently, the **significance of the residual effect** is determined to be **not significant** under EIA regulations. It can therefore be concluded with confidence that the predicted cumulative effects from the Project, in combination with other plans, projects, and developments, **will not result in an Adverse Effect on Site Integrity** for the Scapa Flow SPA.

Disturbance to prey species and habitats of prey species

The HRA (Appendix A) concluded that the project alone would not cause an adverse effect on site integrity. Specifically, there are no significant impacts regarding disturbance to prey species or their associated habitats. Potential impacts are managed on a case-by-case basis, remain rare, and are highly unlikely to occur. The relevant plans and projects with potential cumulative effects on habitats within, or functionally linked to, the Scapa Flow Special Protection Area (SPA) include:

- Hatston Pier Expansion;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;

Construction activities for the Hatston Pier expansion may disturb prey species and their habitats. However, this impact will be highly localised and affect only a negligible proportion of the Scapa Flow SPA

Vantage point surveys for the Hatston Pier Expansion HRA Report recorded the following peak counts within the adjacent marine area:

- **Red-throated diver**: 5 individuals (10.6% of the North Orkney SPA breeding population)
- **Great northern diver**: 31 individuals (10.0% of the North Orkney SPA non-breeding population)
- **Slavonian grebe**: 10 individuals (6.0% of the North Orkney SPA non-breeding population)

Additionally, the development footprint may be utilised by other qualifying features of the Scapa Flow SPA, including black-throated diver, long-tailed duck, eider, red-breasted merganser, and shag

Individual qualifying features may use both the North Orkney SPA and Scapa Flow SPA for foraging, exposing them to potential prey and habitat disturbance. However, Hatston Pier is an established, active port within Kirkwall Bay. The **magnitude** of any potential cumulative disturbance to the qualifying features of North Orkney SPA and Scapa Flow SPA from Project activities is predicted to be **low**, with impacts characterised as **temporary, localised, and fully reversible**. Consequently, the **significance of the residual effect** is determined to be **not significant** under EIA regulations. It can therefore be concluded with confidence that the predicted cumulative effects from the Project, in combination with other plans, projects, and developments, **will not result in an Adverse Effect on Site Integrity** for the Scapa Flow SPA.

Conclusion

The aquaculture developments involve minor alterations to existing infrastructure, resulting in a **negligible magnitude of change** to the baseline environment. Consequently, the **significance of effect** is assessed as **negligible (not significant)**.

Construction-phase impacts on marine bird prey resources are characterized as **short-term, temporary, reversible, and recoverable**. Any physical modifications will remain transient and confined to a **small spatial extent** relative to the extensive alternative foraging habitat available within the wider marine area.

Consequently, the **significance of effect** is assessed as **negligible (not significant)** across all assessed plans and developments, the **cumulative magnitude of change** remains low. Therefore, there **will be no Adverse Effect on Site Integrity** in-combination with other plans, projects, and developments."

Accidental release of contaminants or pollutants

The HRA (Appendix A) concluded that the project alone **will not cause an Adverse Effect on Site Integrity** via the accidental release of contaminants or pollution. Pollution risks are effectively controlled on a case-by-case basis through strict compliance protocols.

Following the implementation of robust **mitigation measures**, the residual **magnitude of change** is **negligible**, rendering any accidental release event rare, highly unlikely, and **not significant**. Consequently, taking into consideration the mitigation measures applied across all other schemes, **there will be no Adverse Effect on Site Integrity** or cumulative effects with other plans, projects, and developments.

Ornithological habitat change

The HRA (Appendix A) concluded that the project, when operating in isolation, will not cause an adverse effect on site integrity regarding ornithological habitat change. However, cumulative effects on habitat within—and functionally linked to—the Scapa Flow Special Protection Area (SPA) may arise from other relevant plans and projects. In Scotland, these include:

- Hatston Pier Expansion;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;

Construction activities for the Hatston Pier expansion could result in temporary or permanent habitat change for the qualifying features of the Scapa Flow Special Protection Area (SPA). However, these impacts are anticipated to be localised and will affect only a small proportion of the SPA bird populations.

The Habitats Regulations Appraisal (HRA) Report for the Hatston Pier Expansion recorded peak counts from vantage point surveys within the marine area adjacent to the pier. These counts represent notable percentages of the regional non-breeding populations:

- **Red-throated diver:** 5 individuals (10.6% of the North Orkney SPA breeding population)
- **Great-northern diver:** 31 individuals (10% of the North Orkney SPA non-breeding population)
- **Slavonian grebe:** 10 individuals (6% of the North Orkney SPA non-breeding population)

Furthermore, the development locality may be utilised by other qualifying features of the Scapa Flow SPA. These include the black-throated diver, long-tailed duck, eider, red-breasted merganser, and shag.

Individual birds may plausibly use both the North Orkney SPA and the Scapa Flow SPA for foraging at different times. Consequently, these populations could be subject to disturbance within their active foraging or roosting habitats.

However, Hatston Pier is already an established, active port within Kirkwall Bay. Given the extensive baseline activity and the vast extent of alternative habitat available across both SPAs, disturbance is highly unlikely to result in an adverse effect on site integrity. This conclusion applies to the Hatston Pier expansion operating in isolation, as well as in combination with the Project.

The identified aquaculture sites are included based solely on minor modifications to existing infrastructure. Consequently, any associated ornithological habitat change is considered negligible.

The vast majority of the Special Protection Area (SPA) will remain unaffected, continuing to provide extensive foraging, roosting, and commuting habitat for all qualifying species. Therefore, when considered in combination with other plans, projects, and developments, **there will be no adverse effect on site integrity**.

Conclusion

The magnitude of all potential impact pathways is considered **negligible**. Consequently, **no significant effects** are anticipated on any qualifying features of the Scapa Flow SPA. It is concluded that **there will be no adverse effect on site integrity**, either from the Project operating in isolation or cumulatively with other plans, projects, and developments.

5.6.3 Effects on Ornithology - North Orkney SPA

The North Orkney SPA (UK9020314) is a shallow-water, coastal site north of Mainland Orkney, stretching from Deerness to Eynhallow and encompassing areas like Wide Firth and Shapinsay Sound. Its mixed sediment habitats, including extensive maerl beds, support rich invertebrate communities that attract significant concentrations of wintering and breeding seabirds.

The marine site, located 4 km from the Project Site, supports internationally significant non-breeding populations of great northern diver, Slavonian grebe, and velvet scoter, as well as a nationally important breeding population of red-throated diver. The site, which covers an area of 211.73 km², is a critical habitat for these species.

Disturbance of birds due to Project activities (all phases)

While connectivity between the overlapping SPA qualifying features, specifically great northern diver and Slavonian grebe, of the Scapa Flow SPA and North Orkney SPA remains theoretically possible, no empirical evidence exists to support this link. Baseline survey data recorded no commuting flights for either species over Kirkwall between the two protected areas. It is, however, acknowledged that Slavonian grebes predominantly migrate or commute nocturnally, which limits visual detection.

In recent statutory consultation responses from NatureScot regarding developments within the North Orkney SPA, such as the Quanterness Fish Farm responses from August 21, 2024, and March 26, 2025, there is no mention of connectivity between these designations. This absence of reference highlights the ongoing scientific and regulatory uncertainty regarding bird or marine life movements between these sites.

Consequently, for the purposes of this assessment, assuming total interchange between the Scapa Flow SPA and North Orkney SPA populations would be disproportionately conservative and ecologically unrealistic, even when applying the precautionary principle. Instead, a more realistic yet precautionary approach assumes a maximum 10% population exchange between the two SPAs.

Applying this 10% threshold to the baseline data yields the following assessment parameters:

- **Great Northern Diver**: The average seasonal peak count of 46 individuals attributes 4.6 birds to the North Orkney SPA, representing 1.5% of its designated population.
- **Slavonian Grebe**: The average seasonal peak count of 5.67 individuals attributes 0.57 birds to the North Orkney SPA, representing 0.5% of its designated population.
- **Red-throated Diver**: The average seasonal peak count of 3 individuals attributes 0.3 birds to the North Orkney SPA, representing 0.6% of its designated population.

Great northern diver (non-breeding)

Disturbance of birds due to Vessel disturbance

During the construction phase, vessel traffic will increase by an average of 0.12% over the current winter baseline during the great northern diver non-breeding period (October to May; see Appendix A, Table 10-13). This minor increase will be temporary, spanning the 26-month construction programme.

Operational phase vessel movements are detailed further in Sections 2.3.2 within the SEIR and 10.3.1.2 of Appendix A. During the non-breeding period, the Project is expected to generate an average monthly increase of 11 vessel movements. This represents a 0.5% average monthly increase over the current baseline traffic level.

Research by Jarrett et al. (2018) demonstrates that great northern divers do not typically exhibit flight responses to vessels; instead, recorded evasive behaviours are restricted to swimming away or diving. Furthermore, as illustrated in Figure 10-2 (Appendix A), spatial analysis of mean density across Scapa Flow indicates that great northern divers are well represented within active shipping lanes. This spatial overlap strongly suggests a degree of habituation to existing vessel traffic, countering historical literature characterising the species as highly sensitive to vessel movements.

This habituation is supported by project-specific ornithological surveys conducted between 2020 and 2022, which recorded 49 discrete bird-vessel interactions for great northern diver:

- **No reaction**: 24 observations
- **Swimming away slowly**: 10 observations
- **Diving**: 11 observations
- **Alert response (sitting)**: 3 observations
- **Flight response**: 0 observations

These field observations strongly correlate with wider findings by Jarrett et al. (2021), where at least 95% of recorded reactions to vessels involved no response, slow swimming, or diving, with flight responses being exceptionally rare.

While established vulnerability indices categorise great northern divers as highly sensitive to vessel disturbance (e.g., Furness et al., 2012; see Appendix A, Table 10-11), the projected traffic increases along the shipping route are minor relative to the baseline (Appendix A, Sections 10.2.3.1 and 10.3.1.2). Given the baseline vessel speeds within Scapa Flow and the implementation of a project-specific Vessel Management Plan (VMP), these movements will not create a barrier effect to bird displacement. Even applying a precautionary approach where vessel movements occur hourly rather than continuously, the physical presence of vessels will remain intermittent.

A comprehensive VMP will be developed for both the construction and operational phases in consultation with NatureScot. The VMP will establish mandatory vessel routing and speed restrictions. It will incorporate specific, actionable mitigation measures to identify and actively avoid aggregations of rafting birds on the water, thereby minimizing and avoiding disturbance impacts.

The mortality matrix model assessment (Appendix A (HRA Appendix D)) applies a precautionary approach based on the mean seasonal peak count of 4.6 birds associated with the North Orkney SPA (as derived via the 10% connectivity threshold). The model concludes that the Project could result in a highly conservative 1% annual increase in mortality.

- **Annual Non-Breeding Impact**: This equates to the loss of 0.0414 birds annually, or 0.013% of the SPA population at designation, which is considered non-significant.

- **Project Lifetime Impact (25 Years)**: Over the 25-year operational lifespan agreed with NatureScot, the cumulative theoretical mortality is 1.035 birds (0.34% of the SPA population). This equates to approximately one individual over the lifetime of the Project resulting from the respective 0.12% and 0.5% increases in construction and operational vessel traffic.

- **Flightless Moult Period Impact**: During the flightless moult period, the mean seasonal peak count is 3.3 birds (representing 10% of the Scapa Flow SPA count (Appendix A, Table 10-3). This yields an estimated annual mortality of 0.03 birds (0.01% of the SPA population). Over the 25-year operational period, this equates to a cumulative mortality of 0.7 birds, representing 0.2% of the SPA population at designation.

Mobile cranes

The projected use of mobile and vessel-mounted cranes is detailed in 2.3.4 of this SEIR and Appendix A, Sections 5.4 and 10.2.3.1. Crane activity will be highly intermittent, seasonal, and strictly tied to vessel operations, with a distinct concentration during the summer months.

Operational frequency and structural characteristics vary by season and crane type:

- **Summer Operations**: Cranes will operate between 8 and 20 days per month.
- **Winter Operations**: Activity drops to 2 to 5 days per month. High wind downtime and limited daylight hours restrict winter operations, reducing potential disturbance during sensitive avian wintering periods.
- **Crane Specifications**: Movements involve slow, low-noise mobile cranes and larger on-vessel cranes. Booms can reach 60 to 125 m in height during operations, but are retracted to a low-profile storage height of approximately 5 m when not in use.

Appendix A, Section 10.4.3.1.1.2 establishes the operational differences between fixed land-based infrastructure and offshore wind farm structures. This comparative analysis justifies why standard offshore wind displacement guidance cannot be directly applied to quayside cranes without critical caveats.

While great northern diver is classified as highly sensitive to vessel-induced disturbance and displacement (Appendix A, Table 10-11), no published evidence exists regarding the specific impacts of quayside cranes on this species. Consequently, this assessment adopts vessel disturbance as a conservative proxy for crane-induced impacts. However, the underlying mechanisms of disturbance differ fundamentally from mobile vessels at sea (Refer to Appendix A, 10.5.3.1.1.2 Mobile cranes):

- **Static Footprint**: Cranes will operate from fixed locations on the quay or from vessels securely berthed alongside the quay.
- **Confined Movement**: While cranes present a tall, moving structure, their movement is slow and confined strictly within the radial bounds of the crane height and jib length.
- **Harbour Habituation**: The presence of overwintering great northern divers within active harbours suggests that stationary vessels and operating cranes do not exert significant disturbance pressures on individuals foraging near the Project.

Great northern divers exhibit heightened vulnerability during their flightless moult period (February to mid-April, as defined in NatureScot correspondence), during which they cannot utilise flight as an evasive response.

- **Wider Study Area (2 km)**: The average peak count within a 2 km radius during the moult period is 3.3 birds, representing 1.1% of the North Orkney SPA citation population.

- **Localised Core Area (0–500 m)**: In accordance with NatureScot guidance, bird numbers within 0 to 500 m of the primary vantage point were utilised to assess localised disturbance and displacement. This approach aligns with the standard 100 to 300 m disturbance distance defined by Goodship and Furness (2022).

The low density of birds recorded near the site demonstrates that the species successfully utilises alternative habitats across Scapa Flow. This indicates that the wider Flow possesses sufficient carrying capacity to support displaced individuals associated with the North Orkney SPA.

Project-induced vessel traffic during the non-breeding period (October to May) will cause a temporary 0.12% average increase over the current baseline levels between October and May during construction, and an average monthly increase of 11 movements (a 0.5% baseline increase) during operations.

When evaluated alongside these minor traffic increases, the potential disturbance from crane operations is considered non-significant based on the following factors:

- **Low Winter Frequency**: Crane usage is minimal during the winter (2 to 5 days per month between October and March),) and 8-20 days/month in April and May, any disturbance to great northern divers from vessel activity and crane use is expected to result only in temporary disturbance, particularly during the majority of the flightless moult period, with effects that are intermittent during cargo loading and unloading operations.
- **Reversibility**: Any localised disturbance will be temporary, intermittent (confined to active cargo loading and unloading), and immediately reversible upon the cessation of crane operations.

Given the species' demonstrated habituation to static vessel presence, the low density of North Orkney SPA birds within the immediate zone of influence, and the implementation of a comprehensive Vessel Management Plan (VMP), no significant or sustained adverse impacts are anticipated.

Airborne noise

Based on the airborne noise modelling detailed in Appendix A, Section 10.3.1.1.2, construction noise levels should be restricted to below 70 dB. Consequently, the main terrestrial works are not expected to result in significant noise disturbance to waterbirds. This conclusion aligns with waterbird response thresholds established by the University of Hull (2013) and accounts for the deployment of localized acoustic bunds around the active working area, which will attenuate construction noise to <35 dB at a distance of 250 m.

While birds present in the immediate vicinity are likely to be displaced from the active working area, the wider Scapa Flow and North Orkney Special Protection Areas (SPAs) possess the environmental carrying capacity to accommodate these individuals. Birds will naturally maintain a sufficient buffer distance from the works where noise levels do not induce physiological or behavioural impacts. Any such displacement will be:

- **Short-term**: Restrictive to specific, high-intensity phases of the construction programme.
- **Temporary**: Limited strictly to the duration of the noisy activity.
- **Immediately Reversible**: Baseline distribution patterns will recover rapidly following the cessation of construction works.

Crucially, these potential disturbance effects will not create barriers to movement, nor will they restrict long-term access to preferred foraging and roosting habitats. Consequently, the works will not cause excessive energy expenditure or a reduction in body condition that could compromise overwinter survival or subsequent migration.

Empirical literature identifies the disturbance distance for great northern diver as 100 to 350 m (Goodship and Furness, 2022). To evaluate localised exposure within this zone, Appendix A, Table 10-17 provides peak and average bird counts derived from the 0 to 500 m survey distance band across the three-year baseline period:

- **Peak Localised Density**: The peak count within this core zone is 0.9 birds (Appendix A, Table 10-17).
- **Population Proportion**: Utilising the 10% connectivity threshold, this peak count corresponds to a maximum of 0.3% of the North Orkney SPA population at the time of designation.

Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A) detail the full suite of committed mitigation measures designed to avoid significant adverse impacts on marine avifauna.

Conclusion

Magnitude of Impact: The magnitude of potential disturbance effects from the Project is assessed as **Negligible**. The active disturbance footprint is small relative to the expansive, alternative high-quality habitat available within Scapa Flow and the North Orkney SPA. There is no empirical evidence indicating that the small area of port footprint represents a critical or disproportionately important resource for prey availability.

Vulnerability and Displacement: The qualifying feature exhibits low vulnerability to the predicted spatial restriction. The Project will not result in significant barriers to connectivity, nor will it continuously restrict access to key foraging or roosting areas. Any localised distributional changes or spatial displacement will remain within the range of natural baseline variability.

Energetic Consequences: The operational impact on avian bioenergetics is assessed as **Negligible**. Any temporary increase in energy expenditure will not affect the vital rates of the population, as displaced individuals can readily resume foraging in adjacent, undisturbed functional habitat.

Significance of Effect (Project Alone): Based on objective scientific evidence, and securing mandatory embedded mitigation measures, the predicted noise and visual disturbance impacts from the Project alone are assessed as **Not Significant** in EIA terms. .

Red-throated diver (breeding)

Disturbance of birds due to Vessel disturbance

Construction and operation of the proposed project will cause minor increases in vessel traffic, with a 0.58% rise during the breeding season (April-September) over a 26-month construction period, and a 1.0% increase during operation. Due to the low frequency of movements, less than daily during operation and fewer than two per week in winter, the project is not expected to create a significant barrier effect or disturbance, despite the high sensitivity of red-throated divers.

A Vessel Management Plan will be developed and will implement routing and speed controls to avoid bird aggregations. Based on a precautionary mortality matrix, the project is expected to result in a non-significant annual mortality of 0.0027 birds, representing 0.006% of the SPA population. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 0.07 birds, or 0.14% of the SPA population.

Mobile cranes

The operational parameters for the mobile cranes required for the Project are detailed in Section 5.4 and Section 10.2.3.1 of the HRA (Appendix A). Crane activity will be intermittent, seasonal, and strictly tied to vessel operations, with a marked increase during the summer months. On-site movements will involve slow-moving, low-noise mobile cranes alongside large on-vessel cranes. Operations are projected to span 8–20 days per month in summer, reducing to 2–5 days per month in winter. Depending on the specific crane model, boom heights will range between 60 m and 125 m during operation, but will be retracted to approximately 5 m when stored. Winter operations will be minimal due to frequent high-wind downtime and daylight-only working restrictions. This operational reduction significantly minimizes potential disturbance pressure during ecologically sensitive winter bird periods.

Section 10.4.3.1.1.2 delineates the structural and operational differences between offshore wind farm infrastructure and land-based quayside cranes. This distinction provides the scientific justification for applying specific caveats regarding red-throated diver sensitivity to displacement and disturbance from quayside activities, while contextualizing the use of offshore wind guidance.

Baseline surveys within 1 km of the Project site recorded red-throated diver presence on 30% of surveys during the 2021 breeding season, and on 37.5% of surveys in 2022.

- **2021 Peak Count:** A peak count of 4 individuals was recorded. Assuming these were all adult birds from distinct breeding pairs, this represents 5.26% of the local population (based on a regional citation level of 76 breeding pairs).
- **2022 Peak Count:** A peak count of 2 individuals was recorded, representing 2.6% of the regional population.

These baseline figures for red-throated diver are considered low. Dedicated flight-mapping surveys recorded a total of 13 birds in 2021 and 54 birds in 2022, with a peak monthly count of 19 birds in July.

The survey data indicates that red-throated divers within 1 km of the Project site primarily use the area as a staging location. Behaviours are predominantly characterised by birds flying into the area to loaf, with only occasional foraging observed before individuals disperse further into the Scapa Flow. This behavioural pattern is supported by predictive habitat modelling, which classified the waters within the Project footprint as falling within the lowest category for foraging suitability. Consequently, any potential displacement of red-throated divers within the 1 km zone is expected to have a negligible impact on the regional population, as high-quality alternative foraging habitat is widely available nearby.

Consequently, any potential displacement of red-throated divers within a 1 km radius of the Project site, particularly during crane operations, would not result in an adverse effect on the species, as individuals utilize more favourable foraging habitats located greater than 1 km from the site. On this basis, disturbance impacts arising from crane operations are assessed as not significant.

The empirical evidence typically cited to assert that divers are highly sensitive to towering structures in the marine environment (e.g., Dierschke et al., 2017) relates primarily to the visual and spatial impacts of offshore wind farms. These studies provide no evidence that quayside or coastal mobile cranes induce comparable levels of disturbance or displacement. In the absence of published literature specifically evaluating the effects of quayside cranes on red-throated diver, vessel-induced disturbance has been adopted as a conservative proxy for this assessment.

However, it is important to distinguish the operational mechanics of quayside cranes from mobile vessels. Cranes will operate from static locations on the quay itself or from vessels moored at the berth. While cranes present a tall, moving structure, their movements are localized, slow, and structurally confined within fixed bounds determined by the crane height and jib length. Furthermore, the documented presence of red-throated divers within active harbour environments during the breeding

season (refer to Appendix A, Section 10.2.1.2) strongly indicates that static vessels, including those equipped with active cranes, do not exert a major disturbance impact on individuals foraging in proximity to the port infrastructure.

Spatial analysis of flight paths (presented in EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report) identified at least one breeding pair established inland to the east on moorland lochans. Outward flights from this location frequently resulted in birds alighting within the marine survey area as their initial destination. Recorded flight heights varied between 20 m and 100 m, with the majority of observations concentrated between 50 m and 100 m. The vast majority of these flight observations occurred over the marine environment rather than over land.

Red-throated divers are recognised as highly sensitive to disturbance (as detailed in Appendix A, Table 10.11), particularly during the critical chick-rearing period spanning June to mid-September (NatureScot, 2022b), when unimpeded access to high-quality foraging marine habitat is vital. However, potential disturbance from project vessel activity, low-noise mobile cranes, and large on-vessel cranes is predicted to be temporary, highly localized, and intermittent—occurring strictly during cargo loading and unloading sequences.

The scale of this pressure is heavily constrained by the low projected vessel traffic, which is limited to a frequency of 8 vessels per month during the breeding season. Any disturbance event would be fully reversible upon the cessation of crane and vessel operations. Given the species' demonstrated tolerance to stationary harbour infrastructure and the mandatory implementation of a Vessel Management Plan (VMP) designed to minimize marine interactions, no significant, adverse, or sustained impacts on the regional red-throated diver population are anticipated

Airborne noise

Based on the airborne noise modelling (Appendix A, Section 10.3.1.1.2), which recommends limiting construction noise levels to below 70 dB, the main terrestrial works are not expected to cause noise disturbance to waterbirds. This conclusion is supported by findings from the University of Hull (2013) and the installation of perimeter bunds around the working area, which will attenuate construction noise to <35 dB at a distance of 250 m.

While birds will likely be displaced from the immediate working area, the surrounding Scapa Flow Special Protection Area (SPA) and North Orkney SPA have sufficient capacity to accommodate them. Displacement will occur at a distance where noise does not cause an adverse impact. Furthermore, any disturbance will be short-term (restricted to specific construction phases), temporary (ceasing immediately upon completion of the activity), and reversible (allowing rapid baseline recovery).

Consequently, these potential disturbance effects will not create barriers to movement or restrict access to preferred foraging and roosting habitats in a continuous or sustained manner. They will not result in significant energy expenditure or reductions in body condition that could compromise survival or subsequent migration.

Project mitigation measures to avoid significant impacts on marine bird species, including red-throated diver, are detailed in Section 5.7 and 11 of this SEIR, Section 7 and Section 10.2.3.4 of the HRA (Appendix A). Any distributional shifts are expected to remain within the range of natural variability, as the disturbance zone is small relative to the alternative habitats available within the Scapa Flow and North Orkney SPAs. There is no evidence indicating that the areas affected by port operations are disproportionately important for red-throated diver prey availability. Any localized increase in energy expenditure or minor reduction in body condition would be short-lived and negligible, given the abundance of alternative foraging grounds and the high likelihood that displaced birds will resume foraging elsewhere.

Conclusion

When factoring in the embedded mitigation measures committed to by the Project, the residual **significance of the effect** under EIA criteria is determined to be **not significant**. Consequently, when evaluated against the site's Conservation Objectives, the predicted disturbance impacts on the red-throated diver qualifying feature from the Project **will not adversely affect the integrity** of the Scapa Flow SPA.

Slavonian grebe (non-breeding)

Disturbance of birds due to Vessel disturbance

Construction and operation of the project will result in minor increases to vessel traffic (0.35% and 0.5% respectively) during the Slavonian grebe non-breeding season, with no increase in March or April. A Vessel Management Plan, will mitigate potential disturbance to the species, which is moderately sensitive to vessel activity. The assessment concludes that potential impacts and a projected 1% increase in annual mortality, representing 0.004% of the SPA population, are not significant (Appendix A: HRA (Appendix D: Mortality Matrix Model). Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 0.13 birds, or 0.1% of the SPA population.

Mobile cranes

The use of mobile cranes during the Project is detailed in Section 2.3.4 of this SEIR and Appendix A (Section 5.4 and Section 10.2.3.1). Crane activity will be intermittent, seasonal, and tied directly to vessel operations, with markedly higher frequency during the summer months. Operations will occur over 8–20 days per month in summer, dropping to 2–5 days per month in winter. Movements involve slow-moving, low-noise mobile land cranes and large on-vessel cranes. Depending on the crane type, booms can reach 60–125 m in height but will be retracted to approximately 5 m when stored. Winter operations will be minimal due to high wind downtime and restrictions to daylight hours, significantly reducing potential disturbance during sensitive winter bird periods.

The landform behind the Project slopes sharply to approximately 20 m higher than the quay level where the cranes will operate, rising to 60 m above quay level within 1 km. Consequently, the cranes will not be viewed entirely against the open skyline, but will instead be backdropped against the surrounding landform.

Slavonian grebe is considered to have a moderate sensitivity to disturbance and displacement from vessels (Appendix A, Table 10-9). In the absence of specific evidence regarding waterbird disturbance from quayside cranes, vessel disturbance has been applied as a conservative proxy for this assessment. However, cranes will operate from a static location on the quay or from berthed (stationary) vessels. This presents a fundamentally different disturbance mechanism compared to mobile vessels at sea; while cranes introduce a moving, tall structure, their movement is slow and confined within strict structural bounds. Furthermore, during the 2017/18 inshore surveys, Slavonian grebes demonstrated a strong preference for sheltered, relatively shallow waters, with only seven birds recorded across all boat-based surveys. This indicates that Scapa Flow is not a preferred foraging habitat for this species.

Given the infrequent nature of crane usage during winter, any potential disturbance to Slavonian grebe within the Scapa Flow SPA from combined vessel and crane activity will be short-term and temporary. Effects will be intermittent, restricted to cargo loading and unloading operations, and further limited by a very low winter vessel frequency of 0.8 vessels per week. Any displacement will be rapidly reversible following the cessation of crane activities. Given the minimal baseline presence of the species within the project area and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained adverse impacts are anticipated.

Airborne noise

Based on the airborne noise modelling (Appendix A, Section 10.3.1.1.2), which recommends limiting construction noise levels to below 70 dB, the main terrestrial works are not expected to cause noise disturbance to waterbirds. This conclusion is supported by findings from the University of Hull (2013) and the installation of perimeter bunds around the working area, which will attenuate construction noise to <35 dB at a distance of 250 m.

While birds will likely be displaced from the immediate working area, the surrounding Scapa Flow Special Protection Area (SPA) and North Orkney SPA have sufficient capacity to accommodate them. Displacement will occur at a distance where noise does not cause an adverse impact. Furthermore, any disturbance will be short-term (restricted to specific construction phases), temporary (ceasing immediately upon completion of the activity), and reversible (allowing rapid baseline recovery).

Consequently, these potential disturbance effects will not create barriers to movement or restrict access to preferred foraging and roosting habitats in a continuous or sustained manner. They will not result in significant energy expenditure or reductions in body condition that could compromise survival or subsequent migration.

Project mitigation measures to avoid significant impacts on marine bird species, including Slavonian grebe, are detailed in Section 5.7 and 11 of this SEIR and Section 7 and Section 10.2.3.4 of the HRA (Appendix A). Any distributional shifts are expected to remain within the range of natural variability, as the disturbance zone is small relative to the alternative habitats available within the Scapa Flow and North Orkney SPAs. There is no evidence indicating that the areas affected by port operations are disproportionately important for Slavonian grebe prey availability. Any localized increase in energy expenditure or minor reduction in body condition would be short-lived and negligible, given the abundance of alternative foraging grounds and the high likelihood that displaced birds will resume foraging elsewhere.

Conclusion

Based on this evidence and the committed project mitigation measures, it is concluded that the predicted disturbance impacts from the Project alone will not result in an adverse effect on the integrity of the North Orkney SPA with respect to its Slavonian grebe qualifying feature.

Based on the findings of the HRA (Appendix A), the potential disturbance effects arising from the Project will not create significant barriers to ecological connectivity. These effects will not restrict access to preferred foraging and roosting habitats in a continuous or sustained manner.

Any localised changes in distribution are predicted to remain well within the range of natural baseline variability. Furthermore, the spatial extent of the zone of influence (ZoI) is ***minor*** relative to the extensive alternative, high-quality habitat available within the North Orkney SPA and Scapa Flow SPA. Baseline data indicates no evidence that the specific footprint of port operations holds disproportionate importance for Slavonian grebe prey availability or foraging success.

Consequently, any localised increase in energy expenditure or subsequent reduction in individual body condition is predicted to be **temporary**. This represents an impact of **negligible magnitude** at the **individual level**, given the availability of alternative habitats and the high capacity for displaced birds to resume foraging elsewhere.

When accounting for the embedded and additional **mitigation measures** committed to by the Applicant, the **residual effects** of the Project alone are deemed to be **not significant** in EIA terms. Specifically, regarding the HRA, it is concluded beyond reasonable scientific doubt that the predicted disturbance

impacts **will not lead to an adverse effect on the integrity** of the SPA in relation to this qualifying feature.

Disturbance to prey species and habitats of prey species (construction only)
According to NatureScot's Conservation and Management Advice for the North Orkney SPA (NatureScot, 2022b), supporting habitats encompass the seabed and water column characteristics relevant to the qualifying features. These habitats are influenced by wider oceanographic processes—including upwellings, tidal flows, and hydrological movements—that drive nutrient cycling and prey distribution.

Hydrodynamic modelling (Technical Appendix 4.1 of the Environmental Impact Assessment Report [EnviroCentre 2023, updated 2024) indicates that the Project will have a negligible impact on the surrounding water column and seabed, owing to the low-energy environment in this part of Scapa Flow. Consequently, impacts on prey species for the qualifying features are expected to be negligible, ensuring their abundance and distribution remain within baseline parameters.

The total dredge volume comprises approximately 17% gravel, 60% sand, and 23% silt and clay. Combined with weak tidal currents near the proposed dredge pockets, capital dredging will only generate highly localised, short-term sediment plumes. The magnitude of sediment discharge and dispersion will be low within the immediate dredge area and negligible beyond it. Furthermore, no sediment transport will occur within the Hoy SPA boundary, thereby maintaining the supporting habitats for qualifying species outside the direct development footprint.

To protect the water environment and prey sources from pollution, surface water drainage systems will be designed to prevent any untreated discharges into surrounding coastal waters. Silt curtains will also be deployed during land reclamation works to contain suspended solids. Potential water pollution risks from the pier and berthed vessels will be managed through strict adherence to Pollution Prevention Plan (PPP) controls. These measures will ensure the supporting habitats for the qualifying species are fully maintained.

For marine dredged material disposal, no sediment transport will occur within the North Orkney SPA boundary because the designated sea disposal site is located entirely outwith the SPA. The supporting habitats for the qualifying SPA species beyond the development footprint will therefore be maintained.

Great northern diver (non-breeding)

Based on the assessment presented in Sections 10.3.2 and 10.5.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the great northern diver qualifying feature of the North Orkney SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained."

Red-throated diver (breeding)

Based on the assessment presented in Appendix A (Section 10.3.2 and Section 10.5.3.2), of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver qualifying feature of the North Orkney SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained."

Slavonian grebe (non-breeding)

Based on the assessment presented in Appendix A (Section 10.3.2 and Section 10.5.3.2), of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Slavonian grebe qualifying feature of the North Orkney SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained."

Velvet scoter (non-breeding)

Based on the assessment presented in Appendix A (Section 10.3.2 and Section 10.5.3.2), of the HRA (Appendix A), the magnitude of the predicted indirect impacts on prey species is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Velvet Scoter qualifying feature of the North Orkney SPA is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained."

Accidental release of contaminants or pollutants (all phases)

The sections below present the Adverse Effect on Site Integrity (AESI) conclusions for the North Orkney SPA qualifying species that have been screened into the assessment, based on the project parameters outlined in Appendix A, Section 10.3.3.

During construction, robust mitigation measures will collectively minimise the risk of accidental pollutant releases. A Construction Environmental Management Document (CEMD), supported by Environmental Clerk of Works (EnvCoW) oversight, will ensure all activities follow approved methods designed to prevent spills, manage materials safely, and maintain compliance with environmental commitments. A Pollution Incident Response Plan (PIRP) will provide clear spill-response procedures, emergency contacts, and staff training to ensure rapid and effective containment of any incident. Furthermore, a Pollution Prevention Plan (PPP) will be implemented during construction and will continue into the operational phase, detailing specific contingency measures to manage accidental spillages.

Water quality will be protected through real-time turbidity monitoring and controlled dredging protocols. These controls will prevent significant sediment plumes and the mobilisation of contaminated materials, reducing the risk of pollutant dispersal. In addition, Ballast Water Management procedures will ensure controlled, compliant ballast operations to prevent unauthorised discharges. Best-practice environmental monitoring will enable the early detection of any water quality changes, allowing prompt corrective action. Together, these integrated controls establish a structured environmental management framework that substantially reduces the likelihood, magnitude, and extent of accidental pollutant releases during both construction and operation.

In the unlikely event of a spill, hydrodynamic circulation patterns and established best-practice spill response will ensure that residual pollutants remain localised. Accidental releases of potential contaminants from project vessels will be strictly controlled, with robust procedures in place to minimise any subsequent environmental effects. Throughout the operational phase, operations will adhere to an Operational Environmental Management Document (OEMD) and industry best practices, including standard SEPA Guidance for Pollution Prevention (GPPs).

Great northern diver (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.5.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted

effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of North Orkney SPA with respect to its great northern diver qualifying feature.

Red-throated diver (breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.5.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of North Orkney SPA with respect to its red-throated diver qualifying feature.

Slavonian grebe (non-breeding)

Based on the assessments detailed in Sections 10.3.3 and 10.5.3.3 of the Habitats Regulations Appraisal (Appendix A), the **low magnitude** of any potential accidental pollutant release ensures that the predicted effects from the Project alone are of **minor significance** and evaluated as **not significant**. Consequently, it is concluded that these effects **would not adversely affect the integrity** of North Orkney SPA with respect to its Slavonian grebe qualifying feature.

Ornithological habitat changes (operation and maintenance only)

The Project will result in the direct loss of 19.1 ha of the Scapa Flow Special Protection Area (SPA), an area where qualifying features of the North Orkney SPA may be present. This footprint equates to approximately 0.06% of the total Scapa Flow SPA area, which represents a negligible fraction of the designation. The affected area is extremely localised, and the remainder of both the Scapa Flow SPA and the North Orkney SPA will continue to provide extensive foraging, roosting, and commuting habitats for the qualifying species.

The lost habitat functions relate primarily to marine foraging areas used by qualifying bird species that may range within the Scapa Flow SPA. Given the vast size and heterogeneous habitat availability of the Scapa Flow SPA, alongside the extensive alternative habitats within the North Orkney SPA, this minor localised loss is not expected to alter the overall ecological functioning of either site.

Scapa Flow provides large expanses of suitable foraging waters with comparable depths, prey availability, and hydrodynamic characteristics. Consequently, the small area lost does not constitute a unique or limiting foraging resource. Mobile marine bird species, including divers, grebes, and seaduck, possess wide foraging ranges that enable them to readily exploit abundant alternative habitats across both SPAs.

Furthermore, birds commuting between feeding grounds, resting locations, and open water will not be impeded. The operational footprint of the Project will not create a barrier to movement and will maintain the wider habitat connectivity required by North Orkney SPA features foraging within the Scapa Flow SPA.

Great northern diver (non-breeding)

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outside the Project boundary, operational habitat change is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.5.3.4 of the HRA (Appendix A) the **magnitude of change** to the habitat is classified as **negligible**. Given the high sensitivity of the great northern diver qualifying feature, this results in an environmental effect of **minor/negligible** significance.

It is therefore concluded that the predicted habitat impacts from the Project will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of North Orkney SPA.

Red-throated diver (breeding)

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outwith the Project boundary, operational habitat change is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.5.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the high sensitivity of the red-throated diver qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project will be **not significant** in EIA terms, and will not result in an **adverse effect on the integrity** of North Orkney SPA

Slavonian grebe (non-breeding)

Given the highly localised area of potential disturbance or habitat loss during operation, combined with the extensive availability of alternative foraging and commuting habitat outwith the Project boundary, operational habitat change is concluded to be of **negligible magnitude**.

Based on the assessments detailed in Section 10.3.4 and Section 10.5.3.4 of the HRA (Appendix A), the **magnitude of change** to the habitat is classified as **negligible**. Given the high sensitivity of the Slavonian grebe qualifying feature, this results in an environmental effect of **minor/negligible** significance. It is therefore concluded that the predicted habitat impacts from the Project alone will be **not significant** in EIA terms, and **will not result in an adverse effect on the integrity** of the North Orkney SPA.

Cumulative Effects

Appendix A Table 10.14 provides a summary of the other developments considered within the assessment of cumulative effects.

Disturbance of birds from Project activities

There is potential for in-combination vessel disturbance during the construction and operational phases of the plans, projects, and developments listed in Appendix A, Table 10-14. Vessels associated with other projects may transit through the North Orkney SPA, potentially disturbing qualifying features. Because the North Orkney SPA is functionally linked to the Scapa Flow SPA, these in-combination effects may also impact qualifying species foraging or roosting outwith the North Orkney SPA boundary.

The majority of vessel movements from other plans and projects will follow established shipping routes. These primarily include the main routes in and out of Scapa Flow from the south (between Flotta and South Ronaldsay) and the west (between Hoy/Graemsay and Stromness). Both routes experience moderate levels of baseline vessel traffic. The in-combination addition of project-related vessels represents only a minor departure from these baseline shipping levels. The only area experiencing a more pronounced increase in vessel activity is the 167 ha corridor branching east off the established route toward the Project site. No vessels from other proposed plans or developments are anticipated within this specific corridor, though baseline vessel movements do occur here (Appendix A HRA (Appendix B: Heat Maps and Noise Contour Maps)). Furthermore, existing fish farms that have undergone variations are subject to seasonal restrictions and planned vessel routing to avoid important foraging areas, in line with site-specific advice for the North Orkney SPA (NatureScot, 2022b). Consequently, regional vessel traffic is expected to avoid key foraging grounds, mitigating potential cumulative impacts.

Construction activities for the Hatston Pier expansion could result in intermittent disturbance within habitats used by North Orkney SPA qualifying features. However, this disturbance will be localized, affecting a small proportion of the bird populations that forage outside the SPA (e.g., within the Scapa Flow SPA). The Habitats Regulations Appraisal (HRA) Report for the Hatston Pier Expansion recorded the following peak counts from vantage point surveys within the marine area adjacent to Hatston Pier:

- Red-throated diver: 5 birds (10.6% of the North Orkney SPA breeding population)
- Great northern diver: 31 birds (10% of the North Orkney SPA non-breeding population)
- Slavonian grebe: 10 birds (6% of the North Orkney SPA non-breeding population)
- Velvet scoter: 38 birds (25% of the North Orkney SPA non-breeding population)

It is plausible that individual birds utilise both the Hatston Pier locality and the Project area at different times, potentially subjecting them to intermittent disturbance across separate foraging or roosting habitats. However, Hatston is already a highly active commercial port within Kirkwall Bay. Given the vast extent of alternative, high-quality habitat available within both the North Orkney SPA and the Scapa Flow SPA, disturbance to these individuals is not expected to result in an adverse effect on site integrity for the Hatston project alone, nor in combination with this Project.

Any potential cumulative disturbance to the qualifying features of the North Orkney SPA will be short-term, temporary, and rapidly reversible following the cessation of specific activities. Based on this evidence, it is concluded that the predicted cumulative disturbance impacts from the Project cumulatively with other plans, projects, and developments will not result in an adverse effect on the integrity of the North Orkney SPA.

The **magnitude** of any potential cumulative disturbance to the qualifying features of the North Orkney SPA from Project activities is predicted to be **low**, with impacts characterised as **temporary, localised, and fully reversible**. Consequently, the **significance of the residual effect** is determined to be **not significant** under EIA regulations. It can therefore be concluded with confidence that the predicted cumulative effects from the Project, in combination with other plans, projects, and developments, **will not result in an Adverse Effect on Site Integrity** for the North Orkney SPA.

Disturbance to prey species and habitats of prey species

It was concluded that the Project alone will not result in an adverse effect on site integrity (AESI) in relation to disturbance to prey species and their habitats. Cumulative impacts are managed case-by-case, remain rare, and are highly unlikely to occur. The relevant plans and projects that could affect supporting habitats within the North Orkney SPA and functionally linked habitats include:

- Backaland Pier, Eday
- Scammalin Bay Pier
- Hatston Pier Expansion
- Eynhallow Sound aquaculture site
- Hunda aquaculture site
- Lober salmon farm
- Bringhead aquaculture site
- Westerbister aquaculture site
- Toyness aquaculture site
- West Fara aquaculture site
- Bay of Cleat, Westray aquaculture site
- Wyre aquaculture site
- Puldrite aquaculture site
- East of Skelwick Skerry, Westray aquaculture site
- Vestness, Westray aquaculture site

- Hunda, Scapa Flow aquaculture site
- Scarfhall Point, Westray aquaculture site
- Lober Salmon Farm, Scapa Flow aquaculture site
- East Moclett, North Sound aquaculture site
- Bringhead, Scapa Flow aquaculture site
- Quanterness aquaculture site
- Veantrow Bay, Shapinsay aquaculture site
- Chalmers Hope aquaculture site
- Bay of Cleat (south) aquaculture site
- Bay of Ham aquaculture site
- Bay of Vady aquaculture site
- Kirknoust aquaculture site
- Meil Bay aquaculture site

Construction activities at Backaland Pier and Scammalin Bay Pier could result in localised disturbance to prey species and supporting habitats. However, these effects will be spatially restricted and will affect only a small proportion of the available foraging habitat within the North Orkney SPA and functionally linked areas.

Similarly, construction activities for the Hatston Pier expansion could disturb prey resources and habitats utilised by North Orkney SPA qualifying features. These impacts will remain localized, affecting a minor proportion of the habitat available to marine bird populations foraging outside the SPA (e.g., within the Scapa Flow SPA). The Habitats Regulations Appraisal (HRA) Report for the Hatston Pier Expansion recorded the following peak counts from vantage point surveys within the marine area adjacent to Hatston Pier:

- **Red-throated diver:** 5 birds (10.6% of the North Orkney SPA breeding population)
- **Great northern diver:** 31 birds (10% of the North Orkney SPA non-breeding population)
- **Slavonian grebe:** 10 birds (6% of the North Orkney SPA non-breeding population)
- **Velvet scoter:** 38 birds (25% of the North Orkney SPA non-breeding population)

Individual birds may utilise both the Hatston Pier locality and the Project area at different times, potentially subjecting them to cumulative prey or habitat disturbance. However, Hatston is an active commercial port within Kirkwall Bay. Given the vast extent of alternative, high-quality foraging habitat within both the North Orkney SPA and the Scapa Flow SPA, localized disturbance to this restricted area is not expected to result in an adverse effect on site integrity for the Hatston project alone, nor in combination with the Project.

The listed aquaculture sites are included based on minor variations to existing infrastructure; therefore, their cumulative effects on prey species will be negligible. Construction-phase impacts on marine bird prey resources across all projects are expected to be short-term, temporary, and rapidly reversible. Any changes will remain transient and confined to a small spatial footprint relative to the extensive alternative foraging grounds available.

Conclusion

Taking into consideration the mitigation measures applied across these other plans and developments, it is concluded that the predicted cumulative impacts on prey species and their habitats from the Project cumulatively with other plans, projects, and developments will not result in an adverse effect on the integrity of the North Orkney SPA

The aquaculture developments involve minor alterations to existing infrastructure, resulting in a **negligible magnitude of change** to the baseline environment. Consequently, the **significance of effect** is assessed as **negligible (not significant)**.

Construction-phase impacts on marine bird prey resources are characterised as **short-term, temporary, reversible, and recoverable**. Any physical modifications will remain transient and confined to a **small spatial extent** relative to the extensive alternative foraging habitat available within the wider marine area.

Consequently, the **significance of effect** is assessed as **negligible (not significant)** across all assessed plans and developments, the **cumulative magnitude of change** remains low. Therefore, there **will be no Adverse Effect on Site Integrity** cumulatively with other plans, projects, and developments."

Accidental release of contaminants or pollutants

Based on the assessments presented in Appendix A, Section 10.3.3 and Section 10.5.3.3, it is concluded that the predicted impacts from the accidental release of pollutants or contaminants by the Project alone will not result in an adverse effect on the integrity of the North Orkney SPA.

Conclusion

Accidental pollution risks across developments are strictly managed on a case-by-case basis under statutory regulations, making significant cumulative pollution events rare and highly unlikely. When taking into consideration the robust, embedded mitigation measures and pollution prevention controls, the residual **magnitude of change** is **negligible**, rendering any accidental release event rare, highly unlikely, and **not significant**. Consequently, taking into consideration the mitigation measures applied across all other schemes, **there will be no Adverse Effect on Site Integrity** cumulative effects with other plans, projects, and developments.

Ornithological habitat change

It is **concluded** that the Project, in combination with various pier developments and aquaculture sites, will not result in an adverse effect on the integrity of the North Orkney SPA regarding ornithological habitat change. While construction activities at Backaland Pier, Scammalin Bay, and Hatston piers present localised habitat loss or change, the vast extent of alternative habitat within the North Orkney and Scapa Flow SPAs ensures no significant impact on bird populations.

Conclusion

The qualifying features of the North Orkney Special Protection Area (SPA) are **assigned high ecological sensitivity** based on their statutory designation and vulnerable marine lifecycle stages. Following a comprehensive review of all reasonably foreseeable projects and consented developments within the zone of influence, the cumulative impact magnitude across all identified disturbance pathways, including acoustic and visual stressors, is assessed as **Negligible**.

When considering the localised, **temporary** nature of the project's residual effects alongside the spatial separation and timelines of other regional developments, no additive or synergistic interactions are predicted. The cumulative effect is therefore assessed as **Not Significant** under the EIA Regulations (Scotland).

Incorporating secured, project-specific mitigation measures, the predicted in-combination impacts will not compromise the overarching Conservation Objectives of the designated site. In accordance with the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland), it is concluded objectively that the Project, both alone and in-combination with other plans, projects, and developments,

will not result in an Adverse Effect on the Integrity of the North Orkney SPA in relation to any of its qualifying features

5.6.4 Effects on Ornithology - Orkney Mainland Moors SPA

The Orkney Mainland Moors Special Protection Area (SPA) (UK9002311) covers a total area of 5,324 ha across four extensive moorland sectors on Mainland Orkney. The designation is characterised by a diverse mosaic of upland habitats, including: [

- Blanket bog and acid grassland
- Wet and dry heath
- Acidic raised mire and calcareous valley mire
- Willow scrub and tall herb vegetation within sheltered valleys
- Several small oligotrophic lochs

The SPA is designated for supporting breeding populations of European importance, specifically hen harrier (*Circus cyaneus*), red-throated diver (*Gavia stellata*), and short-eared owl (*Asio flammeus*). The expansive moorland landscape provides essential nesting and foraging habitat for these raptors and upland species. Notably, the Orkney Mainland Moors SPA supports one of the largest and densest breeding populations of hen harrier in Great Britain.

Originally classified in 2000 and subsequently extended in 2008, the SPA boundaries align directly with four underlying Sites of Special Scientific Interest (SSSIs):

- West Mainland Moorlands SSSI
- Glims Moss & Durkadale SSSI
- Orphir & Stenness Hills SSSI
- Keelylang & Swartabeck Burn SSSI

During the Habitats Regulations Appraisal (HRA) screening phase (Appendix A), hen harrier and short-eared owl were formally screened out of further assessment as it was concluded that there is no potential for a Likely Significant Effect (LSE) on these two qualifying features as a result of the Project. Consequently, the ongoing assessment for this SPA focuses exclusively on the potential impacts on breeding red-throated diver.

Red-throated diver

Disturbance of birds due to Vessels

Project-induced vessel traffic during the red-throated diver (*Gavia stellata*) breeding season (April to September; see Appendix A, Table 10-13) will vary across the lifetime of the development:

- **Construction Phase:** Vessel movements will increase by an average of 0.58% over current summer baseline levels. Notably, no project vessel movements are predicted to occur during April or May. This minor increase will be temporary, spanning the 26-month construction programme.

- **Operational Phase:** As detailed in Sections 5.4 and 10.3.1.2 of the HRA (Appendix A), operations will generate an average monthly increase of 26 vessel movements. This represents a 1.0% average monthly increase over existing baseline traffic levels.

Vulnerability indices classify the red-throated diver as possessing a very high sensitivity to vessel disturbance (Appendix A, Table 10-11). However, the projected vessel movements along the shipping

route to the project are minor relative to the existing baseline (Sections 10.2.3.1 and 10.3.1.2 of the HRA (Appendix A)).

The physical movement of vessels in the vicinity of the Project is highly unlikely to create a barrier effect or displace birds moving through the area. Even applying a conservative, precautionary approach, project-related vessel movements will occur less than once per day during the breeding season. The presence of these vessels represents a highly transient, intermittent activity that is unlikely to be discernible from baseline shipping variations.

To manage and minimise potential impacts, a Vessel Management Plan (VMP) will be developed for both the construction and operational phases in consultation with NatureScot. The VMP will establish mandatory vessel routing and speed restrictions. It will incorporate specific, actionable protocols to identify and actively avoid aggregations of rafting birds on the water, thereby minimizing or avoiding disturbance impacts.

The mortality matrix model assessment (Appendix A HRA (Appendix D)) applies a highly conservative, precautionary framework to evaluate potential population-level impacts on the Orkney Mainland Moors SPA. Based on a seasonal peak count of 15 birds within a 1 km disturbance zone (Appendix A, Table 10-4), the model applies a precautionary 1% annual mortality increase:

- **Annual Impact**: This equates to a theoretical loss of 0.018 birds annually, representing 0.1% of the SPA population. This minor increment is considered non-significant.

- **Project Lifetime Impact (25 Years):** Over the 25-year operational lifespan agreed with NatureScot, the cumulative theoretical mortality is 0.45 birds. This represents 3% of the SPA population at designation and indicates that less than one individual would be lost over the entire multi-decade lifetime of the Project.

Mobile cranes

While empirical literature indicates that divers are sensitive to towering structures in the marine environment (e.g., Dierschke et al., 2017), these findings are derived almost exclusively from offshore wind farm developments. Crucially, there is no published evidence to demonstrate that quayside or vessel-mounted cranes at coastal developments cause comparable levels of visual disturbance or displacement.

As detailed in Section 10.2.1.2 of the HRA (Appendix A), the core breeding pairs of the red-throated diver population are geographically concentrated within the northern sectors of the Orkney Mainland Moors SPA.

- **Distance Thresholds**: There are no known breeding sites associated with the Orkney Mainland Moors SPA located within 14 km of the Project footprint.
- **Foraging Ranges**: This 14 km separation significantly exceeds the standard mean-maximum foraging range of 9 km defined for this species by Woodward et al. (2019).

Consequently, foraging trips from these breeding locations toward the Project area within Scapa Flow are highly unlikely. Even when accounting for a hypothetically expanded zone of visual disturbance due to towering crane booms, the absolute spatial segregation ensures that breeding red-throated divers from the Orkney Mainland Moors SPA will not be present within the Project's zone of influence.

In the highly unlikely event that an individual is exposed to crane operations, the resulting impact will be strictly non-significant and transient:

- **Reversibility**: Any localised avoidance behaviour will be immediately reversible upon the cessation of crane activities.
- **Baseline Tolerance**: The species has demonstrated behavioural tolerance to stationary vessel footprints within active coastal settings.
- **Mitigation Compliance**: All project operations will be governed by a Vessel Management Plan (VMP) designed to minimize close-range avifaunal interactions.

Given the spatial separation exceeding established foraging ranges, the lack of operational overlap with breeding sites, and the localised, intermittent nature of quayside activities, it is concluded that crane operations associated with the Project will not cause a continuous or sustained disruption. Therefore, no significant or sustained impact is anticipated.

Airborne noise

Breeding red-throated divers from the Orkney Mainland Moors SPA are located beyond the 9 km foraging range (14 km separation) from the Project site, rendering it highly unlikely that individuals will be present in areas susceptible to construction-related airborne noise. Combined with proposed mitigation measures, the Project is unlikely to cause an adverse effect on the integrity of the Orkney Mainland Moors SPA regarding its red-throated diver population.

Section 5.7 and 11 of this SEIR and Section 7 and Section 10.2.3.4 of the HRA (Appendix A) detail the full suite of committed mitigation measures designed to avoid significant adverse impacts on marine avifauna, including the red-throated diver.

Conclusion

Based on the objective evidence presented above, and incorporating the mandatory project mitigation measures, it is concluded that the predicted vessel, visual and noise disturbance impacts from the Project alone will not result in an adverse effect on the integrity (AEOI) of the Orkney Mainland Moors SPA in relation to its breeding red-throated diver qualifying feature.

The magnitude of the predicted vessel, visual and noise disturbance impact is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the black-throated diver is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Disturbance to prey species and habitats of prey species (construction only)

While red-throated divers from the Orkney Mainland Moors SPA may occasionally forage within Scapa Flow, the Project will not compromise the marine supporting habitats required to sustain their prey baseline. As defined in NatureScot's Conservation and Management Advice **(**2022c), supporting habitats encompass the critical seabed and water column characteristics regulated by wider oceanographic processes, including upwellings, tidal flows, and hydrological movements that drive nutrient cycling and prey distribution.

The integrity of these supporting habitats will be preserved across the following pathways:

- **Hydrodynamic Profiling**: Hydrodynamic modelling (Appendix A, Section 10.3.2) indicates negligible impacts on the surrounding water column and seabed, owing to the low-energy hydrodynamic regime characterising this sector of Scapa Flow. Prey abundance and spatial distribution will remain unchanged from the baseline.

- **Plume Dispersion Limits**: The total dredge volume comprises approximately 17% gravel, 60% sand, and 23% silt/clay. Weak local tidal currents will restrict sediment plumes to highly localised, short-term fields. Sediment discharge and dispersion magnitudes will remain low within the immediate dredge pockets and negligible beyond them, with zero sediment transport entering the Hoy SPA boundary.
- **Surface Water and Pollution Controls**: Engineering designs ensure that no untreated surface water discharges will enter coastal waters. Structural silt booms deployed during land reclamation works will prevent pollution spills from reaching the SPA or affecting prey resources.
- **Operational Marine Controls**: Strict adherence to formal Guidance for Pollution Prevention (GPPs) and operational vessel controls will eliminate pollutant releases from the pier and berthed vessels, ensuring ambient water quality is maintained.
- **Sea Disposal Allocation**: Dredge disposal will occur exclusively at a designated site located entirely outside the boundaries of the Scapa Flow SPA, ensuring no sediment transport into functionally linked habitats.

Conclusion

Based on the hydrodynamic evidence, restricted sediment transport modelling, and pollution prevention measures, the supporting habitats and prey resources for this species will be fully maintained beyond the direct development footprint. It is concluded that the predicted indirect impact is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the black-throated diver is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of Orkney Mainland Moors SPA in relation to its red-throated diver qualifying feature.

Accidental release of contaminants or pollutants (all phases)

While red-throated divers from the Orkney Mainland Moors Special Protection Area (SPA) may forage within the functionally linked waters of Scapa Flow, the implementation of a comprehensive environmental management framework will prevent adverse impacts from accidental contaminant releases. Protection of water quality and avifaunal prey resources will be governed by structured, legally binding mitigation protocols across both the construction and operational phases.

Operational safety and risk reduction are anchored by the following procedural controls:

- **Construction Environmental Management Document (CEMD)**: Overseen by a dedicated Environmental Clerk of Works (EnvCoW), the CEMD mandates that all site activities adhere to approved construction methods designed to prevent spills, govern safe material handling, and enforce environmental compliance.
- **Pollution Incident Response Plan (PIRP)**: The PIRP establishes definitive, rapid spill-response procedures, defines emergency communication chains, and dictates mandatory staff training to ensure any accidental release is immediately contained at source.
- **Pollution Prevention Plan (PPP)**: The PPP prescribes proactive engineering and housekeeping measures to eliminate spill pathways. This plan will transition seamlessly from the construction phase into long-term operations.
- **Operational Environmental Management Document (OEMD)**: The OEMD ensures continuous environmental oversight throughout the lifecycle of the development, mandating strict compliance with the Scottish Environment Protection Agency (SEPA) Guidance for Pollution Prevention (GPPs).

To isolate potential contamination pathways and preserve localised water quality, the Project incorporates integrated physical and operational barriers:

- **Plume Mitigation**: Silt booms, turbidity monitoring, and strictly controlled dredging protocols will prevent excessive sediment plumes and block the mobilization of any historical seabed contaminants.
- **Ballast Water Management**: Enforced ballast water management procedures guarantee controlled, legally compliant vessel ballast operations, removing the risk of unregulated biological or chemical discharges.
- **Early Detection Systems**: Best-practice environmental monitoring ensures the rapid identification of any ambient water quality changes, triggering immediate corrective site actions.

In the highly unlikely event of spill, hydrographic baseline conditions and response mechanisms insulate the wider SPA from systemic exposure. Prevailing tidal circulation patterns within this sheltered sector of Scapa Flow naturally restrict material transport. Backed by the localised deployment of rapid-response spill equipment, any residual pollutants will remain strictly confined near the source. Accidental contaminant pathways from project vessels or quayside operations are thus heavily minimized in probability, magnitude, and spatial extent.

Conclusion

Based on the integrated engineering barriers, multi-tiered environmental governance plans, and the localised hydrodynamics detailed in Appendix A, Section 10.3.3, the potential for accidental pollution to affect foraging avifauna or their prey species is negligible. It is concluded that the predicted indirect impact is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Red-throated diver is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of Orkney Mainland Moors SPA in relation to its red-throated diver qualifying feature.

Ornithological habitat changes (operation and maintenance only)

As detailed in Appendix A, Section 10.2.1.2, the core breeding pairs of the red-throated diver population are geographically concentrated within the northern sectors of the Orkney Mainland Moors Special Protection Area (SPA).

The risk of population-level exposure to marine habitat changes is negligible due to the following factors:

- **Spatial Separation**: There are no known breeding sites associated with the Orkney Mainland Moors SPA located within 14 km of the Project footprint.
- **Foraging Ranges**: This 14 km buffer significantly exceeds the standard 9 km mean-maximum foraging range defined for this species by Woodward et al. (2019).

Consequently, foraging trips from these inland breeding locations toward the Project area within Scapa Flow are highly unlikely. Given this spatial segregation, it is unlikely that breeding red-throated divers originating from the Orkney Mainland Moors SPA will be present in areas susceptible to localized ornithological habitat modifications or changes generated by the Project.

Conclusion

Based on the extensive spatial separation exceeding established species foraging limits, it is concluded that localised habitat changes from the Project alone will not result in an adverse effect on the integrity of the Orkney Mainland Moors SPA in relation to its breeding red-throated diver qualifying feature.

It is concluded that the predicted indirect impact is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Red-throated diver is determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of Orkney Mainland Moors SPA in relation to its red-throated diver qualifying feature.

Cumulative Effects

Disturbance of birds from Project activities

There is potential for cumulative vessel disturbance to breeding red-throated divers during the concurrent construction or operational phases of the regional plans, projects, and developments catalogued in Appendix A (Table 10-14). Vessels pass through Scapa Flow, creating a pathway for combined disturbance to foraging avifauna associated with the Orkney Mainland Moors SPA.

The significance of this cumulative pathway is mitigated by the following spatial and regulatory factors:

- **Established Shipping Routes**: The vast majority of vessel movements are confined to established shipping routes entering Scapa Flow from the south (between Flotta and South Ronaldsay) and the west (between Hoy/Graemsay and Stromness). These routes experience moderate baseline traffic; the addition of project vessels represents an indistinguishable deviation from current baseline shipping volumes.
- **Localised Project Footprint**: Heightened vessel activity is restricted to a 167 ha branching zone extending east from the main channel toward the Project site. No vessels from other planned developments utilise this specific branch, although baseline traffic does exist (see Appendix A HRA (Appendix B: Heat Maps and Noise Contour Maps).
- **Aquaculture Routing Controls**: Existing fish farms that have undergone variations are bound by seasonal restrictions and designated vessel routes. Under site-specific conservation advice for the Scapa Flow SPA (NatureScot, 2022c), these vessels actively avoid critical foraging zones.

Coinciding construction activities at the Hatston Pier expansion could cause localized, intermittent displacement within the marine habitats used by red-throated divers originating from the Orkney Mainland Moors SPA.

- **Localised Exposure**: Any displacement will be localized to Kirkwall Bay, affecting a minor proportion of the SPA population (18 breeding pairs) that might forage across both the Scapa Flow SPA and the waters adjacent to Hatston.
- **Baseline Densities**: The Hatston Pier Expansion Habitats Regulations Appraisal (HRA) recorded a peak count of just 5 red-throated divers during baseline vantage point surveys within its adjacent marine zone.
- **Habituation and Carrying Capacity**: Hatston is a highly active, established commercial port. Given the vast extent of alternative marine habitat across both the North Orkney SPA and Scapa Flow SPA, and considering the species' standard 9 km breeding foraging range (Woodward et al., 2019), any localised disturbance at Hatston will not result in population-level impacts, either alone or cumulative with the Project.

While individual red-throated divers may exploit foraging habitats across both the North Orkney and Scapa Flow SPAs at different times, any cumulative disturbance from these combined project activities will remain strictly temporary, intermittent, and immediately reversible upon the cessation of specific vessel or construction tasks.

Conclusion

Consequently, based on the spatial segregation of shipping lanes, localised port footprints, and mandatory regional vessel routing, it is concluded that the predicted effects from the Project cumulatively with other plans, projects, and developments will not result in an adverse effect on the integrity of the Orkney Mainland Moors SPA regarding its breeding red-throated diver qualifying feature.

Based on the assessment presented in the HRA (Appendix A), the magnitude of the predicted cumulative effects on disturbance of birds from Project activities is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver qualifying feature of the Orkney Mainland Moors SPA determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Disturbance to prey species and habitats of prey species

The project-alone assessment concluded that the development will not result in an adverse effect on site integrity regarding disturbance to prey species or their marine supporting habitats. At a regional scale, cumulative pressures on the marine habitats within the Scapa Flow SPA, which are utilised by foraging red-throated divers from the Orkney Mainland Moors SPA, could theoretically arise from the concurrent construction or operation of the following seven cumulative developments:

- Hatston Pier Expansion
- Hunda Aquaculture Site
- Lober Salmon Farm
- Bringhead Aquaculture Site
- Westerbister Aquaculture Site
- Toyness Aquaculture Site
- West Fara Aquaculture Site

Construction activities at the Hatston Pier expansion could cause localised, transient disturbance to prey species and benthic habitats within Kirkwall Bay. However, the potential for population-level in-combination impacts is negligible due to the following factors:

- **Targeted Exposure**: Any indirect impacts on prey distribution will remain heavily restricted to the immediate vicinity of Kirkwall Bay, interacting with a minor proportion of the Orkney Mainland Moors SPA population (18 breeding pairs) that may forage across the North Orkney and Scapa Flow SPAs.
- **Low Baseline Exploitation**: The HRA documentation for the Hatston Pier Expansion recorded a peak baseline count of only 5 red-throated divers utilizing the marine waters adjacent to the existing pier structure.
- **Habitat Context**: Hatston is a highly active, established commercial port footprint. Given the vast extent of alternative, high-quality foraging habitat across both the North Orkney SPA and Scapa Flow SPA, and considering the species' standard 9 km breeding foraging range (Woodward et al., 2019), any localized footprint pressure on prey from Hatston will not result in adverse effects, either alone or in combination with the Project.

The six regional aquaculture developments (Hunda, Lober, Bringhead, Westerbister, Toyness, and West Fara) are included in this cumulative assessment based on minor, localized modifications to existing infrastructure. Consequently, their net incremental effect on prey species and marine habitats is negligible:

- **Impact Characteristics**: Construction-phase impacts on marine prey resources from these sites will be short-term, temporary, localised, and fully reversible.

- **Spatial Scale**: Any disturbance to the seabed or water column will remain minor, transient, and tightly confined to a small spatial extent relative to the extensive alternative foraging habitat available throughout Scapa Flow.
- **Mitigation Alignment**: These third-party developments operate under case-by-case statutory permissions incorporating embedded environmental mitigation measures, ensuring that regional cumulative habitat degradation remains highly unlikely.

Conclusion

When accounting for the minor scale of aquaculture variations, the localised nature of the port expansion footprint, and the mitigation frameworks applied regionally, the supporting habitats and prey resources for this species will be fully maintained. It is concluded that the predicted indirect impacts from the Project, cumulatively with other plans, projects, and developments, will not result in an adverse effect on the integrity of the Orkney Mainland Moors SPA in relation to its breeding red-throated diver qualifying feature.

Based on the assessment presented in the HRA (Appendix A), the magnitude of the predicted cumulative effects on disturbance to prey species and habitats of prey species from Project activities is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver qualifying feature of the Orkney Mainland Moors SPA determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Accidental release of contaminants or pollutants

The project-alone assessment concluded that the development will not result in an adverse effect on site integrity regarding the accidental release of contaminants or pollution. At a regional scale, the risk of cumulative, in-combination pollution impacts from other plans, projects, and developments is negligible. This conclusion is supported by the following factors:

- **Strict Case-by-Case Management**: Potential pollution pathways from nearby marine and coastal developments are governed by independent, statutory environmental regulations and managed on a case-by-case basis.
- **Low Probability of Occurrence**: The risk of simultaneous or overlapping major pollution incidents remains rare and highly unlikely.
- **Embedded Mitigation**: All relevant third-party projects are bound by project-specific Pollution Prevention Plans (PPPs) and emergency response frameworks.

Conclusion

When taking into consideration the strict, legally binding mitigation measures embedded across all regional developments, the risk of cumulative pollution exposure is effectively controlled. It is concluded that the predicted risks from the Project, in combination with other plans, projects, and developments, will not result in an adverse effect on the integrity of the Orkney Mainland Moors SPA regarding its breeding red-throated diver qualifying feature

Based on the assessment presented in the HRA (Appendix A), the magnitude of the predicted cumulative effects on accidental release of contaminants or pollutants from Project activities is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver qualifying feature of the Orkney Mainland Moors SPA determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Ornithological habitat change

The project-alone assessment concluded that the development will not result in an adverse effect on site integrity regarding localised ornithological habitat changes. At a regional scale, cumulative modifications to the marine habitats within the Scapa Flow SPA, which are utilized by foraging red-throated divers from the Orkney Mainland Moors SPA, could theoretically arise from the concurrent construction or operation of the following seven cumulative developments:

- Hatston Pier Expansion
- Hunda Aquaculture Site
- Lober Salmon Farm
- Bringhead Aquaculture Site
- Westerbister Aquaculture Site
- Toyness Aquaculture Site
- West Fara Aquaculture Site

Cumulative Analysis: Hatston Pier Expansion

Construction activities at the Hatston Pier expansion could result in localized temporary or permanent habitat changes within Kirkwall Bay. However, the potential for population-level in-combination impacts is negligible due to the following factors:

- **Targeted Exposure**: Any indirect impacts on habitat availability will remain heavily restricted to the immediate vicinity of Kirkwall Bay, interacting with a minor proportion of the Orkney Mainland Moors SPA population (18 breeding pairs) that may forage across the North Orkney and Scapa Flow SPAs.
- **Low Baseline Exploitation**: The HRA documentation for the Hatston Pier Expansion recorded a peak baseline count of only 5 red-throated divers utilising the marine waters adjacent to the existing pier structure.
- **Habitat Context**: Hatston is a highly active, established commercial port footprint. Given the vast extent of alternative, high-quality foraging habitat across both the North Orkney SPA and Scapa Flow SPA, and considering the species' standard 9 km breeding foraging range (Woodward et al., 2019), any localised footprint pressure on habitats from Hatston will not result in adverse effects, either alone or in combination with the Project.

Cumulative Analysis: Aquaculture Operations

The six regional aquaculture developments (Hunda, Lober, Bringhead, Westerbister, Toyness, and West Fara) are included in this cumulative assessment based on minor, localized modifications to existing infrastructure. Consequently, their net incremental effect on ornithological habitat availability is negligible:

- **Impact Characteristics**: Structural changes to habitats from these aquaculture variations will be negligible, short-term, and confined to a small spatial extent.
- **Habitat Carrying Capacity**: The remainder of the Scapa Flow SPA will continue to provide expansive, undisturbed foraging, roosting, and commuting habitats for the qualifying species.

When accounting for the minor scale of aquaculture variations, the localised nature of the port expansion footprint, and the vast availability of alternative regional habitats, the baseline foraging and roosting distribution for this species will be fully maintained. It is concluded that the predicted indirect impacts from the Project, in combination with other plans, projects, and developments, will not result in an adverse effect on the integrity of the Orkney Mainland Moors SPA in relation to its breeding red-throated diver qualifying feature

Conclusion

Following a comprehensive appraisal of all reasonably foreseeable plans, projects, and consented developments within the regional zone of influence, the cumulative impact magnitude across all identified environmental pathways is assessed as **Negligible**. The total additive spatial footprint of the combined developments is extremely restricted, and the regional baseline exhibits no significant overlapping development pressures. Furthermore, construction timelines do not coincide with other sensitive regional infrastructure works, ensuring that cumulative habitat loss, fragmentation, and displacement pressures across the island remain negligible.

The significance of residual cumulative effects has been evaluated under the framework of the EIA Regulations (Scotland). When **high receptor sensitivity** is cross-referenced against a **negligible impact magnitude** within the standard EIA significance matrix, the resulting effect is determined to be **Not Significant**. There are no additive or synergistic interactions identified that would elevate the risk to avian receptors, and all predicted residual effects are considered **minor** and **localised** in EIA terms.

In accordance with the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland), a definitive legal determination has been reached regarding site integrity. Incorporating all secured, project-specific mitigation measures, it is objectively concluded that the Project, both alone and in-combination with other plans, projects, and developments, **will not result in an Adverse Effect on the Integrity** of the Orkney Mainland Moors SPA. The overarching statutory Conservation Objectives of the designated site will be fully maintained, ensuring that the long-term population viability, recruitment, and distribution of the breeding qualifying features remain entirely secure.

5.6.5 Effects on Ornithology - Hoy SPA

The Hoy Special Protection Area (SPA) is situated on the mountainous island of Hoy within the south-western sector of the Orkney archipelago, approximately 16.5 km west of the Project site (NatureScot, 2024). The SPA encompasses the northern and western two-thirds of the island, which is geologically formed of Old Red Sandstone and contains Orkney's highest topographic elevations alongside adjacent coastal waters.

The terrestrial and marine environment within the designation is characterised by:

- A highly diverse mosaic of mire, heath, and alpine vegetation.
- Great Britain's most northerly native woodland habitat.
- Expansive upland areas and high coastal sea cliffs.

These specialised habitats support an internationally important assemblage of moorland breeding birds and breeding seabirds.

Originally classified on 7 December 2000, the SPA boundaries overlap directly with the underlying Hoy Site of Special Scientific Interest (SSSI). On 25 September 2009, a marine extension was formally classified, extending the SPA boundary approximately 2 km into the marine environment to protect the underlying seabed, water column, and sea surface for breeding seabird populations.

During the Habitats Regulations Appraisal (HRA) screening phase (Appendix A), peregrine (*Falco peregrinus*) was formally screened out of further assessment. As detailed in the project screening documentation, it was concluded that there is no potential for a Likely Significant Effect (LSE) on this qualifying feature as a result of the Project. Consequently, the ongoing assessment for this SPA focuses exclusively on the remaining scoped-in breeding avifaunal features.

Assessment of Adverse Effects Alone: Disturbance of birds due to Project activities (all phases)

During the construction phase, potential disturbance may arise from dredging activities, vessel movements, and airborne noise generated by terrestrial works. Empirical data isolating marine bird responses to noise disturbance—particularly underwater noise—from other compounding variables like vessel movements or human presence remain limited. Consequently, this specific stressor pathway is not yet fully understood.

However, recent research indicates that diving seabirds may be more sensitive to underwater noise than previously assumed. For instance, hearing thresholds for the great cormorant (*Phalacrocorax carbo*) are comparable to those of seals and toothed whales within the 1 kHz to 4 kHz frequency band (Hansen et al., 2017). Due to these overlapping frequency ranges, current assessment methodologies apply pinniped or low-frequency cetacean sensitivity criteria to seabirds as a conservative proxy (Teachout, 2012).

Acoustic modelling for the project provides the following specific thresholds and parameters:

- **Dredging Underwater Noise (EIAR, Technical Appendix 5.6):** Predicts a Temporary Threshold Shift (TTS) range extending up to 250 m. A Permanent Threshold Shift (PTS) range is restricted to 50 m or less, and would require a prolonged, continuous exposure period of 8 hours.

- **Terrestrial General Construction Noise (EAIR, Technical Appendix 9.1):** Identifies source noise levels between 70 dB and 90 dB at 10 m, which attenuate over distance. Noise contour mapping (Appendix B) demonstrates that the installation of a 6 m seaward perimeter bund will restrict noise levels immediately outside the bund to 40–50 dB. This will further dissipate to <35 dB at a distance of 250 m. This falls safely below the 50 dB threshold identified by the University of Hull (2013) as having low effect and no impact on waterbirds.

- **Terrestrial Blasting Operations:** Routine blasting will generate air overpressure levels of approximately 120 dB at the source, decaying at a rate of 6 dB per doubling of distance. These sound waves are subject to localised meteorological attenuation (wind, temperature, cloud cover, and humidity). Blasting will be highly infrequent, restricted to a single event per week over a 35-week period.

- **Construction Vessel Movements (Section 2.2.11 of this SEIR):** Vessel traffic will be minor, limited to a maximum total of 112 vessel movements distributed across the entire 26-month construction phase.

To mitigate these temporary pressures, a Construction Environmental Management Document (CEMD; Appendix I of the Mat 2025 SEIR) will be implemented. This includes oversight by an Environmental Clerk of Works (EnvCoW) or specialist ornithologist. The ornithologist will monitor a 500 m buffer zone around the development footprint for the presence of Special Protection Area (SPA) qualifying features and record any behavioural responses. If significant disturbance behaviour is observed, the monitoring and exclusion zone will be adaptively expanded to eliminate adverse impacts.

In terms of potential disturbance from vessel movements, the maximum number of vessel movements is 112 over the 26-month construction phase.

Arctic skua (breeding)

Small numbers of Arctic skua (*Stercorarius parasiticus*) were recorded flying past the Project area very infrequently during the summer months, with a seasonal peak count of five birds in June 2022. The closest known breeding colonies are located on the East Mainland approximately 10 km away,

supporting only one or a few pairs at each location. The five recorded individuals represent 4.2% of the Hoy SPA qualifying population (59 pairs).

Based on the assessments presented in Section 10.3.1 and Section 10.7.3.1 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance of birds due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Arctic skua qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained

Atlantic puffin (breeding)

Atlantic puffin (*Fratercula arctica*) was observed on 7 of 48 watch days in 2020 and 2022, with a peak count of three individuals representing 0.04% of the Hoy SPA breeding population. **Due to low usage, the project is not expected to adversely affect the integrity of the Hoy SPA** regarding this species.

Based on the assessments presented in Section 10.3.1 and Section 10.7.3.1 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance of birds due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Atlantic puffin qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained

Black-legged kittiwake (breeding)

Black-legged kittiwake (*Rissa tridactyla*) was recorded in small numbers flying past the Project area during the summer months, with a peak passage rate of seven birds per hour in June 2022. A peak count of 83 birds on the water was also recorded within 2 km of the site. It is considered that the vast majority, if not all, of these recorded birds originate from the breeding colony located to the north of the Project site. This peak count of 83 individuals represents approximately 1.4% of the Hoy SPA qualifying population (3,000 pairs).

Based on the assessments presented in Section 10.3.1 and Section 10.7.3.1 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance of birds due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Black-legged kittiwake qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained

Common guillemot (breeding)

Common guillemot (*Uria aalge*) was recorded in small numbers, with a peak count of 27 birds within 1 km of the Project site and 87 birds within 2 km. Small numbers were also recorded transiting past the site, with a peak passage rate of six birds per hour in June 2022. It is considered that the vast majority, if not all, of these recorded birds originate from the breeding colony located to the north of the Project site. This peak count of 87 individuals represents approximately 0.3% of the Hoy SPA qualifying population (13,400 pairs).

Based on the assessments presented in Section 10.3.1 and Section 10.7.3.1 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance of birds due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Common guillemot qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained

Great black-backed gull (breeding)

Great black-backed gull (*Larus marinus*) was recorded in low numbers, with a peak count of 11 birds during the summer months and a peak passage rate of seven birds per hour transiting past the site. One pair was recorded nesting in close proximity to the Project site. It is considered unlikely that the individuals recorded are associated with the Hoy SPA complex. This peak count of 11 birds represents approximately 0.96% of the Hoy SPA qualifying population (570 pairs).

Based on the assessments presented in Section 10.3.1 and Section 10.7.3.1 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance of birds due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Great black-backed gull qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained

Great skua (breeding)

Great skua (*Stercorarius skua*) was recorded in small numbers, with a peak passage rate of four birds per hour transiting past the site in July 2021. Recorded numbers were significantly lower in 2022, a trend likely attributable to the widespread prevalence of Highly Pathogenic Avian Influenza (HPAI), which severely impacted local and national populations. This peak passage rate of four birds per hour represents approximately 0.1% of the Hoy SPA qualifying population (1,900 pairs).

Based on the assessments presented in Section 10.3.1 and Section 10.7.3.1 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance of birds due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Great skua qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained

Northern fulmar (breeding)

Northern fulmar (*Fulmarus glacialis*) was recorded in sizeable numbers flying past the Project area during the summer months, with a peak passage rate of 56 birds per hour in July 2022. It is considered that the vast majority, if not all, of these recorded birds originate from the breeding colony located to the north of the Project site. This peak passage rate of 56 birds per hour represents approximately 0.08% of the Hoy SPA qualifying population (35,000 pairs).

Based on the assessments presented in Section 10.3.1 and Section 10.7.3.1 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance of birds due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Northern fulmar qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained

Red-throated diver (breeding)

Vessel movements to and from the dredging site will pass through a favoured foraging area for breeding red-throated diver. This activity overlaps with critical stages of the species' breeding cycle (June–August), most notably the sensitive chick-rearing period.

A total of 42 vessel movements will occur over a 12-week period, averaging 3.5 movements per week. This does not represent a significant increase relative to baseline vessel traffic in the area. To manage

potential pressures, mitigation measures detailed in Table 11-1 of this SEIR and the Construction Environmental Management Document (CEMD) will be strictly implemented. All vessel operators will be issued standard best-practice navigational protocols and a project-specific Vessel Management Plan (VMP). The VMP will enforce mandatory slow transit speeds, adherence to defined shipping routes, and strict compliance with the Scottish Marine Wildlife Watching Code (SMWWC) to minimise disturbance. Crucially, transiting project vessels will completely avoid the marine portion of the Hoy Special Protection Area (SPA) to eliminate direct interaction with foraging divers, which likely originate from the nearby breeding sites on Hoy.

According to NatureScot's Conservation and Management Advice for the Hoy SPA (NatureScot, 2024), breeding red-throated divers commute between upland moorland nesting sites on freshwater lochs and coastal foraging grounds, typically within a 10 km radius. While vessels transiting near the SPA boundary have the potential to cause disturbance, the risk is highly restricted. Project vessels will not enter the SPA, will maintain constant, slow speeds along pre-determined routes, and will remain clear of the shallow coastal bays and inlets preferred by foraging divers. Consequently, any potential marine disturbance will be short-term, temporary, and rapidly reversible.

Furthermore, while divers are known to be sensitive to tall marine structures (Dierschke et al., 2017), the project site is located beyond the maximum 9 km species foraging range (Woodward et al., 2019) from the Hoy SPA boundary. There is therefore no operational pathway for visual or structural disturbance from quayside cranes.

Based on the assessments presented in Section 10.3.1 and Section 10.7.3.1 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance of birds due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained

Disturbance to prey species and habitats of prey species (construction only)

According to NatureScot's Conservation and Management Advice for the Hoy SPA (NatureScot, 2024), supporting habitats encompass the seabed and water column characteristics relevant to the qualifying features. These habitats are influenced by wider oceanographic processes, including upwellings, tidal flows, and hydrological movements, that drive nutrient cycling and prey distribution.

Hydrodynamic modelling (summarised in Appendix A, Section 10.3.2) indicates that the Project will have a negligible impact on the surrounding water column and seabed, owing to the low-energy environment in this part of Scapa Flow. Consequently, impacts on prey species for the qualifying features are expected to be negligible, ensuring their abundance and distribution remain within baseline parameters.

The total dredge volume comprises approximately 17% gravel, 60% sand, and 23% silt and clay. Combined with weak tidal currents near the proposed dredge pockets, capital dredging will only generate highly localised, short-term sediment plumes. The magnitude of sediment discharge and dispersion will be low within the immediate dredge area and negligible beyond it. Crucially, no sediment transport will occur within the Hoy SPA boundary, thereby maintaining the supporting habitats for qualifying species outside the direct development footprint.

To protect the water environment and prey sources from pollution, surface water drainage systems will be designed to prevent any untreated discharges into surrounding coastal waters. Silt curtains will also be deployed during land reclamation works to contain suspended solids. Potential water pollution risks from the pier and berthed vessels will be managed through strict adherence to Pollution Prevention Plan

(PPP) controls. These measures will ensure the supporting habitats for the qualifying species are fully maintained.

For marine dredged material disposal, no sediment transport will occur within the Hoy SPA boundary because the designated sea disposal site is located entirely outwith the SPA footprint. The supporting habitats for the qualifying SPA species beyond the development footprint will therefore be maintained

Arctic skua (breeding)

Based on the assessments presented in 10.3.2 and Section 10.7.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance to prey species and habitats of prey species due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Arctic skua qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Atlantic puffin (breeding)

Based on the assessments presented in 10.3.2 and Section 10.7.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance to prey species and habitats of prey species due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Atlantic puffin qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Black-legged kittiwake (breeding)

Based on the assessments presented in 10.3.2 and Section 10.7.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance to prey species and habitats of prey species due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Black-legged kittiwake qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Common guillemot (breeding)

Based on the assessments presented in 10.3.2 and Section 10.7.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance to prey species and habitats of prey species due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Common guillemot qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Great black-backed gull (breeding)

Based on the assessments presented in 10.3.2 and Section 10.7.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance to prey species and habitats of prey species due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Great black-backed gull qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the

Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Great skua (breeding)

Based on the assessments presented in 10.3.2 and Section 10.7.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance to prey species and habitats of prey species due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Great skua qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Northern fulmar (breeding)

Based on the assessments presented in 10.3.2 and Section 10.7.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance to prey species and habitats of prey species due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Northern fulmar qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Red-throated diver (breeding)

Based on the assessments presented in 10.3.2 and Section 10.7.3.2 of the HRA (Appendix A), the magnitude of the predicted indirect impacts on disturbance to prey species and habitats of prey species due to Project activities (all phases) is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the Red-throated diver qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Accidental release of contaminants or pollutants (all phases)

The sections below present the Adverse Effect on Site Integrity (AESI) conclusions for the Hoy SPA qualifying species that have been screened into the assessment, based on the project parameters outlined in Appendix A (Section 10.3.3).

During construction, robust mitigation measures will collectively minimise the risk of accidental pollutant releases. A Construction Environmental Management Document (CEMD), supported by Environmental Clerk of Works (EnvCoW) oversight, will ensure all activities follow approved methods designed to prevent spills, manage materials safely, and maintain compliance with environmental commitments. A Pollution Incident Response Plan (PIRP) will provide clear spill-response procedures, emergency contacts, and staff training to ensure rapid and effective containment of any incident. Furthermore, a Pollution Prevention Plan (PPP) will be implemented during construction and will continue into the operational phase, detailing specific contingency measures to manage accidental spillages.

Water quality will be protected through real-time turbidity monitoring and controlled dredging protocols. These controls will prevent significant sediment plumes and the mobilisation of contaminated materials, reducing the risk of pollutant dispersal. In addition, Ballast Water Management procedures will ensure controlled, compliant ballast operations to prevent unauthorised discharges. Best-practice environmental monitoring will enable the early detection of any water quality changes, allowing prompt corrective action. Together, these integrated controls establish a structured environmental management

framework that substantially reduces the likelihood, magnitude, and extent of accidental pollutant releases during both construction and operation.

In the unlikely event of a spill best-practice spill response will ensure that residual pollutants remain localised. Accidental releases of potential contaminants from project vessels will be strictly controlled, with robust procedures in place to minimise any subsequent environmental effects. Throughout the operational phase, operations will adhere to an Operational Environmental Management Document (OEMD) and industry best practices, including standard SEPA Guidance for Pollution Prevention (GPPs).

Arctic skua (breeding)

Based on the assessments presented in 10.3.3 and Section 10.7.3.3 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with the accidental release of contaminants or pollutants (all phases) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Arctic skua qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Atlantic puffin (breeding)

Based on the assessments presented in 10.3.3 and Section 10.7.3.3 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with the accidental release of contaminants or pollutants (all phases) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Atlantic puffin qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Black-legged kittiwake (breeding)

Based on the assessments presented in 10.3.3 and Section 10.7.3.3 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with the accidental release of contaminants or pollutants (all phases) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Black-legged kittiwake qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Common guillemot (breeding)

Based on the assessments presented in 10.3.3 and Section 10.7.3.3 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with the accidental release of contaminants or pollutants (all phases) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Common guillemot qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Great black-backed gull (breeding)

Based on the assessments presented in 10.3.3 and Section 10.7.3.3 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with the accidental release of contaminants or pollutants (all phases) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Great black-backed gull qualifying feature of Hoy SPA

is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Great skua (breeding)

Based on the assessments presented in 10.3.3 and Section 10.7.3.3 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with the accidental release of contaminants or pollutants (all phases) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Great skua qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Northern fulmar (breeding)

Based on the assessments presented in 10.3.3 and Section 10.7.3.3 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with the accidental release of contaminants or pollutants (all phases) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Northern fulmar qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Red-throated diver (breeding)

Based on the assessments presented in 10.3.3 and Section 10.7.3.3 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with the accidental release of contaminants or pollutants (all phases) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Red-throated diver qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Ornithological habitat changes (operation and maintenance only)

The Project will result in the direct loss of 19.1 ha of the Scapa Flow Special Protection Area (SPA), an area where qualifying features of the Hoy SPA may be present. This footprint equates to approximately 0.06% of the total Scapa Flow SPA area, which represents a negligible fraction of the designation. The affected area is extremely localised, and the remainder of both the Scapa Flow SPA and the Hoy SPA will continue to provide extensive foraging, roosting, and commuting habitats for the qualifying species.

The lost habitat functions relate primarily to marine foraging areas used by qualifying bird species that may range within the Scapa Flow SPA. Given the vast size and heterogeneous habitat availability of the Scapa Flow SPA, alongside the extensive alternative habitats within the Hoy SPA, this minor localised loss is not expected to alter the overall ecological functioning of either site.

Scapa Flow provides large expanses of suitable foraging waters with comparable depths, prey availability, and hydrodynamic characteristics. Consequently, the small area lost does not constitute a unique or limiting foraging resource. Mobile marine bird species, including divers, grebes, and seaduck, possess wide foraging ranges that enable them to readily exploit abundant alternative habitats across both SPAs.

Furthermore, birds commuting between feeding grounds, resting locations, and open water will not be impeded. The operational footprint of the Project will not create a barrier to movement and will maintain the wider habitat connectivity required by Hoy SPA features foraging within the Scapa Flow SPA.

Arctic skua (breeding)

Based on the assessments presented in Section 10.3.4 and Section 10.7.3.4 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with Ornithological habitat changes (operation and maintenance only) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Arctic skua qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Atlantic puffin (breeding)

Based on the assessments presented in Section 10.3.4 and Section 10.7.3.4 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with Ornithological habitat changes (operation and maintenance only) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Atlantic puffin qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Black-legged kittiwake (breeding)

Based on the assessments presented in Section 10.3.4 and Section 10.7.3.4 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with Ornithological habitat changes (operation and maintenance only) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Black-legged kittiwake qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Common guillemot (breeding)

Based on the assessments presented in Section 10.3.4 and Section 10.7.3.4 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with Ornithological habitat changes (operation and maintenance only) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Common guillemot qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Great black-backed gull (breeding)

Based on the assessments presented in Section 10.3.4 and Section 10.7.3.4 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with Ornithological habitat changes (operation and maintenance only) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Great black-backed gull qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Great skua (breeding)

Based on the assessments presented in Section 10.3.4 and Section 10.7.3.4 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with Ornithological habitat changes (operation and maintenance only) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Great skua qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Northern fulmar (breeding)

Based on the assessments presented in Section 10.3.4 and Section 10.7.3.4 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with Ornithological habitat changes (operation and maintenance only) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Northern fulmar qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Red-throated diver (breeding)

Based on the assessments presented in Section 10.3.4 and Section 10.7.3.4 of the HRA (Appendix A), the magnitude of the predicted indirect impacts associated with Ornithological habitat changes (operation and maintenance only) is classified as **negligible**. Given the low exposure and localised nature of these events, the resulting significance of effect on the Red-throated diver qualifying feature of Hoy SPA is determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Cumulative Effects

Appendix A, Table 10-14 provides a summary of the other developments considered within the in-combination assessment of effects.

Disturbance of birds due to Project activities (all phases)
There is potential for cumulative effects from vessel disturbance during the construction and operational phases of the plans, projects, and developments listed in Appendix A, Table 10-14. Vessels associated with other projects may pass through or near the Hoy SPA, potentially causing localised disturbance to qualifying features.

The breeding seabird qualifying features of the Hoy SPA are highly mobile and are generally not considered highly sensitive to vessel disturbance. While individuals foraging outside the SPA boundaries could interact with regional shipping traffic, these vessel movements occur within marine corridors that are already subject to moderate levels of baseline shipping activity.

Vessel movements to and from the dredging site will transit an area used as a favoured foraging ground by breeding red-throated diver. However, as established in Appendix A, Section 10.7.3.1.8, any resulting disturbance will be short-term, temporary, and rapidly reversible. It is assumed that vessels associated with other regional plans, projects, and developments will adhere to their respective Vessel Management Plans (VMPs). These plans aim to minimise vessel passing through the marine portion of the Hoy SPA, thereby protecting foraging red-throated divers during the critical breeding and chick-rearing periods (June–August) when birds commute from their upland nesting sites on Hoy.

Furthermore, there are no other regional projects with overlapping effect pathways involving tall, moving structures like mobile cranes. Consequently, there is no potential for cumulative visual impacts on any of the SPA qualifying features from crane operations.

Conclusion

Based on the assessment presented in the HRA (Appendix A), the magnitude of the predicted cumulative effects on disturbance of birds from Project activities is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the qualifying feature of the Hoy SPA determined to be **minor adverse** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Disturbance to prey species and habitats of prey species (construction only)

It is concluded that the predicted impacts on prey species and their habitats from the Project alone will not result in an adverse effect on the integrity of to prey species and habitats of prey species. The relevant plans and projects located within the Scapa Flow SPA that have the greatest potential to act cumulatively with the Project include:

- Hatston Pier Expansion
- Hunda aquaculture site
- Lober salmon farm
- Bringhead aquaculture site
- Westerbister aquaculture site
- Toyness aquaculture site
- West Fara aquaculture site

Construction activities for the Hatston Pier expansion could result in localised disturbance to prey species and supporting habitats. However, these effects will be spatially restricted, remaining confined to the immediate vicinity of Kirkwall Bay and affecting only a minor proportion of the extensive foraging habitat available across the wider Scapa Flow SPA.

The listed aquaculture sites are included based on minor infrastructure variations to existing operations. Consequently, their ongoing cumulative effects on prey species and localised hydrodynamic conditions will be negligible.

Across all identified projects, construction-phase impacts on marine bird prey resources are expected to be short-term, temporary, and rapidly reversible. Any localised changes in prey distribution or minor increases in turbidity will remain transient and confined to a small spatial footprint. This ensures that the vast majority of the high-quality, high-capacity foraging grounds remain fully accessible to foraging birds.

Conclusion

Taking into consideration the embedded mitigation measures and regulatory compliance standards applied across these other plans and developments, it is concluded that based on the assessment presented in the HRA (Appendix A), the magnitude of the predicted cumulative effects on disturbance to prey species and habitats of prey species from Project activities is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver qualifying feature of the Hoy SPA determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Accidental release of contaminants or pollutants

It is concluded that the predicted impacts from the accidental release of pollutants or contaminants by the Project alone will not result in an adverse effect on the integrity of the Hoy SPA.

Accidental pollution risks across]developments are managed on a case-by-case basis under statutory regulations, making significant cumulative pollution events rare and highly unlikely. When taking into consideration the robust, embedded mitigation measures and pollution prevention controls applied to both this Project and the other plans, projects, and developments within the region, it is concluded that the cumulative risk, based on the assessment presented in the HRA (Appendix A), the magnitude of the predicted cumulative effects on accidental release of contaminants or pollutants from Project activities is classified as **negligible**. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver qualifying feature of the Hoy SPA determined to be **minor** and **not significant** in EIA terms. Consequently, the Project **will not result in an adverse effect on the integrity** of the designated site, and its conservation objectives will be fully maintained.

Ornithological habitat change

It is concluded that the predicted impacts from habitat changes resulting from the Project alone will not result in an adverse effect on ornithological habitat change.

The relevant plans and projects located within the Scapa Flow SPA that have the greatest potential to act in combination with the Project regarding habitat change include:

- Hatston Pier Expansion
- Hunda aquaculture site
- Lober salmon farm
- Bringhead aquaculture site
- Westerbister aquaculture site
- Toyness aquaculture site
- West Fara aquaculture site

Construction activities for the Hatston Pier expansion could result in a localised loss or modification of marine foraging habitat. However, this impact will be spatially restricted to the immediate vicinity of the pier and will affect only a minor, fractional proportion of the extensive foraging habitat available across the wider Scapa Flow SPA.

The identified aquaculture sites are included based on minor infrastructure variations to existing operations. Consequently, any associated ornithological habitat change or localised footprint modification will be negligible. Given the low exposure and localised nature of these changes, the resulting significance of effect on the red-throated diver qualifying feature of the Hoy SPA determined to be **minor** and **not significant** in EIA terms. Because the vast remainder of the SPA continues to provide extensive, high-capacity foraging, roosting, and commuting habitats for the qualifying species, these localised changes will not alter wider ecological connectivity or baseline habitat functions. Taking into consideration the mitigation measures applied across these other plans and developments, it is concluded that there **will be no adverse effect on site integrity** cumulatively with other plans and projects.

Conclusion

The avian qualifying features of the Hoy SPA maintain High baseline sensitivity. This high sensitivity ranking is driven by their statutory protection, specific nesting terrain requirements, and low tolerance thresholds for visual and acoustic disturbance during the breeding season.

Following a comprehensive review of all reasonably foreseeable plans, projects, and consented developments within the regional zone of influence, the cumulative impact magnitude across all identified environmental pathways is assessed as **Negligible**. The total additive spatial footprint of the combined developments is extremely restricted, and the regional baseline exhibits **no significant** overlapping development pressures. Furthermore, construction timelines do not coincide with other sensitive regional infrastructure works, ensuring that cumulative habitat loss, fragmentation, and displacement pressures remain negligible.

The significance of residual cumulative effects has been evaluated under the EIA Regulations. When high receptor sensitivity is cross-referenced against a negligible impact magnitude, the resulting effect is determined to be **Not Significant**. There are no additive or synergistic interactions identified that would elevate the risk to avian receptors, and all predicted residual cumulative effects are considered **minor** and **localised** in EIA terms.

5.6.6 Marine Mammals- Sanday SAC

The Sanday Special Area of Conservation (SAC) is located approximately 85 km from the Project site (at sea distance). Harbour seals (*Phoca vitulina*) typically exhibit localised foraging ranges of circa 50 km. Although historical telemetry data indicate that individuals from the Sanday population can wide-range between 20 km and 100 km, movements are predominantly constrained to the shorter end of this spectrum. Furthermore, targeted telemetry studies demonstrate negligible connectivity between tagged Sanday SAC individuals and the Project's zone of influence (Marine Scotland, 2016). Consequently, while the Project site is not considered a core foraging area for this designated population, the transient presence of SAC-associated individuals within the study area cannot be entirely discounted.

The Sanday SAC encompasses an area of 10,976.97 ha (109.76 km²) and is situated on a large, low-lying island in the north-east of the Orkney archipelago (NatureScot, 2025). The designated site features a complex coastline characterised by extensive sandy beaches, sheltered inlets, and exposed rocky headlands. Ecologically, the Sanday SAC supports the largest discrete colony of harbour seal (*Phoca vitulina*) in Scotland, with the associated nearshore kelp beds providing critical foraging habitat for this population (JNCC, 2021). The SAC is located approximately 36 km north-east of the Project site, which equates to an at-sea transit distance of circa 85 km.

The coastal waters of Sanday support the largest colony of harbour seal (*Phoca vitulina*) at any discrete site in Scotland, with historical records showing approximately 1,450 adults hauling out on intertidal reefs to pup, moult, and rest. This historically represented roughly 17% of the Orkney, 5% of the UK, and 2% of the EU populations for the species. During the 1998 baseline breeding survey, over 550 pups were recorded, accounting for 34% of newborn pups in Orkney (SCOS, 2024). While large breeding colonies are critical for maintaining regional population resilience and acting as sources of emigration, the current conservation status of the harbour seal feature at Sanday SAC is unfavourable, declining.

Trend analysis between 1997 and 2019 reveals a 95% population decline within the SAC, identifying it as one of the areas most severely impacted by the wider harbour seal declines documented across northern and eastern Scotland. The most recent comprehensive count in 2019 recorded just 77 individuals, representing approximately 5% of the North Coast and Orkney Seal Management Unit (SMU) (SCOS, 2024). This trend is mirrored across the wider Orkney region, which has experienced a circa 90% decline. Statutory conservation management advice indicates that the primary drivers of this decline are off-site pressures, including predation, interspecific competition for prey, reduced prey quality and availability, and biotoxin exposure from harmful algal blooms. Consequently, the drivers causing the unfavourable condition of the harbour seal feature operate outwith the SAC boundary.

Disturbance to prey species and habitats of prey species through increase in suspended sediment concentration (SSC) (construction phase only)

Elevated suspended sediment concentrations (SSC) resulting from construction-phase dredging activities have the potential to indirectly impact harbour seal. This pathway operates via localised modifications to the distribution, availability, or behaviour of target fish prey species.

Hydrodynamic modelling (Technical Appendix 4.1, Volume 3 of the EIAR; EnviroCentre, 2023) demonstrates that tidal currents within the dredge footprint are weak, generating only highly localised and short-lived sediment plumes. Given that the dredge material composition comprises approximately 17% gravel, 68% sand, and 15% silt and clay, the majority of the liberated sediment will settle rapidly out of the water column, limiting any meaningful dispersion of SSC beyond the immediate working area. Consequently, Section 8.3.3.1 of the EIAR (EnviroCentre, 2023) concluded that the magnitude of impacts from sediment discharge, dispersion, and changes to sediment transport on the coastal waters and benthic substrate of Scapa Flow will be **negligible**, following the implementation of the construction-phase mitigation measures presented in Section 5.7 and 11 of this SEIR and Section 7 of the HRA (Appendix A).

Proposed reclamation fill activities could also generate sediment plumes and elevated SSC, presenting a potential secondary pathway of impact for prey species. The fill material will comprise a mixture of locally quarried aggregates and coarser dredged sediment. The coarse grain size of this material, combined with the weak ambient tidal currents, will strictly limit the duration and spatial extent of any plume generated during the reclamation phase.

Chapter 5 of the EIAR (EnviroCentre, 2023) states that impacts on prey species will be temporary and spatially restricted (Section 5.6.3.1). The assessment confirmed the extensive availability of alternative foraging and commuting habitat outwith the Project boundary for individual harbour seals. Consequently, Section 5.6.3.1 and Table 5-9 of the EIAR concluded that indirect impacts on the Sanday SAC harbour seal population resulting from prey disturbance will be **not significant** during the construction phase.

Construction-phase impacts on fish species from underwater noise and pollution were assessed as being of **low magnitude** and **not significant** in the EIAR (EnviroCentre, 2023). This determination was based on the restricted spatial footprint which are confined to discrete zones adjacent to the dredging and reclamation areas, their short-term duration, intermittent nature, and high reversibility. Consequently, any secondary, indirect effects on foraging harbour seals via the prey pathway during construction will similarly be localised and **not-significant**.

As a precautionary measure during construction, a comprehensive turbidity monitoring program will be implemented to safeguard water quality and minimise broader environmental impacts. Monitoring sediment resuspension levels will prevent adverse effects on the localised marine ecosystem and regional aquaculture assets, where elevated SSC can induce physiological stress in caged fish due to restricted movement and impaired gill function. Real-time turbidity monitoring will enable the Project to track sediment dynamics and execute rapid corrective actions if established thresholds are exceeded. Furthermore, silt curtains will be deployed to contain fine sediments during reclamation works, minimising downstream plume dispersion and preventing secondary disturbance to marine mammal prey species.

Mitigation measures, including the deployment of silt booms and adherence to stringent dredging protocols, will effectively minimise localised sediment disturbance and prevent the subsequent release and wider dispersal of suspended plumes.

Conclusion

The magnitude of impact from elevated Suspended Sediment Concentrations (SSC) is classified as **negligible**, as any sediment increases will be highly localised and short-term in duration. The localised sediment plume will not extend into the wider marine foraging grounds utilised by harbour seals associated with the Sanday SAC, leaving supporting prey habitats outside the Project boundary entirely unaffected.

Given the high sensitivity of this Annex II marine mammal qualifying feature, a **negligible magnitude** of impact results in an environmental effect of **minor/negligible** significance, which is **not significant** in EIA terms. Based on the HRA (Appendix A) and the secured mitigation measures, there is no credible pathway by which SSC could cause a reduction in foraging efficiency or altered behaviour via indirect impacts on prey populations. It is therefore concluded that the predicted habitat and water quality impacts from the Project alone **will not result in an adverse effect on the integrity** of the Sanday SAC

Accidental Release of Pollutants (all phases)

Accidental chemical or hydrocarbon releases may occur due to spills from vessels or marine equipment, presenting a potential risk of adverse effects on Annex II marine mammal features. The potential pathway for accidental pollutant release arises from the following Project activities

- Vessel activity (fuel, oils, lubricants, hydraulic fluids);
- Refuelling, maintenance, and engine operation;
- Accidental spills of construction-related materials; and
- Loss of containment from plant, machinery, or storage facilities.

The primary pollution risk is associated with vessel and plant refuelling activities. Any accidental hydrocarbon spillage would result in localised degradation of water and sediment quality, inducing adverse toxicological effects on marine flora, fauna, and benthic substrates. Such releases present a direct risk to marine mammal receptors and their prey via the acute deterioration of the marine water environment.

The release of contaminated material during dredging operations is considered unlikely. Comprehensive sediment sampling and chemical analysis confirmed that no contaminants are present at concentrations exceeding thresholds that would adversely affect water quality or pose a toxicological hazard to marine biota (EnviroCentre, 2023 and 2024).

A suite of proposed mitigation measures will collectively minimise the risk of accidental pollutant releases. The Construction Environmental Management Document (CEMD), supported by dedicated Environmental Clerk of Works (EnvCoW) oversight, ensures that all site activities adhere to approved construction methodologies designed to prevent spills, manage hazardous substances safely, and maintain strict compliance with environmental commitments. Furthermore, the Pollution Incident Response Plan (PIRP) will define clear spill-response procedures, emergency contact protocols, and mandatory staff training to ensure rapid containment and mitigation of any incident. This framework is reinforced by the Pollution Prevention Plan (PPP)—which extends into the operational phase—incorporating robust control measures to effectively manage accidental spillages in the unlikely event of an occurrence.

The deployment of turbidity monitoring, silt booms, and controlled dredging protocols will actively mitigate sediment resuspension and prevent the mobilisation of contaminated materials, thereby preserving water quality and restricting pollutant dispersal. Furthermore, strict adherence to existing Ballast Water Management procedures will ensure compliant and controlled ballast operations, effectively mitigating the risk of unauthorised bio-pollution or chemical discharges. Best-practice

monitoring frameworks guarantee the early detection of any environmental changes resulting from localised contamination, facilitating immediate corrective action. Together, these integrated controls establish a robust environmental management framework that substantially reduces the likelihood, magnitude, and spatial extent of accidental pollutant releases during both the construction and operational phases.

In the unlikely event of a spill, residual pollutants would remain spatially localised to the immediate vicinity of the site due to prevailing hydrodynamic circulation patterns and the deployment of best-practice spill management protocols. Consequently, the accidental release of potential contaminants from Project vessels will be strictly controlled, with robust emergency response procedures in place to minimise the scale and extent of any environmental impacts should an incident occur.

Furthermore, there is extensive availability of alternative foraging and commuting habitat for individual harbour seals outwith the Project footprint. Any accidental release of potential contaminants from construction vessels will be strictly controlled, with robust emergency response methodologies in place to minimise the magnitude and spatial extent of environmental impacts should an occurrence take place.

Conclusion

Considering the robust mitigation measures outlined above, alongside the extensive availability of alternative foraging and commuting habitats outwith the Project footprint, the predicted operational and construction-phase impacts on the harbour seal receptor are concluded to be of **negligible magnitude**. Consequently, the overall effect on this marine mammal feature is determined to be **not significant** in EIA terms. It can therefore be concluded that the predicted impacts from the Project alone **will not result in an adverse effect on site integrity** for the Annex II qualifying feature of the Sanday SAC.

Acoustic Impacts (construction phase only)

Underwater noise generated during construction activities, specifically dredging, has the potential to cause auditory injury to the harbour seal qualifying feature of the Sanday SAC.

Underwater noise modelling (Technical Appendix 5.6; EnviroCentre, 2023) indicates that the risk of Permanent Threshold Shift (PTS) to harbour seals is restricted to within 50 metres of dredging activities. Auditory injury is therefore highly unlikely, as mobile seals will naturally avoid the immediate area before accumulating damaging exposure levels. While Temporary Threshold Shifts (TTS) could occur within 70 to 250 metres under prolonged exposure, the species' natural avoidance behaviour makes this scenario improbable. Consequently, impacts are limited to minor, short-range behavioural displacement, with normal activities expected to resume immediately upon the cessation of dredging (Section 5.6.8.1; EnviroCentre, 2023).

The baseline context of the Project site further reduces the potential for adverse effects, as it lacks critical breeding, mating, or resting habitat for harbour seals. The nearest designated haul-out site is located 4.5 km south at Selwick, and extensive alternative foraging habitat is available throughout the wider region. Furthermore, harbour seals frequently utilise busy commercial ports and display a degree of habituation to anthropogenic noise. Given this existing tolerance and the continuous, predictable nature of dredging sound, the receptor sensitivity to acoustic disturbance is low. Consequently, the magnitude of effect is minor, and the residual disturbance is assessed as not significant.

To ensure a conservative assessment in line with NatureScot consultation, a 5 km disturbance buffer was applied. Quantitative analysis indicates a theoretical maximum of 33 harbour seals could experience localised disturbance at any one time. This represents a worst-case overestimate, with actual exposure expected to be substantially lower. While some disturbed individuals could potentially originate from the Sanday SAC, any resulting impact would be negligible. This conclusion is supported by the localised spatial footprint, the short duration of the dredging activities, the significant geographic separation from

the SAC, and the demonstrated limited connectivity between the project site and the SAC qualifying features. Consequently, limited adverse effects on site integrity are anticipated.

A suite of embedded mitigation measures will manage the spatial and temporal execution of high-noise activities to minimise acoustic disturbance and eliminate injury risks to marine mammals. Precautionary monitoring will be maintained throughout the construction phase. Specifically, the deployment of trained Marine Mammal Observers (MMOs) and Environmental Clerks of Works (EnvCoWs) will ensure the early detection of harbour seals near dredging or terrestrial blasting operations. If a seal enters a defined mitigation zone, works will be delayed or suspended until the animal has voluntarily moved outside the area, preventing exposure to potentially harmful acoustic emissions.

Furthermore, the Marine Mammal Protection Plan (MMPP) (Appendix D) and Seal Protection Plan (SPP) (Appendix B) introduce robust safeguards, including localised noise-attenuation measures such as acoustic screens and physical bunding for terrestrial blasting. Complementary controls within the Vessel Management Plan (VMP) mandate transit corridors, vessel speed restrictions, and crew training in wildlife-sensitive operations to minimise vessel-related disturbance. Collectively, these management plans ensure that underwater noise is managed, monitored, and mitigated at source. This comprehensive approach significantly reduces the potential for both behavioural disturbance and auditory injury to the harbour seal population.

Acoustic emissions and air overpressure from terrestrial blasting activities during the construction phase have the potential to cause disturbance to seals on land. However, seals are highly unlikely to haul out within or immediately adjacent to the construction footprint, minimising the risk of direct exposure or injury. While blasting operations typically generate air overpressure levels of approximately 120 dB at the source, the received sound pressure levels at distance will attenuate naturally depending on local meteorological variables (such as wind vector, temperature inversions, cloud cover, and relative humidity). Given these attenuation factors and the rapid, transient nature of blast pressure waves, impacts on the harbour seal qualifying features of the Sanday SAC are considered unlikely.

To ensure robust mitigation, a 6-metre-high bund will be retained along the seaward boundary of the site during initial excavation. This feature will act as a natural acoustic screen, intercepting line-of-sight noise transmission from terrestrial blasting and general works until final site profiling is complete. Furthermore, supplementary engineering controls (Table 11.1), including localised acoustic screens and noise-dampening blankets, will be deployed during blasting events to further suppress sound propagation toward seals hauled out on land or resting at the water's surface.

Conclusion

Overall, while underwater and terrestrial acoustic emissions may cause temporary behavioural disturbance to a small number of individual seals, the **magnitude of impact** is classified as **negligible** due to its highly localised and short-term nature. Given the high sensitivity of the harbour seal feature, the resulting environmental effect is determined to be of **minor/negligible** significance and is **not significant** in EIA terms at the population level.

Acoustic impacts will be further minimised through the strict implementation of secured mitigation measures, including a MMO and a specialised dredging protocol committed to within the MMPP. Consequently, there is no credible pathway for acoustic disturbance to disrupt the long-term dynamics or distribution of the population. It is therefore concluded that the predicted acoustic impacts from the Project **will not result in an adverse effect on the integrity** of Sanday SAC.

Risk of Injury and Disturbance from Vessels (all phases)

Vessel movements during both the construction and operational phases have the potential to increase the risk of anthropogenic collisions with harbour seals

Acoustic and visual disturbance from increased vessel movements will be intermittent during both the construction and operational phases. Given the relatively minor projected increase in vessel traffic, harbour seals utilising the waters surrounding the Project site are anticipated to exhibit habituation due to the baseline commercial activity at Scapa Pier and wider oil industry-related transits within Scapa Flow. This tolerance is supported by empirical evidence; telemetry-based behavioural studies undertaken by the Sea Mammal Research Unit (SMRU) in the Moray Firth found that individual harbour seals demonstrated no apparent behavioural or avoidance responses to close-passing vessels (Onoufriou *et al.*, 2016).

Furthermore, the majority of project-related vessel movements will utilise established, shipping channels, including the main shipping lane extending west toward Stromness). The only area of increased vessel activity is restricted to a localised 2.9 km (1.6 NM) approach corridor leading from the primary shipping lane to the Project site (see HRA Appendix A (Appendix B: Bird Heat Maps and HiDef Data Combined with Construction Vessel Routes)). In the unlikely event that localised displacement occurs during peak construction or operational phases, extensive alternative foraging and commuting habitat is widely available throughout the wider marine environment, ensuring the ecological functionality of the population is maintained.

During the construction phase, a total of 112 vessel movements are projected over a 26-month period. This traffic comprises approximately 42 dredge disposal transits scheduled over a 12-week window (June–August 2028), alongside 70 movements for caisson delivery, installation, and scour protection. This represents a low frequency of additional maritime traffic relative to the project duration, with potential interactions highly localised along established shipping routes.

The risk of collision or vessel strike to the harbour seal population is assessed as negligible. Vessel strikes predominantly affect larger, less agile marine mammals; harbour seals are highly manoeuvrable and capable of active avoidance. While the larger displacement of project vessels increases their physical footprint, their consistent courses and low operational speeds present a lower risk of sudden disturbance or collision than smaller, erratic vessels. Because collision probability depends on vessel speed, animal behaviour, and vessel manoeuvrability, slower transit speeds provide sufficient reaction windows for both seals and operators to avert encounters. To formalise these controls, a Seal Protection Plan (SPP) will be implemented. The SPP establishes mandatory compliance protocols to minimise collision risk, including strict vessel speed restrictions and dedicated marine mammal watch parameters.

During the operational phase, vessels calling at the Project Quay is estimated at 96 vessels per year, generating 192 total vessel movements. This traffic comprises 28 large commercial vessels and 12 smaller vessels annually, accounting for 80 core vessel movements (arrival and departure). To support the 28 large vessels, will require two associated pilot vessel movements, In total, the estimated vessel movements per year is 192.

Seasonality data indicates that approximately 80% of operational traffic will occur during the summer months (April to September), introducing an average increase of 26 vessel movements per month. Winter traffic (October to March) will remain minimal, at approximately 6 movements per month. Mirroring the construction phase, the physical and acoustic effects of operational transit will be highly localised. Because the majority of vessel movements will utilise established routes, harbour seals are expected to exhibit localised avoidance or baseline habituation.

Within the immediate approach corridor to the Project site, the risk of collision or vessel strike is marginally elevated due to the introduction of new movements. However, the absolute volume of traffic remains exceptionally low, facilitating gradual habituation along this short spur over time. As collision risks depend on vessel speed, animal manoeuvrability, and operator reaction windows, the enforcement of mandatory low-speed transits under the operational Seal Protection Plan (SPP) will effectively prevent acute encounter risks. Consequently, in alignment with Section 5.6.8.2 of the original EIAR

(EnviroCentre, 2023), the sensitivity of harbour seals to operational vessel movements is classified as negligible, with no significant adverse effects anticipated.

Vessel movement protocols secured via adherence to the Vessel Management Plan, would further mitigate risk of vessel collision to harbour seals.

Conclusions

In conclusion, the risk of physical injury or acoustic disturbance to harbour seals from marine traffic is evaluated as minimal, with any potential behavioural effects restricted to a localised footprint. The introduction of Project-related vessels during both construction and operation represents an insubstantial increment relative to baseline shipping volumes.

The magnitude of impact from vessel movements is determined to be **negligible**. Given the sensitivity of the marine mammal feature, the resulting environmental effect is classified as **minor/negligible** and **not significant**. Consequently, when accounting for the secured mitigation measures within the MMPP, it is concluded that the predicted impacts from the Project alone **will not result in an adverse effect on the integrity** of Sanday SAC.

Cumulative Effects

With reference to Section 9.3.3 of the HRA (Appendix A), a number of plans and projects have been screened in for LSE on the harbour seal qualifying feature of Sanday SAC:

- Ayre Offshore Wind Farm;
- Westray Tidal Array (Orbital);
- Fall of Warness Tidal Test Site (European Marine Energy Centre; EMEC);
- Billia Croo Wave Test Site (EMEC);
- Mocean Deerness Wave Energy;
- SHEPD North Coast and Orkney regional cable surveys;
- Backaland Pier redevelopment, Eday;
- Scammalin Bay pier, Faray;
- Hatston Pier Expansion;
- Stronsay Harbour dredging;
- Hatston dredging; and
- Scammalin Bay (Faray) dredging.

Offshore Wind Developments

The Ayre Offshore Wind Farm is located within the 50 km foraging range of harbour seals from the Sanday Special Area of Conservation (SAC). While harbour seals in Orkney typically exhibit a predominantly coastal distribution, certain construction impacts, particularly underwater noise, can extend significantly beyond the development footprint. Consequently, a Likely Significant Effect (LSE) was identified for the harbour seal feature of the Sanday SAC.

The Ayre Wind Farm Report to Inform an Appropriate Assessment (RIAA) stated that the risk of auditory injury to Sanday SAC harbour seals can be fully mitigated. However, during construction, it is estimated that on any given day of piling, up to 81 harbour seals (representing 2.79% of the North Coast and Orkney population) could experience behavioural disturbance. Additionally, fewer than one harbour seal per day is predicted to experience disturbance from geophysical surveys, or Temporary Threshold Shift (TTS) from unexploded ordnance (UXO) clearance.

While underwater noise sources may cause temporary behavioural disturbance to individual seals, these effects will be localised, short-term, and not significant at the population level. The RIAA therefore

concluded that the Ayre Offshore Wind Farm poses no risk of an adverse effect on the integrity (AEOI) of the harbour seal feature of the Sanday SAC.

Pier and harbour developments

Three port infrastructure projects within the region have identified a LSE on the harbour seal qualifying feature of the Sanday Special Area of Conservation (SAC): the Backaland Pier, Scammalin Bay, and Hatston Pier Expansion developments. Port and harbour developments can adversely impact harbour seals, primarily through the propagation of high-amplitude impulsive underwater noise during construction activities.

While these underwater sound sources have the potential to cause auditory injury or behavioural displacement to individual marine mammals, these effects are predicted to be localised, short-term, and confined to the construction phase. The risk of Permanent Threshold Shift (PTS) or auditory injury is considered highly unlikely due to the elevated exposure thresholds required for phocid seals in water, combined with standard mitigation protocols.

Furthermore, individual harbour seals exhibit high ecological resilience to short-term behavioural disturbance, as they can readily avoid localised sound fields and temporarily relocate to alternative foraging grounds. Consequently, it is considered that temporary construction disturbances will not result in significant population-level effects, nor will they compromise the conservation objectives of the Sanday SAC.

Dredging Operations

A LSE on the harbour seal qualifying feature of the Sanday Special Area of Conservation (SAC) has been identified for three dredging campaigns (including licensed activities and pending applications): Stronsay Harbour, Hatston Pier, and Scammalin Bay. Dredging and subsequent disposal operations can adversely affect harbour seals, primarily via the emission of continuous, non-impulsive underwater noise.

Unlike impulsive construction noise, the acoustic profile of dredging operations means that auditory injury (Permanent Threshold Shift) is not a plausible impact pathway for marine mammals. While underwater sound emissions may induce behavioural disturbance or avoidance in a small number of individuals, these effects will be strictly localised, short-term, and confined to the active dredging and disposal windows.

Harbour seals exhibit high ecological resilience to temporary behavioural displacement of this nature. Individuals can readily navigate away from localised noise fields to exploit alternative foraging habitats within the wider Orkney area. Consequently, these temporary disturbances are predicted to have no significant effects at the population level, and there is no risk of an adverse effect on the integrity of the Sanday SAC from these operations.

Geophysical Surveys

A regional five-year plan for subsea cable route surveys, for Scottish Hydro Electric Power Distribution (SHEPD), has identified a LSE on the harbour seal qualifying feature of the Sanday SAC. This activity has undergone assessment regarding potential disturbance to European Protected Species (EPS; specifically cetaceans and otters), alongside its potential impacts on protected sites, including the Sanday SAC.

The primary impact pathway is localised underwater acoustic disturbance originating from geophysical survey equipment, most notably the use of sub-bottom profilers. Due to the highly transient and short-term duration of each individual cable corridor survey, combined with the intermittent nature of the overall campaign across the five-year period, the assessment concluded that acoustic emissions will not

result in an adverse effect on the integrity of the harbour seal feature of the Sanday SAC, either alone or cumulatively with other activities

Wave and Tidal Energy Developments

Four marine renewable energy developments have identified a LSE on the harbour seal qualifying feature of the Sanday SAC: the Fall of Warness Tidal Test Site, the Westray Tidal Array, the Bilia Croo Wave Test Site, and the Deerness Wave Energy Project. While there are no clear, significant impact pathways linking wave energy devices to adverse effects on harbour seals, the recent Section 36 consent variation application for the expansion of the Fall of Warness Tidal Test Site is notable. The application's assessments indicated potential for an Adverse Effect on Site Integrity (AEOI) regarding the harbour seal feature of the Sanday SAC.

Although the applicant argued that the scale of impact would be relatively minor, the conclusion of AEOI was driven by a conservative collision risk assessment (CRA) with recognised operational limitations. Consequently, the HRA for the Fall of Warness expansion required a derogation case for Sanday SAC, supported by a proposal for compensatory measures to offset the predicted tidal turbine collision risks.

While the Fall of Warness consent variation remains pending determination, it will only be granted if An appropriate compensation plan is agreed upon with the regulator and advisers. A similar approach applies to the Westray Tidal Array, which is preparing a Section 36 consent application for submission in late 2026. If consented, the Westray project will also require a formal derogation and compensatory measures to address potential collision risks to the Sanday SAC harbour seal population.

As a result, it is concluded that unless further evidence becomes available which reduces the predicted risk of collision from tidal turbines, both these tidal developments will require derogation from the Habitats Regulations, including the provision of compensatory measures, then their residual impacts will be reduced to zero when considered in combination with the Project.

Vessel Disturbance

The projects considered for the cumulative assessment of marine mammal features have the potential to generate increased vessel traffic during both their construction and operational phases. This elevated vessel activity may cause acoustic and visual disturbance to harbour seals (while marginally increasing the risk of vessel collision. Consequently, vessel-related impacts have been evaluated across all proposed developments.

However, vessel movements associated with those developments are generally expected to utilise established navigation routes and will be temporary and intermittent. Furthermore, these activities will occur within marine zones where harbour seals are already habituated to high baseline levels of anthropogenic vessel activity, including commercial shipping, inter-island ferry services, port operations, and oil and gas industry traffic. Additionally, because the identified plans and projects are at varying stages of the planning lifecycle, ranging from scoping and formal application through to consented or active status, it is highly improbable that peak construction and operational vessel campaigns will occur concurrently.

Given the negligible magnitude of the vessel traffic increase associated with the proposed SDWQ, the transient nature of traffic from other developments, and the availability of alternative habitats across Orkney waters, any cumulative disturbance effects will be temporary, spatially restricted, and reversible. Moreover, the implementation of project-specific Vessel Management Plans (VMPs) and associated best-practice mitigation, such as localised speed restrictions and wildlife-sensitive vessel operation protocols (e.g., the Scottish Marine Wildlife Watching Code), will further minimise disturbance and strike risks.

Therefore, when evaluated cumulatively with other relevant plans and projects, construction and operational vessel disturbance is not predicted to compromise the conservation objectives of the Sanday SAC harbour seal qualifying feature. It is concluded that vessel disturbance will not result in an adverse effect on the integrity of the Sanday SAC, either alone or cumulatively with other plans or projects.

Cumulative Effects Summary

Consequently, when considering the negligible cumulative interactions arising from SDWQ in combination with relevant offshore wind arrays, pier and harbour developments, maintenance dredging operations, and marine geophysical surveys, the **cumulative magnitude of impact** remains **negligible**. Given the high sensitivity of the harbour seal feature, the cumulative environmental effect is evaluated as **minor/negligible** and **not significant** under the EIA (Scotland) Regulations. It is concluded that the Project will not have a cumulative effect **and will not result in an adverse effect on the integrity** of Sanday SAC in combination with other plans or projects.

Furthermore, any future consented tidal energy developments will be subject to strict statutory requirements to implement legally binding compensatory measures addressing potential collision risks with tidal turbines. Because these mandatory obligations ensure that residual impacts from tidal projects are ecologically offset, effectively reducing their net contribution to zero within the statutory framework, they introduce no viable mechanism to alter this conclusion. Accordingly, it is confirmed that cumulatively, the overall integrity of the Sanday SAC and its supporting conservation objectives will be fully maintained.

5.6.7 Non European Site Marine Mammals: Activities Affecting Marine Mammals

Underwater Noise Producing Activities

The Marine Scotland 'Guidance for Scottish Inshore Waters: The Protection of Marine European Protected Species from Injury and Disturbance'[6] defines what disturbance means to cetaceans as: 'Changes in behaviour which may not appear detrimental in the short-term, but may have significant long-term consequences. Additionally the effects may be minor in isolation, but may become more significant in accumulation'. Disturbance may be identified via the following behaviour:

- Changes in (direction or speed of) swimming or diving behaviour;
- Bunching together or females shielding calves;
- Certain surface behaviours such as tail splashes and trumpet blows; and
- Moving out of a previously occupied area.

The following negative effects are linked to disturbance:

- Displacement from important feeding areas;
- Disruption of feeding;
- Disruption of social behaviours such as communication, calving, breeding, nursing, resting and feeding; and
- Increased risk of injury or mortality;
- Increased vulnerability of an individual or population to predators or physical stress; and
- Changes to regular migration pathways to avoid human interaction.

[6] https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2020/07/marine-european-protected-species-protection-from-injury-and-disturbance/documents/marine-european-protected-species-guidance-july-2020/marine-european-protected-species-guidance-july-2020/govscot%3Adocument/EPS%2Bguidance%2BJuly%2B2020.pdf

Underwater noise modelling was carried out to support the EIAR (Technical Appendix 5.6; EnviroCentre, 2023). Since the underwater noise modelling was undertaken, piling and associated drilling works have been removed from the design.

Dredging Method and Duration

Dredging for the project will involve a total of 379,407 m³ of material, comprising 72,653 m³ of hard dredge and 306,754 m³ of soft dredge, with up to 82,000 m³ of unsuitable glacial till potentially requiring sea disposal. A single dredge campaign is planned using a cutter suction dredger over an estimated twelve-week period from June to August 2028, covering the full quay alignment to depths of –15 m CD in most areas and –20 m CD in the deep pocket.

Dredged sediments will be pumped through a pipeline into a reclamation bund constructed to +4.0 m CD using screened site-won material, with an integrated weir box to manage overflow. Turbidity will be monitored outside the bund and silt booms deployed during infilling.

Increased vessel movement: Current Vessel Movements

The Project have provided information on the current typical monthly vessel movements experienced within the eastern area of Scapa Flow. This baseline is derived from the Project NRA (see Appendix 2.3 of EnviroCentre, 2025a). Baseline vessel activity in Scapa Flow is characterised by a high level of diverse maritime traffic year-round, with Automatic Identification System (AIS) data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow, closest to the Project site, current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents only ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

Vessel Movements During Construction

The construction phase will see a total of 112 vessel movements over the 26-month period. This includes: Caisson deliveries and tug operations; Scour protection trips; Caisson infill trips; and dredging disposal trips (barge to FI040).

Vessel movements during operation

There will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; see Technical Appendix 2.3 of EnviroCentre, 2024) this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

Cumulative Impacts

Other developments within Orkney are considered to have the potential to result in an in-combination effect for marine mammals. The developments that have been considered for the in-combination assessment are listed in Section 9.2.2 and 9.3.3 of the HRA (Appendix A).

Effects of Acoustic Impacts on Marine Mammals

The way in which noise affects marine mammals is dependent on several factors, including the type of noise generated, the noise level, the species of marine mammal and the distance between the animal and the source of the noise (Appendix D). The National Oceanic and Atmospheric Administration (NOAA) describes how different groups of marine mammals hear and are affected by sounds, which can be found in the *'Guidance for Assesing the Effects of Anthropogenic Sound on Marine Mammal Hearing'*[7]. The effects can be described as either a Permanent Threshold Shift (PTS), where an animal experiences irreversible damage to their hearing which can in turn affect their ability to forage and reproduce and in extreme circumstances result in death; or a Temporary Threshold Shift (TTS) which an animal can recover from, but may experience 'masking' which reduces its ability to communicate with other animals and locate prey, resulting in fatigue[8].

Cetaceans rely on their hearing for foraging, navigation and mating. The impact of noise to a population level is difficult to determine, however the expected impact on an individual animal's hearing ability and potential damage that could be caused by noisy activities during construction is assessed by modelling representative scenarios, taking into account environmental variables and the animal's hearing capabilities.

Two noise sources were considered for this assessment, but drilling was screened out as it was not considered loud enough to be meaningfully assessed in an environment with many vessels and general human activity. The underwater noise modelling provide a comparison of drilling noise with the other noise producing works and vessel noise which is depicted below (Figure 5-1).

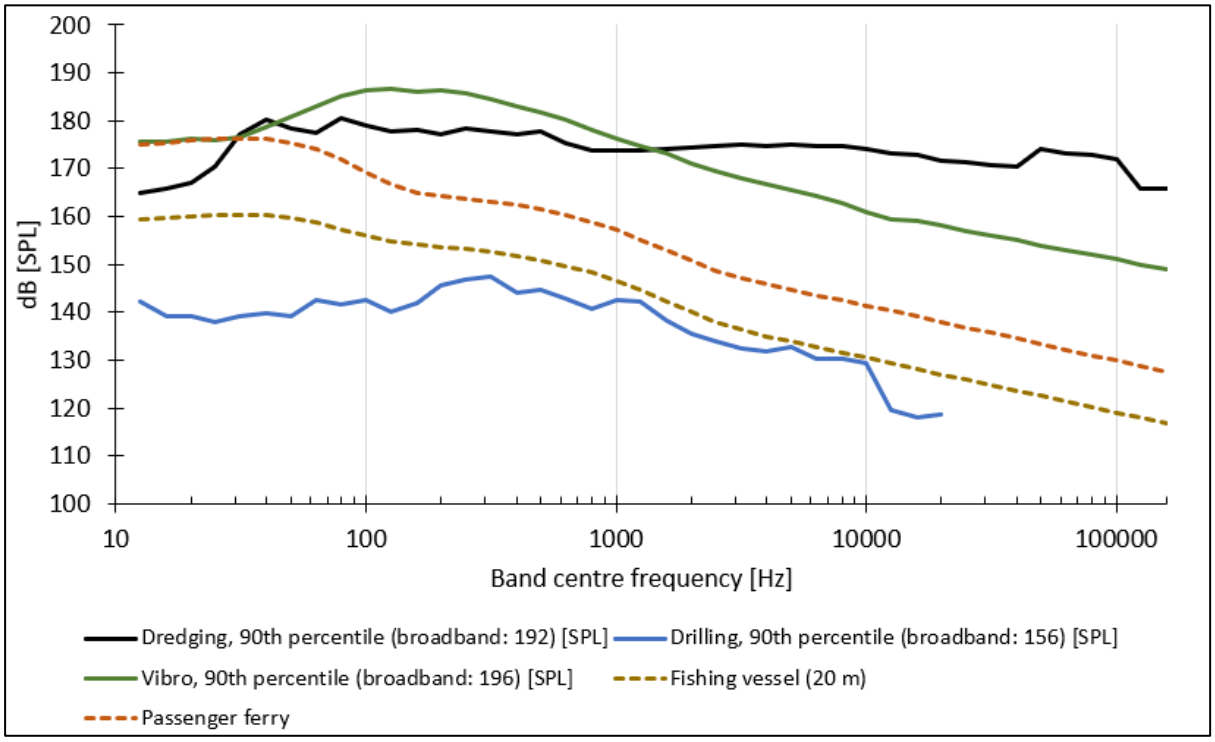


Figure 5-1: Underwater noise modelling showing the three sound sources considered in the report, alongside a fishing boat and a small ferry for context.

[7] NOAA guidance available at: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm (Accessed 07/06/2024)
[8] JNCC UK Marine Noise Registry: Information Document available at: https://jncc.gov.uk/resources/177d89a6-0f84-4eef-aefb-9fe6d781e7cd (Accessed 07/06/2026)

Dredging

The noise from dredging has short risk ranges for PTS for minke whale, fin whale and humpback whale (60 m) and killer whale, Risso's dolphin, common dolphin and pilot whales (<50 m) over an 8hr period and <50 m over 1hr period (Appendix D). TTS risk ranges for minke whale, fin whale and humpback whale are 1250 m and 160 m for killer whale, Risso's dolphin, common dolphin and pilot whales over an 8hr period, reducing to 230 m and 60 m respectively for 1hr period. Porpoises are at a PTS risk of 80m and TTS risk of 620 m, at close range, during short exposure (<1hr) and PTS risk of 210 m and TTS risk of 1350 m over 8hr period. Whilst dredging is being assumed to take place up to 24 hours a day, it is considered that any animals would move away from the noise source and so prolonged exposure is considered unlikely. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away.

Disposal of Dredged Materials

Following identification and screening of available disposal options by EnviroCentre[9], a combination of on land and at sea disposal were considered the most appropriate options. At sea disposal (within the disposal site) would only consist of material considered unsuitable for construction works i.e. material with high silt content. At sea disposal was considered as it would require minimal transportation requirements and low environmental risk. The selected licensed marine waste disposal site which has been 'open' since 2020, is located 24km from the proposed SDWQ development site. It has been agreed that disposal of any dredge arising, to sea, will take place out with the SPA (disposal site FI040).

Overall, the associated risk of degradation of water quality directly associated with the proposed disposal and thus impacts on marine mammals are considered to be low i.e., unlikely to cause a change in status of the waterbodies in question at both the dredge and disposal sites.

Comparisons of dredging sound for all activities associated with dredging (dredging itself, transit, placement, pumping and rainbowing – aerial discharge of dredged material in a fountain) for a 2,000ha harbour extension of the Port of Rotterdam using modelling revealed that rainbowing had the second lowest sound levels recorded out of all elements of the dredging activities (sediment consisted of sand)[10]. As such, with dredge noise levels for the SDWQ project having short risk ranges of PTS (80m) and TTS (620m), based on the modelling example, it could be assumed that disposal would have reduced risk ranges of noise output on marine mammals.

General Disturbance

Disturbance to marine mammals may occur as a result of the works occurring. The most likely disturbance to marine mammals as a result of the noise related activities include both physiological (increased stress and cortisol levels, rapid heartbeat and increased breathing rate) and behavioural disturbance (Changes in (direction or speed of) swimming or diving behaviour, bunching together or females shielding calves, surface tail splashes and trumpet blows and moving out of occupied area).

Underwater acoustic disturbance is anticipated to induce localised behavioural modifications in marine mammals. Individuals are expected to exhibit aversive displacement away from the sound source, accompanied by trumpet blows and splashing occurring and surface agitation. Concurrently, anthropogenic noise may trigger physiological stress responses. This could impact marine mammals energy and fitness levels through disturbing foraging or causing avoidance of feeding areas for periods of time.

[9] SDWQ BPEO Report Final – Rev2
[10] https://dredging.org/documents/ceda/html_page/2013-06-woda-technicalguidance-underwatersound_lr.pdf

Effects of Water quality in relation to dredging

Increases in suspended sediment concentration (SSC) arising from project dredging activities during construction have the potential to affect marine mammals indirectly by altering the availability or behaviour of their prey.

As outlined in section Technical Appendix 4.1, Volume 3 of the EIAR (EnviroCentre, 2023), the marine deposits within the dredge area comprise an approximate stratigraphic order of superficial marine deposits (loose to medium dense gravelly silty sands with shell fragments and occasional cobbles) overlying glacial till. A Dredging Best Practicable Environmental Option Report (BPEO) has been produced for the proposed SDWQ which identifies the dredge budget to consist of approximately 17% gravel, 60% sand, and 23% silt and clay.

Hydrodynamic modelling summarised in Technical Appendix 4.1, Volume 3 of the EIAR (EnviroCentre 2024) show little impact on the surrounding water column and seabed due to the low energy environment in this part of Scapa Flow. Therefore the EIAR (EnviroCentre, 2023) concluded that impacts on prey species for marine mammals are expected to be negligible such that their abundance and general distribution remains unchanged from the baseline. In addition, the magnitude or the sediment discharge and dispersion from dredging works will be low within the dredge area and its immediate vicinity, and negligible out with this area. Thus, the supporting habitats for marine mammals beyond the development footprint will be maintained.

Proposed reclamation fill activities could also result in plumes and increased SSC, with a resultant impact on prey species. The fill material will be a mixture of sediment locally generated by quarries and dredging, the coarse nature of which, in combination with locally weak tidal currents, will limit the duration and spread of any plume generated.

Chapter 5 of the EIAR (EnviroCentre, 2023) states that impact on prey species will be temporary and spatially restricted (Section 5.6.3.1 of EnviroCentre, 2023) and confirmed that there is sufficient alternative habitat for foraging and commuting for marine mammals.

Construction impacts to fish species, from underwater noise and pollution, was assessed as being of low magnitude and not significant in the EIAR (EnviroCentre, 2023), due to the limited spatial extent (i.e. restricted to discrete areas near the dredging and reclamation areas), the relatively short-term duration (as it is limited to the duration of the dredging activities), intermittent nature and high reversibility.

As a precautionary measure during construction, the project proposes to undertake turbidity monitoring to protect water quality and ensure minimal environmental impact. The project proposes to monitor sediment re-suspension levels to prevent damage to the local ecosystem and aquaculture as high sediment concentrations can contribute to suboptimal conditions and may harm aquaculture fish since it affects the overall ecological balance and the fish have restricted movement. By monitoring turbidity, the project can determine potential impacts on the environment and implement corrective actions. Furthermore, silt booms will be utilised to contain fine sediments while reclamation works are undertaken, to minimise the spread of sediments and thus disturbance to prey species in the marine environment.

Measures such as silt booms and careful dredging protocols will act to limit sediment disturbance and prevent the release and dispersal of sediments.

Any SSC increases will be confined to a very small spatial area and short-term duration and will not extend into wider foraging grounds used by marine mammals. The supporting habitats for prey species beyond the project site will therefore remain unaffected.

Overall, the associated risk of degradation of water quality directly associated with the proposed disposal and thus impacts on marine mammals are considered to be low i.e., unlikely to cause a change in status of the waterbodies in question at both the dredge and disposal sites.

Effects of Terrestrial Noise from Blasting

Disturbance of marine mammals whilst at the surface on land could be caused by noise associated from terrestrial blasting, which could have a negative impact on marine mammals (Appendix D).

Although the majority of energy generated within the atmosphere from any surface mineral blasting will be of a sub-audible nature, there will also be a component that is audible, i.e. at frequencies greater than 20 Hz, and as such can be heard as noise and measured in terms of dB(A).

Routine blasting operations regularly generate air overpressure levels at the closest point to blast area of around 120 dB and the National Marine Fisheries Service (NMFS) predicts that marine species exposed to ≥100 dB (in-air) will be behaviourally harassed[11]. However, the intensity of these noise levels experienced at a distance from the blast site are affected by a range of meteorological conditions (wind speed and direction, temperature, cloud cover and humidity). For example, if a blast is detonated in a motionless atmosphere in which the air temperature is constant, then the air overpressure intensity will decrease purely as a function of distance and will, once outside of the immediate vicinity of the blast, reduce by 6 dB as the distance from source doubles. Although such conditions are very rare, the overall result is that the nominal 6 dB reduction may be greater in some directions from the source and less in others.

A 6m high bund will be formed at the seaward boundary of the site by retaining the existing land and excavating behind, creating a natural noise screen from terrestrial blasting (and other works) and will only be removed once the site is excavated to the final profile. This would reduce the effects of noise on marine mammals at the water's surface. Furthermore, a 10-minute pre-work search is to be implemented to ensure that no marine mammals in the marine environment are in the vicinity of the works that could be impacted.

In addition to bunding, a range of other controls and mitigation measures can and should be implemented when undertaking terrestrial blasting, including screens to further dampen sound, which would also reduce the effects of noise on marine mammals at the water's surface.

Due to the reduction in noise doubling from the source of blast site, doubling incrementally, it will be unlikely that marine mammals would be negatively impacted to a population level from terrestrial noise associated with blasting.

Effects of Increased Vessel Movement

Vessel movements of approximately 42 vessel movements over a 12-week period (between June – August 2028) are expected for the dredge disposal for the Project. 70 vessel movements are expected for works associated with caisson delivery, scour protection and caisson installation. This equates to 112 vessel movements in total during construction, which is considered a relatively low number of vessel movements over the length of the period of works (26 months in total).

During the operational phase, the estimated number of vessels calling at the Project Quay in the operational phase is 96 per year (192 vessel movements), comprising 28 large vessels and 12 smaller vessels per year. Each of the 28 large vessels will have two associated pilot boat (2 vessel movements). In total, the estimated vessel movements per year is 192. The majority of these vessels (approximately

80 %) are expected to occur during the summer months (April – September), so there will be an increase of 26 vessel movements per month in summer and 6 per month in winter.

All vessels will follow designated shipping lanes, with the only area of increased vessel being the route of 2.9km (1.6 nautical miles) leading from the main shipping lane into the SDWQ.

Overall, there will be a small increase in the number of vessels in the SDWQ area, associated with the construction and operational phases of the project, with vessels mainly using existing shipping routes and the works are considered to be temporary in nature, however, more vessels increase the risk of collision with marine mammals, potentially resulting in death or injury to individuals.

The construction phase will require a variety of vessels that differ in size, speed and operating procedure. This can result in a wide range of marine mammal collision risk levels for different vessels and SDWQ development activities. Larger vessels have a greater footprint and therefore are more likely to make encounters with marine mammals than smaller vessels.

The likelihood of vessel collisions is dependent upon vessel speed, animal behaviour and vessel manoeuvrability[12]. Vessels travelling at slower speeds in general can allow time for marine mammals and vessel operators to react to avoid collisions.

In general, larger whales are considered to exhibit limited avoidance behaviours in close range to vessels. Minke whale may experience negative effects as a result of increased vessel movements, in part as the low frequency noise generated may interfere with their communication. Unlike some other species, minke whale are less able to adapt their vocalisations to adapt to increased background noise[13]. They are also less able to manoeuvre away from vessels to avoid vessel strike.

Humpback whales are considered to be vulnerable to vessel strikes throughout their range, with risks increasing in coastal areas with heavier ship traffic[14].

Harbour porpoises often live in the vicinity of vessel traffic and reactions by porpoises to various types of vessel showed only short-term negative effects from speedboats and large ferries in a study by the Sea Watch Foundation[15]. HWDC[16] indicate that as harbour porpoise are naturally shy of boats, they will for the most part avoid them, and so for most types of marine traffic the risk of collision is minimal. There is more potential for collision with fast-moving engine-powered vessels due to their speed and ability to change direction quickly and evidence of incidents where dead or stranded harbour porpoise have shown propeller damage evidence or massive trauma indicative of ship collision[17].

Risso's dolphins are rarely seen approaching vessels or bow-riding, suggesting that this species may actively avoid vessel traffic.

Killer whales are generally inquisitive and are observed approaching vessels, however, like other smaller cetaceans (white-beaked dolphin and pilot whales) they are fast, agile and manoeuvrable in water.

The increase in the number of vessels travelling through to SDWQ, during construction (including dredge disposal) and operation, would increase the risk of collision with marine EPS, potentially resulting

[12] SEER U.S. Offshore Wind Synthesis pf Environmental Effects Research: Presence of Vessels: Effects of Vessel Collision on Marine Life (2022): https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Effects-of-Vessel-Collision-on-Marine-Life.pdf

[13] Helble, T.A., Guazza R.A., Martin, C.R., Durbach, Alongi, G.C., Martin, S.W., Boyle, J.K. and Henderson, E.E (2020) Lombard effect: Minke whale boing call source levels vary with natural variations in ocean noise. The Journal of Acoustical Society of America Vol 147 (2).

[14] https://www.fisheries.noaa.gov/species/humpback-whale (Accessed 07/06/2024)

[15] Sea Watch Foundation: The Harbour Porpoise in UK Waters available at: http://seawatchfoundation.org.uk/wp-content/uploads/2012/07/Harbour_Porpoise.pdf (Accessed 07/06/2024)

[16] HWDC Harbour Porpoise information available at: https://hwdt.org/harbour-porpoise (Accessed 07/06/2024)

[17] http://ukmpa.marinebiodiversity.org/uk_sacs/activities/ports/ph3_2_2.htm

in death or injury to individuals, with larger species (minke whale and humpback whale) being more at risk.

However, the effects of these impacts from vessels will be highly localised around the established shipping routes. As the majority of the vessel routes will be using existing routes, marine mammals will likely already be habituated to vessels in those areas and/ or avoid the area already. In the area of increased vessel activity close to the project site, there is a greater likelihood of vessel collision with marine mammals, however, the vessel numbers in this area are very low, and over time, marine mammals would likely become habituated to vessels using this route. The MMPP will be adhered to during operation. This includes limits on vessel speed.

Vessel movement protocols secured via adherence to the Vessel Management Plan would further mitigate risk of vessel collision to marine mammals.

Overall, the risk of injury or disturbance from vessels is considered minimal, and any effects are expected to be highly localised. The introduction of project vessels during construction and operation is not considered to be a substantive increase to baseline vessel movements. As such, when considering the proposed mitigation measures, it can be concluded that the predicted impacts on marine mammals would be limited.

Cumulative Effects

Other developments within Orkney are considered to have the potential to result in an in-combination effect for marine mammals. The developments that have been considered for the in-combination assessment are listed in Section 9.2.2 and 9.3.3 of the HRA [July 2026]. Please refer to these sections where this is discussed further.

Conclusion

The assessment evaluated the potential impacts on marine mammals arising from dredging, vessel movements, and construction activities at the SDWQ development. Marine mammal receptors within the study area possess a **High sensitivity** due to their protected status and ecological vulnerability. Without mitigation, the proposed activities present risks of localised disturbance, auditory injury, or vessel collision to individual cetaceans. However, the spatial footprint of the disturbance is highly localised, and the duration of the construction and dredging phases is classified as **short-term** and **temporary**. Consequently, the magnitude of impact is determined to be **Low**. With the strict implementation of the Marine Mammal Mitigation Plan, the risk of physical injury or mortality is reduced to **negligible levels**. While **short-term**, temporary habitat avoidance will occur at an **individual level**, it will not adversely affect the Favourable Conservation Status of any regional population. Therefore, the residual effect of the proposed SDWQ on marine mammals is concluded to be **Not Significant**.

Mitigation

Mitigation in the form of a Marine Mammal Protection Plan (MMPP) will be implemented and will reduce the risk of injury as well as limit the potential disturbance. The MMPP includes a Marine Mammal Observer (MMO) protocol with an exclusion zone of 800m, Passive Acoustic Monitoring (PAM) and soft start construction methods.

Whilst mitigation will reduce the likelihood of impacts from underwater noise, and lessen the severity of the predicted effects, it won't be possible to completely avoid some level of disturbance to marine mammals which may be present in the area**. A derogation licence to permit disturbance from dredging of harbour porpoise, minke whale, humpback whale, fin whale, Risso's dolphin, white-beaked dolphin, short-beaked common dolphin, long-finned pilot whale and killer whale will be required for imperative reasons of overriding public interest.**

5.7 Mitigation and Monitoring

Table 11-1 outlines the Schedule of Mitigation the Project has committed to during both construction and operation phases. Those specifically related to this SEIR include:

- Adherence to a Construction Environnemental Management Document (CEMD)
- Use of an ECoW;
- Pollution Incident Response Plan;
- Turbidity Monitoring;
- Vessel Management Plan
- Use of a silt boom during construction;
- Ballast Water Management;
- Pollution Prevention Plan.
- Marine Mammal Protection Plan (MMPP)

5.8 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 5 of the EIAR (August 2024).

5.9 Summary and Conclusions

Potential effects of the proposed SDWQ on the qualifying interests of European designated sites were evaluated through a Habitats Regulations Appraisal (HRA). This appraisal was informed by a standalone Seal Risk Assessment, which is provided in **Appendix B)**

Likely Significant Effects (LSE) on the Scapa Flow, North Orkney, Orkney Mainland Moors, and Hoy Special Protection Areas (SPAs), as well as the Loch of Stenness and Sanday Special Areas of Conservation (SACs), could not be ruled out during the screening stage. Consequently, an Appropriate Assessment (AA) was conducted to evaluate whether the proposed works will adversely affect the integrity of these sites' qualifying features.

5.10 Statement of Significance

It was possible to rule out adverse effects from impacts to the assessed designated sites and qualifying features.
The HRA screening stage identified potential impact pathways to SPA bird species and the harbour seal a qualifying feature of the Sanday SAC. During construction, potential direct and indirect impacts include:

- **Disturbance:** Visual presence and noise, disrupting foraging or resting behaviour and disturbance during the flightless moult period.
- **Water Quality Pressures:** Accidental pollution incidents or increased sedimentation and turbidity, potentially reducing prey availability.
- **Direct Injury or Mortality:** Marine mammals (harbour seals) encountering risk from underwater noise or vessel collisions.

Mitigation and Residual Effects

Following a detailed appraisal, and assuming the strict implementation of specified mitigation measures, it is concluded that the proposed works will not result in an adverse effect on the integrity of any European site, nor will they negatively impact their qualifying features.

6 ARCHAEOLOGY AND CULTURAL HERITAGE

6.1 Introduction

This section assesses whether the amendments to the Proposed SDWQ require any updates to the conclusions of Chapter 6 of the EIAR (July 2023, updated August 2024) and the SEIR (May 2025, amended September 2025).

6.2 Updated Policy Context

There are no updates to policy context.

6.3 Consultee Comments

Historic Environment Scotland in their consultation response dated 24 July 2025, stated "*We understand that the disposal site shown on the plan below is in active use for the dumping of dredged material. We are not aware of any issues relating to the scheduled monument resulting from the previous use of this area for dredging disposal. This activity does not appear to have affected the survival of the monument or to have impacted significantly on its visible characteristics. The material to be deposited as a result of the deep water quay construction works is unlikely to differ greatly from that already deposited in this area. We therefore consider that the proposed use of this disposal area as part of the deep water quay development would not be likely to result in significant impacts or effects on cultural heritage assets within our remit.*

We are content to maintain our position that we have not identified any potentially significant impacts or effects on our cultural heritage interests from the proposed development and have no further comments to offer on the application."

OIC Planning, Islands Archaeologists within their consultee response dated stated *September 202*"*The 5 additional information for the proposed Scapa Deep Water Quay development 23/289/NATEIA contains no new information concerning the historic environment. Therefore I have no comments to make.*"

Defence Infrastructure Organisation Estates/ Safeguarding in their Response to MD Marine Licencing, dated 27 June, stated "*The MOD have no Safeguarding objections to this proposal however, with regards to HMS Royal Oak, we would like to ensure the applicant continues to take note of its protected status and will take account of any possible expansion of the exclusion zone that may shortly be designated*."

No other consultee comments were received, therefore, this section is considering only design changes.

6.4 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 6 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025).

6.5 Future Baseline

There are no updates to the future baseline conditions detailed in Chapter 6 of the EIAR (July 2023, updated August 2024) and the SEIR (May 2025, amended September 2025).

6.6 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 6 of the EIAR (July 2023, updated August 2024) and the SEIR (May 2025, amended September 2025).

Note: The wreck of HMS Royal Oak, located in Scapa Flow, is an official military war grave of national importance. The Ministry of Defence (MoD) has designated the wreck as a Controlled Site under The Protection of Military Remains Act 1986. Located approximately one kilometre west of Gaitnip Hill in Scapa Bay (Grid Ref 58°55.848′N. 02°59.001′W), the site's position is marked by a green channel buoy.

It is noted that The Protection of Military Remains Act 1986 (Designation of Vessels and Controlled Sites) Order 2026 extended the statutory exclusion zone around HNS Royal Oak from a 200 metre radius to a 350 metres radius on 30th March 2026 to prevent unauthorised disturbance and provide extra protection.

6.6.1 Dredge Plume Dispersion and Impact

As noted within Section 4.6.1 hydrodynamic modelling (Technical Appendix 4.1; EnviroCentre 2023, updated 2024) indicates that the physical impacts of dredging will be highly localised and short-term.

Due to weak ambient tidal currents and the predominantly coarse nature of the material, sands and gravels are predicted to settle immediately within the active dredge footprint. Conversely, finer silts and clays will disperse gradually, exhibiting a net northward transport path driven by the ebb tide.

Total Suspended Solids (TSS) concentrations will remain low, with peak elevated levels restricted to the immediate vicinity of the dredger. Consequently, prior to the implementation of mitigation measures, the magnitude of impact from sediment discharge and dispersion is classified as **low** within the immediate dredge area and **negligible** across the wider study area.

6.6.2 Construction

A Construction Environmental Management (CEM) Document will serve as the primary framework outlining environmental protocols for the construction of the SDWQ.

The purpose of this outline CEM Document is to guide the Orkney Islands Council Harbour Authority (OICHA) and their appointed contractors during the construction phase. It ensures that all commitments to mitigation, management, and monitoring presented in the Environmental Impact Assessment Report (EIAR), and subsequent Supplementary Environmental Information (SEI), are rigorously applied.

Because specific project design elements will only be finalised following contractor appointment, a fully detailed document is not practical at this stage. Instead, the outline provides the structural framework required to develop the final, detailed CEM Document. The final CEM Document will make provision to address any UXO that may be encountered whilst completing the proposed works.

As previously noted, HMS Royal Oak, an official military war grave of national importance, is located in Scapa Bay, approximately one kilometre west of Gaitnip Hill. Appendix I contains an indicative

Archaeology and Cultural Heritage Plan that the contractor will finalise prior to the commencement of works. During the construction process, the contractor will maintain direct communications with relevant stakeholders to provide advance notice of scheduled works that may affect sensitive heritage assets. Additionally, the contractor will ensure that any unearthed archaeological artefacts are immediately recorded and reported to the appropriate regulatory body in accordance with statutory requirements.

6.6.3 General Directions for the Ports and Harbours of Orkney

Orkney Islands Council Harbour Authority (OICHA) has published updated General Directions for the Ports and Harbours of Orkney (effective October 2025). These Directions establish the statutory navigational, operational, and reporting requirements for all vessels operating within Orkney's Harbour Authority areas. The primary objectives of these updated regulations are to mandate the safe and efficient movement of maritime traffic, enforce strict compliance with harbour authority bylaws, and safeguard the receiving marine environment.

For comprehensive operational compliance, the Directions must be read in conjunction with the Orkney Harbour Byelaws, Pilotage Directions, and active Local Notices to Mariners. Together, these documents constitute the core regulatory framework underpinning safe, effective, and compliant marine management across the region, reflecting an ongoing commitment to maintaining international standards of maritime safety and operational excellence throughout Orkney's ports and harbours.

6.7 Mitigation Measures

There are no updates to the mitigation measures detailed in Chapter 6 and Chapter 11 of the EIAR (July 2023 and updated in August 2024 and within the SEIR (May 2025).

6.8 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 6 of the EIAR ((July 2023, updated August 2024) and the SEIR (May 2025, amended September 2025).

6.9 Summary and Conclusions

There are no updates on the likely effects of the development on Archaeology and Cultural Heritage.

6.10 Statement of Significance

Based on the updated project description, the conclusions of the EIAR dated(July 2023, updated August 2024, and the SEIR (May 2025, amended September 2025) remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on Archaeology and Cultural Heritage continue to be assessed as not significant.

7 SEASCAPE, LANDSCAPE AND VISUAL IMPACT

7.1 Introduction

As noted in section 7.7 of the EnviroCentre 2025(a) SEIR there is little change to the effects identified in Chapter 7 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025).).

7.2 Updated Policy Context

There are no updates to policy context.

7.3 Consultee Reponses

There are no consultee responses to address.

7.4 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 7 of the EIAR (July 2023, updated in August 2024 and the May 2025 SEIR).

7.5 Future Baseline

There are no updates to the future baseline conditions detailed in Chapter 7 of the EIAR (July 2023, updated in August 2024 and the May 2025 SEIR).

7.6 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 7 of the EIAR (July 2023, updated in August 2024 and the May 2025 SEIR).

7.7 Mitigation Measures

There are no updates to the mitigation measures detailed in Chapter 7 and Chapter 11 of the EIAR (July 2023, updated in August 2024 and the May 2025 SEIR).

7.8 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 7 of the EIAR (July 2023, updated in August 2024 and the May 2025 SEIR).

7.9 Summary and Conclusions

There are no updates on the likely effects of the development on Seascape, Landscape and Visual Assessment .

7.10 Statement of Significance

Based on the updated project description, the conclusions of the EIAR dated July 2023 and updated in August 2024 and the May 2025 SEIR remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on the Seascape, Landscape and Visual Impact continue to be assessed as not significant.

8 SOCIO-ECONOMICS

8.1 Introduction

There are no consultee responses to address. As noted in section 8.7 of the May 2025 SEIR there is little change to the effects identified in Chapter 8 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025).

8.2 Updated Policy Context

There are no updates to policy context.

8.3 Consultee Responses

There are no consultee responses to address.

8.4 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 8 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

8.5 Future Baseline

There are no updates to the future baseline conditions detailed in Chapter 8 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

8.6 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 8 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

8.7 Mitigation Measures

There are no updates to the mitigation measures detailed in Chapter 8 and Chapter 11 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

8.8 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 8 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

8.9 Summary and Conclusions

There are no updates on the likely effects of the development on Socio-Economics.

8.10 Statement of Significance

Based on the updated project description, the conclusions of the 2024 EIAR remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on Socio-Economics continue to be assessed as not significant.

9 AIRBORNE NOISE

9.1 Introduction

There are no consultee responses to address. As noted in Section 9.2 of the SEIR dated May 2025, the NIA presents a reasonable worst-case scenario and any update based on the current design changes would not result in changes to the reported outcome of no adverse impacts at surrounding NSRs. Based on this, we discount the requirement for a revised Noise Impact Assessment (NIA).

9.2 Updated Policy Context

There are no updates to policy context.

9.3 Consultee Responses

In relation to Noise Disturbance, NatureScot responded in their consultee response dated 7th November 2026:

"We are content that no marine blasting is being proposed. Terrestrial blasting will occur once a week over 35 weeks and we welcome the mitigation measures outlined in the CEMD including a 500m disturbance impact zone to assess displacement of birds from noisy activities.

In relation to terrestrial blasting, the following sentence does not make it clear as to what distance 120db will drop to a level that will not fatally impact marine birds and at what starting distance noise levels will reduce by 6db.

However, routine blasting operations regularly generate air overpressure levels at the closest point to blast area of around 120 dB but the intensity of these noise levels experienced at a distance from the blast site are affected by a range of meteorological conditions (wind speed and direction, temperature, cloud cover and humidity) and in general reduce by 6 dB reduction as the distance from the source doubles, and that when sound waves pass a given position, the pressure of the air rises very rapidly then falls more slowly then returns to the ambient value after a number of oscillations.

We are however content that noise contour maps, the 6m bund and the above-water noise assessment has confirmed that there will be no adverse effect on site integrity from airborne noise.

No piling or drilling will be required for the mooring/anchoring of caissons and we can agree that any noise associated with this activity will not be significant.

9.4 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 9 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

9.5 Future Baseline

There are no updates to the future baseline conditions detailed in Chapter 9 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

9.6 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 9 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

9.7 Mitigation Measures

There are no updates to the mitigation measures detailed in Chapter 9 and Chapter 11 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

9.8 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 9 of the EIAR (July 2023 and updated in August 2024 and the May 2025 SEIR).

9.9 Summary and Conclusions

There are no updates on the likely effects of the development on airborne noise.

9.10 Statement of Significance

Based on the updated project description, the conclusions of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025) remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on airborne noise continue to be assessed as not significant.

10 SUPPORTING ASSESSMENTS

10.1 Accidents and Natural Disasters

10.1.1 Introduction

No consultee comments were received on this topic, therefore, this section is considering only design changes.

10.1.2 Updated Policy Context

There are no updates to policy context.

10.1.3 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 10.1 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025)).

10.1.4 Future Baseline

There are no updates to the future baseline conditions detailed in Chapter 10.1 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025)).

10.1.5 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 10.1 of the EIAR July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025)).

10.1.6 Mitigation Measures

There are no updates to the mitigation measures detailed in Chapter 10.1 and Chapter 11 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025)).

10.1.7 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 10.1 of the EIAR July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025)).

10.1.8 Summary and Conclusions

There are no updates on the likely effects of the development on accidents and natural disasters.

10.1.9 Statement of Significance

Based on the updated project description, the conclusions of the 2024 EIAR remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on Accidents and Natural Disasters continue to be assessed as not significant.

10.2 Air Quality

No consultee comments were received on this topic, therefore, this section is considering only design changes.

10.2.1 Updated Policy Context

There are no updates to policy context.

10.2.2 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 10.2 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025))).

10.2.3 Future Baseline

As noted within Section 10.2 Air Quality of the EIAR (July 2023 and updated in August 2024), there are no Air Quality Management Areas (AQMAs) within the surrounding area. The Department for Environment, Food and Rural Affairs (DEFRA) air quality monitoring archive confirms the air quality estimated background concentrations are well below relevant air quality objectives indicating good local air quality with no exceedances of the national air quality objectives.

Based on the amended project design i.e. installation of caissons as opposed to the exemplar design, the findings within Section 10.2 of the EIAR July 2023, updated August 2024 and the SEIR (May 2025) remain valid and it is not anticipated to affect the future baseline.

10.2.4 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 10.2 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025, amended September 2025)).

10.2.5 Mitigation Measures

There are no updates to the mitigation measures detailed in Chapter 10.2 and Chapter 11 of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025).

10.2.6 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 10.2 of the EIAR July 2023, updated August 2024 and the SEIR (May 2025).

10.2.7 Summary and Conclusions

There are no updates on the likely effects of the development on air quality.

10.2.8 Statement of Significance

Based on the updated project description, the conclusions of the EIAR (July 2023, updated August 2024 and the SEIR (May 2025) remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on Air Quality continue to be assessed as not significant.

10.3 Carbon, Climate Change and Greenhouse Gas Emissions Assessment

No consultee comments were received for this topic, therefore, this section is considering only design changes.

10.3.1 Updated Policy Context

There are no updates to policy context.

10.3.2 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 10.3 of the EIAR (July 2023, updated in August 2024 and Supplemental Environmental Information Report, May 2025).

10.3.3 Future Baseline

There are no updates to the future baseline conditions detailed in Chapter 10.3 of the EIAR (July 2023, updated in August 2024 and Supplemental Environmental Information Report, May 2025).

10.3.4 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 10.3 of the EIAR (July 2023, updated in August 2024 and Supplemental Environmental Information Report, May 2025).

10.3.5 Mitigation Measures

There are no updates to the mitigation measures detailed in Chapter 10.3 of the EIAR (July 2023, updated in August 2024 and Supplemental Environmental Information Report, May 2025).

10.3.6 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 10.3 of the EIAR (July 2023, updated in August 2024 and SEIR (May 2025).

10.3.7 Summary and Conclusions

There are no updates on the likely effects of the development on Carbon, Climate Change and Greenhouse Gas Emissions Assessment

10.3.8 Statement of Significance

Based on the updated project description, the conclusions of the 2024 EIAR remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on Carbon, Climate Change and Greenhouse Gas Emissions Assessment continue to be assessed as not significant.

10.4 Transport – Aviation

No consultee comments were received for this topic, therefore, this section is considering only design changes

10.4.1 Updated Policy Context

There are no updates to policy context.

10.4.2 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 10.4 of the EIAR (July 2023 and updated in August 2024).

10.4.3 Future Baseline

There are no updates to the future baseline conditions detailed in Chapter 10.4 of the EIAR (July 2023 and updated in August 2024).

10.4.4 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 10.4 of the EIAR (July 2023 and updated in August 2024).

10.4.5 Mitigation Measures

There are no updates to the mitigation measures detailed in Chapter 10.4 and Chapter 11 of the EIAR (July 2023 and updated in August 2024).

10.4.6 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 10.4 of the EIAR (July 2023 and updated in August 2024).

10.4.7 Summary and Conclusions

There are no updates on the likely effects of the development on Transport – Aviation

10.4.8 Statement of Significance

Based on the updated project description, the conclusions of the 2024 EIAR remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on Transport – Aviation continue to be assessed as not significant.

10.5 Transport – Roads

No consultee comments were received for this topic, therefore, this section is considering only design changes.

10.5.1 Updated Policy Context

There are no updates to policy context.

10.5.2 Updated Baseline Conditions

There are no updates to the baseline conditions detailed in Chapter 10.5 of the EIAR ((July 2023, updated in August 2024 and SEIR (May 2025)) as a result of the change from the exemplar design to the caisson design.

10.5.3 Future Baseline

It is unknown at present how many vehicle trips will be associated with SDWQ once operational.

10.5.4 Updated Potential Effects

There are no updates to the potential effects detailed in Chapter 10.5 of the EIAR (July 2023, updated in August 2024 and SEIR (May 2025) as a result of the change from the exemplar design to the caisson design.

10.5.5 Updated Residual Effects

There are no updates to the residual effects detailed in Chapter 10.4 of the EIAR (July 2023, updated in August 2024 and SEIR (May 2025).

10.5.6 Summary and Conclusions

There are no updates to the likely effects of the development on Transport – Roads.

10.5.7 Statement of Significance

Based on the updated project description, the conclusions of the EIAR (July 2023, updated in August 2024 and SEIR (May 2025)) remain valid. There is no change to the previously stated significance levels, and the overall effects of the proposed SDWQ on Transport – Roads continue to be assessed as not significant.

11 SCHEDULE OF MITIGATION

The change from the exemplar design is a construction method variation, with the use of caisson structures instead of a piled quay. The Schedule of Mitigation within the August 2024 EIA Report has been updated to reflect this change.

Table 11-1: Schedule of Mitigation

Feature / Topic	Mitigation
Construction	
Construction Environmental Management Document (CEMD)	A CEMD will be developed and adhered to, to ensure that the mitigation measures outlined in the EIAR, HRA Report and Project consents are followed during the proposed construction works. The CEMD will be developed as a practical tool to facilitate the management of environmental mitigation measures and to provide a clear roadmap of the key roles and responsibilities during construction. All mitigation measures will be incorporated into the CEMD, which will include detailed Construction Method Statements (CMS). A Biosecurity Plan will be produced as part of the CEMD, which will set out the measures to prevent the introduction of invasive non-native species, in accordance with relevant legislation and best practice. An Outline CEMD has been produced (see Appendix I of the SEIR May 2025) and will be developed once a contractor has been appointed. The CEMD will remain a live document and will be updated as the work progresses.
Environmental Clerk of Works (ECoW)	An ECoW will monitor the construction works to ensure that the CEMD and associated mitigation measures are implemented effectively.
Pollution Incident Response Plan	A Pollution Incident Response Plan will be developed relating to the construction of the Project site, identifying statutory requirements and areas of highest sensitivity. This will provide site spill response procedures, emergency contact details, and equipment inventories and their location. All staff will be made aware of this document and its content during site induction. A copy will be available in the site office(s) at all times.
Turbidity Monitoring	As a precautionary measure, turbidity monitoring will be undertaken to protect water quality and ensure minimal environmental impact. Details of the monitoring, including threshold levels, will be set out in the CEMD.
Vessel Management Plan	A Vessel Management Plans will be developed and adhered to for the construction and operational phases, with input from NatureScot, to avoid disturbance to and/or collision with birds and marine mammals. Plans will include vessel routes, speed limits and safe vessel operation, and will incorporate advice from the Scottish Marine Wildlife Watching Code, including: • Keep a safe distance from marine mammals. Never get closer than 100m (200m if another boat is present), but if within 100m, switch the engine to neutral; • Never drive head on to, or move between, scatter or separate marine mammals. If unsure of their movements, simply stop and put the engine into neutral; • Spend no longer than 15 minutes near the animals; • Special care must be taken with mothers and young; • Maintain a steady direction and a slow ‘no wake’ speed; • Avoid sudden changes in speed; and • Consider training courses such as the WiSe scheme
Ballast Water Management	• A Ballast Water Management Plan will be developed and adhered to, incorporating industry standard ballast water management practices. • The Plan will include the continuation of OICHA’s biosecurity monitoring programme, as detailed in the existing Ballast Water Management Policy.
Silt boom	A silt boom will be used to contain fine sediments if any open water reclamation work activities are undertaken.
Marine Mammal Protection Plan (MMPP)	An Outline MMPP has been developed Appendix D of this SEIR (July 2026) and will be developed once a contractor has been appointed. An Outline Seal Protection Plan (SPP) has also been produced (see SEIR Appendix B July 2026) and will be developed once a contractor has been appointed. This will include: • Safe vessel operation to minimise risk of collision with marine mammals (and basking shark) including adherence to the Scottish Marine Wildlife Watching Code, will be promoted to users (see also Vessel Management Plans above). • A 6 m high bund will be formed at the seaward boundary of the site by retaining the existing land and excavating behind, creating a natural noise screen from terrestrial blasting (and other works) and will only be removed once the site is excavated to the final profile.
Construction and Operation & Maintenance	
Pollution Prevention Plan	Part of the CEMD will include pollution prevention measures (e.g., Pollution Prevention Plan) that will be in place during construction will include measures to deal with accidental spillages.

Vessel Management Plan	A Vessel Management Plans will be developed and adhered to for the construction and operational phases, with input from NatureScot, to avoid disturbance to and/or collision with birds and marine mammals. Plans will include vessel routes, speed limits and safe vessel operation, and will incorporate advice from the Scottish Marine Wildlife Watching Code[18], including: • Keep a safe distance from marine mammals. Never get closer than 100m (200m if another boat is present), but if within 100m, switch the engine to neutral; • Never drive head on to, or move between, scatter or separate marine mammals. If unsure of their movements, simply stop and put the engine into neutral; • Spend no longer than 15 minutes near the animals; • Special care must be taken with mothers and young; • Maintain a steady direction and a slow 'no wake' speed; • Avoid sudden changes in speed; and • Consider training courses such as the WiSe scheme[19].

[18] https://www.nature.scot/doc/scottish-marine-wildlife-watching-code-smwwc
[19] Information available at: https://www.wisescheme.org/

12 SUMMARY OF RESIDUAL EFFECTS

The additional information provided in this SEI Report (July 2026) incorporates consideration of the change from the exemplar design to the use of caisson structures instead of a piled quay and addressing consultee comments.

The conclusions reached within this SEI Report (July 2026) are consistent with those identified within the EIA Report (August 2024 and May 2025 SEIR).

The table below details the residual effects of the proposed SDWQ after the mitigation measures outlined in the Schedule of Mitigation have been applied.

Topics	Construction Phase Impacts	Operational Phase Impacts
Water Environment	Not Significant	Not Significant
Biodiversity	Not Significant	Not Significant
Archaeology and Cultural Heritage	Not Significant	Not Significant
Seascape, Landscape and Visual	Significant	Significant
Socio-Economics	Not Significant	Not Significant
Airborne Noise	Not Significant	Not Significant
Topics Not Requiring Full EIA	Not Significant	Not Significant

13 CUMULATIVE EFFECTS

13.1 Introduction

This section identifies whether any updates or modifications require consideration regarding the cumulative impact assessment and the subsequent summary of mitigation and monitoring established in the July 2023 and August 2024 Environmental Impact Assessment Reports (EIAR).

The original EIAR submissions evaluated the potential for cumulative effects by assessing the Proposed SDWQ alongside other reasonably foreseeable proposals within the surrounding area, as detailed in Section 3.7.4 of those reports. The cumulative schemes identified by Orkney Islands Council (OIC) in Appendix 2 of their Scoping Opinion (see Technical Appendix 3.2, Volume 3 of the EIAR) are presented in Table 13-1, alongside additional developments identified through direct consultation with OIC.

The Marine Directorate Licensing Operations Team (MD-LOT) did not specify a standalone list of projects, but mandated that a cumulative assessment be incorporated into the Habitats Regulations Appraisal (HRA).

Table 13-1: Cumulative Schemes for Consideration in the EIAR (Council Recommendations)

Planning Ref	Address	Description of Development	Status
23/256/NATEIA	Hatston Ferry Terminal	Construct a 300 metre pier extension, reclaim land to create a 7.5 hectare laydown area including rock armour, construct a ship lift, linkspan, fuel supply infrastructure, water storage tanks, roads and vehicle parking and associated infrastructure	Planning and marine license applications being submitted in August 2024.
24/279/WL	Scapa Flow Test Site, Orkney	Operation of a renewable technology deployment and test site (no permanent construction).	Application Refused
22/250/MARCON	Westerbister, Scapa Flow	Marine licence request to undertake works below the Mean High Water Springs (MHWS) level.	Renewal of an existing licence with no changes
20/037/TPPMAJ	Quanterness (Land Near), St Ola, Orkney.	Erection of 6 wind turbines (maximum height 149.9 metres, maximum capacity 50MW), a meteorological mast (maximum height 90 metres), a substation, access tracks, and associated infrastructure.	Consent issued December 2021. The proposed development would be located on land approximately 2.7 kilometres north-west of Kirkwall town centre, on Orkney's mainland. Limited potential for cumulative impacts.

			The cumulative assessment concludes the project will not cause an Adverse Effect on Site Integrity (AESI) for the North Orkney Special Protection Area (SPA), as potential disturbances will not create significant barriers to movement or reduce access to foraging habitats. Cumulative impacts are deemed minor relative to available habitat, with any distributional changes remaining within natural variability.
20/313/TPPMAJ	Lyness (land near), Hoy, Orkney	Erection of 6 wind turbines (maximum height 149.9 metres, maximum capacity 50MW), a meteorological mast (maximum height 90 metres), a substation, access tracks, a water crossing, underground cabling, a borrow pit, and associated infrastructure.	Consent issued December 2021; The windfarm would be located on land approximately 1.3km west of the settlement of Lyness, which is towards the south eastern end of the island of Hoy. Limited potential for cumulative impacts. The Hoy SPA is located is located approximately 16.5 km west of the proposed SDWQ site. Cumulative disturbance will not create significant barriers or continuously reduce access to preferred foraging, roosting, or prey habitats. The combined zones of disturbance are small relative to the extensive alternative habitats available within the foraging range of the SPA's bird species. Evidence indicates that the areas affected by port operations are not disproportionately important for prey availability. Any increase in energy expenditure or reduction in bird body condition will be short-lived and negligible, as displaced birds can

			easily resume foraging nearby. Any changes in seabird distribution will remain well within the limits of natural regional variability.
20/239/SCR	Scapa Pier, Scapa, Orkney.	Screening opinion request to extend a pier and reclaim land to create laydown and operational area and slipway.	Screening opinion adopted 19/03/21. Project subsequently withdrawn; excluded from further assessment.
15/409/MAR	Scapa Flow, Near Tongue of Westerbister, Holm.	Creation of a salmon farming site comprising 16 x 100m circumference cages (2 x 8 configuration in a 60m grid) and a feed barge.	Approved 10/02/16

13.2 Methodology and Screening Criteria

Because the Proposed SDWQ has the potential to result in cumulative effects on the qualifying interests of European protected sites, additional sites were integrated into the assessment. The short-listed plans and projects evaluated within the cumulative assessment are detailed in Table 5-2, which was derived from a comprehensive long-list provided in Appendix A (Appendix E In-combination Projects Long-List).

The assessment distinguishes between two types of interactive impacts:

- **Cumulative Effects:** Impacts accruing over time and space, considering the Proposed SDWQ alongside other reasonably foreseeable projects with active planning submissions within a defined geographical scope.

- **Combined Effects:** Multiple, distinct impacts originating from the Proposed SDWQ alone acting upon a single receptor to create a greater overall effect (such as the simultaneous noise and visual disturbance impacts on birds during construction).

To ensure a robust assessment, a comprehensive search of both the MD-LOT application portal and the OIC planning portal was conducted. The following screening criteria were applied:

- **Aquaculture Sites:** All aquaculture sites within the Scapa Flow Special Protection Area (SPA) with active Marine Licence or planning applications submitted post-designation of the SPA were automatically screened in.

- **Other Developments:** A baseline search for other development types submitted since 2022 was conducted across both portals. Projects were screened out if they lacked specific impact data regarding SPA qualifying features, or if they were confirmed as completed (e.g., where the associated marine licence had expired).

Overlapping construction and operational timelines were evaluated where they did not already form part of the established environmental baseline. For instance, where vessel movements from neighbouring developments were already captured within the operational vessel estimates for the Proposed SDWQ, these were screened out to avoid double-counting.

13.3 Summary and Conclusions

As established within the technical assessments, the magnitude of all potential impact pathways on ornithological features is considered **negligible**. Consequently, **no significant cumulative effects** are anticipated on any qualifying features of the European Sites or Marine Mammals.

Furthermore, any future consented tidal energy developments will be subject to strict statutory requirements to implement legally binding compensatory measures addressing potential collision risks with tidal turbines. Because these mandatory obligations ensure that residual impacts from tidal projects are ecologically offset, effectively reducing their net contribution to zero within the statutory framework, they introduce no viable mechanism to alter this conclusion. Accordingly, it is confirmed that the overall cumulative integrity of qualifying features of the European Sites and marine mammal populations will be maintained.

REFERENCES

BTO. (2026). BirdFacts Black-throated diver: profiles of birds occurring in the United Kingdom. BTO, Thetford. www.bto.org/birdfacts

Dierschke, V., Furness, R.W., Gray, C.E., Petersen, I.K., Schmutz, J., Zydelis, R. & Daunt, F. 2017. Possible Behavioural, Energetic and Demographic Effects of Displacement of Red- throated Divers. JNCC Report No. 605. JNCC, Peterborough.

EnviroCentre (2023). Scapa Deep Water Quay. Volume 1: Environmental Impact Assessment. Available at : https://marine.gov.scot/?q=node/24419

EnviroCentre (2024). Scapa Deep Water Quay. Additional Information. Available at : https://marine.gov.scot/?q=node/25697

EnviroCentre (2025(a). Scapa Deep Water Quay. Supplementary Environmental Information Report – May 2025. Available at: https://marine.gov.scot/?q=data/additional-information-2025-scapa-deep-water-quay

EnviroCentre (2025(b). Scapa Deep Water Quay. Supplementary Environmental Information Report – October 2025. Available at : https://marine.gov.scot/?q=node/26879

Furness, R. W., Wade, H. M., Robbins, A. M. C., Masden, E. A. (2012). Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. - ICES Journal of Marine Science, 69: 1466-1479.

Gittings, I. et al. Disturbance response of Great Northern Divers Gavia immer to boat traffic in Inner Galway Bay. Irish Birds 10: 163–166 (2015)

Goodship, N.M. and Furness, R.W. (2022). Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species. NatureScot Research Report 1283.

Institute of Estuarine and Coastal Studies, University of Hull. (2013). Available at: https://gat04-live-1517c8a4486c41609369c68f30c8-aa81074.divio-media.org/filer_public/8f/bd/8fbdd7e9-ea6f-4474-869f-ec1e68a9c809/11367.pdf

Jarrett, A S C P Cook, I Woodward, K Ross, C Horswill, D Dadam and E M Humphreys. (2018) . Short-Term Behavioural Responses of Wintering Waterbirds to Marine Activity: Quantifying the Sensitivity of Waterbird Species during the Non-Breeding Season to Marine Activities in Orkney and the Western Isles. Scottish Marine and Freshwater Science Vol 7 No 9, 88pp. DOI: 10.7489/12096-1

JNCC (2003–2013), Red-throated diver marine SPA identification: data collection and analysis. Joint Nature Conservation Committee, Open Data. Available at: https://data.jncc.gov.uk/data/4bf39157-852c-4a27-87eb-fb44e6f55b32/sas-identification-breeding-red-throated-divers.pdf

JNCC. (2021). Sanday SAC. https://sac.jncc.gov.uk/site/UK0030069

Marine Scotland (2016) Fine-scale harbour seal at-sea usage mapping around Orkney and the North coast of Scotland Scottish Marine and Freshwater Science Vol 7 No 27, available at: https://data.marine.gov.scot/sites/default/files/SMFS%200727_0.pdf

NatureScot (2022). Scapa Flow SPA – Conservation and Management Advice. Available at: https://www.nature.scot/sites/default/files/special-protection-area/10510/conservation-and-management-advice.pdf

NatureScot (2022b). North Orkney SPA – Conservation and Management Advice. Available at: https://www.nature.scot/sites/default/files/special-protection-area/10481/conservation-and-management-advice.pdf

NatureScot (2023c). Guidance Note 4: Guidance to Support Offshore Wind Applications: Ornithology - Determining Connectivity of Marine Birds with Marine Special Protection Areas and Breeding Seabirds from Colony SPAs in the Non-Breeding Season. Available at: https://www.nature.scot/doc/guidance-note-4-guidance-support-offshore-wind-applications-ornithology-determining-connectivity

NatureScot (2025). Sanday SAC – Conservation and Management Advice. Available at: https://www.nature.scot/sites/default/files/special-area-conservation/8372/conservation-and-management-advice.pdf

NBN Atlas (2026). Available at: https://nbnatlas.org/

Onoufriou, J., Jones, E., Hastie, G. and Thompson, D. (2016) Investigations into the interactions between harbour seals (*Phoca vitulina*) and vessels in the inner Moray Firth. Scottish Marine and Freshwater Science Report, 7(24). Marine Scotland Science. https://doi.org/10.7489/1805-1

Peters-Grundy, R., Thompson, K., Humphries, G., Harvey, J., Semple, M., Tyler, K., Harker, A.J., Pavat, D., Thomson, R., Olley, N. and Macleod, K. (2026). Scapa Flow and North Orkney Special Protection Areas (SPAs) - Inshore wintering waterfowl surveys 2021/22 and 2022/2023. Report for NatureScot

SCOS (2024). Scientific Advice on Matters Related to the Management of Seal Populations: 2024. Natural Environment Research Council. Available at: https://www.smru.st-andrews.ac.uk/files/2025/05/SCOS-2024.pdf

Schwemmer P., Mendel B., Sonntag N, Dierschke V and Garthe S. (2011). Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21: 1851-1860.

Woodward, I., Thaxter, C.B., Owen, E. & Cook, A.S.C.P. 2019. Desk-based revision of seabird foraging ranges used for HRA screening. BTO Research Report 724: British Trust for Ornithology, Thetford

APPENDICES

A HABITATS REGULATIONS APPRAISAL

ORKNEY
ISLANDS COUNCIL



Scapa Deep Water Quay

Habitats Regulations Appraisal Report

July 2026

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Revisions & Approvals

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1 Introduction

1.1 Background to the Project

The Scapa Deep Water Quay (SDWQ; 'the Project') is a major strategic port infrastructure project proposed by Orkney Islands Council Harbour Authority (OICHA, 'the Applicant') for Scapa Flow, Orkney. It is designed to provide a deep-water berth capable of accommodating floating offshore wind (FOW) assembly, integration, operations and maintenance, alongside heavy-lift capacity for large-scale turbines and foundations. The quay will also support wider marine industries and future energy transition activities. Its location offers naturally deep, sheltered water adjacent to sufficient land for laydown, with safe navigation and minimal dredging - attributes that make Scapa Flow one of the few sites in the UK capable of hosting operations at this scale. The location of the Project is shown in Figure 1-1.

A marine licence application under the Marine (Scotland) Act 2010 and a planning permission application under the Town and Country Planning (Scotland) Act 1997 were submitted in September 2023 for determination by the marine regulators, Scottish Government's Marine Directorate – Licensing Operations Team (MD-LOT) and OIC Planning Department ('the Competent Authorities'). These applications were supported by an Environmental Impact Assessment (EIA) undertaken under both the Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 ('the Terrestrial EIA Regulations') and the Marine Works (Environmental Impact Assessment (Scotland) Regulations 2017 ('the Marine EIA Regulations'). The requirement for Additional Information under the Marine and Terrestrial EIA Regulations has since been triggered four times, with this document supporting the latest Additional Information submission.

1.2 Scope

This HRA Report has been prepared in line with the requirements of the Conservation (Natural Habitats &c.) Regulations 1994 (as amended) ('the Habitats Regulations') to support the Town and Country Planning and Marine Works Licence applications for the Project. It has been updated in response to the requests for Additional Information submitted to date. This Report comprises both Likely Significant Effect (LSE) Screening and 'Information to Inform Appropriate Assessment' stages of the required appraisal.

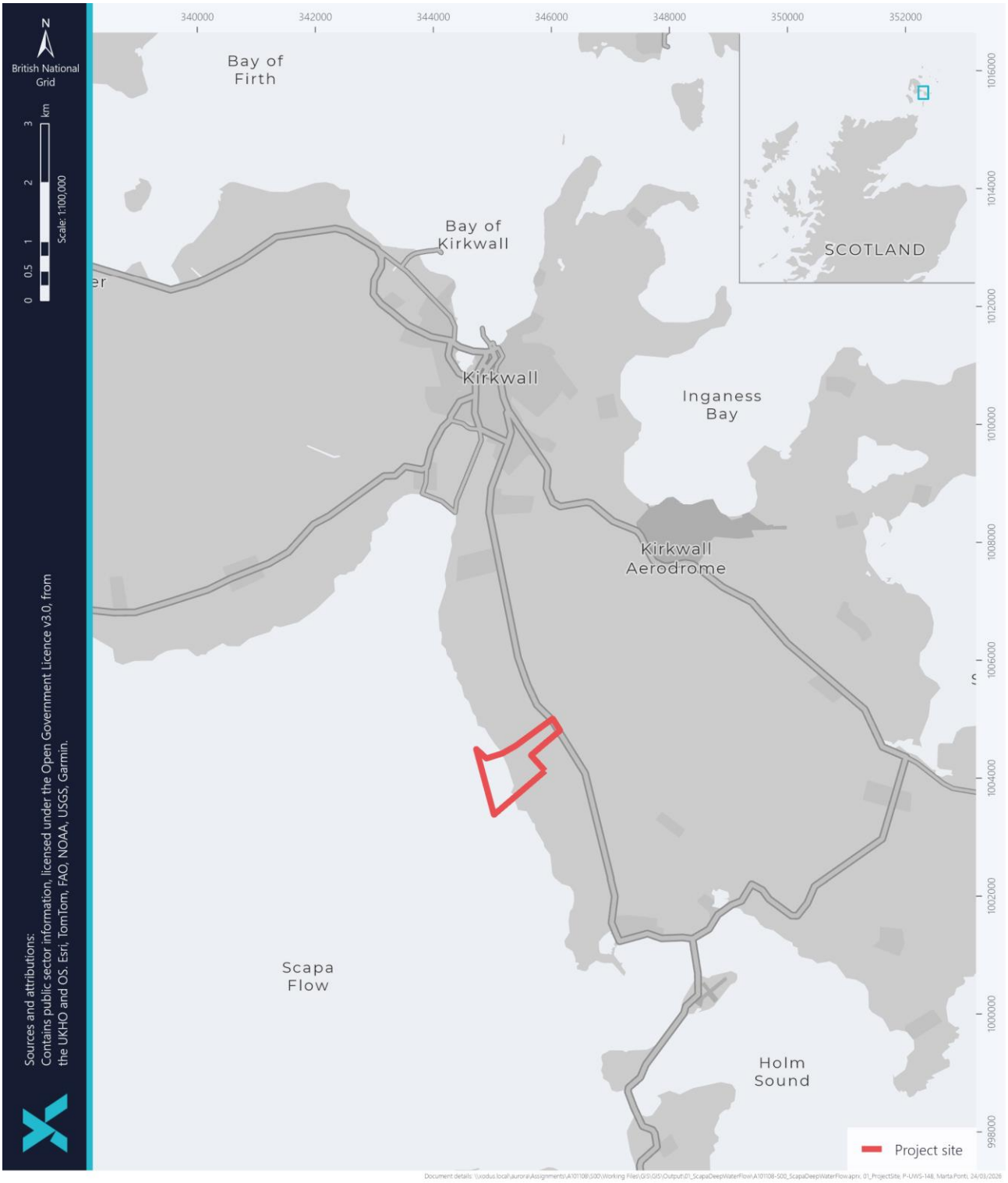


Figure 1-1 Location of Project site

1.3 Purpose of this Report

The consideration of potential impacts of plans and projects on European Sites is required under the European Union's (EU) Habitat's Directive. These requirements are transposed into United Kingdom (UK) legislation by the Habitats Regulations relevant to the Project, as described in Section 2. An HRA must be carried out for any plans and projects with the potential to have LSE on European Sites, for example through spatial connectivity or designated features with an assumed connectivity. Further information on the HRA process and requirements is detailed in Section 3 below.

This Report provides an LSE Screening exercise (see Section 6), which considers whether the Project has the potential to have an LSE on a European Site, either alone or in combination with other plans or projects. In line with the HRA process, the European Sites where LSE could not be excluded have been taken forward for further assessment within this Report and considers whether there is any potential for the Project to adversely affect the integrity of a European Site (Special Areas of Conservation (SACs), Special Protection Areas (SPAs) including candidate and proposed sites, Sites of Community Importance (SCIs) and Ramsar Sites), either alone or in combination with other plans or projects.

Consultation has been undertaken with relevant stakeholders to inform the Screening process and guide the Information to Inform Appropriate Assessment. Further information on consultation undertaken to date is provided in Section 4.

This document aims to provide the Competent Authority (in this case is MD-LOT and OIC) with the information required to assist them in undertaking an Appropriate Assessment (AA) for the Project as required under the Conservation (Natural Habitats &c.) Regulations 1994 (as amended) ("the Habitats Regulations"). The Habitats Regulations transposed into domestic law the requirements of Article 6(3) of Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna ("the Habitats Directive").

1.4 Document Structure

The structure of this document is as follows:

- Section 1: Introduction. Provides the background of the Project and the purpose of this report.
- Section 2: Legislation, Policy and Guidance. Identifies the legislation, policy and guidance driving the need for the LSE Screening and Information to Inform Appropriate Assessment, which also define the structure and content of the report, and an overview of the HRA process.
- Section 3: Methodology. Details the methodology followed through the undertaking of this HRA.
- Section 4: Stakeholder Consultation to Date. Provides details of the consultation process to date with regards to the HRA.
- Section 5: Project Description. Outlines the Project design parameters for the construction, and operation and maintenance phases of the Project.
- Section 6: LSE Screening. Provides the LSE Screening assessment in order to identify the European sites with relevant qualifying features to be considered within the determination of potential LSE.
- Section 7: Mitigation Plans. Provides a summary of mitigation and monitoring measures committed to by the Project.
- Section 8: Annex I Habitats Assessment. Provides an assessment of potential adverse effects on site integrity for SACs with Annex I habitats, including from the Project alone and in combination with other plans or projects.
- Section 9: Annex II Marine Mammals Assessment. Provides an assessment of potential adverse effects on site integrity for SACs with Annex II marine mammal qualifying features, including from the Project alone and in combination with other plans or projects.
- Section 10: Ornithology Features Assessment. Provides an assessment of potential adverse effects on site integrity for SPAs with ornithology qualifying features, including from the Project alone and in combination with other plans or projects.
- Section 11: Conclusions of the Assessment. Summarises the conclusions of the potential adverse effects of the Project on the site integrity of relevant European Sites, either alone or in combination.

1.5 Work to Date

This report builds on the previous application material submitted by the Applicant:

- EIA Report submitted in 2023 in support of the Marine License Application (EnviroCentre, 2023);
- The EIA Addendum and Additional Information submitted to MD-LOT in 2024 (EnviroCentre, 2024a);
- The May 2025 Additional Information and supporting documents (EnviroCentre, 2025a); and
- The Additional Information submitted in October 2025 (EnviroCentre, 2025b).

The Supplementary Environmental Information (SEI) Reports were submitted as part of the request for Additional Information from the Regulator, under the EIA Regulations.

1.6 Authors

This report was jointly authored by EnviroCentre Ltd and Xodus Group Ltd.

For EnviroCentre, Matt Sullivan, Principal Environmental Consultant and topic lead for marine ornithology, was the senior author, and was supported by Jennifer Paterson Principal Ecologist; and Gemma Nixon Associate Director for marine mammals.

For Xodus Group, Dr Ewan Edwards, Environmental Specialist and topic lead for marine ecology was the senior author, and was supported by Jennifer O'Neill, Senior Environmental Consultant; and Pia Ricca, Lead Environmental Consultant.

2 Legislation, Policy and Guidance

This section provides an overview of relevant legislation, planning policy and guidance.

2.1 Legislative Context

The requirement for the Project to consider the potential effects of plans and projects on European Sites falls under The Habitats Regulations, specifically The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) which is applicable to projects within the 12 Nautical Mile (NM) limit.

The Habitats Regulations require consideration of potential effects from projects and plans on European Sites, including SACs, candidate SACs (cSACs), SPAs, potential SPAs (pSPAs), SCIs and Ramsar sites (under the Conservation on Wetlands of International Importance especially as Waterfowl Habitat 'the Ramsar Convention'). An HRA must be carried out to determine the potential for a development to result in an LSE on European Sites, either individually or in combination with other plans or projects. Sites of Special Scientific Interest (SSSIs) and other marine protected areas (MPAs) are not European Sites and do not form part of the HRA process.

Following the UK's exit from the European Union, SACs and SPAs designated under the UK and the Habitats Regulations no longer form part of the EU's Natura 2000 Network. These sites and new SPAs and SACs now form the UK National Site Network. This includes both inshore and offshore sites in the UK. The policies and procedures under the Habitats Regulations remain unchanged. These amendments were made through the Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019 and the Conservation of Habitats and Species Amendment (EU Exit) Regulations 2019 (the "EU Exit Regulations"). Guidance on the implications of EU Exit on the HRA regulations is available through the Scottish Government website (Scottish Government, 2020).

The procedural requirements to undertake HRAs for assessing potential effects on European Sites are contained in the Habitats Regulations. The objectives in relation to the UK National Site Network include:

- To maintain or restore habitats and species listed in the Habitats Directive to favourable conservation status; and
- To contribute to ensuring the survival and reproduction of certain species of wild bird in their area of distribution and to maintaining their populations at levels which correspond to ecological, scientific, and cultural requirements, while taking account of economic and recreational requirements.

2.2 The HRA Process

Scotland enacts a staged process for the assessment of plans or projects under the Habitats Regulations, with guidance provided by NatureScot available through their HRA website[1]. There are nine steps of the Scottish HRA process, as summarised below:

- Step 1. What is the plan or project?
- Step 2. Is the plan or project directly connected with or necessary to site management for nature conservation?
- Step 3. Is the plan or project (either alone or in combination with other plans or projects) likely to have a significant effect on a European Site?
- Step 4. Undertake an appropriate assessment of the implications for the site in view of its conservation objectives.
- Step 5. Can it be ascertained that the proposal will not adversely affect the integrity of the site?
- Step 6. Are there alternative solutions?
- Step 7. Would a priority habitat or species be adversely affected?
- Steps 8 and 9. Are there imperative reasons of overriding public interest (IROPI)?
-

European Commission's (2021) guidance outlines the staged HRA process, condensing the nine steps outlined above into three key stages. The three key stages are commonly categorised as the following:

- Stage One (i.e. Steps 1-3 above): LSE Screening - to determine whether a proposal is likely to have a significant effect on a European site; this stage does not take into account any embedded mitigation measures (provided in Section 6);
- Stage Two (i.e. Steps 4 and 5 above): AA carried out by the Competent Authority and informed by the Information to Inform Appropriate Assessment - to ascertain whether the proposal will or will not adversely affect the integrity of a European site; this stage considers the embedded mitigation measures implemented for the Project (provided in Sections 8 to 10);
- Stage Three (i.e. Steps 6-9 above):
  - Assessment of Alternative Solutions - if it cannot be ascertained that a European site's integrity will not be adversely affected, alternative solutions will need to be considered; and
  - Assessment of 'Imperative Reasons of Overriding Public Interest' (IROPI) - if there are no alternative solutions which can be implemented to ensure no adverse effects on a European site's integrity then an assessment of whether there are imperative reasons of over-riding public interest for the proposal will be undertaken.

Should there be the potential for an adverse effect on the integrity of any European Site, Stage Three will be implemented accordingly.

2.2.1 LSE Screening (Stage One)

LSE Screening aims to determine if the Project may have an LSE on a European Site, either alone or in combination with other projects. The methodology followed is provided in Section 3, and the LSE Screening exercise is provided in Section 6.

2.2.2 HRA Appropriate Assessment (AA) (Stage Two)

Where LSE Screening cannot exclude potential LSE, a European Site is progressed to an AA. The Information to Inform Appropriate Assessment is provided by the applicant for a project, to assess the potential for the Project to adversely affect the integrity of a European Site, alone or in combination with other plans and projects.

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[1] Information on the staged process for completing a HRA is available on the NatureScot maintained sites at https://www.nature.scot/professional-advice/planning-and-development/environmental-assessment/habitats-regulations-appraisal-hra, which is correct as of March 2026.

The assessment is conducted with regard to the European Site's structure and function and its Conservation Objectives. The assessment within the Information to Inform Appropriate Assessment provides the necessary information for the Competent Authority to carry out an AA. This is required before the Competent Authority undertakes or gives any consent, permission, or other authorisation for, a plan or project.

This report includes information to enable the Competent Authority to carry out an AA (Sections 8 to 10).

2.2.3 Assessment of Alternative Solutions (Stage Three)

If the Competent Authority cannot reach a conclusion of no adverse effect on the integrity of a European Site, alternative solutions are evaluated. This may include, for example, modifications to the design or location of a project.

2.2.4 Assessment of Imperative Reasons Of Overriding Public Interest (IROPI) (Stage Three)

If no alternative solutions exist for the plan or project that can be implemented, a development may only proceed by satisfying the principles IROPI. Where the principles of IROPI are satisfied, compensatory measures must be put in place to maintain the coherence of the UK National Site Network and offset the adverse effects caused to the European Site integrity.

2.2.5 Mitigation

Following the outcome of the European Court of Justice in the People Over Wind and Sweetman case in 2018 (Case C323/17), which was further refined in rulings by the same Court in June 2023, NatureScot provided guidance on the consideration of mitigation in the HRA process, by way of an interpretation of the People over Wind judgement. Advice relating to the consideration of mitigation within the HRA process is published and maintained on the NatureScot website[2].

NatureScot guidance outlines that mitigation measures intended to avoid or reduce harmful effects to a European Site cannot be considered at the LSE Screening stage. Embedded mitigation measures which are not specifically designed to avoid or reduce effects on a European Site, but do so incidentally, can be considered.

The LSE Screening (Section 6) does not consider embedded mitigation measures that are specifically implemented to reduce or avoid effects on a European Site but does consider mitigation measures which are not specifically designed in relation to effects on European Sites, for example Shipboard Oil Pollution Emergency Plans. Mitigation measures remain applicable for the determination of adverse effects on site integrity, which is the focus of the Information to Inform Appropriate Assessment (Sections 8 to 10).

2.3 Guidance Documents

Within Scotland, the HRA process draws on guidance and advice provided by NatureScot, primarily through the HRA guidance document 'Habitats Regulations Appraisal of Plans. Guidance for Plan-making Bodies in Scotland' (NatureScot, 2023). Other guidance documents that have been used to inform the HRA process presented within this Report include:

- Article 6 - Managing and protecting Natura 2000 sites (European Commission, 2000);
- Assessment of plans and projects in relation to Natura 2000 sites – Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC (European Commission, 2021);
- Managing Natura 2000 sites – The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (European Commission, 2018);

[2] The NatureScot guidance following the People over Wind judgement is available at https://www.nature.scot/doc/naturescot-guidance-note-handling-mitigation-habitats-regulations-appraisal-people-over-wind-cjeu, with the provided information correct as of May 2025 (NatureScot, 2025).

- European Site Casework Guidance: How to consider plans and projects affecting Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) (NatureScot, 2022a);
- EU Exit: habitats regulations in Scotland (Scottish Government, 2020); and
- The handling of mitigation in Habitats Regulations Appraisal – the People Over Wind Court of Justice of the European Union (CJEU) judgement 3 (NatureScot, 2025a).

3 Methodology

3.1 LSE Screening – Overview of the Screening Process

This Section outlines the LSE Screening process, which has been followed throughout this report. The approach follows the steps detailed in Section 2.2 and has been utilised for the following receptor specific topic assessments:

- Section 6.1 - Annex I habitats;
- Section 6.2 - Annex II marine mammals; and
- Section 6.3- Ornithology features.

3.1.1 Identification of European Sites and Features with Connectivity

The initial step identifies European sites and features with connectivity to the Project. The identification of European sites is conducted with reference to the qualifying interests / features in line with the following process:

- Identifying the range of effects that the Project could potentially have on qualifying feature(s) of a site (pathways for LSE); and
- Determining connectivity to the sites (e.g., if a qualifying interest/feature of the European site may overlap with the Project or the wider Zone of Influence (ZoI)[3]).

Connectivity depends on a variety of factors including life cycle, foraging behaviour, breeding, and migratory characteristics. These qualifying features associated with a particular site and the characteristics and potential for LSE from the Project. Each individual receptor topic has defined the relevant criteria used to determine connectivity. The European sites and features are identified during this step for where there is connectivity to the Project. The distances stated in this Report have been measured from the outer boundary of the Project.

3.1.2 Determination of LSE

Where connectivity is identified between the Project and the qualifying interests of a site, further appraisal is required to determine whether no potential LSE can be concluded as a result of this connectivity. To determine potential LSE, it is necessary to:

- Determine whether that qualifying feature(s) would, due to its behavioural and foraging characteristics, be affected by a particular effect (species sensitivity); and
- Where a qualifying feature is likely to be affected by an effect, identify whether or not this is likely to have a significant effect on the conservation objectives for the site (conclusion of potential LSE or not).

The assessment of no potential LSE uses data and information on effect pathways and characteristics of qualifying interests as part of a high-level appraisal. This appraisal assesses whether or not any of the site's conservation objectives may be undermined due to the potential for LSE. Where there is no potential for the conservation objective to be undermined, no potential LSE is concluded and it is therefore proposed that this is screened out from Stage Two of the HRA Process.

3.1.3 Receptors Not Considered - Diadromous Fish

European Sites designated for diadromous fish have been screened out of this process, in line with recent industry feedback received from MD-LOT and NatureScot. This is due to the uncertainty in the distribution and behaviour of diadromous fish in marine waters which means that impacts cannot be apportioned to individual SACs. Therefore, impacts on diadromous fish are considered within the EIA Report (EnviroCentre, 2023) only.

[3] The ZoI is the area outwith the Project boundary, which may be affected by the proposed activities within the Project. Specifically, the ZoI is the spatial area in which receptors may be affected by biophysical changes as a result of the Project and associated activities (CIEEM, 2019) and is specific to different receptors and can vary depending on the nature of the receptor(s).

4 Stakeholder Consultation To Date

Table 4-1 below summarises the stakeholder consultation received to date that has informed the LSE Screening and Information to Inform Appropriate Assessment, presented in Section 6, and Sections 8 to 10, respectively.

Table 4-1 Summary of consultation that has informed the LSE Screening and Information to Inform Appropriate Assessment

Consultee / Stakeholder	Date	Summary
Scoping Opinion – Marine Directorate	October 2021	The Scottish Ministers agree with representation from NatureScot, RSPB, the OIC and advise that full consideration and assessment of the potential impact of the Proposed Works on the Scapa Flow pSPA, Hoy SPA, Orkney Mainland Moors SPA, Loch of Stenness SAC and Sanday SAC must be fully considered in the EIA Report.
		The Scottish Ministers direct the Applicant to NatureScot's comments on the potential for significant adverse effects on the Scapa Flow pSPA and the possibility of NatureScot objecting if these concerns are not addressed. The Scottish Ministers therefore direct the Applicant to engage with NatureScot to address these concerns.
NatureScot - Scoping Response (reiterated by Orkney Islands Council)	21 May 2021	European Protected Areas The proposed development is likely to have a significant effect on qualifying interests of the Scapa Flow pSPA, Hoy SPA, Orkney Mainland Moors SPA, Loch of Stenness SAC and Sanday SAC. Therefore, effects on these site's features should be assessed for all phases of the development in the EIAR, as well as HRA. The EIA must provide sufficient information for the Competent Authority to be able to undertake appropriate assessments in view of these site's conservation objectives for their qualifying interests. Details of qualifying interests and conservation objectives can be found on our website.
		Scapa Flow pSPA The proposal is located within the Scapa Flow pSPA designated for its breeding red-throated diver and nonbreeding black-throated diver, eider, goldeneye, great northern diver, long-tailed duck, red-breasted merganser, shag and Slavonian grebe. Potential impacts to features may arise from the permanent displacement of birds from the development footprint; disturbance of birds in the vicinity of the proposal during site investigation, construction and/or operational phases and the temporary or permanent loss of or damage to prey-supporting habitats in the development vicinity or at dredge spoil disposal sites. Of potentially greater importance than direct impacts is the associated increased levels of vessel traffic that are the intended consequence of the proposal. Many of the features of this site exhibit high or very high levels of behavioural sensitivity to vessel movements and the potential for impact on site integrity is highest for those species with relatively high levels of habitat specialisation and/or relatively small populations within this site. This includes black-throated diver, red-throated diver and Slavonian grebe. It remains unclear how the nature, routing and frequency/volume of vessel traffic through the Scapa Flow pSPA are anticipated to change as a consequence of this development. Therefore, it is important that the EIA and HRA also includes an assessment of these wider operational phase impacts.
		Hoy SPA The proposal has connectivity to cliff-nesting seabird interests of the Hoy SPA, including fulmar, great-black backed gull, great skua, common guillemot, kittiwake and puffin, as well as breeding red-throated diver. The proposal is well within foraging ranges of the cliff-nesting seabird features of the Hoy SPA and there is potential for disturbance to these features, although likely sensitivities are less than for wintering waterbirds. The footprint of the proposal itself is outwith the 10km foraging range for breeding red throated diver associated with the Hoy SPA. However, as detailed above increased vessel traffic associated with the proposal within wider parts of Scapa Flow could have connectivity to the Hoy SPA population and should be assessed.
		Orkney Mainland Moors SPA The proposal is within 10km of parts of the Orkney Mainland Moors SPA, and hence potentially within the foraging range of breeding red-throated divers from this site, although actual diver nesting locations within the SPA may be more distant. Associated vessel movements across wider parts of Scapa Flow could have connectivity to red-throated divers from this site and should also be assessed.
		North Orkney SPA We would not consider there to be any connectivity for assessment purposes with the North Orkney pSPA, unless there are associated vessel movements during the construction phase (e.g. to deliver equipment or materials or to remove dredge spoil). If this is the case then information on the features of this site can be found on our website.
		We note the intention of undertaking a cumulative assessment as part of the EIA, cumulative impacts will also need to be assessed as part of the HRA.
		MSS note, in agreement with the advice from NatureScot, that the proposed development is in proximity to the Sanday SAC, designed for harbour seals, and that this site is not mentioned in the scoping report. Impacts on this species should be assessed for all phases of the development as part of the EIA, and sufficient information should be provided to assess impacts to the species as a qualifying features of Sanday SAC as part of the HRA. When considering potential impacts on seals, the serious decline in harbour seal populations on the east coast of Scotland will need to be taken into account, which is reflected in the small Potential Biological Removal (PBR) limit calculated for harbour seals in the management area. This may also have implications for the HRA.
		The proposal is within Scapa Flow SPA, protected for its non-breeding and breeding marine birds. The proposal could also affect Sanday SAC protected for Harbour seal and various intertidal and subtidal habitats; Loch of Stenness SAC, protected for its coastal lagoon; and North Orkney SPA, Hoy SPA and Orkney Mainland Moors SPA, protected for a number of breeding and non-breeding birds.
NatureScot – response to October SEI **Nb these responses have been summarised for brevity.**	11 November 2025	Scapa Flow SPA – Black-throated diver We are unable to conclude no adverse effect on site integrity for the black-throated diver of Scapa Flow SPA. This is based on the potential disturbance and displacement impacts associated with the use of cranes at the proposed development site. The operation of cranes could potentially lead to the disturbance and displacement of a minimum of 19% of the SPA population of black-throated diver… We advise that it is not possible to fully mitigate the potential impacts. Despite some outstanding issues and uncertainties, we are satisfied with some of the suggested mitigation to minimise impacts associated with the construction phase of the proposal, this includes vessel movements, dredging, and airborne noise disturbance, and with the operation vessel movements. However, due to the scale and nature of impacts from operational activities on a significant proportion of the black-throated diver SPA population, we have concluded that adequate mitigation to minimise these impacts on this feature is not feasible.
		Scapa Flow SPA – Great northern diver Due to the lack of assessment for crane operations we cannot conclude no adverse effect on site integrity for this feature. The applicant's information and impact assessment on the construction phase vessel movements is incomplete. An assessment of impacts from crane operations has only been assessed for black-throated diver and whilst we agree that this is the feature that will most likely be impacted by this operation, other qualifying features which are sensitive to towering structures should have been assessed within the HRA, specifically great northern diver and red-throated diver.
		Scapa Flow SPA – Red-throated diver Due to the lack of assessment for crane operations we cannot conclude no adverse effect on site integrity for this feature at this time. An assessment of impacts from crane operations has only been assessed for black-throated diver and whilst we agree that this is the feature that will most likely be impacted by this operation, other qualifying features which are sensitive to towering structures should have been assessed within the HRA, specifically great northern diver and red-throated diver.
		North Orkney SPA Due to the lack of assessment for crane operations… we cannot conclude no adverse effect on site integrity for these features at this time.
		Orkney Mainland Moors SPA

Consultee / Stakeholder	Date	Summary
		Due to the lack of assessment for crane operations for this feature… we cannot conclude no adverse effect on site integrity.
		Sanday SAC We conclude LSE for harbour seal but consider that it has not been ascertained that the proposal will not adversely affect the integrity of the Sanday SAC… based on an incomplete in-combination assessment.
		Loch of Stenness SAC Our conclusion is that the proposal will not adversely affect the integrity of the site *provided that* the final Biosecurity Plan should be submitted for approval… prior to construction. This proposal could be progressed with appropriate mitigation. However, because it could affect internationally important natural heritage interests, we object to this proposal unless it is made subject to conditions so that the works are done strictly in accordance with the mitigation detailed in our appraisal.
		In-Combination Assessment The in-combination assessment is still insufficient and lacking in detail considering the scale of the development. The applicant's HRA was unable to conclude if there are any in-combination effects associated with the Quanterness Fish Farm. Therefore, adverse effect… cannot be ruled out.
RSPB – response to October SEI	31 January 2025	We have considered the proposal and are concerned that it will result in a loss of approximately 19 hectares (ha) of the Scapa Flow SPA. This results in a loss of habitat, from a combination of harbour pier construction and immediate disturbance to the qualifying species of the SPA set out above.
		At this stage we consider the quality of the information and assessments in both the EIA and HRA to be insufficient to be able to conclude that there would be no adverse effect on site integrity for the qualifying features of Scapa Flow SPA and North Orkney SPA (used by the same species), namely Red-throated diver, Slavonian grebe, Great-northern diver of Scapa Flow SPA. From the information available, the proposed scheme would result in effects on SPA species as result of direct habitat loss and from construction disturbance.
Marine Directorate – request for further information	15 January 2026	Further information is required on the use of cranes, in line with NatureScot advice, including the in-combination assessment and impact assessment for crane use, the impacts of crane use on the black-throated diver, great northern diver and red-throated diver qualifying features of the SPAs.
		Further Information is required, in line with NatureScot advice, on the vessel movements during construction impacting Scapa Flow SPA. This includes, but is not limited to, information on vessels required for scour protection and caisson filling activities during the nonbreeding season of the black-throated diver.
		Further information is required, in line with NatureScot advice, on the plume dispersal modelling to ensure the Conservation Objective, 2c is not undermined for all SPA features.
		Further information is required on the in-combination assessment and cumulative impacts, in line with NatureScot advice, with consideration of the cumulative impacts of both construction and operational vessel movements.
		Further information is required on the in-combination effects for the harbour seal qualifying interest of the Sanday SAC, in line with NatureScot advice
NatureScot revised HRA	March to June 2026	Various meetings and written consultations during the preparation of the Additional Information submission, including letter dated 30th June 2026 providing comments on the draft revised HRA and confirming: 1) they agree with the Applicants conclusion of no AEoSI for North Orkney SPA, Orkney Mainland Moors SPA and Hoy SPA 2) however, with regards to the Scapa Flow SPA, and contrary to the Applicants assessment, they advise '*the development and associated operations will undermine Conservation Objective 2b [The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species] and therefore lead to adverse effect on site integrity for black-throated diver*.'

5 Project Description

5.1 Site Location

The Project is located adjacent to the Bay of Deepdale, approximately 8 km south of Kirkwall. It is located on the eastern coastline within Scapa Flow, approximately 4 km south of the existing Scapa Pier. A Location Plan is provided in Figure 1-1.

5.2 Main Purpose and Associated Activities

The Project shall provide deep-water berthing facilities for a wide range of industrial activities with the main purpose upon completion, and in the medium to long term, being the storage of components, and assembly of wind turbines serving the floating offshore wind industry. The Project shall be complete with additional emergency berthing facilities for small vessels. The Project is also identified as a potential site for the storage and supply of future fuels for the marine industry.

The Project is a permanent addition to the Orcadian infrastructure, and therefore decommissioning is not a planned phase of the Project and has not been considered within the assessment presented in this report.

5.3 Construction

5.3.1 Programme

Table 5-1 below outlines the key construction stages, their indicative durations and projected periods for works to be carried out therein.

Table 5-1 Outline Construction Programme

Works Description	Est. Duration	Est. Works period
Access road construction, haul road, earthworks and A961 re-alignment	60 weeks	December 2027 – February 2029
Caisson fabrication (off-site)	24 weeks	December 2027 – June 2028
Caisson transport (off-site fabrication to Orkney)	8 weeks	June 2028 – August 2028
Dredging bund construction	32 weeks	December 2027 – July 2028
Dredging	12 weeks	June 2028 – August 2028
Caisson installation (placement only)*	8 weeks	August 2028 – September 2028
Landside earthworks – Overburden removal, rock blasting and excavation	100 weeks	October 2027 – September 2029
Quay finishings	52 weeks	January 2029 – January 2030
Demobilisation	12 weeks	January 2030 – February 2030
Completion	N/A	February 2030

*Completion of the quay wall, including infilling of caisson cells and backfill to the rear of the units shall continue on to February 2029. This may or may not involve the vessel movements detailed in table 5-3 depending on availability of suitable material on island. The vessel movements shown in table 5-3 which refer to caisson infilling are worst case.

Blasting is anticipated to be completed within the first 59 weeks of the landside earthworks programme. However, ground conditions may dictate a change in the blasting pattern, which may extend the blasting programme to up to 100 weeks. No more than two blasts would be carried out in any one week.

5.3.2 Outline Design Criteria

The below criteria will ensure the design provides a robust, long-lasting marine structure, ensuring safety, stability, and durability under challenging environmental conditions.

- **Dredging Requirements**: The operational depths of -15.0m Chart Datum (CD) and -20.0m CD
- **Environmental conditions**: Consideration of climate change and sea-level rise scenarios (A projected sea level rise of 0.9 m by 2100 is considered, based on national climate projections), with tidal lag (normal conditions) and wave conditions (1 in 50-year, 1 in 200-year, 1 in 570-year return periods) integrated into the design.
- **Materials**: Concrete and reinforcement materials must comply with Eurocodes and British Standards, with specifications for exposure classes, cement types, and aggregate properties.
- **Caisson design**: The caissons are designed with a focus on durability, using concrete that is resistant to degradation in marine environments. Concrete properties, cement types, and aggregate characteristics have been carefully specified to ensure a long lifespan.
- **Caisson foundations and fill**: Crushed imported rock is used as the foundation layer, with strict controls on durability and strength. Fill materials inside and behind caissons are selected for high density and internal friction to ensure stability.
- **Scour protection**: Concrete scour protection mattresses and rock armour is installed to mitigate seabed erosion caused by vessel thrusters and propellers near the quay wall.

5.3.3 Site establishment and access

The access road design comprises of an 8 m wide asphalt surfaced roadway, 1.8 m wide hard verge (service strip) and 1.8 m wide remote path (south side), 1.5 m soft verge (north side) and surface water conveyance swales (both sides).

Access will be formed from A961 which is to be realigned as part of the works. This road realignment has its own planning permission and is not part of this application Safe access and egress from the A961 will be achieved with reflective signage and 2-way lights as necessary.

The access road is prioritised as a critical path activity as its completion triggers the commencement of the laydown area, landside cut and fill operations and shall provide access for the construction of the dredge containment bund, allowing dredge operations to commence. The contractor will require temporary service connections to the landside site area early in the programme to facilitate blasting, quarrying and earthworks operations.

The contractor will carry out the topsoil strip, overburden removal and elements of rock cut for the new access road. The contractor will place the subbase and surcharge it to act as a robust haul road during the construction programme. This will take cognisance of Scottish Environment Protection Agency (SEPA) comments on the need to protect Groundwater Dependent Terrestrial Ecosystems at the Project site.

The contractor will install the service trenching, drainage and ducting as the works progress to ensure water is managed effectively, services can be connected, and a safe road is completed prior to temporary traffic using it. Upon completion of the project, the contractor will trim the surcharge and carry out the final surfacing.

5.3.4 Dredging

Prior to the commencement of dredging operations, a containment bund will be constructed around the proposed reclamation area using site won general fill material screened of fines and suitable for placement below water, sourced from the initial landside excavation works and transported from the on-site designated processing areas. The bund shall be constructed up to a level of +4.0m CD using general fill below-water material, placed from the land. The bund shall be located approximately 40m behind the position of the caissons (within the footprint of the development). Integrated into this bund, a weir box system shall be installed in the northwest corner of the reclamation area. The weir box is an adjustable weir used to dewater the reclamation area, control the water level and the discharge of water/fines at a designated discharge point. All suitable dredged material will be placed in a reclamation area behind the pre-constructed bund, with any unsuitable material disposed at the licenced sea disposal site. The volumes of material to be dredged are presented in Table 5-2.

The dredging works extend along the entire quay alignment, including the main quay as well as the small vessel berths to the northern end, and are essential for preparing the seabed for subsequent caisson installation. The structures will be founded on hard bearing strata, requiring the removal of superficial soils and hard strata from approx. -15m CD down to a maximum depth of -20.5m CD. The dredged area edge slopes depend on the

material type, ranging from 1:3 in superficial soils to 1:1 in engineering rock, whilst the dredging berth pockets are required to be operative for elevations of -15m CD and -20m CD.

Dredging works will be executed in a single campaign using a cutter suction dredger (CSD) specifically selected for its capacity to operate efficiently under the anticipated soil, sea and weather conditions at Scapa Flow.

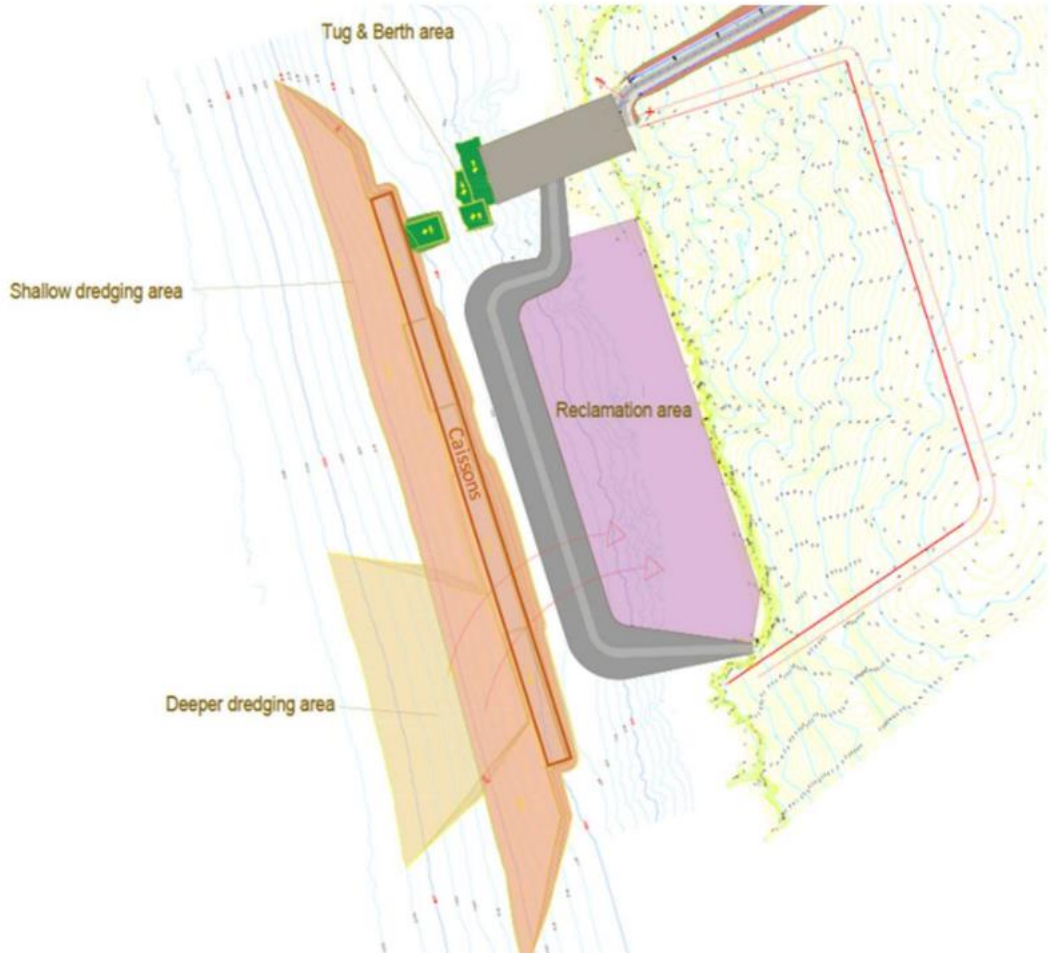


Figure 5-1 Dredging and reclamation areas

The discharging process to the reclamation area shall be carried out through the integration of the dredger pumps with the designated discharge pipeline system where the dredged material will be transported into the reclamation area. This operation will be carried out in parallel with the dredging activities, beginning at the northwest portion of the reclamation.

Turbidity meters will be installed to detect any increase in turbidity outside the reclamation area, the details of which will be included within the supporting Construction Environmental Management Document (CEMD) (see Table 7-1 for further details).

Through the early contractor involvement design stage, it has been identified that a significant reduction in material disposed at sea could be achieved from that which was originally defined in the exemplar design. There is, however, potential for up to 82,000m^3 of glacial till which may be unsuitable for re-use, to be disposed at sea (see Table 5-2).

A 4,000m^3 capacity barge(s) will be used to transport material to the licensed offshore deposit site **FI040**. If the maximum volume (82,000m^3) is deposited, there will be 21 round trips to the sea deposit site (42 vessel movements) over 12 a week period, typically this activity will be carried out between the beginning of June to the end of August (currently 2027).

Table 5-2 Proposed dredge volumes

Description	Total volume dredged (m^3)	Volume reused on site (m^3)	Volume disposed offshore (m^3)
Hard Dredge	72,653	72,653	0
Soft Dredge	306,754	306,754	0
Total	**379,407**	**379,407**	**0**
Disposal Contingency	*379,407*	*297,407*	*82,000*

5.3.5 Quay wall construction

The quay wall will be formed from reinforced concrete caissons installed on a rock bed foundation, as shown on Figure 5-2. The main quay is composed of nine large reinforced concrete caissons, with a smaller caisson at the south end that ties into the south revetment. At the north end, the small vessel berths are formed by four caissons.

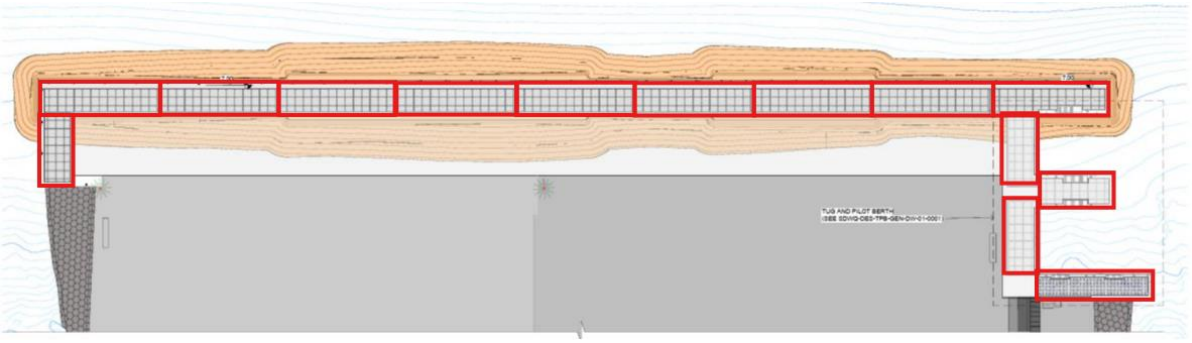


Figure 5-2 Quay Wall General Arrangement

5.3.5.1 Cassion design criteria

The main quay structure comprises nine large reinforced concrete caissons, complemented by a smaller caisson at the southern return that ties into the adjacent rock armour revetment. A range of caisson cross-sections is incorporated along the quay alignment to accommodate variations in finished dredge depths and underlying geotechnical conditions. The quay cope level is fixed at +7.00 m CD, with dredging in front of the quay generally extending to –15.0 m CD, including a 1 m over-dredge allowance. Near the southern end, a 140 m section includes a deeper dredge pocket reaching –20.5 m CD, also with a 1 m over-dredge allowance. At the northern end, the small vessel berths are formed using a series of smaller caissons. Dredging design accounts for slope requirements based on soil type to ensure foundation levels are established on engineering rock, and the geotechnical performance of the caissons is assessed for sliding, overturning, bearing capacity, and overall stability. Figure 5-3 below outlines a typical cross section for the caisson wall structure.

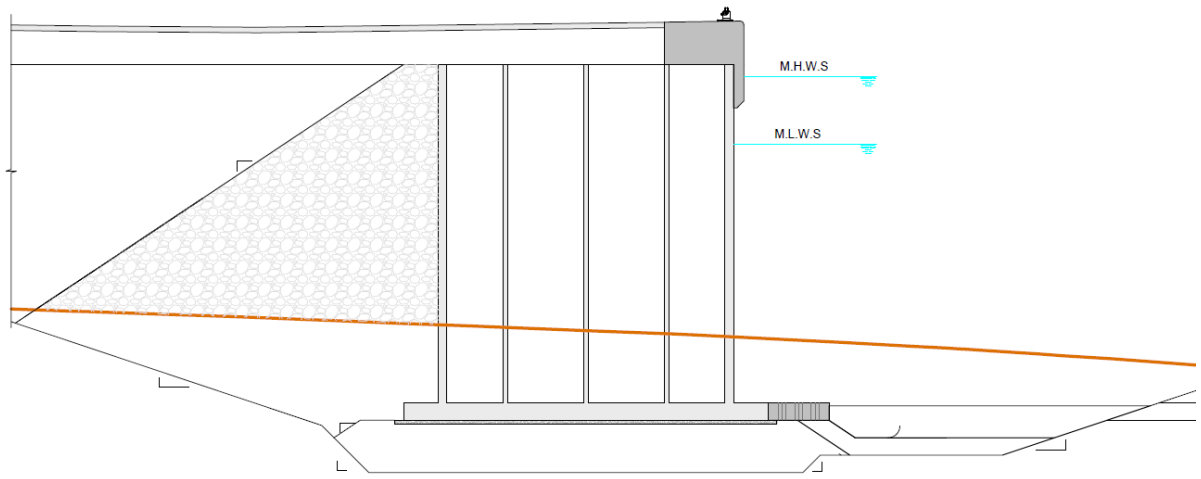


Figure 5-3 Simple cross section of caisson quay wall structure

Each caisson will be ballasted as per design, ensuring naval stability in all phases of transport and installation.

The fourteen caissons will be transported to the site in four shipments. The first batch of caissons will be directly installed in their final positions along the quay line from the semisubmersible delivery vessel. The remaining caissons of a batch in subsequent deliveries will be towed to a temporary wet storage area within the Project boundary until its final installation on the quay line.

Caissons will be dry stored during transport from Spain, reducing the risk of transporting non-native species. A Biosecurity Plan will be produced as part of the CEMD (see Table 7-1), which will set out the measures to prevent the introduction of invasive non-native species, in accordance with relevant legislation and best practice.



Figure 5-4 Image of caisson loading operation

5.3.5.2 Caisson unloading at Scapa Flow

The unloading operation at Scapa Flow requires water depths over 27 m due to the draft of the vessel and caissons, and favourable metocean conditions. The caisson deliveries will be unloaded using 3 tugboats of at least 4,000 Horsepower (3,000kW) which will be hired locally, with the operation carried out in one to two good weather days per shipment.

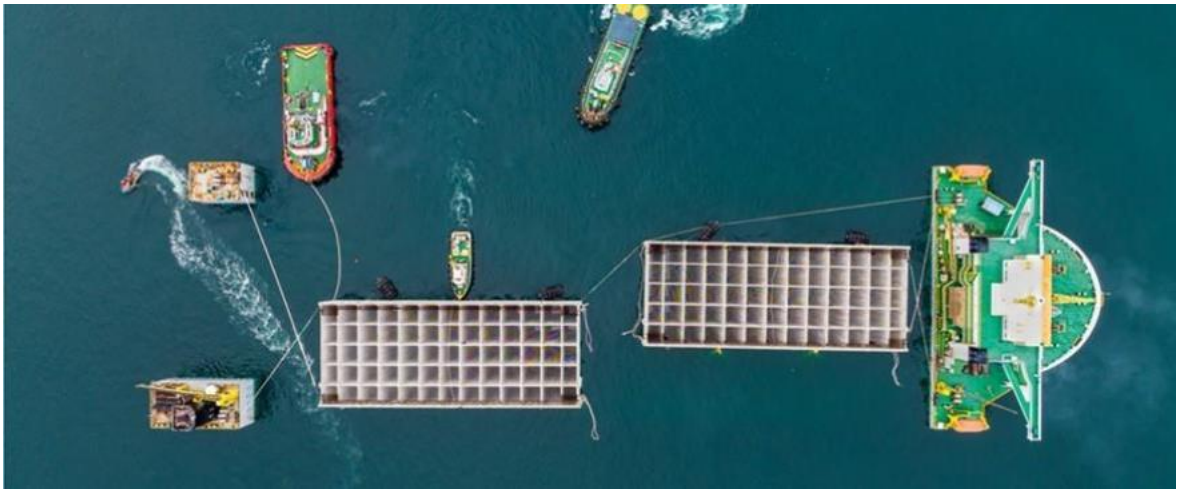


Figure 5-5 Caisson loading onto Semi-submersible vessel

Caissons will be unloaded from the semisubmersible vessel either directly to the quay line or to a nearby storage area, where they will remain until placement. The caissons will be fitted with auxiliary equipment including winches, mooring ropes and anchors, walking platforms, ballast systems, topographic prisms and fenders. After unloading, they will be temporarily secured either by tying them together alongside the partially constructed quay or by anchoring them to the seabed close to the project site. No piling or drilling is required for this operation and underwater noise will be negligible. When weather conditions permit, the caissons will be sunk into their final positions. Alternatively, they may be temporarily set down on the quay-line foundation and later refloated for final installation within tolerance.

5.3.5.3 Caisson installation

The process to install a caisson is typically performed during daylight hours in around 6-8 hours, given suitable metocean conditions which would typically be as follows: mean wave height (Hm) of 0<0.5m, peak wave period of (Tp)<7s and a wind velocity at 10 meters above sea surface (U10) < 15m/s. Caissons will be towed individually from the semisubmersible vessel or their temporary storage location to the quay line. Typically, one to three tugboats will be sufficient for towing from temporary storage, with the same tugs used to assist the installation operation.

Each caisson will be positioned while sinking, using tugs and winches, until a final controlled touchdown on the prepared foundation. Each caisson has independent and watertight groups of cells. During the operation, each group of cells is filled simultaneously with seawater either using a pump or a valve, with surveyors monitoring the level in each group to ensure that the installation process is performed in a controlled manner.

Ballasting water will be taken from the sea at Scapa Flow after caisson placement. If placement meets tolerance, ballasting continues until filled; otherwise, de-ballasting and repositioning are repeated until successful, usually in one attempt.



Figure 5-6 Caisson control platform and positioning equipment

5.3.5.4 Landside excavation platform

Mechanical methods will be used to excavate soft soils on land, while rock removal will involve drilling and terrestrial blasting, with no marine blasting planned. The overall landside earthworks programme is scheduled to be ongoing for approximately 100 weeks (Oct 27' to Sept 29' provisionally) with blasting taking place intermittently throughout this period. Due to the nature of the works, the exact timing of the blasts cannot be confirmed and should not be constrained to specific seasons of the year. It is estimated that during the 100 weeks of earthworks, a total of 35 blasts shall be carried out with no more than 2 blasts per week. Initially, the contractor will set up pre-earthworks drainage to manage surface water runoff. After establishing perimeter cut-off V ditches and before starting main land excavation and blasting, a 6m high bund will be built at least 5m from the cliff edge to ensure safety and reduce noise impact on marine life. The bund height shall be achieved by reducing the landside level by 3m and constructing a 3m high bund at the top of the excavation to achieve the overall height of 6m as shown in Figure 5-7.

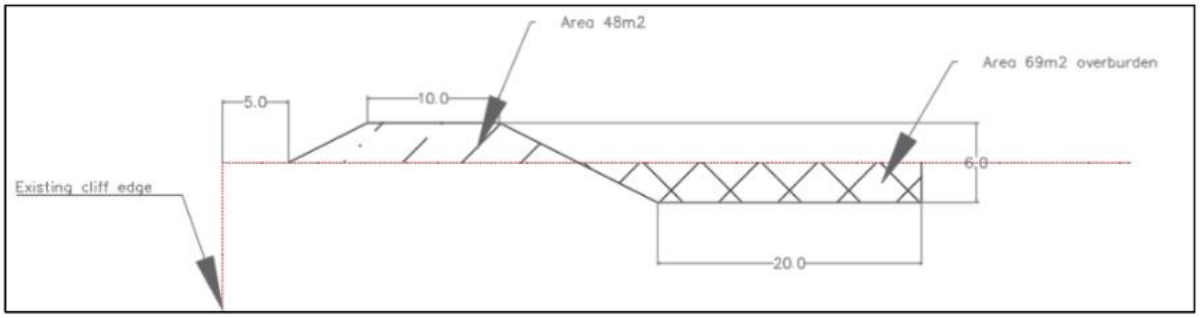


Figure 5-7 Noise bund section

The bund's crest will be 10 m wide to allow equipment movement along its length. It must be in place before any blasting begins near the cliff edge, serving as both a noise barrier and a retention wall for sediment runoff. This natural bund will be removed once the rest of the site is excavated to reach the final profile.

Blasting will be executed in 70 m strips, moving from the front (west) to the back (east) of the site. The initial bund will be constructed from overburden material taken from the first 20 m of the blasting zone. Each strip will be divided into sections sized for up to two weekly blasts, with operations taking place simultaneously at both ends of each strip. Processing areas will be located at both ends of the project site to minimize haul distances for blasted materials, and this dual-end approach will also improve fill distribution, allowing fill operations to be supplied from both directions at once.

5.3.6 Reclaimed land (sea filling)

During the dredging campaign, the dredge bund and reclaimed area which it contains shall be completed forming the initial section of land reclamation. Once caissons are installed, filled and backfilled, rock armour revetments shall be constructed at the north and south ends of the quay wall, closing the perimeter. Rock-armoured revetments protect the north and south sides of the site from wave action. These are designed for a 60-year lifespan and to withstand extreme wave conditions (1:200 years). Armour layers consist of 2.5 tonnes (north) and 4.5 tonnes (south) rocks with appropriately sized underlayers and geotextiles. At this stage, general infilling from land will commence using excavated suitable material from the landside development.

The majority of land reclamation material is comprised of dredged material and land-based excavated material (which will be screened on site to remove fines before placement). There is a requirement for imported quarry material to be used at the rear of the concrete caissons to achieve the correct grading and compaction requirements as per the caisson stability design.

Substantial marine area containment will be achieved before land reclamation fill is progressed by construction of the containment bund mentioned above, thus minimising sediment discharge outside the works.

5.3.7 Pollution control

There is the risk of pollution events (oil spills, etc.) during the construction phase of the Project. Adherence to strict Pollution Prevention controls during land reclamation works will mitigate against pollution spills.

In terms of surface water pollution, drainage will be designed, in accordance with best practice and SEPA requirements, to ensure that there are no untreated surface water discharges directly to the surrounding coastal waters. Suitable prevention measures will be in place at all times to prevent the release of pollutants to the water environment, including adjacent coastal waters.

An Outline CEMD has been produced specifically tailored to this project (see Table 7-1). This document will be further developed and enhanced to fully reflect the potential effects and suitable forms of mitigation specific to the chosen contractor's construction methods and the conditions of all consents.

5.3.8 Vessel movements

The construction phase will see the following vessel movements as outlined in Table 5-3 below. In total during the entire construction phase (26 months), there will be 112 vessel movements taking place over an eight-month period between June 2028 and February 2029, inclusive.

Table 5-3 Construction phase vessel movements

Vessel	Predicted Number of Vessel Movements	Timescales (provisional)
Caisson delivery, offloading and installation	20 movements (4 deliveries) using a semi-submersible vessel (3 tugs for offloading, 1 tug for installation) Tugs deployed from nearby Scapa Pier	July 2028 – September 2028
Scour protection	10 trips (20 movements)	August 2028 – September 2028
Caisson infilling	15 trips (30 movements)	August 2028 – February 2029
Dredging	21 trips (42 movements)	June 2028– August 2028
Total	**112**	

Based on baseline vessel movements (as informed by the Navigational Risk Assessment (NRA);see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3, this will result in an additional 21.5 vessel movements per month on average (+0.16% from baseline) during winter months (October-March) and an additional 90.4 vessel movements per month on average (+0.5% from baseline) during summer months (April-September).

5.4 Operation

The Project is likely to operate as a marine facility 24 hours per day and 7 days per week, so there is the potential for activity at any time of the day or night. This will include:

- Flatbed lorries: delivering and uplifting from site.
- HGVs: delivering and uplifting from site.
- Light vans: delivering cargo or providing maintenance and servicing to site.
- Road Tankers: delivering bulk goods and liquids to site or removing liquids and waste from site; and
- Forklift trucks: loading and unloading vehicles servicing the site. In addition to the general cargo operations, there will be:
- Minibuses / cars collecting and returning people working one site - these vehicles not allowed in the working area.
- Security staff based within the site and undertaking patrols when appropriate.
- Staff looking after the facility maintenance and assisting with vessel moorings.
- Third Party Stevedore Companies loading and unloading vessels; and
- Coaches and taxis facilitating crew changes on vessels.

The internal roadways and footpaths will be demarcated with designated routes, and barriers will be installed where necessary. There will be a security fence around the working area perimeter to protect it as well as the public, in addition to preventing access to breakwaters, rock armour revetments etc. (access gates will be provided for maintenance). The fence will be constructed in accordance with the requirements of the International Ship and Port Facility Security Code (ISPS).

Table 5-4 provides a summary of the indicative infrastructure likely to be present upon completion of the Project.

Table 5-4 Indicative Operational Infrastructure

Infrastructure Type	Qty	Description
Future Marine Fuels	TBC	Possible storage and supply to vessels of very low or zero carbon fuels. Note this will be subject to further assessments and approval.
Water Tanks	4	As indicated on Figure 5-8 outside of the main working area.
Sub-station	1	Main electric supply point to site as indicated on Figure 5-8 not in main working area.
Main gatehouse / Access building	1	As indicated on Figure 5-8– outside of main working area, may contain admin offices and is the security control for site
Car park, cycle storage and bus stop	-	Vehicle parking spaces and bicycle racks. Bus stop for use by internal bus services (drop off and pick up only)

5.4.1 Quayside Services

The indicative locations of quayside infrastructure services are shown on Figure 5-8.

Quayside services such as potable water and shore power will be incorporated into a service trench that will run around the Project with bunker points to the quayside at regular intervals.

Four water storage tanks with built-in treatment systems (as required) will be installed as indicated in Figure 5-8 to supply potable water to the whole site and vessels. Located near to the water tanks will be a 33kV /11kV/415V substation for whole site supply, including shore power for vessels. Service vehicles will be accessing the Project for crew and maintenance support to these vessels.



Figure 5-8 Proposed SDQW Operational Layout

5.4.2 Vessel Movements

The Project is designed to be flexible so that many types of vessels can berth, subject to draught and length. While the quay is a major strategic facility, its operational profile is characterised by the infrequent arrival of large vessels, likely to be aligned with the integration and deployment schedules of major offshore wind developments. Approximately 80% of vessel activity will take place in the summer months.

There is significant existing vessel activity in the wider area around the proposed Project. There will be increased vessel activity introduced by the Project in the area from the existing shipping route to the site, as detailed by the orange hatched area in Appendix C, Figure 1 (EnviroCentre, 2025a); however, there are currently frequent vessel movements in this area, as shown by the vessel tracks in Appendix C EnviroCentre, 2025a, and in more detail in the NRA submitted with the EIAR (Appendix 2.3 of EnviroCentre, 2025a).

Table 5-5 outlines the annual and seasonal operational vessel activity expected for the Project.

Table 5-5 Annual and seasonal operational vessel activity

	Per year		Per winter season (October – March)		Per summer season (April – September)	
	Vessel number	Vessel movements (return trips)	Vessel number	Vessel movements (return trips)	Vessel number	Vessel movements (return trips)
Large vessels	28	56	6	12	22	44
Smaller vessels	12	24	2	4	10	20
Pilot boats for large vessels	56	112	11	22	45	90
Total	**96**	**192**	**19**	**38**	**77**	**154**

Based on baseline vessel movements (as informed by the NRA; see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

5.4.3 Wet storage

There is no planned wet storage of fully constructed turbines at the Project site. Any future proposals for wet storage will be conducted in accordance with the relevant regulations/consents.

5.4.4 Quayside cranes

No fixed or permanent cranage will be installed at the Project site. Instead, lifting operations will be carried out by a combination of cranes fitted to heavy lift vessels and temporary mobile cranes deployed from the quayside. Heavy lifting activities will typically coincide with large vessel movements, so cranes will be operating to similar timeframes as vessel movements.

Crane activity will be dependent on weather conditions, particularly in the winter months, as lifting of large loads is highly susceptible to even light to moderate winds. Based on analysis of 1 in 10-year weather averages in Kirkwall (1979-2010), the time lost to wind in the winter months is >200 hours per month. As such, less than 20% of lifting operations will likely take place in the winter.

There will be approximately 30 operational vessel trips per year (60 vessel movements) that involve a requirement for craneage, with approximately 24 occurring in the summer months and 6 in winter). This equates to 4 vessel trips per month (1 a week) in summer and 1 vessel trip per month (0.25 a week) in winter. As each vessel will be berthed at the Project for approximately 2-5 days, in the summer months cranes are likely to be active between 8 – 20 days per month, and in winter 2 – 5 days per month.

The mobile cranes will typically be up to 250 tonnes capacity (Liebherr LTM1250 or similar). This type of crane has an extendable telescopic boom with a maximum height of 60m in vertical lift. Smaller mobile cranes of 60 and 90 tonnes capacity will be used to support the larger cranes and will find more use during the winter months due to lower boom heights and lower windage. The maximum boom height for Leibherr LTM10-60 is 48m. On-

board vessel cranes would be in the region of 70-125m height. The maximum number of cranes in use on site will depend on activities undertaken, but in the summer months, including on-board vessel cranes, could be up to 4 cranes on site, i.e. one on-vessel crane plus 3 mobile cranes. In winter, this number will be far less and is expected to be 2 (smaller) mobile cranes, given that large shipments requiring on-vessel cranes will be planned for summer months. Mobile cranes are slow-moving and generate limited engine noise at ground level.

During the summer months, mobile cranes will typically be stored on site at the Project, and in winter, either stored on site or taken offsite if they are required elsewhere. When not in use, mobile cranes will be lowered with booms retracted and placed horizontally. In this configuration, they are approximately 5m in height. These types of cranes do not normally provide their own lighting, and lifting operations in winter will typically be carried out in daylight hours.

6 LSE Screening

The section provides the LSE Screening assessment in order to identify the European sites with relevant qualifying features to be considered within the determination of potential LSE.

6.1 European Sites Designated for Annex I Habitats

6.1.1 Initial Screening Criteria

The initial screening criteria utilised to establish European sites with relevant Annex I habitats are:

- Sites which have direct overlap with the Project; and
- Sites located within 15 km of the Project.

6.1.2 Identification of European sites and Features with Connectivity

Based on the screening criteria above, there is one European sites with Annex I habitats that have connectivity to the Project: Loch of Stenness SAC. The site details are provided in Table 6-1 below and the site's location is shown on Figure 6-1.

Table 6-1 Summary of European sites designated for Annex I habitats with potential connectivity to the Project

Site name	Qualifying interest / features	Distance to the Project (km)
Loch of Stenness SAC	Annex I Coastal lagoons	15 km northwest

6.1.3 Potential Pathways for LSE

The following potential pathways for LSE that have been considered for the screening assessment are:

- Construction activities:
  - Temporary habitat loss and/or disturbance;
  - Increased suspended sediment concentration (SSC) and associate deposition (including mobilisation of potential contaminants within the sediment);
  - Increased risk of introduction of Invasive Non-Native Species (INNS); and
  - Accidental release of pollutants.
- Operation and maintenance activities:
  - Long-term habitat loss and/or disturbance;
  - Increased SSC and associated deposition;
  - Colonisation of hard structures;
  - Accidental release of pollutants; and
  - Introduction and spread of INNS.

6.2 European Sites Designated for Marine Mammals

6.2.1 Initial Screening Criteria

There are five marine mammal species listed in Annex II of the Habitats Directive, which have been considered in the LSE Screening assessment. These are:

- Grey seal (Halichoerus grypus);

- Harbour seal (*Phoca vitulina*);
- Harbour porpoise (*Phocoena phocoena*);
- Bottlenose dolphin (*Tursiops truncatus*); and
- Eurasian otter (*Lutra lutra*).
-

The initial screening criteria utilised to establish European sites with relevant Annex II marine mammal species (SACs) are:

- The European sites with marine mammal qualifying features which overlap the Project; and
- European sites with marine mammal qualifying features within a ZoI around the Project. For each marine mammal species, the ZoI is justified in the sections below.

6.2.2 Identification of European sites and Features with Connectivity

6.2.2.1 Pinnipeds

Table 6-2 outlines the foraging ranges for the Annex II pinniped species, which will be used to determine the potential connectivity to European sites.

Table 6-2 ZoI used to identify pinniped SACs with potential connectivity to the Project.

Species	Justification	Search area
Grey Seal	Grey seals can forage great distances (more than 100 km) from their haul-out sites. However, foraging tends to be concentrated closer to haul-out sites, especially during breeding season (Carter *et al*., 2020). NatureScot general advice is that protected areas for grey seals within 20 km should be considered for connectivity.	20 km (at sea distance)
Harbour Seal	Harbour seals usually forage around 30 – 50 km from the coastline, with high concentrations near haul-out sites (Bailey *et al.,* 2014). SACs for harbour seal are to protect the breeding population, and harbour seals can travel up to 50 km from their colonies during the breeding period. NatureScot general advice is that protected areas for harbour seals within 50 km should be considered for connectivity.	50 km (at sea distance)

No European sites designated for the protection of grey seals as a primary conservation feature overlap or are within 20 km of the Project. As such, it is considered there is no potential for connectivity to any European site designated for grey seal, and therefore, these sites have been screened out for further assessment.

Harbour seals are a designated feature of the Sanday SAC which is located 36 km northeast from the Project (see Figure 6-1) with an at-sea-distance of ~85 km.

Although the standard screening distance for potential effects on harbour seals is typically 50 km – a threshold that would ordinarily result in the Sanday SAC being screened out based on the at-sea distance of 85 km, recent evidence of the significant and ongoing decline in the Orkney harbour seal population, alongside increasing understanding of wider-ranging foraging behaviour, supports a more precautionary approach. These factors indicate that seals associated with the Sanday SAC may utilise areas well beyond traditional screening buffers, increasing the likelihood of potential interaction with project activities. NatureScot has requested the inclusion of the Sanday SAC within the Project's HRA process since the Project Scoping stage in 2021 (Table 4-1) on the basis that any harbour seals present within Scapa Flow may be functionally linked to the SAC and should therefore be assessed. Ongoing consultation has reinforced the expectation for a more quantitative evaluation of Project impacts on the Sanday SAC harbour seals. For these reasons, the harbour seal qualifying features of the Sanday SAC remain within the LSE Screening.

6.2.2.2 Cetaceans

The overlapping cetacean Management Units (MU) are used to delineate an area of search for European sites with potential connectivity with the Project. The relevant MU for Annex II cetaceans are:

- Harbour porpoise: North Sea MU; and
- Bottlenose dolphin: Coastal East Scotland MU.

There are 52 SACs for harbour porpoise that lie within/overlap the North Sea MU. The closest of these SACs to the Project is the Inner Hebrides and the Minches SAC, which lies approx. 200 km from the Project.

There is one SAC for bottlenose dolphin which lies within/overlaps the Coastal East Scotland and/or Greater North Sea MUs. This is the Moray Firth SAC, which lies in the inner Moray Firth, in Scottish waters, and is designated to protect key habitat for the resident east of Scotland population of around 226 individual bottlenose dolphins (Cheney *et al*,. 2024).

Table 6-3 outlines the ZoI for the Annex II cetacean species, which will be used to determine potential connectivity to European sites.

Table 6-3 ZoI used to identify cetaceans SACs with potential connectivity to the Project.

Species	Justification	Search area
Harbour porpoise	Harbour porpoise are the most abundant cetacean species in UK waters (Reid *et al.,* 2003) and are most commonly observed along the east coast of Scotland (NMPi, 2026). Harbour porpoise are extremely mobile, nonetheless, a 50 km buffer from the Project is considered proportionate for consideration of potential connectivity from impacts from the Project.	50 km (at sea distance)
Bottlenose dolphin	The species are common in coastal waters and are mostly distributed in nearshore, shallow waters within 2 km of the coast (Quick *et al.*, 2014). Bottlenose dolphin are very mobile, nonetheless, a 50 km buffer from the Project is considered proportionate for consideration of potential connectivity from impacts from the Project.	50 km (at sea distance)

No European sites designated for the protection of harbour porpoise or bottlenose dolphin as a primary conservation feature overlap, or are within 50 km of the Project. Due to the distance to any European site for harbour porpoise, and the short-term, temporary, and transient nature of any activity resulting from the Project that could have impacts on porpoises or dolphins, no LSE resulting from the Project will occur within the boundaries of any European site designated for harbour porpoise or bottlenose dolphin.

Secondly, while these cetacean species are mobile predators, and individuals associated with a European site could theoretically occur within or close to (<50 km) the Project, any short-term, temporary and transient impacts on those individuals would not be likely to have a significant effect on the population occurring within those European sites. As such, it is considered there will be no LSE on any European site designated for cetaceans, and therefore, they have been screened out for further assessment.

6.2.2.3 European Otter

Otters in coastal habitats can hold ranges of up to 20 km, which is less than inland otter, which may have territories of up to 32 km. There are records of otters in the locality of the Project site (NBN Atlas, 2026). The Loch of Isbister SAC is a designated area for Eurasian otter which is located ~26 km from the Project. Therefore, otter have not been considered further in this assessment as no potential for effects are anticipated from activities associated with the Project.

6.2.3 Summary of European sites and Features Considered for Screening

Table 6-4 presents a summary of the SACs and qualifying features taken forward for the screening assessment within Section 9. These European sites are shown in Figure 6-1.

Table 6-4 Summary of European sites and features considered for screening assessment.

SAC Name	Marine mammal qualifying interest / feature	Distance to the Project
Sanday SAC	Harbour seal	36 km northeast (85 km at-sea)

6.2.4 Potential Pathways for LSE

The following potential pathways for LSE that have been considered for the screening assessment are:

- Construction activities:
  - Disturbance to prey species and habitats of prey species through increase in SSC;
  - Accidental release of pollutants.
  - Acoustic impacts (including physiological impacts, barrier effects and displacement) associated with construction noise (vessels and construction activities);
  - Risk of injury resulting from collisions with construction vessels;
- Operation and maintenance activities:
  - Risk of injury resulting from collision with operation and maintenance vessels.

6.3 European Sites Designated for Ornithological Features

6.3.1 Identification of European Sites and Features with Connectivity

The screening criteria approach was not used to identify European sites and features with connectivity. Instead, the selection of these sites has been informed through the consultation with NatureScot, as outlined in Table 4-1, as well as specialist judgement.

Based on the above, there are four European sites with ornithological features that have connectivity to the Project: Scapa Flow SPA; North Orkney SPA; Orkney Mainland Moors SPA; and Hoy SPA. The site details are provided in Table 6-5 below and the site's location is shown on Figure 6-1.

Table 6-5 Summary of European sites designated for ornithological features with potential connectivity to the Project

Site name	Qualifying interest / features	Distance to the Project (km)
Scapa Flow SPA	• Great northern diver (*Gavia immer*), non-breeding; • Long-tailed duck (*Clangula hyemalis*), non-breeding; • Red-breasted merganser (*Mergus serrator*), non-breeding; • Red-throated diver (*Gavia stellata*), breeding; • Shag (Phalacrocorax aristotelis), non-breeding; • Slavonian grebe (*Podiceps auritus*), non-breeding; • Black-throated Diver (*Gavia arctica*), non-breeding; and • Eider (*Somateria mollissima*), non-breeding.	Direct overlap
North Orkney SPA	• Great northern diver, non-breeding;	4 km northeast

Site name	Qualifying interest / features	Distance to the Project (km)
	• Red-throated diver, breeding; • Slavonian grebe, non-breeding; and • Velvet scoter (*Melanitta fusca*), non-breeding.	
Orkney Mainland Moors SPA	• Hen harrier (*Circus cyaneus*), breeding; • Hen harrier, non-breeding; • Red-throated diver, breeding; • Short-eared owl (*Asio flammeus*), breeding.	6 km northwest
Hoy SPA	• Arctic skua (*Pterocarpus parasiticus*), breeding; • Fulmar (*Fulmarus glacialis*), breeding; • Great black-backed gull (*Larus marinus*), breeding; • Great skua (*Stercorarius skua*), breeding; • Guillemot (*Uria aalge*), breeding; • Kittiwake (*Rissa tridactyla*), breeding; • Peregrine (*Falco peregrinus*), breeding; • Puffin (*Fratercula arctica*), breeding; • Red-throated diver, breeding; • Seabird assemblage, breeding.	16.5 km west

6.3.2 Potential Pathways for LSE

Potential pathways for LSE on ornithological features of European sites with potential connectivity to the Project have been identified. These may occur during construction activities, and operation and maintenance. The potential pathways that have been screened in for ornithological features are:

- Construction:
  - Disturbance of birds due to construction activities (via dredging activities, vessel presence, onshore vehicle movement, terrestrial blasting);
  - Disturbance to prey species and habitats of prey species; and
  - Accidental release of contaminants or pollutants
- Operations and maintenance:
  - Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle movement, and use of mobile cranes on the quayside);
  - Accidental release of contaminants; and
  - Ornithological habitat changes including potential alterations to foraging abilities.

6.4 Determination of Potential LSE

Table 6-6 presents the results of the assessment to determine potential LSE on qualifying features and habitats of European sites identified to have potential connectivity. Justification has also been provided for whether no potential LSE can be concluded. Where all potential pathways for LSE across all Project phases are discounted, then the European site has been screened out of further assessment.

Figure 6-1 illustrates the European sites that have been screened into further assessment, following the LSE Screening exercise presented below.

Table 6-6 Screening Assessment for LSE

Site Name	Qualifying Interest / Feature	Distance and direction to the Project	Project Phase	Impact pathway for LSE	LSE Screening	Screening Conclusion
Scapa Flow SPA	• Great northern diver, non-breeding; • Long-tailed duck, non-breeding; • Red-breasted merganser, non-breeding; • Red-throated diver, breeding; • Shag, non-breeding; • Slavonian grebe, non-breeding; • Black-throated Diver, non-breeding; and • Eider, non-breeding.	Direct overlap	Construction	• Disturbance of birds due to construction activities (via dredging activities, vessel presence, onshore vehicle movement, terrestrial blasting).	Construction activities required for the Project (dredging activities, vessel presence and movement, onshore vehicle movement, terrestrial blasting) have the potential to result in behavioural disturbance and/or displacement of the qualifying features of the Scapa Flow SPA given the direct overlap with the Project. **Therefore, there is a potential for LSE on all qualifying ornithological features of the SPA.**	Screened in.
				• Disturbance to prey species and habitats of prey species.	Construction activities required for the Project (particularly the dredging activities) have the potential to disturb the seabed and cause increased sedimentation within the water column, which could result in an adverse impact to prey species and their habitat(s). This may result in indirect effects to the qualifying features of the Scapa Flow SPA through disturbance of prey species. **Therefore, there is a potential for LSE on all qualifying ornithological features of the SPA.**	Screened in.
				• Accidental release of contaminants or pollutants.	Construction activities required for the Project (dredging activities, vessel presence and movement, onshore vehicle movement) have the potential to result in accidental release of contaminants or pollutants which could impact the qualifying features of the Scapa Flow SPA. **Therefore, there is a potential for LSE on all qualifying ornithological features of the SPA.**	Screened in.
			Operation & maintenance	• Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle movement, and use of mobile cranes on the quayside).	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) have the potential to result in behavioural disturbance and/or displacement of the qualifying features of the Scapa Flow SPA given the direct overlap with the Project. **Therefore, there is a potential for LSE on all qualifying ornithological features of the SPA.**	Screened in.
				• Accidental release of contaminants or pollutants.	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) have the potential to result in accidental release of contaminants or pollutants which could affect the qualifying features of the Scapa Flow SPA. **Therefore, there is a potential for LSE on all qualifying ornithological features of the SPA.**	Screened in.
				• Ornithological habitat changes including potential alterations to foraging abilities.	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) may potentially result in changes to lower trophic levels (e.g. benthic fauna and forage fish species) which may result in changes to foraging opportunities for the qualifying features of the Scapa Flow SPA. **Therefore, there is a potential for LSE on all qualifying ornithological features of the SPA.**	Screened in.
North Orkney SPA	• Great northern diver, non-breeding; • Red-throated diver, breeding; • Slavonian grebe, non-breeding; and • Velvet scoter, non-breeding.	4 km northeast	Construction	• Disturbance of birds due to construction activities (vessel presence, onshore vehicle movement, terrestrial blasting).	Construction activities required for the Project (vessel presence and movement, onshore vehicle movement, terrestrial blasting) have the potential to result in behavioural disturbance and/or displacement of the qualifying features of the North Orkney SPA given the proximity to the Project. No velvet scoter were recorded during the baseline surveys. Therefore, it is considered unlikely that this species will have connectivity with the Project via this impact pathway and there is considered to be no potential for LSE on velvet scoter. Therefore, there is a potential for LSE on qualifying ornithological features of the SPA with the exception of velvet scoter.	Screened in (except velvet scoter).
				• Disturbance to prey species and habitats of prey species.	Construction activities required for the Project (particularly the dredging activities) have the potential to disturb the seabed and cause increased sedimentation within the water column, which could result in an adverse impact to prey species and their habitat(s). This may result in indirect effects to the qualifying features of the North Orkney SPA through disturbance of prey species. No velvet scoter were recorded during the baseline surveys. Therefore, it is considered unlikely that this species will have connectivity with the Project via this impact pathway and there is considered to be no potential for LSE on velvet scoter. Therefore, there is a potential for LSE on qualifying ornithological features of the SPA with the exception of velvet scoter.	Screened in (except velvet scoter).
				• Accidental release of contaminants or pollutants.	Construction activities required for the Project (dredging activities, vessel presence and movement, onshore vehicle movement) have the potential to result in accidental release of contaminants or pollutants which could impact the qualifying features of the North Orkney SPA. No velvet scoter were recorded during the baseline surveys. Therefore, it is considered unlikely that this species will have connectivity with the Project via this impact pathway and there is considered to be no potential for LSE on velvet scoter.	Screened in (except velvet scoter).

Site Name	Qualifying Interest / Feature	Distance and direction to the Project	Project Phase	Impact pathway for LSE	LSE Screening	Screening Conclusion
					Therefore, there is a potential for LSE on qualifying ornithological features of the SPA with the exception of velvet scoter.	
			Operation & maintenance	• Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle movement, and use of mobile cranes on the quayside).	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) have the potential to result in behavioural disturbance and/or displacement of the qualifying features of the North Orkney SPA given the direct overlap with the Project. No velvet scoter were recorded during the baseline surveys. Therefore, it is considered unlikely that this species will have connectivity with the Project via this impact pathway and there is considered to be no potential for LSE on velvet scoter. Therefore, there is a potential for LSE on qualifying ornithological features of the SPA with the exception of velvet scoter.	Screened in (except velvet scoter).
				• Accidental release of contaminants or pollutants.	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) have the potential to result in accidental release of contaminants or pollutants which could affect the qualifying features of the North Orkney SPA. No velvet scoter were recorded during the baseline surveys. Therefore, it is considered unlikely that this species will have connectivity with the Project via this impact pathway and there is considered to be no potential for LSE on velvet scoter. Therefore, there is a potential for LSE on qualifying ornithological features of the SPA with the exception of velvet scoter.	Screened in (except velvet scoter).
				• Ornithological habitat changes including potential alterations to foraging abilities.	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) may potentially result in changes to lower trophic levels (e.g. benthic fauna and forage fish species) which may result in changes to foraging opportunities for the qualifying features of the North Orkney SPA. No velvet scoter were recorded during the baseline surveys. Therefore, it is considered unlikely that this species will have connectivity with the Project via this impact pathway and there is considered to be no potential for LSE on velvet scoter. Therefore, there is a potential for LSE on qualifying ornithological features of the SPA with the exception of velvet scoter.	Screened in (except velvet scoter).
Orkney Mainland Moors SPA	• Hen harrier, breeding; • Hen harrier non-breeding; • Red-throated diver, breeding; and • Short-eared owl, breeding.	6 km northwest	Construction	• Disturbance of birds due to construction activities (via dredging activities, vessel presence, onshore vehicle movement, terrestrial blasting).	Construction activities required for the Project (dredging activities, vessel presence and movement, onshore vehicle movement, terrestrial blasting) have the potential to result in behavioural disturbance and/or displacement of the qualifying seabird features of the Orkney Mainland Moors SPA given the proximity to the Project. It is anticipated the potential for LSE will extend to red-throated diver only; hen harrier and short-eared owl are terrestrial species and therefore will have limited connectivity with the Project via this impact pathway. There is therefore no potential for LSE on the hen harrier and short-eared owl terrestrial species. T**here is a potential for LSE on red-throated diver.**	Screened in (red-throated diver only).
				• Disturbance to prey species and habitats of prey species.	Construction activities required for the Project (particularly the dredging activities) have the potential to disturb the seabed and cause increased sedimentation within the water column, which could result in an adverse impact to prey species and their habitat(s). This may result in indirect effects to the qualifying seabird features of the Orkney Mainland Moors SPA through disturbance of prey species. It is anticipated the potential for LSE will extend to red-throated diver only; hen harrier and short-eared owl are terrestrial species and therefore will have limited connectivity with the Project via this impact pathway. There is therefore no potential for LSE on the hen harrier and short-eared owl terrestrial species. **There is a potential for LSE on red-throated diver.**	Screened in (red-throated diver only).
				• Accidental release of contaminants or pollutants.	Construction activities required for the Project (dredging activities, vessel presence and movement, onshore vehicle movement) have the potential to result in accidental release of contaminants or pollutants which could impact the qualifying seabird features of the Orkney Mainland Moors SPA. It is anticipated the potential for LSE will extend to red-throated diver only; hen harrier and short-eared owl are terrestrial species and therefore will have limited connectivity with the Project via this impact pathway. There is therefore no potential for LSE on the hen harrier and short-eared owl terrestrial species. **There is a potential for LSE on red-throated diver.**	Screened in (red-throated diver only).

Site Name	Qualifying Interest / Feature	Distance and direction to the Project	Project Phase	Impact pathway for LSE	LSE Screening	Screening Conclusion
			Operation & maintenance	• Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle movement, and use of mobile cranes on the quayside).	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) have the potential to result in behavioural disturbance and/or displacement of the qualifying seabird features of the Orkney Mainland Moors SPA given the direct overlap with the Project. It is anticipated the potential for LSE will extend to red-throated diver only; hen harrier and short-eared owl are terrestrial species and therefore will have limited connectivity with the Project via this impact pathway. There is therefore no potential for LSE on the hen harrier and short-eared owl terrestrial species. **There is a potential for LSE on red-throated diver.**	Screened in (red-throated diver only).
				• Accidental release of contaminants.	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) have the potential to result in accidental release of contaminants or pollutants which could affect the qualifying seabird features of the Orkney Mainland Moors SPA. It is anticipated the potential for LSE will extend to red-throated diver only; hen harrier and short-eared owl are terrestrial species and therefore will have limited connectivity with the Project via this impact pathway. There is therefore no potential for LSE on the hen harrier and short-eared owl terrestrial species. **There is a potential for LSE on red-throated diver.**	Screened in (red-throated diver only).
				• Ornithological habitat changes including potential alterations to foraging abilities.	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) may potentially result in changes to lower trophic levels (e.g. benthic fauna and forage fish species) which may result in changes to foraging opportunities for the qualifying seabird features of the Orkney Mainland Moors SPA. It is anticipated the potential for LSE will extend to red-throated diver only; hen harrier and short-eared owl are terrestrial species and therefore will have limited connectivity with the Project via this impact pathway. There is therefore no potential for LSE on the hen harrier and short-eared owl terrestrial species. **There is a potential for LSE on red-throated diver.**	Screened in (red-throated diver only).
Hoy SPA	• Arctic skua, breeding; • Fulmar, breeding; • Great black-backed gull, breeding; • Great skua, breeding; • Guillemot, breeding; • Kittiwake, breeding; • Peregrine, breeding; • Puffin, breeding; • Red-throated diver, breeding; and • Seabird assemblage, breeding.	16.5 km west	Construction	• Disturbance of birds due to construction activities (via dredging activities, vessel presence, onshore vehicle movement, terrestrial blasting).	Construction activities required for the Project (dredging activities, vessel presence and movement, onshore vehicle movement, terrestrial blasting) have the potential to result in behavioural disturbance and/or displacement of the qualifying features of the Hoy SPA given the proximity to the Project. It is anticipated the potential for LSE will extend to seabird species only; as a terrestrial species, peregrine will have limited connectivity with the Project via this impact pathway. Therefore there is no potential for LSE on peregrine, but there is a potential for LSE on the seabird species.	Screened in (seabird species only).
				• Disturbance to prey species and habitats of prey species.	Construction activities required for the Project (particularly the dredging activities) have the potential to disturb the seabed and cause increased sedimentation within the water column, which could result in an adverse impact to prey species and their habitat(s). This may result in indirect effects to the qualifying features of the Hoy SPA through disturbance of prey species. It is anticipated the potential for LSE will extend to seabird species only; as a terrestrial species, peregrine will have limited connectivity with the Project via this impact pathway. Therefore there is no potential for LSE on peregrine, but there is a potential for LSE on the seabird species.	Screened in (seabird species only).
				• Accidental release of contaminants or pollutants.	Construction activities required for the Project (dredging activities, vessel presence and movement, onshore vehicle movement) have the potential to result in accidental release of contaminants or pollutants which could impact the qualifying features of the Hoy SPA. It is anticipated the potential for LSE will extend to seabird species only; as a terrestrial species, peregrine will have limited connectivity with the Project via this impact pathway. Therefore there is no potential for LSE on peregrine, but there is a potential for LSE on the seabird species.	Screened in (seabird species only).
			Operation & maintenance	• Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) have the potential to result in behavioural disturbance and/or displacement of the qualifying features of the Hoy SPA given the direct overlap with the Project. It is anticipated the potential for LSE will extend to seabird	Screened in (seabird species only).

Site Name	Qualifying Interest / Feature	Distance and direction to the Project	Project Phase	Impact pathway for LSE	LSE Screening	Screening Conclusion
				movement, and use of mobile cranes on the quayside).	species only; as a terrestrial species, peregrine will have limited connectivity with the Project via this impact pathway. Therefore there is no potential for LSE on peregrine, but there is a potential for LSE on the seabird species.	
				• Accidental release of contaminants or pollutants.	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) have the potential to result in accidental release of contaminants or pollutants which could affect the qualifying features of the Hoy SPA. It is anticipated the potential for LSE will extend to seabird species only; as a terrestrial species, peregrine will have limited connectivity with the Project via this impact pathway. Therefore there is no potential for LSE on peregrine, but there is a potential for LSE on the seabird species.	Screened in (seabird species only).
				• Ornithological habitat changes including potential alterations to foraging abilities.	Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) may potentially result in changes to lower trophic levels (e.g. benthic fauna and forage fish species) which may result in changes to foraging opportunities for the qualifying features of the Hoy SPA. It is anticipated the potential for LSE will extend to seabird species only; as a terrestrial species, peregrine will have limited connectivity with the Project via this impact pathway. Therefore there is no potential for LSE on peregrine, but there is a potential for LSE on the seabird species.	Screened in (seabird species only).
Loch of Stenness SAC	• Annex I Coastal lagoons	15 km northwest	Construction	• Temporary habitat loss and/or disturbance.	All temporary habitat loss and/or disturbance of habitat is anticipated to be within the Project site only. As this SAC is located 15 km from the Project, there is no pathway for temporary loss or disturbance to features of this SAC. **Therefore, there is no potential for LSE.**	Screened out.
				• Increased SSC and associate deposition (including mobilisation of potential contaminants within the sediment).	Construction activities can disturb the seabed and cause increased sedimentation within the water column, impacting the water quality. However, any sediment suspended into the water column during construction activities will be small in volume, highly localised and temporary. As this SAC is located 15 km from the Project, there is no pathway for increased SSC and deposition to impact features of this SAC. **Therefore, there is no potential for LSE.**	Screened out.
				• Increased risk of introduction of INNS.	The movement of vessels during the construction phases of the Project, and discharge from dredging barge water ballast have the potential to result in the introduction of INNS. **Therefore, there is a potential for LSE.**	Screened in.
				• Accidental release of pollutants.	Construction activities have the potential to accidentally release pollutants into the marine environment which may result in impacts to the qualifying features of this SAC. **Therefore, there is a potential for LSE.**	Screened in.
			Operation & maintenance	• Long-term habitat loss and/or disturbance.	All long-term habitat loss and/or disturbance of habitat is anticipated to be within the Project site only. As this SAC is located 15 km from the Project, there is no pathway for temporary loss or disturbance to features of this SAC. **Therefore, there is no potential for LSE.**	Screened out.
				• Increased SSC and associated deposition.	Operation and maintenance activities can disturb the seabed and cause increased sedimentation within the water column, impacting the water quality. However, any sediment suspended into the water column during construction activities will be small in volume, highly localised and temporary. As this SAC is located 15 km from the Project, there is no pathway for increased SSC and deposition to impact features of this SAC. **Therefore, there is no potential for LSE.**	Screened out.
				• Colonisation of hard structures.	There is no potential for colonisation of hard substrate within this SAC. All potential colonisation of hard substrate from Project material on the seabed is expected within the Project footprint only. **As such, there is no potential for LSE.**	Screened out.
				• Accidental release of pollutants.	Operation and maintenance activities have the potential to accidentally release pollutants into the marine environment which may result in impacts to the qualifying features of this SAC. **Therefore, there is a potential for LSE.**	Screened in.
				• Introduction and spread of INNS.	The movement of vessels during the operation and maintenance phases of the Project, and discharge from barge water ballast have the potential to result in the introduction of INNS. **Therefore, there is a potential for LSE.**	Screened in.
Sanday SAC	• Harbour seal.	36 km northeast	Construction	• Disturbance to prey species and habitats of prey species through increase in SSC.	Construction activities can disturb the seabed and cause increased sedimentation within the water column, which may restrict visibility and make it difficult for foraging prey species resulting in habitat loss and increase sediment deposition. This may result in indirect effects	Screened in.

Site Name	Qualifying Interest / Feature	Distance and direction to the Project	Project Phase	Impact pathway for LSE	LSE Screening	Screening Conclusion
					to the qualifying features of this SAC through disturbance of prey species. **Therefore, there is potential for LSE.**	
				• Accidental release of pollutants.	Construction activities have the potential to accidentally release pollutants into the marine environment which may result in impacts to the qualifying features of this SAC. **Therefore, there is a potential for LSE.**	Screened in.
				• Acoustic impacts (including physiological impacts, barrier effects and displacement) associated with construction noise (vessels and activities).	Marine mammals can be sensitive to noise-related construction activities and may cause behavioural changes. Due to the nature of the works (dredging activities, vessel presence and movement), the construction activities could cause significant adverse impacts on marine mammals as the activities will introduce anthropogenic sound to the environment which may result in impacts to the qualifying features of this SAC. **Therefore, there is a potential for LSE.**	Screened in.
				• Risk of injury resulting from collisions with construction vessels.	It is anticipated that increased vessel traffic and dredging activities from the construction phase of the Project has the potential to increase collision risk to marine mammals that are present in and around the Project site. Whilst the likelihood of vessel collisions is dependent upon vessel speed, animal behaviour and vessel manoeuvrability, there is the potential for LSE on the qualifying features of the SAC. **Therefore, there is a potential for LSE.**	Screened in.
			Operation & maintenance	• Risk of injury resulting from collision with operation and maintenance vessels.	It is anticipated that increased vessel traffic from the operation and maintenance phase of the Project has the potential to increase collision risk to marine mammals that are present in and around the Project site. Whilst the likelihood of vessel collisions is dependent upon vessel speed, animal behaviour and vessel manoeuvrability, there is the potential for LSE on the qualifying features of the SAC. **Therefore, there is a potential for LSE.**	Screened in.
				• Accidental release of pollutants.	Operation and maintenance activities have the potential to accidentally release pollutants into the marine environment which may result in impacts to the qualifying features of this SAC. **Therefore, there is a potential for LSE.**	Screened in.

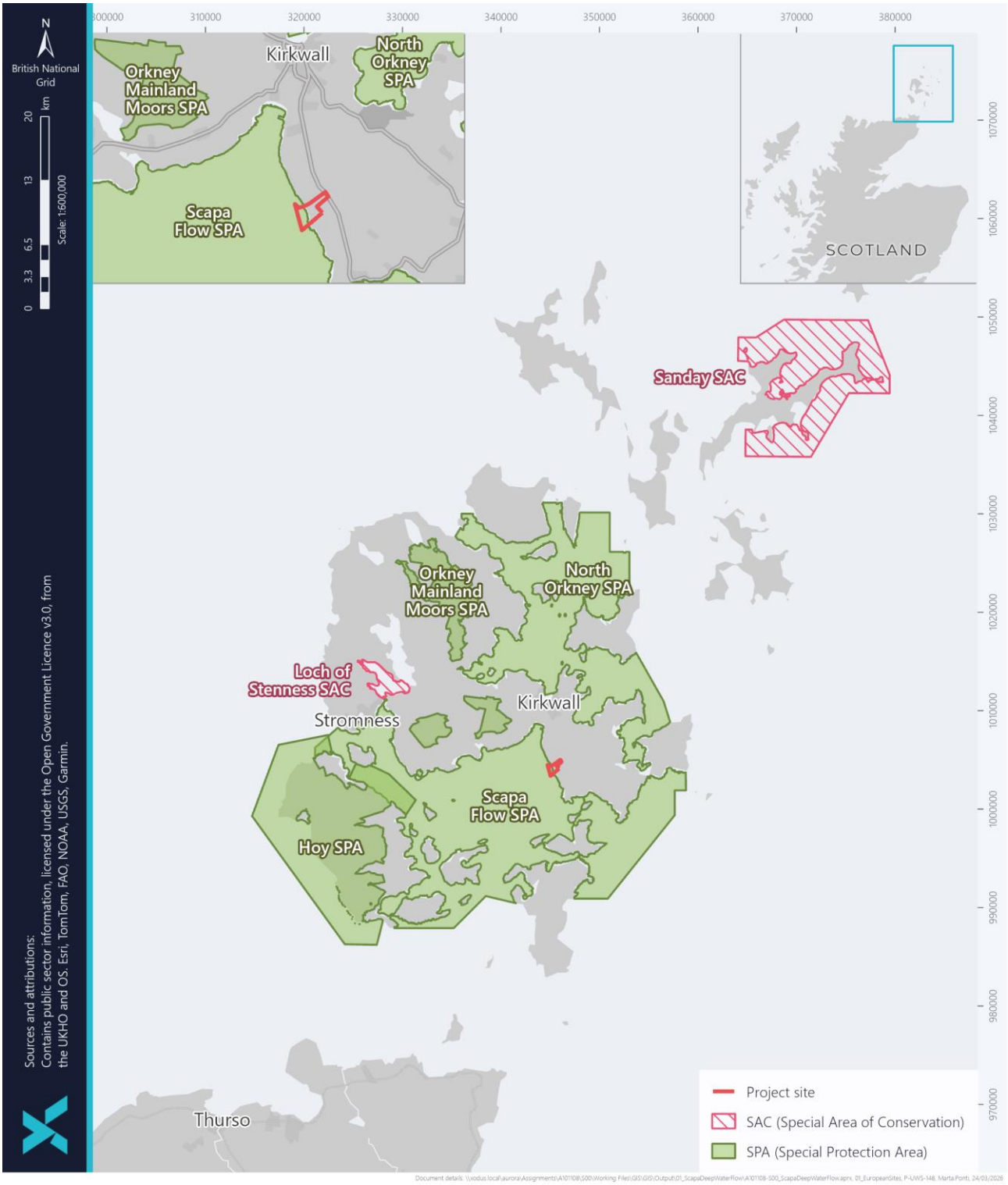


Figure 6-1 European sites screened in for assessment

7 Mitigation Plans

Table 7-1 below outlines the Schedule of Mitigation, comprising measures committed to within the EIA Report (EnviroCentre, 2023), the Supplementary Environmental Information (EnviroCentre, 2025a; 2025b) including the supporting HRA submission (Appendix B of EnviroCentre, 2025a) and the Seal Risk Assessment (Appendix D of EnviroCentre, 2025a).

These mitigation measures and plans will be used to inform the subsequent section Information to Inform Appropriate Assessment, as outlined in the methodology presented in Section 2.2.5.

Table 7-1 Schedule of Mitigation

Feature / Topic	Mitigation	Reference
Construction		
Construction Environmental Management Document (CEMD)	A CEMD will be developed and adhered to, to ensure that the mitigation measures outlined in the EIAR, HRA Report and Project consents are followed during the proposed construction works. The CEMD will be developed as a practical tool to facilitate the management of environmental mitigation measures and to provide a clear roadmap of the key roles and responsibilities during construction. All mitigation measures will be incorporated into the CEMD, which will include detailed Construction Method Statements (CMS). A Biosecurity Plan will be produced as part of the CEMD, which will set out the measures to prevent the introduction of invasive non-native species, in accordance with relevant legislation and best practice. An Outline CEMD has been produced (see Appendix I of the SEIR May 2025) and will be developed once a contractor has been appointed. The CEMD will remain a live document and will be updated as the work progresses.	
Environmental Clerk of Works (ECoW)	An ECoW will monitor the construction works to ensure that the CEMD and associated mitigation measures are implemented effectively.	
Pollution Incident Response Plan	A Pollution Incident Response Plan will be developed relating to the construction of the Project site, identifying statutory requirements and areas of highest sensitivity. This will provide site spill response procedures, emergency contact details, and equipment inventories and their location. All staff will be made aware of this document and its content during site induction. A copy will be available in the site office(s) at all times.	
Turbidity Monitoring	As a precautionary measure, turbidity monitoring will be undertaken to protect water quality and ensure minimal environmental impact. Details of the monitoring, including threshold levels, will be set out in the CEMD.	
Vessel Management Plan	A Vessel Management Plans will be developed and adhered to for the construction and operational phases, with input from NatureScot, to avoid disturbance to and/or collision with birds and marine mammals. Plans will include vessel routes, speed limits and safe vessel operation, and will incorporate advice from the Scottish Marine Wildlife Watching Code[4], including: • Keep a safe distance from marine mammals. Never get closer than 100m (200m if another boat is present), but if within 100m, switch the engine to neutral; • Never drive head on to, or move between, scatter or separate marine mammals. If unsure of their movements, simply stop and put the engine into neutral; • Spend no longer than 15 minutes near the animals; • Special care must be taken with mothers and young; • Maintain a steady direction and a slow 'no wake' speed; • Avoid sudden changes in speed; and • Consider training courses such as the WiSe scheme[5].	
Ballast Water Management	• A Ballast Water Management Plan will be developed and adhered to, incorporating industry standard ballast water management practices. • The Plan will include the continuation of OICHA's biosecurity monitoring programme, as detailed in the existing Ballast Water Management Policy.	
Silt boom	A silt boom will be used to contain fine sediments if any open water reclamation work activities are undertaken.	
Marine Mammal Protection Plan (MMPP)	An Outline MMPP has been developed Appendix F of SEIR May 2025) and will be developed once a contractor has been appointed. An Outline Seal Protection Plan (SPP) has also been produced (see SEIR September 2025) and will be developed once a contractor has been appointed. This will include: • Safe vessel operation to minimise risk of collision with marine mammals (and basking shark) including adherence to the Scottish Marine Wildlife Watching Code, will be promoted to users (see also Vessel Management Plans above). • A 6 m high bund will be formed at the seaward boundary of the site by retaining the existing land and excavating behind, creating a natural noise screen from terrestrial blasting (and other works) and will only be removed once the site is excavated to the final profile.	

[4] https://www.nature.scot/doc/scottish-marine-wildlife-watching-code-smwwc
[5] Information available at: https://www.wisescheme.org/ (accessed 02/06/2023)

Feature / Topic	Mitigation	Reference
Construction and Operation & Maintenance		
Pollution Prevention Plan	Part of the CEMD will include pollution prevention measures (e.g., Pollution Prevention Plan) that will be in place during construction will include measures to deal with accidental spillages.	
Vessel Management Plan	A Vessel Management Plans will be developed and adhered to for the construction and operational phases, with input from NatureScot, to avoid disturbance to and/or collision with birds and marine mammals. Plans will include vessel routes, speed limits and safe vessel operation, and will incorporate advice from the Scottish Marine Wildlife Watching Code[6], including: • Keep a safe distance from marine mammals. Never get closer than 100m (200m if another boat is present), but if within 100m, switch the engine to neutral; • Never drive head on to, or move between, scatter or separate marine mammals. If unsure of their movements, simply stop and put the engine into neutral; • Spend no longer than 15 minutes near the animals; • Special care must be taken with mothers and young; • Maintain a steady direction and a slow 'no wake' speed; • Avoid sudden changes in speed; and • Consider training courses such as the WiSe scheme[7].	

[6] https://www.nature.scot/doc/scottish-marine-wildlife-watching-code-smwwc
[7] Information available at: https://www.wisescheme.org/ (accessed 02/06/2023)

8 Annex I Habitats – Information to Inform Appropriate Assessment

8.1 Introduction

This section provides an assessment of the potential for the Project to result in an Adverse Effect on Site Integrity (AEoSI) on SACs designated for the conversation of Annex I habitats. An assessment of the potential for the Project to result in an AEoSI is provided for the Project-alone and for the Project in combination with other projects, plans and activities.

8.1.1 Screening Outcome

The European sites, Annex I habitat qualifying features and relevant impact pathway where LSE could not be excluded as part of the LSE Screening process are as follows:

Table 8-1 Qualifying features and associated European sites screened in for potential LSE

Site name	Annex I Habitat qualifying interest features /	Project phase	Impact pathways screened in for potential LSE
Loch of Stenness SAC	Annex I coastal lagoons	Construction	Increased risk of introduction of INNS.
			Accidental release of pollutants.
		Operation & maintenance	Increased risk of introduction of INNS.
			Accidental release of pollutants.

This assessment includes consideration of potential impacts to coastal lagoon Annex I habitat as the qualifying feature of the Loch of Stenness SAC only. All other European Sites with Annex I habitat qualifying features have been screened out, as detailed in Section 6, on the basis that LSE could be excluded.

8.2 Assessment Approach

8.2.1 Project Design Envelope Parameters

This section outlines the Project Design Envelope Parameters to support the assessment of the impact pathways screened in to this Information to Inform Appropriate Assessment, as determined from the Project Description presented in Section 5.

8.2.1.1 Vessel movements during construction

Per Table 5-3, the construction phase will see a total of 112 vessel movements over the 26-month period. This includes: Caisson deliveries and tug operations; Scour protection trips; Caisson infill trips; and Dredging disposal trips (barge to FI040).

8.2.1.2 Vessel movements during operation

Per Section 5.4.1. there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

8.2.1.3 Dredging method and duration

Dredging for the project will involve a total of 379,407 m³ of material, comprising 72,653 m³ of hard dredge and 306,754 m³ of soft dredge, with up to 82,000 m³ of unsuitable glacial till potentially requiring sea disposal. A single dredge campaign is planned using a cutter suction dredger over an estimated twelve-week period from June to August 2028, covering the full quay alignment to depths of –15 m CD in most areas and –20 m CD in the deep pocket.

Dredged sediments will be pumped through a pipeline into a reclamation bund constructed to +4.0 m CD using screened site-won material, with an integrated weir box to manage overflow. Turbidity will be monitored outside the bund and silt booms deployed during infilling.

8.2.1.4 Ballast water and caisson transport

Caissons will be transported to site on a semi-submersible vessel and kept dry during transit, which significantly reduces the risk of biofouling. After placement at Scapa Flow, ballasting operations will use local seawater, and some caissons may undergo temporary in-water wet storage before installation.

8.2.1.5 Mitigation and Monitoring

Table 7-1 outlines the Schedule of Mitigation the Project has committed to during both construction and operation phases. Those specifically related to this Annex I assessment (based on the impact pathways screened in) include:

- Adherence to a CEMD;
- Use of an ECoW;
- Pollution Incident Response Plan;
- Turbidity Monitoring;
- Use of a silt boom during construction;
- Ballast Water Management;
- Pollution Prevention Plan.

8.2.2 In-combination Assessment

Projects within the locality of the Loch of Stenness SAC are considered to have the potential to result in in-combination effects on Annex I habitats as qualifying interests of protected sites. The plans and projects considered for the in-combination assessment in relation to the Loch of Stenness SAC are outlined in Table 8-2.

Table 8-2 Plans and projects considered for the in-combination assessment of benthic features

Plan or Project	Development type	Status	Distance from Project
North Coast and Orkney regional cable surveys	Cables	Consented	Various
SSEN Orkney to Caithness HVAC	Cables	Under construction	22 km

8.3 Loch of Stenness SAC

8.3.1 Site Description and Qualifying Features

The Loch of Stenness SAC covers an area of 792.59 ha and is a large, predominantly brackish lagoon situated on Mainland, Orkney (NatureScot, 2025b). It forms part of a linked hydrological system with the neighbouring Loch of Harray, and together these lochs constitute the largest lagoon complex in the UK. This SAC is located 15 km northwest of the Project site.

The loch is characterised by a single basin lagoon system typical of Orkney's coastal lagoon features, exhibiting attributes of both silled lagoons and lagoonal inlets. It is recognised as the largest brackish lagoon in the UK, with a stable and reduced-salinity regime. The brackish nature of the lagoon results from the partial connection to adjacent marine waters at Brig o' Waithe, where tidal currents influence salinity but cause limited water-level variation. Consequently, the system maintains a mixture of marine, brackish, and freshwater conditions across its extent. The feature condition and broader conservation status of the qualifying feature is presented in Table 8-3.

Table 8-3 Protected feature and condition for the Loch of Stenness SAC (NatureScot, 2025b)

Protected feature	Feature condition	Assessment date	Broader conservation status
Lagoon	Favourable, maintained	2003	Unfavourable – Inadequate

8.3.2 Conservation Objectives

The Conservation Objectives of the Loch of Stenness SAC (NatureScot, 2025b) are:

1. To ensure that the lagoons at Loch of Stenness SAC are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status.
2. To ensure that the integrity of Loch of Stenness SAC is maintained in the context of environmental changes by meeting objectives 2a, 2b and 2c for lagoons:
    - 2a. Extent and distribution of the habitat within the site.
    - 2b. Structure and function of the habitat and the supporting environment on which it relies.
    - 2c. Distribution and viability of typical species of the habitat.

As the most recent condition status of the lagoon feature was 'favourable', the Conservation Objectives seek to *Maintain* this condition. Supplementary conservation and management advice to support the achievement of the conservation objectives is provided by NatureScot (2025b) and is considered in the assessments below.

8.3.3 Assessment of Adverse Effects Alone

8.3.3.1 Introduction of INNS (all phases)

8.3.3.1.1 Assessment of Adverse Effects Alone

Project activities may introduce INNS capable of altering lagoon ecology through changes to habitat structure, competition with native biota, or modification of ecological processes. The potential for introduction or spread of INNS may arise from the following Project activities:

- Vessel movements;
- Ballast water transfer and sediment residues;
- Marine plant, animal, or microbial species transported on hulls, equipment, or dredging infrastructure; and
- Possible transfer of propagules to or from dredging and dredge-disposal locations.

The Project includes dredging at the proposed quay site, with dredge disposal at FI040 Stromness A, located outside Scapa Flow. The disposal site lies approximately 15 km direct (or ~24 km at-sea-distance) from the Loch of Stenness SAC.

The dredge volume is estimated to be 379,407m^3, based on bathymetry surveys and proposed berth design. The dredge material comprises approximately 17% gravel, 68% sand, and 15% silt and clay.

Dredging represents a major pathway for the movement of INNS and pollutants, as dredging and sediment transport can introduce INNS via equipment, sediment, or water movement, mobilise contaminants within seabed sediments, generate plumes that spread pollutants, and facilitate potential INNS transfer through disposal at site FI040.

The dredge plume dispersal modelling (Technical Appendix 4.1, Volume 3 of the EIAR; EnviroCentre, 2023) indicates that due to the relatively coarse nature of the dredge budget, and the weak tidal currents within the vicinity of the dredge pickets, plumes generated as a result of the dredging works will be very localised, and short-term in duration. Low current speeds mean that sands and gravels lost to the water column during dredging will fall out of suspension immediately, within the dredge footprint. Clay and silt lost to the water column will remain in suspension for longer, being dispersed gradually over the tidal cycle. Total SSC are predicted to be low, highest within the dredge zone and immediate surroundings, decreasing towards the plume limits.

The Project site is characterised by coarse sediment, lack of significant transport inputs and prevailing weak tidal currents. This results in no significant local sediment transport processes, other than the occasional storm wave driven transport of glacial materials. Chapter 4 of the EIAR (EnviroCentre, 2023) concluded that during the construction phase, the magnitude of impact from sediment discharge and dispersion on the coastal waters and sediment of Scapa Flow, and the magnitude of impact from changes to sediment transport on the coastal waters and sediment of Scapa Flow will be negligible following the implementation of the mitigation measures presented in Section 7. The magnitude of impact for these two impact pathways during the operational phase was also concluded to be negligible following implementation of the mitigation measures presented in Section 7.

The dredge plume dispersion is spatially limited and short-term in duration, the disposal site is located outwith Scapa Flow, and sediment transport modelling indicates negligible potential for connectivity with the lagoon system of Loch of Stenness SAC. Therefore, there is no potential for connectivity through which Project activities, such as dredging or disposal, could facilitate the introduction or spread of INNS to the Annex I lagoon habitat.

The suite of proposed construction and operational mitigations collectively reduces the risk of introducing or spreading INNS by ensuring robust environmental control, biosecurity awareness and best-practice site management. Adherence to the CEMD, supported by oversight from the ECoW will ensure that all site (on- and offshore) activities follow controlled methods that minimise movement of contaminated materials, while the Pollution Incident Response Plan and Pollution Prevention Plan reduce opportunities for pollutants or mobilised sediments to act as pathways for INNS transfer. Measures such as silt booms and careful dredging protocols will act to limit sediment disturbance and prevent the release and dispersal of propagules.

The Vessel Management Plan and Ballast Water Management Plan will further control vessel movements, ballast discharge and water exchange, key pathways for marine INNS, while adherence to industry-standard biosecurity practices provides an added safeguard.

As a precautionary measure during construction, the Project proposes to undertake turbidity monitoring to protect water quality and ensure minimal environmental impact. The Project propose to monitor sediment re-suspension levels to prevent damage to the local ecosystem as high sediment concentrations can contribute to suboptimal conditions By monitoring turbidity, the Project can determine potential impacts on the environment and implement corrective actions.

The combination of mitigation and the intervening distance between the Project and the SAC ensures that no viable impact pathway exists for INNS introduction that could affect the lagoon feature's structure, function, or conservation status.

With the implementation of the mitigation outlined above (see Table 7-1), and considering the spatially limited and highly localised nature of dredging effects and the lack of hydrodynamic connectivity with the SAC lagoon system, it can be concluded that the predicted impacts on the Annex I coastal lagoon qualifying feature of the Loch of Stenness SAC from the Project alone would **not adversely affect the integrity of the site.**

8.3.3.2 Accidental Release of Pollutants (all phases)

8.3.3.2.1 Assessment of Adverse Effects Alone

Accidental releases of pollutants may arise as a result of accidental spills from vessels or other equipment and have detrimental effects on Annex I coastal lagoon features. The potential for accidental pollutant release may arise from the following Project activities:

- Vessel activity (fuel, oils, lubricants, hydraulic fluids);

- Refuelling, maintenance, and engine operation;
- Accidental spills of construction-related materials; and
- Loss of containment from plant, machinery, or storage facilities.

8.3.3.2.1.1.1
The main risk is considered to be posed by refuelling activities. Oil or fuel spillages to the water environment would be detrimental to the water and sediment quality, fauna and flora.

Release of toxic materials during dredging is not considered to be likely as sediment sampling found no contaminants at levels likely to significantly affect water quality or pose a hazard to marine life (EnviroCentre, 2023).

The SAC is located ~15 km from the Project site, and the lagoon system is semi-enclosed which further limits connectivity with potential pollutants accidentally released at the Project site. Given the Project's distance from the SAC, and the hydrodynamically contained nature of the Loch of Stenness lagoon system which characterised by limited water exchange, stability, and an enclosed basin morphology, pollutant transport from the Project area to the SAC is highly unlikely. Additionally, there is no direct hydrodynamic pathway linking the Project activities to the lagoon.

As outlined in section 8.3.3.2, there are proposed mitigation measures that will collectively minimise the risk of accidental pollutant release. The CEMD, supported by ECoW oversight, ensures that all activities follow approved methods designed to prevent spills, manage materials safely and maintain compliance with environmental commitments. The Pollution Incident Response Plan provides clear spill-response procedures, emergency contacts and staff training so that any incident is contained quickly and effectively. The Pollution Prevention Plan (which will continue into the operational phase) will include pollution prevention measures that will include measures to deal with accidental spillages in the unlikely event of their occurrence.

Turbidity monitoring, silt booms and controlled dredging protocols help prevent sediment plumes and the mobilisation of contaminated materials, preserving water quality and reducing the risk of pollutants spreading. Ballast Water Management procedures ensure controlled and compliant ballast operations, preventing uncontrolled discharges. Best-practice measures ensure early detection of any environmental change resulting from pollution, allowing prompt corrective action. Together, these integrated controls establish a structured environmental management framework that substantially reduces the likelihood, magnitude and extent of accidental pollutant releases during both construction and operation.

In the unlikely event of a spill, residual pollutants would remain spatially local to the site due to prevailing circulation patterns and established best-practice spill management. In this manner, accidental release of potential contaminants from Project vessels will be strictly controlled and procedures will be in place to minimise the effect of any accidental release if it occurs. As such, there is no pathway by which accidental pollutant release at the Project site could affect the lagoon qualifying feature of the Loch of Stenness SAC.

Considering the mitigation measures outlined above, and the geographical and hydrodynamic separation between the Project and the Loch of Stenness lagoon, it is concluded that the predicted impacts on the lagoon qualifying feature of the Loch of Stenness SAC from the Project-alone will **not adversely affect the integrity of the site**.

8.3.4 Assessment of Adverse Effects In-Combination

Two projects have been screened in for LSE on the qualifying features of Loch of Stenness SAC:

- Scottish Hydro Electric Power Distribution (SHEPD) North Coast and Orkney regional cable surveys; and
- SSEN Orkney to Caithness 220 kV high voltage alternating current (HVAC) cable.

8.3.4.1 Cable installation and surveys

There are two projects with the potential for LSE on Loch of Stenness SAC: the SSEN Orkney-Caithness HVAC link cable, and SHEPD cable route surveys. Both projects will take place from one or more vessels operating in the locality of the Loch of Stenness SAC.

As with the Project alone assessment, standard mitigation will be in place to prevent the release of pollutants and contaminants, and to avoid the introduction of INNS. These measures reduce the risk of adverse effects on Loch of Stenness SAC to negligible levels and any impacts are highly unlikely.

8.3.4.2 In-combination summary

Given the negligible cumulative effects on the qualifying features of the Loch of Stenness SAC resulting from the Project, in combination with the two cables projects referred to in this assessment, it is concluded that there will be no adverse effects on site integrity as a result of the Project in combination with any other plans and projects.

8.3.5 Summary

It has been determined that impacts both from the Project alone, and in combination with other plans and projects, will not have an adverse effect on site integrity, with respect to the qualifying features of the Loch of Stenness SAC.

9 Annex II Marine Mammals - Information to Inform Appropriate Assessment

9.1 Introduction

This section provides an assessment of the potential for the Project to result in an AEoSI on SACs designated for the conservation of marine mammals. An assessment of the potential for the Project to result in an AEoSI is provided for the Project-alone and for the Project in combination with other projects, plans and activities.

9.1.1 Screening Outcome

The European sites, Annex II marine mammal qualifying features and relevant impact pathway where LSE could not be excluded as part of the LSE Screening process are as follows:

Table 9-1 Qualifying features and associated European sites screened in for potential LSE

Site name	Annex II qualifying interest	Project phase	Impact pathways screened in for potential LSE
Sanday SAC	Harbour seal	Construction	Disturbance to prey species and habitats of prey species through increase in SSC.
			Accidental release of pollutants.
			Acoustic impacts (including physiological impacts, barrier effects and displacement) associated with construction noise (vessels and activities).
			Risk of injury resulting from collisions with construction vessels.
		Operation & maintenance	Risk of injury resulting from collision with operation and maintenance vessels.

As outlined in section 6.2.2, the Sanday SAC harbour seal features have been screened in due to the significant decline of harbour seals in Orkney and evidence that individuals forage beyond standard screening distances. NatureScot has also required their inclusion, considering seals in Scapa Flow to be connected to the SAC.

This assessment includes consideration of potential impacts to harbour seal Annex II marine mammal as the qualifying feature of the Sanday SAC only. All other European Sites with Annex II marine mammal qualifying features have been screened out, as detailed in Section 6, on the basis that LSE could be excluded and as agreed in the consultation with stakeholders (Table 4-1).

9.2 Assessment Approach

9.2.1 Project Design Envelope Parameters

This section outlines the Project Design Envelope Parameters to support the assessment of the impact pathways screened in to this Information to Inform Appropriate Assessment, as determined from the Project Description presented in Section 5.

9.2.1.1 Vessel movements during construction

Per Table 5-3, the construction phase will see a total of 112 vessel movements over the 26-month period. This includes: Caisson deliveries and tug operations; Scour protection trips; Caisson infill trips; and Dredging disposal trips (barge to FI040).

9.2.1.2 Vessel movements during operation

Per Section 5.4.1. there will be an estimated 2, 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

9.2.1.3 Dredging method and duration

Dredging for the project will involve a total of 379,407 m³ of material, comprising 72,653 m³ of hard dredge and 306,754 m³ of soft dredge, with up to 82,000 m³ of unsuitable glacial till potentially requiring sea disposal. A single dredge campaign is planned using a cutter suction dredger over an estimated twelve-week period from June to August 2028, covering the full quay alignment to depths of –15 m CD in most areas and –20 m CD in the deep pocket.

Dredged sediments will be pumped through a pipeline into a reclamation bund constructed to +4.0 m CD using screened site-won material, with an integrated weir box to manage overflow. Turbidity will be monitored outside the bund and silt booms deployed during infilling.

9.2.1.4 Ballast water and caisson transport

Caissons will be transported to site on a semi-submersible vessel and kept dry during transit, which significantly reduces the risk of biofouling. After placement at Scapa Flow, ballasting operations will use local seawater, and some caissons may undergo temporary in-water wet storage before installation.

9.2.1.5 Mitigation and Management Plans

Section 7 outlines the Schedule of Mitigation the Project has committed to during both construction and operation phases. Those specifically related to this Annex II assessment (based on the impact pathways screened in) include:

- Adherence to a CEMD;
- Use of an ECoW;
- Pollution Incident Response Plan;
- Turbidity Monitoring;
- Vessel Management Plan;
- Marine Mammal Observer;
- Use of a silt boom during construction;
- Seal Protection Plan
- Marine Mitigation Zone
- Ballast Water Management;
- Marine Mammal Protection Plan;
- Dredging Protocol
- Pollution Prevention Plan;
- Best Practice.

9.2.2 In-combination Assessment

Other developments within Orkney are considered to have the potential to result in an in-combination effect for marine mammals. The developments that have been considered for the in-combination assessment are listed in Table 9-2, based on the long-list provided in Appendix E: Long List of In-Combination Projects.

The West of Orkney Windfarm has been screened out of the in-combination assessment because vessel movements associated with the use of the SDWQ are already included within the Project-alone assessment. Therefore, including the West of Orkney Windfarm within the in-combination assessment on this basis would result in double-counting of the same vessel activities. Any other construction vessels associated with the West of Orkney Windfarm that do not utilise the SDWQ would have no pathway for interaction with the SPA features considered in this assessment, and therefore would not adversely affect the integrity of the site. Thus, no additional in-combination effects are predicted.

Table 9-2 Plans and projects considered for the in-combination assessment of marine mammal features

Project	Development type	Status	Relevant receptors	Distance from Project
Ayre offshore wind farm	Offshore wind farm	Application	Harbour seal	36 km
Westray Tidal Array (Orbital)	Tidal energy	Scoping	Harbour seal	27 km
Fall of Warness tidal test site (EMEC)	Tidal energy	Application	Harbour seal	24 km
Bilia Croo wave test site (EMEC)	Wave energy	Application	Harbour seal	25 km
Deerness Wave Site (Mocean)	Wave energy	Application	Harbour seal	13 km
North Coast and Orkney regional cable surveys	Cables	Consented	Harbour seal	Various
Backaland Pier, Eday	Port development	Application	Harbour seal	28 km
Scammalin Pier, Faray	Port development	Consented	Harbour seal	33 km
Hatston Pier Expansion	Port development	Application	Harbour seal	9 km
Stronsay Harbour	Dredging	Application	Harbour seal	32 km
Hatston Pier	Dredging	Application	Harbour seal	9 km
Scammalin Pier, Faray	Dredging	Consented	Harbour seal	33 km

9.3 Sanday SAC

9.3.1 Site Description and Qualifying Features

The Sanday SAC covers an area of 10,976.97 ha (109.76 km^2) and is a large, low-lying island situated in the north-east of the Orkney archipelago (NatureScot, 2025c). The island has a complex coastline characterised by extensive sandy beaches, sheltered inlets and exposed rocky headlands. The Sanday SAC also supports the largest discrete group of harbour seals in Scotland, with associated nearshore kelp beds providing important foraging areas for this population (JNCC, 2021). The SAC is located 36 km northeast of the Project site (or ~85 km at-sea-distance).

The coastal waters of Sanday hold the largest colony of harbour seals at any relatively discrete site in Scotland. Around 1,450 adults haul out on the intertidal reefs to pup, moult and rest. This represents around 17% of the Orkney, 5% of the UK and 2% of the EU populations of the species. During the 1998 breeding survey (SCOS, 2024), over 550 pups were observed at the site, accounting for 34% of newborn pups in Orkney. Large breeding colonies are important in maintaining overall population size and are significant as sources of emigration to smaller or newly established groups. The status of harbour seals at Sanday is unfavourable, declining, with a significant decline in numbers since the designation. Based on counts from 1997-2019, there has been a decline of 95% at Sanday SAC, indicating it is one of the local areas hit hardest by the harbour seal declines observed in northern and eastern areas of Scotland. In the last count in 2019, the SAC represented 77 individuals (around 5% of the North Coast and Orkney Seal Management Unit (SMU))[8] (SCOS, 2024). This is reflected across the whole of Orkney, where populations have declined by ~90%. The Sanday conservation management advice suggests that research indicates that off-site factors such as predation, competition for prey, prey quality and availability, and toxin exposure from harmful algae are the most likely potential causes of the decline. For harbour seal at Sanday SAC, the reasons for the unfavourable condition appear to lie outwith the SAC.

The feature condition and broader conservation status of the qualifying feature is presented in Table 9-3.

Table 9-3 Protected feature and condition for the Sanday SAC (NatureScot, 2025c)

Protected feature	Feature condition	Assessment date	Broader conservation status
Harbour seal	Unfavourable: declining	2023	Unfavourable - inadequate

9.3.2 Conservation Objectives

The Conservation Objectives of the Sanday SAC (NatureScot, 2025c) are:

1. To ensure that the qualifying features of Sanday SAC are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status.
2. To ensure that the integrity of Sanday SAC is restored in the context of environmental changes by meeting objectives 2a, 2b and 2c for each qualifying feature:

For Harbour seal:

- 2a. Harbour seal are a viable component of the Sanday SAC.
- 2b. The distribution of harbour seal throughout the site is maintained by avoiding significant disturbance.
- 2c. The supporting habitats within the site relevant to harbour seal are maintained.

As the most recent condition status of the harbour seal feature was ‘unfavourable’, the Conservation Objectives seek to Restore this condition. Supplementary conservation and management advice to support the achievement of the conservation objectives is provided by NatureScot (2025c) and is considered in the assessments below. Assessment of Adverse Effects Alone

[8] Orkney was counted again in 2025 but the numbers have not yet been published.

The Sanday SAC is located approximately 85 km from the Project site (at-sea-distance). Harbour seals have typical foraging ranges of ~50 km, with telemetry data showing individuals from the SAC may range 20–100 km, though predominantly at the shorter end of this range. Telemetry studies further indicate limited connectivity between tagged Sanday SAC seals and the Project site (Marine Scotland, 2016). Although the Project site is not considered to be widely used by seals originating from the SAC, the presence of individuals from the Sanday SAC population in the waters around the Project site cannot be ruled out.

9.3.2.1 Disturbance to prey species and habitats of prey species through increase in SSC (construction phase only)

9.3.2.1.1 Assessment of Adverse Effects Alone

Increases in SSC arising from Project dredging activities during construction have the potential to affect harbour seals indirectly by altering the availability or behaviour of their prey.

Hydrodynamic modelling (Technical Appendix 4.1, Volume 3 of the EIAR; EnviroCentre, 2023) shows that tidal currents in the dredge area are weak, resulting in only highly localised and short-lived sediment plumes. The composition of the dredge material—approximately 17% gravel, 68% sand and 15% silt and clay—means that most sediment will settle quickly, limiting any meaningful dispersion of SSC beyond the immediate dredge footprint. Section 8.3.3.1 of the EIAR (EnviroCentre, 2023) concluded that impacts from sediment discharge and dispersion on the coastal waters and sediment of Scapa Flow, and the magnitude of impact from changes to sediment transport on the coastal waters and sediment of Scapa Flow, will be negligible following the implementation of the mitigation measures presented in Section 7 for the construction phase.

Proposed reclamation fill activities could also result in plumes and increased SSC, with a resultant impact on prey species. The fill material will be a mixture of sediment locally generated by quarries and dredging, the coarse nature of which, in combination with locally weak tidal currents, will limit the duration and spread of any plume generated.

Chapter 5 of the EIAR (EnviroCentre, 2023) states that impact on prey species will be temporary and spatially restricted (Section 5.6.3.1 of EnviroCentre, 2023), and confirmed that there is sufficient alternative habitat for foraging and commuting for harbour seal individuals. For these reasons, section 5.6.3.1 and Table 5-9 of EnviroCentre (2023) concluded that indirect impacts on Sanday SAC harbour seals, as a result of impacts to prey species, will be not significant during construction.

Construction impacts to fish species, from underwater noise and pollution, was assessed as being of low magnitude and not significant in the EIAR (EnviroCentre, 2023), due to the limited spatial extent (i.e. restricted to discrete areas near the dredging and reclamation areas), the relatively short-term duration (as it is limited to the duration of the dredging activities), intermittent nature and high reversibility.

As a precautionary measure during construction, the Project proposes to undertake turbidity monitoring to protect water quality and ensure minimal environmental impact. The Project propose to monitor sediment re-suspension levels to prevent damage to the local ecosystem and aquaculture as high sediment concentrations can contribute to suboptimal conditions and may harm aquaculture fish since it affects the overall ecological balance and the fish have restricted movement. By monitoring turbidity, the Project can determine potential impacts on the environment and implement corrective actions. Furthermore, silt booms will be utilised to contain fine sediments while reclamation works are undertaken, to minimise the spread of sediments and thus disturbance to prey species in the marine environment.

Measures such as silt booms and careful dredging protocols will act to limit sediment disturbance and prevent the release and dispersal of sediments.

Any SSC increases will be confined to a very small spatial area and short-term duration, and will not extend into wider foraging grounds used by harbour seals from the Sanday SAC. The supporting habitats for prey species beyond the Project site will therefore remain unaffected. Based on this and the mitigation measures outlined above, there is no credible mechanism by which SSC arising from the Project could lead to reduced foraging success or altered behaviour of harbour seals linked to the SAC by indirectly impacting prey species. As such, it can be concluded that the predicted impacts on the Annex II marine mammal qualifying feature of the Sanday SAC from the Project alone would **not adversely affect the integrity of the site**.

9.3.2.2 Accidental Release of Pollutants (all phases)

9.3.2.2.1 Assessment of Adverse Effects Alone

Accidental releases of pollutants may arise as a result of accidental spills from vessels or other equipment and have detrimental effects on Annex II marine mammal features. The potential for accidental pollutant release may arise from the following Project activities:

- Vessel activity (fuel, oils, lubricants, hydraulic fluids);
- Refuelling, maintenance, and engine operation;
- Accidental spills of construction-related materials; and
- Loss of containment from plant, machinery, or storage facilities.

The main risk is considered to be posed by refuelling activities. Oil or fuel spillages to the water environment would be detrimental to the water and sediment quality, fauna and flora. Accidental releases of pollutants pose a potential risk to marine mammals and their prey through degradation of water quality.

Release of toxic materials during dredging is not considered to be likely as sediment sampling found no contaminants at levels likely to significantly affect water quality or pose a hazard to marine life (EnviroCentre, 2023).

As outlined in section 8.3.3.2, there are proposed mitigation measures that will collectively minimise the risk of accidental pollutant release. The CEMD, supported by ECoW oversight, ensures that all activities follow approved methods designed to prevent spills, manage materials safely and maintain compliance with environmental commitments. The Pollution Incident Response Plan provides clear spill-response procedures, emergency contacts and staff training so that any incident is contained quickly and effectively. The Pollution Prevention Plan (which will continue into the operational phase) will include pollution prevention measures that will include measures to deal with accidental spillages in the unlikely event of their occurrence.

Turbidity monitoring, silt booms and controlled dredging protocols help prevent sediment plumes and the mobilisation of contaminated materials, preserving water quality and reducing the risk of pollutants spreading. Ballast Water Management procedures ensure controlled and compliant ballast operations, preventing uncontrolled discharges. Best-practice measures ensure early detection of any environmental change resulting from pollution, allowing prompt corrective action. Together, these integrated controls establish a structured environmental management framework that substantially reduces the likelihood, magnitude and extent of accidental pollutant releases during both construction and operation.

In the unlikely event of a spill, residual pollutants would remain spatially local to the site due to prevailing circulation patterns and established best-practice spill management. In this manner, accidental release of potential contaminants from Project vessels will be strictly controlled and procedures will be in place to minimise the effect of any accidental release if it occurs.

Furthermore, it is understood that that there is sufficient alternative habitat for foraging and commuting for harbour seal individuals outwith the Project site. In this manner, accidental release of potential contaminants from construction vessels will be strictly controlled and procedures will be in place to minimise the effect of any accidental release if it occurs.

Considering the mitigation measures outlined above, and the availability of sufficient alternative habitat for foraging and commuting for harbour seal individuals, it can be concluded that the predicted impacts on the Annex II marine mammal qualifying feature of the Sanday SAC from the Project alone would **not adversely affect the integrity of the site**.

9.3.2.3 Acoustic Impacts (construction phase only)

9.3.2.3.1 Assessment of Adverse Effects Alone

Construction activities such as dredging will result in underwater sound sources which may cause injury to harbour seal qualifying features of the Sanday SAC.

Modelling of underwater noise (Technical Appendix 5.6 of the 2023 EIAR; EnviroCentre, 2023) shows that the potential for Permanent Threshold Shift (PTS) for harbour seals is restricted to within 50 metres of the activity,

meaning that injury is unlikely as seals are capable of moving away before accumulating damaging levels of exposure. Temporary Threshold Shifts (TTS) may occur within ranges of approximately 70–250 metres depending on the duration of exposure, although such effects would only arise if an animal remained close to the activity for an extended period. Given the mobility of harbour seals and their known behavioural tendency to avoid sudden or elevated noise sources, prolonged exposure is considered unlikely. Any effects will therefore be limited to temporary, short-range displacement of individuals, with normal behaviour quickly resuming once dredging ceases (Section 5.6.8.1 of the EIAR; EnviroCentre, 2023).

The area around the Project site does not contain important breeding, mating or resting habitat for harbour seals (the nearest designated haul-out site is Selwick, located 4.5 km to the south), and alternative foraging habitat is widely available. Given that seals occur commonly in busy harbours, they are somewhat habituated to anthropogenic noise sources. As such, the consequences of disturbance are not thought to be significant and harbour seals are not considered to be sensitive to acoustic disturbance from continuous sound sources such as dredging.

Quantitative analysis using a conservative 5 km disturbance buffer (as informed by NatureScot consultation) suggests that up to 33 seals could be disturbed at any one time, although this is recognised as a worst-case overestimate and actual numbers would likely be lower than calculated. It is possible that seals subject to general disturbance could be associated with the Sanday SAC. However, given the scale and short temporal and spatial scales of the dredging activities, the distance between the works and the SAC and evidenced limited connectivity between Sanday SAC and the proposed dredging activities, it is considered that limited impacts from dredging activities would occur.

The Project has proposed mitigation measures (Table 7-1) to collectively reduce acoustic disturbance and risk of injury to seals by managing when, where and how noisy activities occur, and by ensuring continuous monitoring of marine mammals throughout construction. Deployment of trained MMOs and ECoWs enables early detection of seals in the vicinity of dredging or terrestrial blasting works, allowing activities to be delayed until animals have moved outside the defined mitigation zone, thereby preventing exposure to harmful sound levels.

The Marine Mammal Protection Plan and Seal Protection Plan add additional safeguards by defining noise-dampening measures such as screens and bunding for terrestrial blasting. Measures within the Vessel Management Plan include agreed routes, slow-speed zones and training in wildlife-sensitive operations to reduce vessel-generated disturbance. Collectively, these controls ensure that underwater noise is closely managed, monitored and reduced at source, thereby significantly mitigating both behavioural disturbance and potential auditory injury to seals.

Noise from terrestrial blasting associated with the construction phase could cause disturbance to seals on land. However, seals are unlikely to be hauled out in or close to the construction site, thereby reducing the risk of injury or disturbance. Furthermore, blasting operations regularly generate air overpressure levels at the closest point to blast area of around 120 dB but the intensity of these noise levels experienced at a distance from the blast site are affected by a range of meteorological conditions (wind speed and direction, temperature, cloud cover and humidity) and when sound waves pass a given position, the pressure of the air rises very rapidly then falls more slowly then returns to the ambient value after a number of oscillations. As such, it is unlikely that qualifying seal features of the Sanday SAC would be impacted. A 6 m high bund will be formed at the seaward boundary of the site by retaining the existing land and excavating behind, creating a natural noise screen from terrestrial blasting (and other works) and will only be removed once the site is excavated to the final profile. This would reduce the effects of noise on seals on land. In addition, a range of other controls and mitigation measures will be implemented (Table 7-1) when undertaking terrestrial blasting, including screens to further dampen sound, which would also reduce the effects of noise on seals on land or at the water's surface.

Overall, while underwater and terrestrial sound sources may cause temporary behavioural disturbance to a small number of individual seals, these effects are expected to be localised, short-term and not significant at the population level. Acoustic impacts will be minimised by the implementation of mitigation measures, including use of a MMO and dredging protocol committed to within the Marine Mammal Protection Plan (Table 7-1). As such, it can be concluded that the predicted impacts on the Annex II marine mammal qualifying feature of the Sanday SAC from the Project alone would **not adversely affect the integrity of the site**.

9.3.2.4 Risk of Injury and Disturbance from Vessels (all phases)

9.3.2.4.1 Assessment of Adverse Effects Alone

Construction and operational vessel movements have the potential to increase the risk of vessel collisions with harbour seals.

Impacts associated with disturbance from increased vessel movements will be intermittent during construction and operation, with the increase being relatively small (see paragraph below), and it is considered that seals utilising waters around the Project site will be somewhat habituated to vessel activity associated with Scapa Pier and the oil industry-related activities in the wider Scapa Flow. For example, telemetry-based studies (Onoufriou., *et* al, 2016)) of the swimming behaviour of seals undertaken by the Sea Mammal Research Unit carried out in the Moray Firth to compare seal and vessel movements with the purpose of identifying potential areas with high spatial overlap found the movements of individual seals and vessels did not show any apparent responses, with seals not appearing to react to close passing vessels (not moving towards nor away from them). In addition, the majority of the routes used by these vessels during construction and operation will be along established routes (i.e., the main shipping channel and the shipping lane west towards Stromness). The only area of increased vessel activity will be the route of 2.9 km (1.6 NM) leading from the main shipping lane into the Project (see Appendix C: Bird Heat Maps and HiDef Data Combined with Construction Vessel Routes). If there is some displacement from areas of high activity during construction or operation, it is considered that there is sufficient alternative habitat for foraging and commuting.

During construction, approximately 42 vessel movements over a 12-week period (between June – August 2028) are expected for the dredge disposal for the Project. 70 vessel movements are expected for works associated with caisson delivery, scour protection and caisson installation. This equates to 112 vessel movements in total during construction, which is considered a relatively low number of vessel movements over the length of the period of works (26 months in total). Vessel strikes are generally more associated with larger and less agile marine mammals, and so the number of harbour seals affected will likely be minimal. The effects of these impacts will be highly localised around the established shipping routes. In addition, although larger vessels have a greater footprint and therefore may be considered more likely to make encounters with seals, Project vessels will travel at relatively slow speeds with a consistent course, which is considered less detrimental to seals than smaller vessels. The likelihood of vessel collisions is dependent upon vessel speed, animal behaviour and vessel manoeuvrability. Vessels travelling at slower speeds in general can allow time for seals and vessel operators to react to avoid collisions. A Seal Protection Plan will be implemented and adhered to, which details protocols to be implemented to reduce collision risk. This includes limits on vessel speed.

During the operational phase, the estimated number of vessels calling at the Project Quay in the operational phase is 96 per year (192 vessel movements), comprising 28 large vessels and 12 smaller vessels per year. Each of the 28 large vessels will have two associated pilot boat (2 vessel movements). In total, the estimated vessel movements per year is 192.

The majority of these vessels (approximately 80 %) are expected to occur during the summer months (April – September), so there will be an increase of 26 vessel movements per month in summer and 6 per month in winter. As with the construction phase vessel movements, the effects of the operational phase impacts will be highly spatially localised. As the majority of the vessel routes will be using existing routes, seals will likely already be habituated to vessels in those areas and/ or avoid the area already. In the area of increased vessel activity close to the Project site, there is a greater likelihood of vessel collision with seals, however, the vessel numbers in this area are very low, as stated above, and over time, seals would likely become habituated to vessels using this route. Again, as above, the likelihood of vessel collisions is dependent upon vessel speed, animal behaviour and vessel manoeuvrability, therefore, vessels travelling at slower speeds in general can allow time for seals and vessel operators to react to avoid collisions. The SPP will be adhered to during operation. This includes limits on vessel speed. Chapter 5 (Section 5.6.8.2) of the EIAR concluded that impacts on harbour seals from vessel movements during the operation phase is of negligible sensitivity.

Vessel movement protocols secured via adherence to the Vessel Management Plan, as outlined in Table 7-1 would further mitigate risk of vessel collision to harbour seals.

Overall, the risk of injury or disturbance from vessels is considered minimal, and any effects are expected to be highly localised. The introduction of Project vessels during construction and operation is not considered to be a substantive increase to baseline vessel movements. As such, when considering the proposed mitigation

measures, it can be concluded that the predicted impacts on the Annex II marine mammal qualifying feature of the Sanday SAC from the Project alone would **not adversely affect the integrity of the site**.

9.3.3 Assessment of Adverse Effects In-Combination

A number of plans and projects have been screened in for LSE on the harbour seal qualifying feature of Sanday SAC:

- Ayre Offshore Wind Farm;
- Westray Tidal Array (Orbital);
- Fall of Warness Tidal Test Site (European Marine Energy Centre; EMEC);
- Billia Croo Wave Test Site (EMEC);
- Mocean Deerness Wave Energy;
- SHEPD North Coast and Orkney regional cable surveys;
- Backaland Pier redevelopment, Eday;
- Scammalin Bay pier, Faray;
- Hatston Pier Expansion;
- Stronsay Harbour dredging;
- Hatston dredging; and
- Scammalin Bay (Faray) dredging.

9.3.3.1 Offshore wind developments

Ayre offshore wind farm lies within the 50 km foraging range of harbour seals from Sanday SAC, although harbour seals in Orkney are known to have a predominantly coastal distribution. However, some impacts from offshore wind farm construction (e.g. noise) can extend significantly beyond the footprint of the development, and Ayre wind farm has LSE on the harbour seal feature of Sanday SAC.

The Ayre wind farm Report to Inform an Appropriate Assessment (RIAA) reported that the risk of auditory injury of Sanday SAC harbour seals could be fully mitigated, and that on any given day of piling up to 81 harbour seals (2.79% of the North Coast and Orkney population) could be disturbed, and <1 harbour seal would experience disturbance from geophysical surveys, or temporary threshold shift (TTS) per day of unexploded ordnance (UXO) clearance. Although underwater sound sources may cause temporary behavioural disturbance to a number of individual seals, these effects are expected to be localised, short-term and not significant at the population level, which was demonstrated through population modelling. It was concluded that there is no risk of an adverse effect on the harbour seal feature of Sanday SAC.

9.3.3.2 Pier and harbour developments

There are three marine licences (and marine licence applications) for port construction works, i.e. Backaland Pier, Scammalin Bay and Hatston Pier Expansion which have LSE on the harbour seal feature of Sanday SAC. Port and harbour development can have adverse impacts on harbour seals, largely through the emission of high-amplitude impulsive sound during construction works. Although underwater sound sources may cause auditory injury or behavioural disturbance to a number of individual seals, these effects are expected to be localised and short-term, only for the duration of construction; and, in the case of injury, are highly unlikely given the high threshold for permanent threshold shift (PTS) in phocid seals. Individual harbour seals are considered to be resilient to short-term behavioural disturbance, and therefore any impacts would not be significant at the population level, as harbour seals are capable of avoiding (moving away from) disturbing sound sources to forage elsewhere.

9.3.3.3 Dredging operations

There are three marine licences (and applications) for dredging operations, i.e. Stronsay harbour, Hatston pier and Scammalin Bay which have LSE on the harbour seal feature of Sanday SAC. Dredging operations can have adverse impacts on harbour seals, largely through the emission of non-impulsive sound during dredging and disposal. Although underwater sound sources may cause behavioural disturbance to a number of individual

seals, auditory injury is not a plausible pathway. Disturbance effects are expected to be localised and short-term, only for the duration of the dredging campaign. Individual harbour seals are considered to be resilient to short-term behavioural disturbance due to dredging works, and therefore any impacts would not be significant at the population level, as harbour seals are capable of avoiding (moving away from) disturbing sound sources to forage elsewhere.

9.3.3.4 Geophysical surveys

There is one five-year regional plan for SHEPD cable (and cable route) surveys around the North Coast and Orkney region which has LSE on the harbour seal feature of Sanday SAC. This activity has been assessed for its impacts on European Protected Species (EPS; i.e., cetacean and otter) and impacts on protected sites, including Sanday SAC. The pathway to impact would be disturbance from geophysical survey equipment, particularly the use of sub-bottom profilers. Due to the short duration of each individual cable route survey, and the likely cumulative duration of all cable route surveys for the five-year period, the assessment concluded that there would be no adverse effect on the harbour seal feature of Sanday SAC.

9.3.3.5 Wave and tidal energy developments

There are four marine renewable energy developments with LSE on the harbour seal feature of Sanday SAC: Fall of Warness tidal test site, Westray Tidal Array, Bilia Croo wave test site, and the Deerness wave energy site. Although there is no clear pathway to adversely impact on harbour seals from these wave energy developments, the recent section 36 variation application for an expansion of the Fall of Warness tidal test site is notable due to its presented conclusions of adverse effects on site integrity for the harbour seal feature of Sanday SAC. Although the applicant argued that the impacts to Sanday SAC will be relatively small (and are based around a collision risk assessment approach with known limitations) the HRA for the Fall of Warness development included a derogation case for Sanday SAC, with a proposal to compensate for collision impacts at the tidal test site.

The Fall of Warness consent variation has not yet been approved, but it is understood that it will only be consented if an appropriate compensation plan can be agreed with the regulator and advisers. The same is true for Westray Tidal Array, which is intending to submit a section 36 consent application in late 2026: should that project be consented, then given the potential for additional collision risk to harbour seals from Sanday SAC, compensation will be required.

As a result, it is concluded that unless further evidence becomes available which reduces the predicted risk of collision from tidal turbines, both these tidal developments will require derogation from the Habitats Regulations, including the provision of compensatory measures, then their residual impacts will be reduced to zero when considered in combination with the Project.

9.3.3.6 Vessel disturbance

The screened-in projects (Table 9-2) have the potential to generate vessel traffic during both their construction and operational project phases. Such vessel activity may contribute to disturbance of harbour seals through increased underwater noise, visual presence, and potentially increases the risk of collision. Potential vessel-related effects have, therefore, been considered across all screened-in projects. However, vessel movements associated with these developments are generally expected to utilise established navigation routes, be temporary and intermittent in nature, and occur within an area where harbour seals are already regularly exposed to vessel activity associated with commercial shipping, ferry services, port operations and the oil industry. Furthermore, the plans and projects that have been considered are currently all at different stages of development, ranging from scoping and application through to consented projects. It is therefore unlikely that all construction and operational activities will occur concurrently. Given the limited magnitude of the increase in vessel traffic associated with the Project, the intermittent and temporary nature of vessel activity associated with the other screened-in developments, and the availability of extensive alternative habitat throughout Orkney waters, any cumulative disturbance effects would be temporary, spatially restricted and reversible. Furthermore, adherence to project-specific Vessel Management Plans and associated mitigation measures, including speed restrictions and wildlife-sensitive vessel operation protocols, would further reduce the potential for disturbance and vessel collision risk.

Therefore, when considered in-combination with other relevant plans and projects, construction and operational vessel disturbance is not predicted to undermine the conservation objectives of the Sanday SAC harbour seal

qualifying feature. It can be concluded that there would be **no adverse effect on the integrity** of the Sanday SAC as a result of in-combination construction and operational vessel disturbance.

9.3.3.7 In-combination summary

Given the minor cumulative effects on Sanday SAC harbour seals resulting from the Project, in combination with offshore wind developments, pier and harbour developments, dredging operations and geophysical surveys, it is concluded that there will be no adverse effects on site integrity as a result of the Project in combination with these plans and projects.

Furthermore, as any future consented tidal energy developments will be required to compensate for impacts on harbour seals (resulting from the risk of collision with tidal turbines), the impacts of these projects will be compensated for (and therefore reduced to nil) from the perspective of the in-combination assessment of adverse effects.

9.3.4 Summary

It has been determined that impacts both from the Project alone, and in combination with other plans and projects, will not have an adverse effect on site integrity, with respect to the harbour seal qualifying feature of Sanday SAC.

10 Ornithological Features - Information to Inform Appropriate Assessment

10.1 Introduction

This section provides an assessment of the potential for the Project to result in an AEoSI on SPAs designated for the conservation of ornithological qualifying features. An assessment of the potential for the Project to result in an AEoSI is provided for the Project-alone and in combination with other projects, plans and activities.

10.1.1 Screening Outcome

The European sites, qualifying ornithological features and relevant impact pathway where LSE could not be excluded as part of the LSE Screening process are summarised in Table 10-1 below.

Table 10-1 Qualifying features and associated European sites screened in for potential LSE

Site name	Qualifying interest / features	Project phase	Impact pathways screened in for potential LSE
Scapa Flow SPA	• Great northern diver, non-breeding; • Long-tailed duck, non-breeding; • Red-breasted merganser, non-breeding; • Red-throated diver, breeding; • Shag, non-breeding; • Slavonian grebe, non-breeding; • Black-throated Diver, non-breeding; and • Eider, non-breeding.	Construction	Disturbance of birds due to construction activities (via dredging activities, vessel presence, onshore vehicle movement, terrestrial blasting).
			Disturbance to prey species and habitats of prey species.
			Accidental release of contaminants or pollutants.
		Operation & maintenance	Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle movement, and use of mobile cranes on the quayside).
			Accidental release of contaminants or pollutants.
			Ornithological habitat changes including potential alterations to foraging abilities.
North Orkney SPA	• Great northern diver, non-breeding; • Red-throated diver, breeding; • Slavonian grebe, non-breeding.	Construction	Disturbance of birds due to construction activities (via dredging activities, vessel presence, onshore vehicle movement, terrestrial blasting).
			Disturbance to prey species and habitats of prey species.
			Accidental release of contaminants or pollutants.

Site name	Qualifying interest / features	Project phase	Impact pathways screened in for potential LSE
		Operation & maintenance	Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle movement, and use of mobile cranes on the quayside).
			Accidental release of contaminants or pollutants.
			Ornithological habitat changes including potential alterations to foraging abilities.
Orkney Mainland Moors SPA	• Red-throated diver, breeding.	Construction	Disturbance of birds due to construction activities (via dredging activities, vessel presence, onshore vehicle movement, terrestrial blasting).
			Disturbance to prey species and habitats of prey species.
			Accidental release of contaminants or pollutants.
		Operation & maintenance	Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle movement, and use of mobile cranes on the quayside).
			Accidental release of contaminants or pollutants.
			Ornithological habitat changes including potential alterations to foraging abilities.
Hoy SPA	• Arctic skua, breeding; • Fulmar, breeding; • Great black-backed gull, breeding; • Great skua, breeding; • Guillemot, breeding; • Kittiwake, breeding; • Puffin, breeding; • Red-throated diver, breeding; and • Seabird assemblage, breeding.	Construction	Disturbance of birds due to construction activities (via dredging activities, vessel presence, onshore vehicle movement, terrestrial blasting).
			Disturbance to prey species and habitats of prey species.
			Accidental release of contaminants or pollutants.
		Operation & maintenance	Disturbance and displacement of ornithology receptors from the Project (vessel presence, onshore vehicle movement, and use of mobile cranes on the quayside).
			Accidental release of contaminants or pollutants.
			Ornithological habitat changes including potential alterations to foraging abilities.

10.2 Assessment Approach

10.2.1 Summary of Occurrence of Qualifying Species at the Project Site and the wider Scapa Flow area

The Project site is regularly used by 14 breeding and non-breeding bird species, all of which are qualifying features of overlapping/nearby SPAs, which are part of populations that range over extensive areas of marine and coastal habitat.

Baseline surveys were undertaken between November 2020 and March 2024, details of which can be found in the Ornithological Technical Report (EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report; EnviroCentre, 2023). This Section utilises the findings from the baseline survey campaign to present the baseline activity and usage of the Project site by qualifying species screened in to this Information to Inform Appropriate Assessment.

10.2.1.1 Great northern diver (non-breeding)

10.2.1.1.1 Seasonality

The regular distribution of survey days at the Project site gives a good indication of the seasonal spread of records.

- 2020/21 peak counts (up to 2 km from the main Vantage Point (VP)) in November and again in May
- 2021/22 peak counts (up to 2 km from the main VP) in November and again in April/May
- 2023/24 peak counts (up to 2 km from the main VP) in November and again in March

10.2.1.1.2 Wider occurrence across Scapa Flow SPA

The Scapa Flow inshore survey in 2017/18 (Jackson, 2018) found a peak of 1,016 birds, with a mean count of 826 birds across the four rounds of surveys. These counts are significantly higher than the SPA citation population (505 birds). Based on the maps and tables from each count provided in the 2017/18 survey report, great northern divers were spread out across Scapa Flow, with the exception of the "Southern Approaches" vantage points. The HiDef survey results from 2021/22 and 2022/23 estimate the population within Scapa Flow to be 1,072 (range 884-1,232) using Bayesian modelling for January 2023 (Peters-Grundy *et al.,* 2026). This, along with the findings in 2017/18 (Jackson, 2018) highlights that recent survey data indicate a significantly (ca. 200%) larger wintering population within Scapa Flow SPA than in the citation when the SPA was designated in 2022 (JNCC, 2022). Nevertheless, the citation population is carried through as the basis of this assessment.

The surveys also indicate that the largest numbers of great northern divers within the eastern half of Scapa Flow occur off the Tongue of Westerbister and in St Mary's Bay, located 2.5-4 km south of the Project site. A map showing the distribution of birds recorded both during the baseline surveys and HiDef surveys from 2021/22 and 2022/23 (Peters-Grundy *et al.,* 2026), as well as maps showing the current baseline vessel routes and the 2017/18 wintering bird data, can be found in Appendix A: Heat Maps and HiDef Survey Data.

10.2.1.1.3 Numbers from Project survey work

Table 10-11 below indicates the peak and average counts within various distance bands around the main VP at the Project in each recording year.

Table 10-2: Peak and average numbers of great northern diver in zones around the main Project VP (NB different start dates in calculation of averages due to survey timing differences between years).

Distance band	Survey period	Peak month	Peak count	Average of peak count	% SPA population (505 birds)	Average number Oct/Nov to Mar (average peak)	% SPA population (505 birds)
0 – 500 m	Yr 1 - 2020/21	April	8	7.67	1.6%	2.036	0.4 %
	Yr 2 - 2021/22	March	9		1.8%	2.156	0.4 %
	Yr 3 - 2023/24	Nov	6		1.2%	2.125	0.4 %
0 – 1 km	Yr 1 - 2020/21	Nov/Feb	27	25	5.3%	8.608	1.7 %
	Yr 2 - 2021/22	Dec	27		5.3%	7.063	1.4 %
	Yr 3 - 2023/24	Nov	21		4.2%	8.875	1.8 %
0 – 2 km	Yr 1 - 2020/21	May	40	45.67	5.9%	15.429	3.1%
	Yr 2 - 2021/22	Jan	38		7.5%	16.031	3.2 %
	Yr 3 - 2023/24	Nov	59		12 %	24.167	4.8 %

A peak count of 27 great northern divers was recorded within 1 km of the Project site, with a peak count of 59 birds within 2 km. The 2020/21 and 2021/22 baseline data correlates well with the inshore surveys undertaken by HiDef for NatureScot (Peters-Grundy *et al.,* 2026), where a peak count of 28 birds were recorded in the same general area in January 2022. There was a notably higher peak count during the 2023/24 surveys within 2 km; but within 500 m and 1 km; the 2023/24 count was lower than the other two years. The peak count of 59 birds represents 12% of the Scapa Flow SPA population, with the average peak representing 4.8% of the SPA citation population. The average seasonal peak count of 46 birds represents 9% of the SPA population (citation level).

Table 10-12 below details the numbers of great northern divers present within 2 km of the Project site during their flightless moult period (February to mid-April).

Table 10-3: Great northern diver numbers during the flightless moult period

Month	No. count days	Average count <2 km	Peak count <2 km
Feb 2021	4	6.5	16
March 2021	4	9	12
April 2021	2	24	26
2021 seasonal figures	10	11	26
Feb 2022	4	17.25 [25.5]*	24 [35]
March 2022	4	22 [27.25]	30 [51]
April 2022	2	35 [36]	38 [40]
2022 seasonal figures	10	22.7 [28.3]	38 [51]
Feb 2024	4	20.5 [23]	26 [29]
March 2024	4	26.5 [28]	35 [35]
2024 seasonal figures	8	23.5 [24.25]	35 [35]

* figures in square brackets include all diver sp.

The peak average count of 35 birds (April 2022) and peak count of 38 (April 2022) within 2 km of the Project site represents 7% and 7.5% of the SPA population (citation level), respectively. Taken as an average across years, the average of 19 birds (taken from 2021, 2022 and 2024 seasonal figures) represents 3.8% of the SPA population (citation level), and the average seasonal peak count during the flightless moult period of 33 birds represents 6.5% of the SPA population (citation level).

Based on more recent (higher) population counts for great northern diver in Scapa Flow, the percentages would be 7% for peak counts and 4.5% for peak counts during the flightless moult period (from the 2017/18 counts) and 5.5% and 3.5% respectively for the HiDef survey population estimates. It is considered that these counts are a more accurate reflection of current population levels.

10.2.1.2 Red-throated diver (breeding)

The results of the 2006 national diver survey are published in Bird Study (Dillon *et al.,* 2009). This paper includes a map with the presence of breeding and non-breeding red-throated divers mapped at a scale of 5-km squares across Orkney.

The general distribution of divers in Orkney is quite stable, given that it is dependent on the presence of suitable breeding waters – no material change is likely since 2006.

The breeding divers comprising the Scapa Flow SPA foraging population are likely to originate from one of the following breeding areas:

- Hoy – on the western side of Scapa Flow, with 58 pairs stated in the SPA citation population (NatureScot, 2009).
- Fara – one pair on the western side of Scapa Flow, not in the Hoy SPA (it is beyond 10 km to the west of the Project).
- West Mainland – usually more than 20 pairs, the bulk of which are on the northern part of the Orkney Mainland Moors SPA and most likely to utilise the North Orkney SPA for foraging. There are no known Orkney Mainland Moors SPA breeding sites within 14 km of the Project site (i.e. beyond the foraging range for the species, per Woodward *et al.*, 2019) and very few foraging trips from there would be expected towards Scapa Flow. There are also several West Mainland sites that are not in the Orkney Mainland Moors SPA – up to four pairs set back a little from the north Scapa Flow shoreline and one or two pairs much more distantly from the Project close to the larger lochs of Harray, Hundland and Swannay.
- East Mainland – ca. five pairs in two locations; only the closest birds in Holm are likely to utilise Scapa Flow SPA, and for these Scapa Flow is likely to be important based on observations of birds during the Project VP watches.

Woodward *et al,* (2019) state that the foraging distance from the nest site for breeding red-throated divers is 9 km. However, a more precautionary estimate of 10 km was used to inform this assessment.

From examination of the 1:25,000 Ordnance Survey maps and personal observations (pers. comm. Andrew Upton), it is possible to deduce the number and location of breeding pairs within 10 km of the Project.

The Project 5-km square, and all the squares to the south of it, held no breeding divers in 2006. The Loch of Tankerness (not an identified breeding site in 2006) is ca. 8 km to the northeast and is not particularly suitable for breeding red-throated divers, being surrounded by intensively managed grass fields with only small areas of natural vegetation.

There are two breeding locations within 8 km and one more at 8–10 km distance. The closest birds are inland from the Project and known to fly down to Scapa Bay regularly during the breeding season, where they loaf and forage, before often moving on into Scapa Flow. The Griffyelt and Loch of Kirbister birds are within foraging distance of the Project but have a very large area of suitable foraging much closer to them; the majority of flight paths at the Project in 2022 could be related to the inland pairs there.

The red-throated divers on Hoy, Fara, a small number on the West Mainland pairs (facing Scapa Flow), and a few pairs on East Mainland together comprise the total breeding population likely to utilise the Scapa Flow SPA for feeding. This totals approximately 70 pairs, the great majority of which are concentrated within the Hoy SPA, well to the west and beyond any realistic potential for significant interaction with the Project site.

The closest diver-supporting parts of the Orkney Mainland Moors SPA lie at about 15 km northwest of the Project, half of which is overland. Since there is plenty of good foraging ground much closer to these breeding lochans in the North Orkney SPA, there is little possibility of a regular or significant connection between the Orkney Mainland Moors SPA and the Project site.

The Marine Directorate website shows a map (NatureScot, 2014a) of the predicted foraging occurrence of red-throated divers across the North Orkney and Scapa Flow SPAs. It indicates that the Project is in the lowest category of modelled diver foraging.

10.2.1.2.1 Numbers from Project survey work

Table 10-4 below indicates the peak and average counts within various distance bands around the main VP at the Project in each recording year.

Table 10-4 Peak and average numbers of red-throated diver in zones around the main Project VP (NB different start dates in calculation of averages due to survey timing differences between years).

Distance band	Survey period	Peak month	Peak count	Average of peak count	% SPA population (76 birds)	Average count	% SPA population (76 birds)
Non-breeding							
0 – 1 km	Yr 1 - 2020/21	Nov-Mar	2	1.67	N/A	0.12	N/A
	Yr 2 - 2021/22	Oct-Mar	2			0.12	
	Yr 3 - 2023/24	Oct-Mar	1			0.18	
0 – 2 km	Yr 1 - 2020/21	Oct-Mar	0	0.67		0	
	Yr 2 - 2021/22	Oct-Mar	1			0.021	
	Yr 3 - 2023/24	Oct-Mar	1			0.09	
Breeding							
0 – 1 km	Yr 1 - 2020/21	Apr-Sept	4	3	5.3%	0.32	0.4%
	Yr 2 - 2021/22	Apr-Sept	2		2.6%	0.33	0.4%
0 – 2 km	Yr 1 - 2020/21	Apr-Sept	0	1	0%	0	0%
	Yr 2 - 2021/22	Apr-Sept	2		2.6%	0.125	1.6%

A peak count of 4 red-throated divers was recorded within 1 km of the Project site during the breeding season, with a peak count of 2 birds within 2 km. The peak count of 4 birds represents 5.3% of the Scapa Flow SPA population, and the average seasonal peak count of 3 birds out to 2 km represents 3.9% of the SPA population (citation level).

Table 10-5 below details the numbers of red-throated divers present within 2 km of the Project site during their flightless moult period (mid-September to mid-October, per Duckworth *et al*, 2024).

Table 10-5 Red-throated diver numbers during the flightless moult period

Month	No. count days	Average count 2 km	Peak count <2 km
Sept 2021	3	1.33	2
Oct 2021	3	0.67	1
2021 seasonal figures	6	1	2
Sept 2022	3	1	2

The peak average count of 1.33 birds (September 2023) and peak count of 2 (September 2021 and 2022) represents 1.75% and 2.6% of the SPA population, respectively. The average peak count during the flightless moult of 2 birds (2021 seasonal figures and September 2022) represents 2.6% of the SPA population.

10.2.1.3 Black-throated diver (non-breeding)

10.2.1.3.1 Seasonality

The spread of count days at the Project site gives a good indication of the seasonal spread of records.

- 2020/21 peaks (within 1km of the main VP) in November and again in February/March.
- 2021/22 peaks (within 1km) in October and again in December/January, but overall peaking within 2 km in January.
- 2023/24 peaks (within 1km) in November and January, but overall peaking within 2 km in late October/November.

The SPA citation population of this species is 57 birds (JNCC, 2022).

10.2.1.3.2 Wider occurrence across Scapa Flow SPA

The Scapa Flow inshore survey in 2017/18 (Jackson, 2018) observed a total of 39 black-throated divers during a dedicated search for the species in February (the third of four count rounds). Based on the maps and tables from each count provided in the 2017/18 survey report (Jackson, 2018), the key area for black-throated divers was along the central north shore of the Flow between Bay of Swanbister and Hobbister, three or more kilometres to the west of the Project site. All the divers were seen in that area during the second count, while a group of three birds was in the Project vicinity on each of the first and third counts, and most were scattered at the far, western, side of the Flow in the fourth (last) count round in March.

HiDef surveys undertaken in 2021/22 and 2022/23 (Peters-Grundy *et al.,* 2026) indicate that the majority of black-throated divers were recorded off the Tongue of Gangsta, approximately 1 km south of the Project site and in St Mary's Bay, 4 km south in 2021/22 and in Scapa Bay and off Hemp Stack, to the north of the Project site and off Tongue of Westbister, approximately 2.5km south in 2022/23 (Peters-Grundy *et al.,* 2026). This demonstrates the transient nature of this species within Scapa Flow throughout the winter season.

On 13 December 2023 a tight group of 11 was seen fishing in Mill Bay, Hoy at the far side of the Flow from the Project (Andrew Upton personal observation), then on 26th December 2023 a tight group of 25 actively foraging divers, almost certainly black-throated, was seen from the Project in calm conditions at the mouth of Waulkmill Bay some 5 km to the west (from the upper and north VPs, beyond the spreadsheet recording zones). This larger group was probably comprised mainly of the same individuals as seen the previous month, much closer to the Project, whilst the smaller group may have represented additional birds. If so, this suggests an SPA minimum total of around 36 black-throated divers in 2023/24, in the same two general areas where most were found during the first and third count rounds in 2017/18, thus possibly forming the bulk of the SPA population.

A map showing the distribution of birds recorded both during the baseline surveys and HiDef surveys from 2021/22 and 2022/23 (Peters-Grundy *et al.,* 2026) can be found in Appendix A: Heat Maps and HiDef Survey Data.

Figure 10-1 below shows the distribution of black-throated diver across Scapa Flow, as illustrated by data from the NatureScot (2014b) available on NMPI (2026). Although it shows the area around the Project site to be a regularly used area, it also shows several other areas across Scapa Flow that the species frequents.

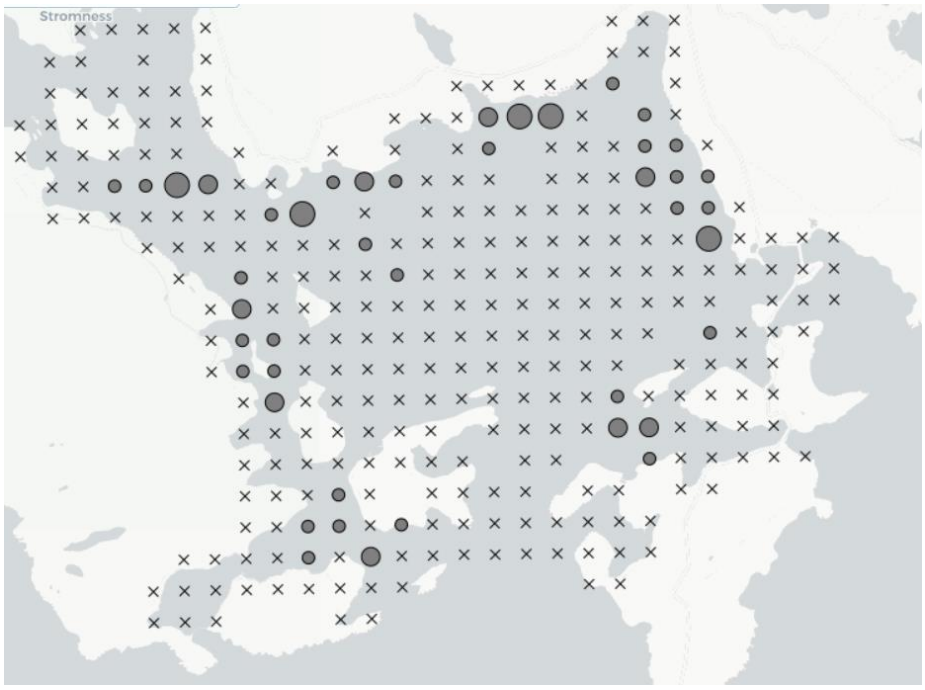


Figure 10-1 Site Usage of Black-throated Diver in Scapa Flow SPA (NatureScot, 2014b)

10.2.1.3.3 Numbers from Project survey work

Table 10-6 below indicates the peak and average counts within various distance bands around the main VP at the Project in each recording year.

Table 10-6: Peak and average numbers of black-throated diver in zones around the main Project VP (NB different start dates in calculation of averages due to survey timing differences between years).

Distance band	Survey period	Peak month	Peak count	Average of peak count	% SPA population (57 birds)	Average number Oct/Nov to Mar (Average peak)	% SPA population (57 birds)
0 – 500 m	Yr 1 - 2020/21	Nov	7	8.33	12%	0.70	1.2 %
	Yr 2 - 2021/22	Oct	7		12 %	0.46	0.8 %
	Yr 3 - 2023/24	Nov	11		19 %	0.64	1.1 %
0 – 1 km	Yr 1 - 2020/21	Nov/Feb	7	9.33	12%	2.15	3.8 %
	Yr 2 - 2021/22	Dec	10		17 %	1.33	2.3 %
	Yr 3 - 2023/24	Nov	11		19 %	1.55	2.7 %
0 – 2 km	Yr 1 - 2020/21	n/c	-	19	-	-	-
	Yr 2 - 2021/22	Jan	11		19 %	3.00	5.3 %
	Yr 3 - 2023/24	Nov	27		47 %	6.23	11.0 %

The 2021/22 peak of 11 birds within 2 km in January 2022 correlates well with the inshore surveys undertaken by HiDef for NatureScot (Peters-Grundy *et al.,* 2026), where a peak count of 14 birds was recorded in the same general area in the same month.

The numbers present at or near the Project in the 2023/24 winter were higher than previously, particularly in the autumn, when four out of five days at the end of October through November held double figures within 2 km of the main VP (19 on 31st October; 20 on 7th November, and 27 on 19th November 2023). It should be noted that these numbers should be considered outliers, as this three-week period is the only time over 3 years of surveys where numbers reached such levels. This coincides with increased numbers of great northern diver during the same period (peak of 59 birds on 19th November 2023). Reasons for this notable increase in both diver species are uncertain; however this could speculatively indicate a reliable availability of food in this area over this limited period, that birds were using this area for shelter during certain weather conditions, or possibly that birds had been displaced from other regions and were aggregating close to the proposed development.

Based on the Scapa Flow SPA population of 57 birds, the peak of 11 birds in the first two survey years represents 19% of the total numbers, with the peak of 14 birds during the HiDef surveys in 2022 (Peters-Grundy *et al.,* 2026) representing 24.6%. Assuming the same SPA population, then up to 47% of birds were within 2 km of the main VP at times for a month in the autumn of 2023. The average of the seasonal peak count out to 2 km is 15 birds (taking the peak count for the 0-1km due to data availability), representing 26% of the SPA population.

The average number of birds present within 500 m of the main VP was less than 2% of the SPA numbers in all three years, rising to 3.8% within 1 km (2020/21) and up to 11% within 2 km (2023/24).

Table 10-20 below details the numbers of black-throated divers present within 2 km of the Project site during their flightless moult period (mid-September to the end of December).

Table 10-7: Black-throated diver numbers during the flightless moult period

Month	No. count days	Average count 0-1km	Peak count 0-1km	Average count 2 km	Peak count <2 km
Nov 2020	4	4.25	7	4.25	7
Dec 2020	4	0.75	2	2.25	6
2020 seasonal figures	8	2.5	7	3.25	7
Sept 2021	2	1	2	1	2
Oct 2021	4	3	7	3	7
Nov 2021	4	0	0	0	0
Dec 2021	4	3	10	3.5	10
2021 seasonal figures	14	1.9	10	1.9	10
Oct 2023	2	7	11	9.5	19
Nov 2023	4	0.5	1	16.5	28
Dec 2023	4	1.25	3	3.25	11
2023 seasonal figures	10	2.1	11	9.8	28

The peak average count of 16.5 birds (November 2023) and peak count of 28 (November 2023) during the flightless moult period represents 29% and 49% of the SPA population, respectively. Taken as an average across years, the average of 5.02 birds (taken from 2020, 2021 and 2023 seasonal figures) represents 8.8% of the SPA population, and the average peak count during the flightless moult of 15 birds represents 26% of the SPA population. Note that this identifies the percentage of the population occurring close to the Proposed Development during this particularly sensitive period of the species' life history, but not for the full non-breeding period when birds may be present.

10.2.1.3.4 Features of observed distribution around the Project

As can be seen in

Table 10-2 and as illustrated in the bar charts and the density heat maps (Appendix A: Heat Maps and HiDef Survey Data), single figures of birds were recorded within the 500 m radius around the main VP (the effective disturbance zone) in the first two survey years, with up to 11 in November 2023, these swimming steadily through the area as a group and away to the northwest.

The heat maps for the first two years indicate a rather uniform likelihood of occurrence within the 1 km radius, and a slightly lower density at 1–2 km in the second year. However, the monthly bar charts indicate a considerably higher proportion of birds at 1–2 km in the third year (2023/24).

10.2.1.3.5 Observed behaviours around the Project

The swimming track observations from the first two survey years show that black-throated divers can move rapidly, especially when foraging in groups. This was also noted in 2023/24, although detailed swimming track maps were not made, and was commented on in the report for the 2017/18 pSPA survey (Jackson, 2018) when birds were noted moving several kilometres in a few hours.

The swimming track samples recorded the behaviour of individuals or groups of birds at approximately five-minute intervals; the results were variable between years for black-throated diver, with 33 % of bird-records noted as foraging in 2020/21 (from nearly 14 hours) and 66 % in 2021/22 (from nearly 27 hours).

This species undergoes wing-moult for several weeks during the winter when the birds are rendered flightless and can only move around by swimming or diving.

10.2.1.3.6 Observed reactions to vessels at the Project and Hatston

The combined table of observed reactions (referenced in EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report) to vessels at the Project and Hatston sites includes black-throated diver. During the ornithological surveys undertaken, bird and boat interactions were recorded..For black-throated diver, there were ten observations of interactions with boats. Of these, five resulted in birds swimming away slowly, two were of birds diving, one caused an alert response, and two resulted in no apparent response. There were no instances of boat movements causing a flight response.

This notion is supported by survey data recorded in Haston Pier Ornithological Technical Report (EnviroCentre, 2024b). Although recorded only in low numbers, black-throated diver was observed on three occasions within the Hatston survey area during a 2022/23 survey campaign, including sightings from both the north and south pier vantage points adjacent to the operational harbour, indicating that the species is present within and utilises areas subject to existing harbour activities and vessel movements.

This aligns with the findings of Jarrett *et al.* (2021) where 21 observations of black-throated divers from ferries in Scapa Flow (in 2016/17) also recorded no flight responses. In that study, one third of individuals/groups within 300 m of a ferry did not respond at all, another quarter (approximately) swam out of the way, and the rest dived. All birds within 100 m of the ferry track exhibited a response, with fewer responding birds at 100–300 m. Overall, however, there were too few records for this difference to be statistically significant.

A recent paper (O'Hanlon *et al.*, 2024) following tagged kittiwakes off Aberdeenshire highlighted a wide range of individual differences in foraging and habitat selection, which are hidden when averaged across individuals to give a population response. Thus, an averaged response will underestimate some individuals and overestimate others, potentially leading to unforeseen impacts on population dynamics. Whilst the authors' concern was the underestimation of some individuals' response, in the present case, an assumption of responses towards the maximum recorded clearly does not account for the many birds that do not exhibit such a great response, as indicated by the data collected at the Project and Hatston. Ad hoc observations also show that some individuals appear unmoved by vessels in their close vicinity e.g. a black-throated diver inside Scrabster Harbour that merely continued to forage within 100 m while the Motor Vessel (MV) *Hamnavoe* ferry arrived and tied up (Andrew Upton personal observation, 18th Dec 2021).

10.2.1.4 Long tailed duck (non-breeding)

10.2.1.4.1 Seasonality

The spread of count days at the Project site gives a good indication of the seasonal spread of records.

- 2020/21 peaks (up to 2 km from the main VP) in May

- 2021/22 peaks (up to 2 km from the main VP) in March
- 2023/24 peaks (up to 2 km from the main VP) in March

The SPA citation population of this species is 505 birds (JNCC, 2022).

10.2.1.4.2 Wider occurrence across Scapa Flow

During inshore surveys undertaken in 2017/18 (Jackson, 2018), long-tailed duck were distributed all around the coast of the SPA, apart from the 'Southern Approaches' sectors where they were scarce. Particularly large numbers were present along the east coast of Hoy, where they were commonly found in relatively large numbers around fish farms. The east coast of Hoy, between Ore Bay and Burra Sound, accounted for 39% of the total recorded long-tailed duck.

A map showing the distribution of birds recorded both during the baseline surveys and HiDef surveys from 2021/22 and 2022/23 (Peters-Grundy *et al.,* 2026) can be found in Appendix A: Heat Maps and HiDef Survey Data.

10.2.1.4.3 Numbers from Project survey work

During the vantage point surveys undertaken, a peak count of 655 birds were recorded in March 2024. This correlates with previous survey findings, with peak counts of 414 and 232 around the Westerbister finfish farm in May 2021 and March 2022, respectively. During the spring, this species forms larger, concentrated flocks prior to migration.

As can be seen in the density heat maps produced in Appendix A: Heat Maps and HiDef Survey Data, small numbers of long-tailed duck were recorded within the Project site footprint (mainly between 1 and 3, but with a peak of 10 birds). The majority of birds were recorded to the south, in the vicinity of the fish farm cages.

Table 10-8 below details the numbers of long-tailed duck present within 2 km of the Project site during their pre-migration congregation period (March to mid-May).

Table 10-8: Long-tailed duck numbers during the pre-migration congregation period

Month	No. count days	Average count <2 km	Peak count <2 km
March 2021	4	35	60
April 2021	4	134	176
May 2021	2	310	414
2021 seasonal figures	10	130	414
March 2022	4	73	234
April 2022	4	42	75
May 2022	1	58	58
2022 seasonal figures	9	58	234
March 2024	4	374	515

The peak average count of 374 birds (March 2024) and peak count of 515 (March 2024) during the pre-migration congregation period represents 26.8% and 37% of the SPA population, respectively. Taken as an average across years, the average of 187.3 birds (taken from 2021, 2022 and 2024 seasonal figures) represents 13.4% of the SPA population, and the average peak count of 387.6 birds represents 27.8% of the SPA population. Note that this identifies the percentage of the population occurring close to the Proposed Development during the pre-migration congregation period, but not for the full non-breeding period when birds may be present.

10.2.1.5 Eider (non-breeding)

10.2.1.5.1 Seasonality

The spread of count days at the Project site gives a good indication of the seasonal spread of records.

- 2020/21 peaks (up to 2 km from the main VP) in August

- 2021/22 peaks (up to 2 km from the main VP) in August
- 2023/24 peaks (up to 2 km from the main VP) in November

The SPA citation population of this species is 1,997 birds (JNCC, 2022).

10.2.1.5.2 Wider occurrence across Scapa Flow

During inshore surveys undertaken in 2017/18 (Jackson, 2018), eider were distributed all around the coast of the SPA, apart from the 'Southern Approaches' sectors where they were scarce. Particularly large numbers were present along the east coast of Hoy, where they were commonly found in relatively large numbers around fish farms. The east coast of Hoy, between Ore Bay and Burra Sound, accounted for 55% of the total recorded eider.

A map showing the distribution of birds recorded both during the baseline surveys and HiDef surveys from 2021/22 and 2022/23 (Peters-Grundy *et al.,* 2026) can be found in Appendix A: Heat Maps and HiDef Survey Data.

10.2.1.5.3 Numbers from Project survey work

During the vantage point surveys between 2020/21 and 2023/24, a peak count of 104 eider were recorded within 2 km of the Project site. This is higher than the counts from the inshore surveys undertaken by HiDef for NatureScot (Peters-Grundy *et al.,* 2026), where a peak count of 30 birds were recorded in the same general area in January 2022. The peak counts for 2020/21 and 2021/22 occurred in August, when eider are moulting and form large flightless flocks. The peak of 104 birds represents 5.2% of the SPA population.

As can be seen in the density heat maps provided in EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report, a large proportion of the birds were recorded within the Project site footprint area, feeding and loafing close inshore.

Table 10-9 below details the numbers of eider present within 2 km of the Project site during their flightless moult period (July to mid-September).

Table 10-9: Eider numbers during their flightless moult period

Month	No. count days	Average count <2 km	Peak count <2 km
July 2021	4	1.25	3
August 2021	4	51.75	93
September 2021	2	51	71
2021 seasonal figures	10	31.4	93
July 2022	4	72	80
August 2022	4	64.75	91
September 2022	2	50.5	57
2022 seasonal figures	10	64.8	91

The peak average count of 64.75 birds (August 2022) and peak count of 93 (August 2021) during the flightless moult period represents 3.2% and 4.6% of the SPA population, respectively. Taken as an average across years, the average of 48.1 birds (taken from 2021 and 2022 seasonal figures) represents 2.4% of the SPA population, and the average peak count of 92 birds represents 4.6% of the SPA population. Note that this identifies the percentage of the population occurring close to the Proposed Development during this particularly sensitive period of the species' life history, but not for the full non-breeding period when birds may be present.

10.2.1.6 Red-breasted merganser (non-breeding)

10.2.1.6.1 Seasonality

The spread of count days at the Project site gives a good indication of the seasonal spread of records.

- 2020/21 peaks (up to 2 km from the main VP) in January to March
- 2021/22 peaks (up to 2 km from the main VP) in January
- 2023/24 peaks (up to 2 km from the main VP) in October

The SPA citation population of this species is 539 birds (JNCC, 2022).

10.2.1.6.2 Wider occurrence across Scapa Flow:

During the inshore surveys undertaken in 2017/18 (Jackson, 2018), red-breasted mergansers occurred almost exclusively along the most sheltered coastlines and typically were close inshore, in pairs or small groups. The highest numbers were recorded in North Bay at Hoy, around Burray and in Water Sound between South Ronaldsay and Burray.

10.2.1.6.3 Numbers from Project survey work

During the vantage point surveys, red-breasted merganser was very infrequently recorded, with a peak of three birds noted within 1 km and a peak of 4 birds within 2 km. This correlates well with the counts from the inshore surveys undertaken by HiDef for NatureScot (Peters-Grundy *et al.,* 2026), where a peak count of 2 birds was recorded in the same general area. The average peak of 3 birds represents 0.5% of the Scapa Flow SPA population. The average seasonal peak count (1 and 3 birds within 1 km and 4 birds within 2 km) is 2.7 birds, representing 0.5% of the SPA population.

10.2.1.7 European shag (non-breeding)

10.2.1.7.1 Seasonality

The regular spread of count days at the Project site gives a good indication of the seasonal spread of records.

- 2020/21 peaks (up to 2 km from the main VP) in October
- 2021/22 peaks (up to 2 km from the main VP) in September
- 2023/24 peaks (up to 2 km from the main VP) in November

This correlates with the findings of the 2017/18 inshore surveys (Jackson, 2018), which found that Scapa Flow SPA has particular importance for this species in the early part of the winter. The SPA citation population of this species is 2,927 birds (JNCC, 2022).

10.2.1.7.2 Wider occurrence across Scapa Flow SPA

During the inshore surveys undertaken in 2017/18 (Jackson, 2018), shags on the sea were very widely distributed across the SPA, with the only part where they were infrequently seen was the central part of Scapa Flow, where presumably the seabed lies too deep for profitable foraging. The majority of shags (on average 58%) were recorded in the Scapa Flow inshore count sectors, with the 'East Coast' count sectors having particular importance for this species, accounting, on average, for nearly 12% of the birds seen. The 'Southern Approaches' count sectors also accounted, on average, for 7% of the birds seen. European shag was the only SPA qualifying species that occurred in reasonably high numbers in this part of the SPA.

10.2.1.7.3 Numbers from Project survey work

During the vantage point surveys, a peak count of 72 European shag were recorded within 1km of the Project site, with a peak of 73 birds within 2 km (Table 3 of EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report). This is higher than the counts from the inshore surveys undertaken by HiDef for NatureScot (Peters-Grundy *et al.,* 2026), where a peak count of 24 birds were recorded in the same general area in January and February 2022. The peak of 73 birds represents 2.5% of the Scapa Flow SPA population. The average of the seasonal peak count (38 and 72 birds within 1 km In years 1-2, and 73 birds within 2 km in year 3) is 61 birds, representing 2.1% of the SPA population.

As can be seen in the density heat maps provided in Appendix A: Heat Maps and HiDef Survey Data, birds were recorded within the Project site footprint area, although in small numbers (usually between one and five). However, there was a peak count of 30 birds on 18th December 2022.

10.2.1.8 Slavonian grebe (non-breeding)

10.2.1.8.1 Seasonality

The spread of count days at the Project site gives a good indication of the seasonal spread of records.

- 2020/21 peaks (within 500m of the main VP) in February.
- 2021/22 peaks (within 1km) in December and again in February.
- 2023/24 peaks (within 1km) in March.

The SPA citation population of this species is 135 birds (JNCC, 2022).

10.2.1.8.2 Wider occurrence across Scapa Flow SPA

During the inshore surveys undertaken in 2017/18 (Jackson, 2018), Slavonian grebes showed a strong preference for sheltered, relatively shallow parts of the survey area with only seven birds seen in all the boat-based surveys, underlining the lack of importance of the central part of Scapa Flow. The 'East Coast' part of the SPA also had low numbers of this species, and none were recorded in the 'Southern Approaches' count sections. The largest counts were around Swanbister and Waulkmill Bay in the northern part of the SPA, and around Burray. The distribution of records in Scapa Flow showed that there was some noticeable redistribution throughout the winter. Moderate numbers were seen in Round 1 between Hoy and South Walls (but these had largely moved away in later count rounds). In contrast, relatively few birds were seen between South Ronaldsay and Burray in Round 1, but they were commonly seen here in later count rounds.

A map showing the distribution of birds recorded both during the baseline surveys and HiDef surveys from 2021/22 and 2022/23 (Peters-Grundy *et al.,* 2026) can be found in Appendix A: Heat Maps and HiDef Survey Data.

10.2.1.8.3 Numbers from Project survey work

Table 10-10 below indicates the peak and average counts within various distance bands around the main VP at the Project in each recording year.

Table 10-10: Peak and average numbers of Slavonian grebe in zones around the main Project VP (NB different start dates in calculation of averages due to survey timing differences between years).

Distance band	Survey period	Peak month	Peak count	Average of peak count	% SPA population (135 birds)	Average number Oct/Nov to Mar (average peak)	% SPA population (135 birds)
0 – 500 m	Yr 1–- 2020/21	Feb	7	5.67	5.2 %	3.45	2.5 %
	Yr 2–- 2021/22	Dec/Feb	5		3.7 %	1.85	1.4%
	Yr 3–- 2023/24	March	5		3.7%	1.125	0.8%
0 – 1 km	Yr 1–- 2020/21	Feb	7	5.67	5.2%	3.55	2.6%
	Yr 2–- 2021/22	Dec/Feb	5		3.7%	2.05	1.5 %
	Yr 3–- 2023/24	Nov	5		3.7%	1.625	1.2 %
0 – 2 km	Yr 1–- 2020/21	Feb	7	5.67	5.2%	3.55	2.6%
	Yr 2–- 2021/22	Dec/Feb	5		3.7 %	2.05	1.5 %
	Yr 3–- 2023/24	March	5		3.7 %	1.625	1.2 %

A peak count of 7 Slavonian grebes was recorded within 1km of the Project site, with a peak of 7 birds within 2 km. This is slightly higher than the counts from the inshore surveys undertaken by HiDef for NatureScot (Peters-Grundy *et al.,* 2026), where a peak count of 2 birds were recorded in the same general area in January and February 2022. The peak of 7 birds represents 5% of the Scapa Flow SPA population. The average of the seasonal peak count is 5.67 birds, representing 4.2% of the SPA population.

As can be seen in the density heat maps provided in Appendix A: Heat Maps and HiDef Survey Data, birds were recorded within the Project footprint area, although in small numbers (usually singles). However, there was a peak count of five birds on 2^{6t}h January 2022.

10.2.1.9 Arctic skua (breeding)

Small numbers were recorded flying past very infrequently during the summer months, with a peak of five birds in June 2022. The closest known breeding areas are on the East Mainland, ~10 km distance, supporting only one or a few pairs at each location. The five birds recorded represents 4.2% of the Hoy SPA citation population (59 pairs).

10.2.1.10 Atlantic puffin (breeding)

This species was recorded on 7 out of 48 watch days during 2020 and 2022, with a peak of 3 birds. It is possible that these birds are from Hoy SPA but the area in the vicinity of the proposed Project site is not considered to be of importance to this species. The peak of three birds represents 0.04% of the Hoy SPA citation population (3,500 pairs).

10.2.1.11 Black-legged kittiwake (breeding)

Small numbers were recorded flying past during the summer months, with a peak of 7/hr in June 2022. A peak count of 83 birds on the water within 2 km was also recorded. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Project site. The peak of 83 birds represents 1.4% of the Hoy SPA citation population (3,000 pairs).

10.2.1.12 Common guillemot (breeding)

Small numbers were recorded, with a peak of 27 birds within 1km of the Project site and 87 within 2 km. Small numbers were also recorded flying past the Project site, with a peak of 6/hr in June 2022. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Project site. The peak of 87 birds represents 0.3% of the Hoy SPA citation population (13,400 pairs).

10.2.1.13 Great black-backed gull (breeding)

A peak of 11 birds were recorded during the summer, and up to 7 birds per hour were recorded flying past at its peak. One pair recorded nesting close to the Project site. It is unlikely that the birds recorded were part of the Hoy SPA complex. The peak of 11 birds represents 0.96% of the Hoy SPA citation population (570 pairs).

10.2.1.14 Great skua (breeding)

Small numbers, with a peak of 4 birds/hr flying past in July 2021. Numbers in 2022 were significantly lower, probably due to the prevalence of avian flu, which has decimated the local and national populations. The 4 birds/hr represents 0.1% of the Hoy SPA citation population (1,900 pairs).

10.2.1.15 Northern fulmar (breeding)

Sizable numbers were recorded flying past during the summer months, with a peak of 56/hr in July 2022. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Project site. The peak of 56 birds/hr represents 0.08% of the Hoy SPA citation population (35,000 pairs).

10.2.2 Key Data Sources

The following sections present key data sources that inform the Information to Inform Appropriate Assessment.

10.2.2.1 Sensitivity to Disturbance

Sensitivity to vessel disturbance differs across bird species. Studies by Garthe and Hüppop (2004) and Schwemmer *et al.* (2011) suggest that divers and scoters may avoid shipping activity by several kilometres, while gulls are not considered susceptible to disturbance because of their habituation to fishing boats (e.g. Camphuysen, 1995; Hüppop and Wurm, 2000). Table 10-11 summarises the rated sensitivity of the key qualifying features of the SPAs included in this Information to Inform Appropriate Assessment, based on the data review undertaken by Furness *et al. (*2012).

NatureScot have stated in previous correspondence[9] that divers are highly sensitive to towering structures in the marine environment, and therefore, the use of cranes should be included as a pathway to impact in this assessment. There is no comparable evidence for disturbance as a result of crane movements or similar towering structures, and so the sensitivity factors for disturbance due to vessels presented in Table 10-11 below will be used as a proxy.

Table 10-11 Sensitivity to vessel disturbance of the qualifying features of the SPAs screened in to this Information to Inform Appropriate Assessment (Furness et al., 2012).

Qualifying feature	Sensitivity to disturbance and displacement
Great northern diver	High
Long-tailed duck	Low
Red-breasted merganser	Medium
Red-throated diver	Very high
Shag	Medium
Slavonian grebe	Medium (however, NatureScot advise **very high** sensitivity to boat disturbance in Orkney, based on Jarrett *et al.*, 2018)
Black-throated diver	Very high
Common eider	High
Velvet scoter	Medium
Arctic skua	Very low
Fulmar	Very low
Great-black backed gull	Low
Great skua	Very low
Guillemot	Medium
Kittiwake	Low
Puffin	Low

10.2.2.2 Foraging Ranges

Table 10-12 below outlines the breeding season foraging ranges (Woodward *et al.,* 2019) that have been used to support this Information to Inform Appropriate Assessment.

Table 10-12 Breeding seasons foraging ranges for relevant SPA qualifying seabird species (Woodward et al., 2019)

	Foraging Range (km)		
Qualifying feature	Maximum	Mean Max	Mean Max + 1 SD
Red-throated diver	9	9	9
Shag	46	13.2 ± 10.5	23.7
Common eider	22.5	21.5	21.5
Arctic skua	2.7		
Fulmar	2,736	542.3 ± 657.9	1,200.2
Great-black backed gull	73	73	73
Great skua	1003	443.3 ± 487.9	
Guillemot	338	73.2 ± 80.5	153.7

[9] NatureScot Consultation Response 7th November 2025 (Ref: CDM181903)

	Foraging Range (km)		
Kittiwake	770	156.1 ± 144.5 300.6	
Puffin	383	137.1 ± 128.3	265.4

For all non-breeding seabird qualifying features of the SPAs (great northern diver; long-tailed duck; red-breasted merganser; Slavonian grebe; black-throated diver), impacts are considered within 15 km of the SPA based on NatureScot (2023b).

10.2.2.3 Baseline vessel movements

The Project have provided information on the current typical monthly vessel movements experienced within the eastern area of Scapa Flow. This baseline is derived from the Project NRA (see Appendix 2.3 of EnviroCentre, 2025a). Baseline vessel activity in Scapa Flow is characterised by a high level of diverse maritime traffic year-round, with AIS data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow—closest to the Project site—current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents only ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

10.2.3 Project Design Envelope Parameters

This section outlines the Project Design Envelope Parameters to support the assessment of the impact pathways screened in to this Information to Inform Appropriate Assessment, as determined from the Project Description presented in Section 5.

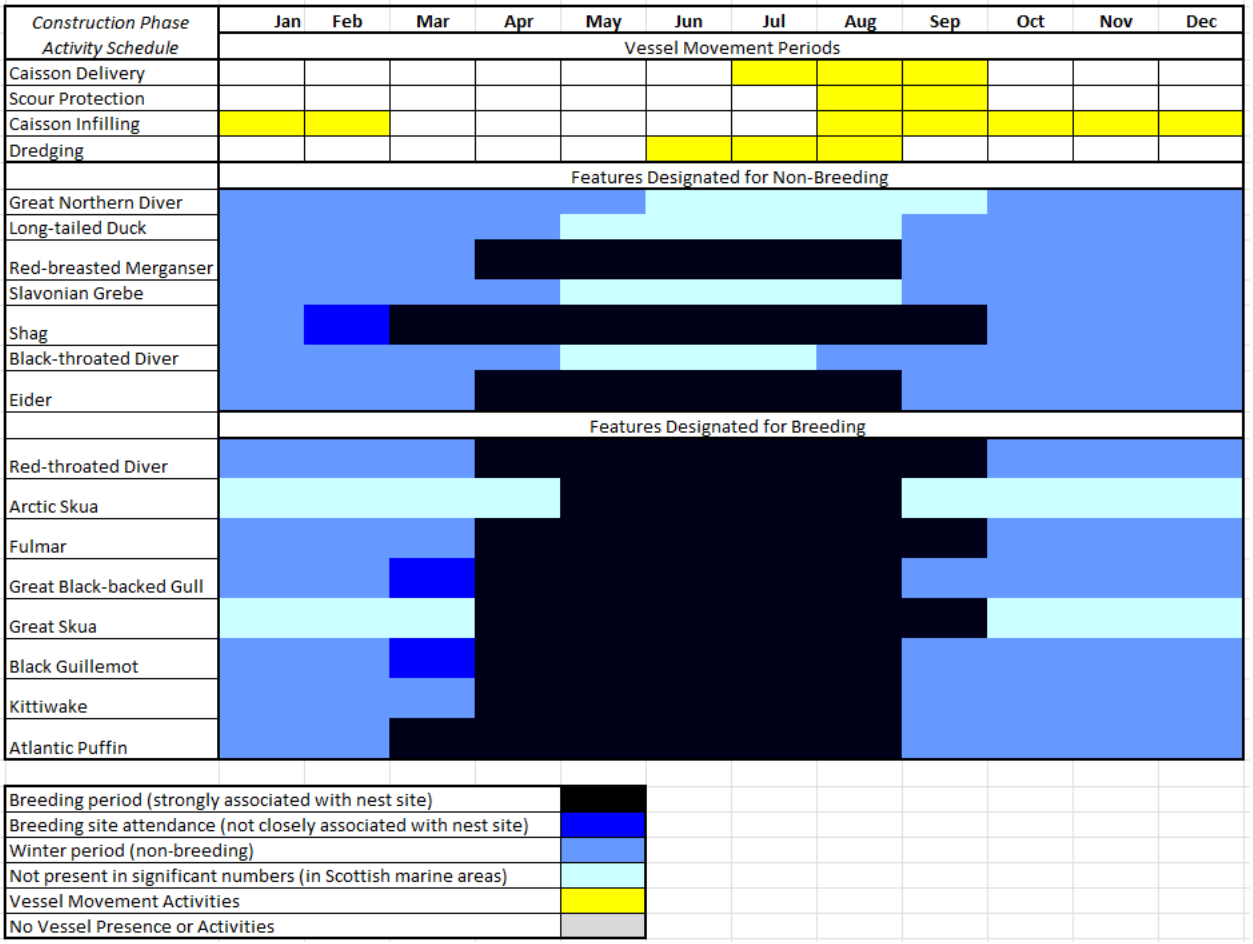
10.2.3.1 Vessel movements during construction

Per Table 5-3, the construction phase will see a total of 112 vessel movements over only an 8-month period between June 2028 and February 2029.

Based on baseline vessel movements (as informed by the NRA; see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3, this will result in an additional 21.5 vessel movements per month on average (+0.16% from baseline) during winter months (October-March) and an additional 90.4 vessel movements per month on average (+0.5% from baseline) during summer months (April-September). This increase will be temporary over the construction period and vessel movements will occur only over only eight months of the 26-month construction period, between June 2028 and February 2029, inclusive.

Table 10-13 below illustrates they key vessel movement periods during construction, presented against key breeding and non-breeding periods for qualifying features to help inform the assessment.

Table 10-13 Vessel movement periods presented against key breeding and non-breeding periods for qualifying features



10.2.3.2 Vessel movements during operation

Per Section 5.4.1. there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

10.2.3.3 Crane operation

Crane usage will be during operation of the Project only. Cranes are used primarily to load/unload cargo to/from vessels. Crane operations will involve on-vessel cranes (approximately 70-125 m in height) and temporary mobile cranes positioned on the quay edge. Quayside cranes will include mobile cranes (up to 250 t and 60 m maximum boom height) and smaller support cranes (up to 90 t and 48 m maximum boom height). When not in use, the cranes will be lowered and the booms retracted horizontally.

10.2.3.3.1 Frequency and timing of crane activity

Crane use will be driven by vessel operations, with around 30 vessel trips per year requiring craneage (60 vessel movements). Approximately 24 of these trips will occur in summer and six in winter, equating to about four trips per month in summer and one per month in winter. As each vessel remains berthed for roughly 2–5 days, this results in cranes being active for approximately 8–20 days per month in summer and 2–5 days per month in winter.

Crane activity will be highly seasonal due to weather limitations, particularly wind. Winter conditions in Kirkwall result in more than 200 hours per month lost to wind, meaning that less than 20% of lifting operations can be undertaken in winter. Consequently, most heavy-lift operations—especially those requiring on-vessel cranes—will be scheduled for the summer months when weather conditions are more favourable.

The number of cranes operating at any one time will vary by season and task, with up to four cranes (one on-vessel crane and up to three mobile cranes) operating simultaneously during the summer period. In winter, activity will be substantially reduced, typically involving only two smaller mobile cranes, as large shipments requiring on-vessel craneage will be planned for summer.

Mobile cranes do not generally carry their own lighting, and winter lifting operations will normally be undertaken during daylight hours. This reduces the likelihood of artificial-light-related disturbance, as crane operations outside daylight periods are not expected.

10.2.3.4 Mitigation and Monitoring Measures

Section 7 outlines the Schedule of Mitigation the Project has committed to during both construction and operation phases. Those specifically related to this assessment of ornithological qualifying features (based on the impact pathways screened in) include:

- Adherence to a CEMD;
- Use of an ECoW;
- Pollution Incident Response Plan;
- Turbidity Monitoring;
- Vessel Management Plan;
- Use of a silt boom during construction;
- Marine Mitigation Zone;
- Ballast Water Management;
- Pollution Prevention Plan;
- Best Practice.

10.2.4 In-combination Assessment

Projects in and around Orkney are considered to have the potential to result in in-combination effects on ornithological features as qualifying interests of protected sites. The plans and projects considered for the in-combination assessment are outlined in

Table 10-14. This short-list has been derived from a long-list of plans and projects, which is provided in Appendix E: Long List of In-Combination Projects. To adequately assess in-combination effects, a thorough search of both the MD-LOT applications portal and the Orkney Islands Council planning applications portal was undertaken. By default, all aquaculture sites within Scapa Flow SPA with Marine Licence applications or planning applications submitted after the designation of the Scapa Flow SPA are included. For other development sites, a search of both planning portals for developments since 2022 was undertaken, and a determination was made whether to screen them in or out for assessment. Projects were screened out if there was no information on project specifics, such as impacts or adverse effects on SPA qualifying features or if projects were deemed to have been completed (i.e., marine licence expiry).

Overlapping construction periods and/or operational periods were also considered if these did not form part of the baseline. However if, for example, vessel movements of developments are already included in the estimates of operational vessel movements at the Project, these were screened out.

The West of Orkney Windfarm has been screened out of the in-combination assessment because vessel movements associated with the use of the SDWQ are already included within the Project-alone assessment. Therefore, including the West of Orkney Windfarm within the in-combination assessment on this basis would result in double-counting of the same vessel activities. Any other construction vessels associated with the West of Orkney Windfarm that do not utilise the SDWQ would have no pathway for interaction with the SPA features considered in this assessment, and therefore would **not adversely affect the integrity of the site**. Thus, no additional in-combination effects are predicted.

Table 10-14 Plans and projects considered for the in-combination assessment of ornithological features

Plan or Project	Development type	Status	Distance from Project
Ayre Offshore Wind Farm	Offshore Wind	Application	36 km
Orbital Westray Tidal Array	Tidal	Pre-Application (Scoping)	27 km
EMEC Fall of Warness	Tidal	Application	24 km
EMEC Billia Croo	Wave	Application	25 km
Mocean– East of Deerness	Wave	Pre-Application	13 km
Orkney–- Caithness	Cable	Under construction	22 km
SHEPD North Coast and Orkney cable route surveys (EPS Licence)	Cable	Consented	30 km
Backaland Pier, Eday	Ports and harbours	Application	28 km
Scammalin Bay (Faray)	Ports and harbours	Consented	33 km
Hatston Pier Expansion	Ports and harbours	Application	9 km
Eynhallow Sound	Aquaculture	Operational	24 km
Bay of Cleat, Westray	Aquaculture	Operational	42 km
Wyre	Aquaculture	Operational	22 km
Puldrite	Aquaculture	Operational	14 km
East of Skelwick Skerry, Westray	Aquaculture	Operational	41 km
Vestness, Westray	Aquaculture	Operational	45 km
Hunda, Scapa Flow	Aquaculture	Operational	6 km
Scarfhall Point, Westray	Aquaculture	Operational	44 km
Lober Salmon Farm, Scapa Flow	Aquaculture	Operational	9 km
East Moclett, North Sound	Aquaculture	Operational	44 km
Bringhead, Scapa Flow	Aquaculture	Operational	17 km

Plan or Project	Development type	Status	Distance from Project
Quanterness	Aquaculture	Operational	10 km
Westerbister	Aquaculture	Operational	550 m
Veantrow Bay, Shapinsay	Aquaculture	Operational	18 km
Chalmers Hope	Aquaculture	Operational	16 km
Toyness	Aquaculture	Operational	10 km
Bay of Cleat (south)	Aquaculture	Operational	42 km
Bay of Ham	Aquaculture	Operational	28 km
Bay of Vady	Aquaculture	Operational	24 km
Kirknoust	Aquaculture	Operational	25 km
Meil Bay	Aquaculture	Operational	9 km
Fara West	Aquaculture	Operational	15 km
Stronsay Harbour	Dredging & disposal	Application	32 km
Hatston, Kirkwall	Dredging & disposal	Application	9 km
Scammalin Bay (Faray)	Dredging & disposal	Consented	33 km

10.3 Impact Pathways

10.3.1 Disturbance of birds due to Project activities (all phases)

During construction and operation, increased levels of vessel traffic and other activities associated with the Project, such as terrestrial works, may cause direct disturbance to birds which use the Project site and surrounding waters for purposes such as foraging and roosting.

Temporary disturbance may cause changes in behaviour and could lead to a reduction in foraging opportunities or increased energy expenditure, resulting in impacts on vital rates, such as survival or reproductive success. Displacement may occur as a result of disturbance, causing birds to be excluded from areas of preferred habitat, either in the short-term or for long periods. Where this affects foraging habitat, this could lead to reduction in foraging opportunities, increased competition in other areas, or increased energy expenditure, resulting in impacts on survival or productivity in affected populations.

It is understood that disturbance may occur at a range of up to 1,000 m for diver species (Goodship and Furness, 2022), representative of the potential range of distances needed to protect birds from human disturbance. A similar disturbance range is applied for crane operations as a proxy.

10.3.1.1 Construction

Disturbance to bird species may occur through vessel presence and movement, dredging activities, and airborne noise through terrestrial works during the construction phase.

It is expected that construction will take a total of 26 months to complete and will be split into discrete stages as outlined in Table 5-1. While dredging works are required for the Project, these will be limited to ~12 weeks in summer 2028 (July-August).

10.3.1.1.1 Disturbance from vessels

In terms of potential disturbance from vessel movements, the maximum number of vessel movements is 112 over the 26-month construction phase (see Section 5.3.8 and Section 10.2.3).

During construction, vessel activity will be clustered around the quay; therefore if multiple vessels are on site at any one time the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be smaller. Thus, the total area affected by vessel disturbance over the construction phase will be small relative to the areas used by marine birds throughout the year (JNCC, n.d; JNCC, 2003-2013; Orkney Islands Council., n.d; Peters-Grundy *et al.,* 2026). Birds that are displaced from areas of vessel disturbance are likely to relocate to the extensive areas of similar habitat in the wider vicinity within the SPA. Disturbance/displacement associated with vessel activity is reversible, with studies indicating that numbers of non-wintering birds (common scoter; common eider; long-tailed duck; white winger scoter) present in the area where displacement occurred returns to pre-disturbance levels after a matter of hours (Schwemmer *et al*., 2011).

The majority of Project construction vessel movements will be along established routes (i.e., the main shipping channels in/out of Scapa Flow from the south (between Flotta and South Ronaldsay) and the west (between Hoy/Graemsay and Stromness)). Both routes experience moderate levels of existing vessel traffic, and the addition of small numbers of Project construction vessels will constitute only a minor departure from baseline levels of shipping. The only area that will experience a greater increase in vessel activity will be the 167 ha branching east off the established route, to the Project site (although there are baseline vessel movements in this area – as shown in Appendix A: Heat Maps and Noise Contour Maps).

During the 26-month construction period, the Project site will experience an increase of 0.16% vessel movements on average during winter months (October-March) and a 0.5% increase during summer months (April-September). This is not considered to constitute a significant change from baseline levels. Vessel movements through the individual species' breeding / non-breeding periods are presented in the respective assessment sections.

10.3.1.1.2 Disturbance form airborne noise (terrestrial works)

Empirical data specifically linking marine bird response to noise disturbance (and underwater noise in particular), separate from other sources of disturbance (e.g. vessel movement or human presence), is limited, and this source of disturbance on marine birds is not yet well understood. Recent research generally suggests that diving seabirds could be more sensitive to underwater noise than previously assumed. For example, hearing thresholds for great cormorant were found to be comparable to seals and toothed whales in the frequency band 1 to 4 kHz (Hansen *et al.,* 2017). A number of assessments have been conducted, based on the limited information available, and the similar frequency ranges between seabirds and phocid pinniped and cetacean species, applied methodologies developed for pinnipeds or low-frequency cetaceans in assessing seabird sensitivity to underwater noise (Teachout, 2012). Underwater noise modelling (Technical Appendix 5.6 of the EIAR) for dredging shows a TTS range of up to 250 m and a PTS range of 50 m or less for prolonged exposure (8 hours). One significant difference, however, between birds and marine mammals, is that while marine birds may use sound to communicate with conspecifics e.g. at breeding colonies, they are not known to be highly dependent on sound whilst foraging underwater.

The construction activities (excluding terrestrial blasting which is dealt with separately) have been highlighted in the Airborne Noise Report (Technical Appendix 9.1 of the EIAR; EnviroCentre, 2023), and noise contour maps have been prepared (see Appendix B: Bird Heat Maps and Noise Contour Maps) as having noise creation levels of between 70-90 dB(A) at 10 m from the source, with noise levels decreasing over distance. With the creation of a 4 m bund on the seaward side of the working area, the noise maps demonstrate that noise levels beyond the seaward bund would be between 40-50 dB(A) in the immediate vicinity of the bund and dissipate to <35 dB(A) at 250 m. A study compiled by the Institute of Estuarine and Coastal Studies, University of Hull (2013) found that construction noise emissions below 50 dB(A) had a low effect and no impact on waterbirds. Disturbance noise above 70 dB(A) resulted in a moderate to high effect on birds, resulting in movement within the feeding zone. The study concluded that construction noise levels should be restricted to below 70 dB(A).

10.3.1.1.3 Disturbance from terrestrial blasting

Terrestrial blasting associated with the construction phase could cause disturbance to bird species. Blasting is expected to be completed within the first 59 weeks of the landside earthworks programme. However, ground conditions may dictate a change in the blasting pattern, which may extend the blasting programme to up to 100 weeks. No more than two blasts would be carried out in any one week.. Routine blasting operations regularly generate air overpressure levels at the closest point to blast area of around 120 dB(A) but the intensity of these noise levels experienced at a distance from the blast site are affected by propagation loss, which is influenced by a range of meteorological conditions (wind speed and direction, temperature, cloud cover and humidity). Furthermore, blasting is characterised by short sound pressure impulses, whereby the pressure rises very rapidly then falls more slowly then returns to the ambient value after a small number of oscillations (typically within 1-2 seconds), meaning that terrestrial blasting typically manifests as a high-amplitude but short-duration impact. Terrestrial blasting will occur once a week over a 35-week period.

10.3.1.1.4 Mitigation

Mitigation measures, as outlined in Table 7-1, includes a Vessel Management Plan which will be adhered to, to minimise and where possible, avoid any disturbance impacts. This includes adherence to vessel speeds and routes, and adherence to Scottish Marine Wildlife Watching code, to minimise the potential for any disturbance. Mitigation measures of standard best practice in relation to navigational protocols and the CEMD will be issued to all vessel operators.

10.3.1.2 Operation and maintenance

As per the construction phase, increased levels of vessel traffic and other activities directly associated with the operation of the Project (such as crane movements) may cause disturbance to marine birds which use the area and surrounding waters for purposes such as foraging and roosting.

During the operational phase, the estimated number of vessels calling at the Project in the operational phase is 96 per year (192 vessel movements comprised of 154 in summer and 38 in winter), comprising 28 large vessels and 12 smaller vessels per year. Each of the 28 large vessels will have two associated pilot boat (2 vessel movements). In total, the estimated vessel movements per year is 192.

The majority of these vessels (approximately 80%) are expected to occur during the summer months (April – September), so there will be an increase of 26 vessel movements per month in summer and 6 per month in winter.

Based on baseline vessel movements (as informed by the NRA; see Appendix 2.3 of EnviroCentre, 2025a) and summarised in section 10.2.2.3, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September). This is not considered to constitute a significant change from baseline levels.

As per the construction phase, the total area affected by vessel disturbance and crane operation will be small relative to the areas used by marine birds throughout the year as evidenced by the HiDef survey data (Peters-Grundy *et al.,* 2026) and other broad scale surveys within Scapa Flow that were used to designate the SPA (JNCC, n.d; JNCC, 2003-2013; Orkney Islands Council., n.d). Birds that are displaced from the areas of vessel and crane disturbance are likely to relocate to the extensive habitat in the wider vicinity within the SPA. Disturbance/displacement is reversible, with studies indicating that numbers present in the area where displacement occurred returns to pre-disturbance levels after a matter of hours (Schwemmer *et al*., 2011).

Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

10.3.2 Disturbance to prey species and habitats of prey species (construction only)

Indirect effects on marine birds may occur as a result of changes in prey distribution, availability or abundance. Reduction or disruption to prey availability for marine birds may cause displacement from foraging grounds in the area or reduced energy intake, affecting survival rates or productivity in the population in the short-term.

Construction activities such as dredging may lead to temporary habitat loss or disturbance. The proposed dredge volume is 379,407 m^3. The volume of fines within the proposed dredge budget is 53,022 m^3. The duration of the proposed dredge campaign is 12 weeks, with a proposed dredge rate of 1,578 m^3/day (or 65.75 m^3/hr). There is therefore considered to be an average fines dredge rate of 9.53 m^3/hr.

Although seabed sediments will be disturbed or removed within a spatially limited area during construction, seabed habitats are expected to commence recovery immediately following completion of construction, which will allow key prey species to repopulate the areas of disturbance. In some areas, where e.g. soft seabed sediments have been replaced by hard structures, the community composition of those habitats may change, albeit in a small spatial area associated with the installation of the new quay.

SSC increases and associated sediment deposition may also reduce abundance and distribution of prey species. Dredge plume dispersal modelling (Technical Appendix 4.1, Volume 3 of the EIAR; EnviroCentre, 2023) indicates that due to the relatively coarse nature of the dredge budget, and the weak tidal currents within the vicinity of the dredge pickets, plumes generated as a result of the dredging works will be very localised, and short-term in duration. Low current speeds mean that sands and gravels lost to the water column during dredging will fall out of suspension immediately, entirely within the footprint of the dredge. Clay and silt lost to the water column will remain in suspension for longer, being dispersed gradually over the tidal cycle and settling out of suspension more slowly. Total SSC are predicted to be low, highest within the dredge zone and immediate surroundings, decreasing towards the plume limits. The modelling outputs indicate that deposition from the proposed dredging is highly localised, with measurable sedimentation (up to 0.03 m) restricted to the dredge footprint. Deposition thickness decreases sharply with distance, falling to negligible levels within tens of metres of the dredging area. No appreciable accumulation is predicted elsewhere in Deepdale Bay or within the broader Scapa Flow environment.

This may result in short-term avoidance of affected areas by prey species (fish and sessile organisms). Adult fish have high mobility and may show avoidance behaviour in areas of high sedimentation (Kjelland, *et al*., 2015). Most bivalve molluscs are known to be highly tolerant to sediment deposition due to the nature of re-suspension and deposition within their natural high energy environment, and it is therefore very likely that any effect from increased SSC during construction will be limited. Deposited sediments are expected to be removed by the currents and dispersed gradually, resulting in thin layers of sediment being deposited. Given the small amount of predicted deposition, the local spatial extent and relatively short duration of the predicted SSC increases, no effect on survival of any prey species is predicted.

Increases in SSC and the resulting reduction in water clarity may impair the ability of foraging marine birds to detect fish both at the surface and within the water column, potentially reducing access to important prey. However, the low-level and short-term duration of these SSC increases means that most marine bird species will be largely unaffected.

There is the potential for understand sound and vibration during construction to affect the abundance and distribution of prey species. Construction activities will generate a degree of underwater noise (for example, from dredging) but this is not considered to be significant with respect to its intensity and duration. Noise and vibration emitted by construction activities is anticipated to be highly localised, and short-term in nature.

Construction impacts to fish species, from underwater noise and pollution, was assessed as being of low magnitude and not significant in the EIAR (EnviroCentre, 2023).

As a precautionary measure during construction, the Project proposes to undertake turbidity monitoring to protect water quality and ensure minimal environmental impact. The Project propose to monitor sediment re-suspension levels to prevent damage to the local ecosystem and aquaculture as high sediment concentrations can contribute to suboptimal conditions and may harm aquaculture fish since it affects the overall ecological balance and the fish have restricted movement. By monitoring turbidity, the Project can determine potential impacts on the environment and implement corrective actions.

The construction-phase impacts on marine bird prey resources are expected to be short-term, temporary, reversible and recoverable, with any changes remaining transient and confined to a small spatial extent relative to the extensive alternative foraging habitat available to seabirds. Localised increases in SSC and temporary seabed disturbance resulting from dredging will be short-lived, with coarse sediments settling rapidly and finer sediments dispersing gradually to form only thin, limited deposits. Seabed habitats are anticipated to commence recovery immediately once construction ends, enabling prey communities to repopulate disturbed areas. Most prey species, including mobile fish and sediment-tolerant bivalves, are expected to demonstrate avoidance behaviour or natural resilience, reducing the likelihood of any significant or lasting effect on prey availability. Underwater noise and vibration will be low in magnitude, highly localised, and short-term, further supporting the assessment that impacts will be minimal. With turbidity monitoring in place to manage potential effects on water quality, and given the very small scale of predicted changes in prey abundance or distribution relative to the wide foraging ranges of SPA seabird species, any indirect effects on marine birds are assessed as not significant, temporary, and fully recoverable. As such, construction effects on qualifying bird features are not likely to significantly alter the overwinter survival of non-breeding birds, or the breeding success and survival of breeding birds.

10.3.3 Accidental release of contaminants or pollutants (all phases)

Accidental releases of pollutants may arise as a result of accidental spills from vessels or other equipment and have detrimental effects on qualifying ornithological features. The potential for accidental pollutant release may arise from the following Project activities:

- Vessel activity (fuel, oils, lubricants, hydraulic fluids);
- Refuelling, maintenance, and engine operation;
- Accidental spills of construction-related materials; and
- Loss of containment from plant, machinery, or storage facilities.

The main risk is considered to be posed by refuelling activities. Oil or fuel spillages to the water environment would be detrimental to the water and sediment quality, fauna and flora. Accidental releases of pollutants pose a potential risk to ornithological features and their prey through degradation of water quality.

As outlined in Section 7, the Project will implement and adhere to industry best practice and standard mitigation measures to reduce the risk and effect of accidental release of hazardous substances. This includes adherence to a Project CEMP during construction. The CEMP includes a Pollution Prevention Plan and a Pollution Incident Response Plan to which the Project will adhere.

In the unlikely event of a spill, residual pollutants would remain spatially local to the site due to prevailing circulation patterns and established best-practice spill management. In this manner, accidental release of potential contaminants from Project vessels will be strictly controlled and procedures will be in place to minimise the effect of any accidental release if it occurs.

Release of toxic materials during dredging is not considered to be likely as sediment sampling found no contaminants at levels likely to significantly affect water quality or pose a hazard to marine life (EnviroCentre, 2023).

Procedures will be in place to minimise the effect of any accidental release if it occurs. Accidental release of potential contaminants from construction vessels will be strictly controlled. Any accidental release of pollutants during construction is expected to be of small magnitude, confined to a very localised area, and although the potential consequences would be high, the likelihood of such an event is deemed extremely low due to mitigations in place. As such, any accidental spill would be short-duration, temporary, and reversible, with rapid containment ensuring full recovery.

10.3.4 Ornithological habitat changes (operation and maintenance only)

Operation and maintenance activities required for the Project (vessel presence and movement, onshore vehicle movement, and mobile cranes) may potentially result in changes to lower trophic levels (e.g. benthic fauna and forage fish species) which may result in changes to foraging opportunities for the qualifying features of the SPAs.

The Project will result in the loss of 19.1 ha of the Scapa Flow SPA. This equates to 0.06% of the total SPA area (31,819 ha). The habitat functions lost will relate primarily to marine foraging areas used by qualifying bird species.

10.4 Scapa Flow SPA

10.4.1 Site Description and Qualifying Features

Scapa Flow SPA comprises a total area of 31,819 ha located within Scapa Flow (NatureScot, 2022b), an enclosed sea area, sheltered by Mainland Orkney to the north; Hoy, Graemsay, South Walls and Flotta to the west and south; and Burray and South Ronaldsay to the east. The Flow is linked to the Pentland Firth in the south through the Sound of Hoxa, and to the Atlantic Ocean in the west through Hoy Sound. The site also includes nearshore waters to the east of Orkney, extending from South Ronaldsay to Deerness, and including the sheltered shallow waters of Holm Sound, between Burray and East Mainland, but is almost cut off from the North Sea by the Churchill Barriers. It encompasses a range of sheltered and diverse marine communities which provide a range of food resources for breeding, moulting and roosting sea birds. Scapa Flow SPA directly overlaps the Project site. It is designated for a number of non-breeding seabirds and waterbirds, and one breeding bird species, the red-throated diver (Table 10-15).

Table 10-15 Protected feature and condition for the Scapa Flow SPA (NatureScot, 2022b)

Protected feature	Feature condition	Assessment date	Broader conservation status*
Black-throated diver (non-breeding)	Favourable	Not yet assessed	UK: Amber European region: Least Concern
Great northern diver (non-breeding)	Favourable	Not yet assessed	UK: Amber European region: Least Concern
Long-tailed duck (non-breeding)	Favourable	Not yet assessed	UK: Red European region: Least Concern
Red-breasted merganser (non-breeding)	Favourable	Not yet assessed	UK: Amber European region: Near Threatened
Red-throated diver (breeding)	Favourable	Not yet assessed	UK: Green European region: Least Concern
Shag (non-breeding)	Favourable	Not yet assessed	UK: Red European region: Declining
Slavonian grebe (non-breeding)	Favourable	Not yet assessed	UK: Red European region: Near Threatened
Eider (non-breeding)	Favourable	Not yet assessed	UK: Amber European region: Endangered
***UK Broader conservation status based on Birds of Conservation Concern 5 (BoCC5) and European region is based on BirdLife International, 2021.**			

10.4.2 Conservation Objectives

The Conservation Objectives of Scapa Flow SPA (NatureScot, 2022b) are:

1. To ensure that the qualifying features of the Scapa Flow SPA are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status.
2. To ensure that the integrity of the Scapa Flow SPA is maintained in the context of environmental changes by meeting objectives 2a, 2b and 2c for each qualifying feature:

- 2a. The populations of qualifying features are viable components of the site.
- 2b. The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species.
- 2c. The supporting habitats and processes relevant to qualifying features and their prey/food resources are maintained.

Supplementary conservation and management advice to support the achievement of the conservation objectives is provided by NatureScot (2022a) and is considered in the assessments below.

10.4.3 Assessment of Adverse Effects Alone

10.4.3.1 Disturbance of birds due to Project activities (all phases)

10.4.3.1.1 Black-throated diver (non-breeding)

10.4.3.1.1.1 Vessel disturbance

During construction, the number of vessel movements relevant to the black-throated diver non-breeding period for which they are a qualifying feature (August-April, see Table 10-13) will see an average 0.35% increase of vessel movements over current winter baseline levels, with no increase in vessel movements in March or April. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and during the black-throated diver non-breeding period (August-April) are expected to comprise an average monthly increase of 13 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 0.5% from current baseline levels.

Black-throated diver display a very high sensitivity to disturbance (Table 10-11). In previous correspondence, NatureScot suggested referring to Guidance Note 8: Guidance to Support Offshore Wind Applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects on Marine birds. Specifically, the suggestion was to undertake a matrix-based model to calculate potential displacement and mortality as a result of the Project on black-throated diver. This has been undertaken (see Appendix D: Mortality Matrix Model). It should be noted that there are inherent flaws in this method, particularly around the use of precautionary principles. A recent paper (SOWEC, 2025) has highlighted these flaws, namely:

- Applying precaution at multiple points in the impact assessment process means precaution is compounded through the assessment, resulting in potentially excessive levels of precaution in outputs;
- Current approaches produce precautionary estimated impacts that are very likely to be larger than true impacts that could occur if a proposed project became operational;
- The extent of precaution in these estimated impacts (i.e. the extent to which precautionary estimated impacts are greater than true impacts) is not transparent; the likelihood of these estimated impacts occurring is not considered; and scientific uncertainty is not fully taken into account; and
- Statutory Nature Conservation Body (SNCB)-advised approaches lack transparency and consistency in how scientific evidence is evaluated and used to inform the precautionary approach presented in SNCB guidance and advice.

The matrix table has been populated for black-throated diver using the mean peak across the three winters of survey effort (7, 11 and 27 – mean peak of 15 birds[10] km buffer), indicating the highly mobile nature of the

[10] Mean peak count of 15 is calculated using year 1 to 1km (7 birds) and year 2 (11 birds) and 3 (27 birds) out to 2 km.

species within the SPA, and the high variability and ephemeral occurrence of the species in the vicinity of the Project.

Daily and hourly peaks were obtained from the survey data[11]. Table 10-16 presents the average daily and hourly peaks from 2021/22 and 2023/24.

Table 10-16 Average daily and hourly peaks from 2021/22 and 2023/24

Year	Buffer	Season peak	Average daily peak	Average hourly count
2021/22	2 km	11	3.54	2.08
2023/24	2 km	27	6.00	2.78
2023/24	>2 km*	29	9.32	4.89
***These data included to provide context regarding the ephemeral nature of the peak counts over the survey period (not material to the conclusions of the HRA).**				

It is highly unlikely that the movement of vessels in the vicinity of the proposed Project (both during construction and operation) will provide a barrier effect to birds moving through the area, as vessel movements are likely to occur less than once per day across the construction and operational phase with vessel movements likely to be fewer than twice a week in the winter (taking the precautionary approach) as opposed to continuously. During the 2021/22 surveys, a small test rig and associated vessels did not entirely displace black-throated divers, and birds were still present and observed moving through the site (present on 14/24 watch days or 58% of watch days), which supports the consideration that no barrier effects will occur and it is unlikely that barrier effects would be associated with vessel movements from the Project.

The matrix model assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, based on an average seasonal peak count of 15 birds (Table 10-6). This equates to 0.135 birds annually, or 0.2% of the SPA population per year. Over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 3.375 birds, or 6% of the SPA population at designation. This equates to a mortality of one bird every 7.4 years as a result of an increase in 0.35% and 0.5% from current baseline levels of vessel movements during the construction and operational phase, respectively.

10.4.3.1.1.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and occurring in short periods during vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and larger on-vessel cranes, with operations occurring over 8–20 days/month in summer (April-August) and 2–5 days/month in winter (October-March). Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m and remain stationary when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

NatureScot advise that divers are particularly sensitive to disturbance and displacement, which also includes visual disturbance and displacement caused by tall, unfamiliar structures in the marine environment (Dierschke *et al.*, 2017). With regards to cranes, there is no evidence available to suggest that quayside cranes cause disturbance and displacement to black-throated diver. The justification for birds being sensitive to towering structures is based on offshore windfarms/turbines and make no mention of coastal developments and/or quayside crane use within such facilities. There are important differences between offshore windfarm structures and land-based cranes, including:

- **Height**: As stated, land-based cranes for the Project range from approximately 48 – 60 m in height. Vessel-mounted cranes are approximately 70 – 125 m in height. It is likely that the smaller cranes will be used during the winter months. Offshore wind turbines are taller, typically approx. 140 – 190m (to

[11] Using the 'max counts' worksheet in each seasonal Excel document getting an estimate of the average hourly count by going through the field sheets and black-throated diver swimming track maps or location maps to identify four points

blade tip) for existing UK offshore wind turbines[12], with the latest projects projecting heights well over 200m.

- **Number and Area**: Up to 4 cranes will be in use at the Project in summer (one on-vessel crane plus 3 mobile quayside cranes). In winter, up to 2 mobile quayside cranes is more realistic given that large shipments requiring on-vessel cranes will take place in summer months. The number of turbines at existing UK offshore wind farms is significantly greater (e.g. 102 for East Anglia One; 174 for Hornsea One). Cranes at the Project are contained to an area approx. 0.2 km^2, whereas existing UK offshore wind farms typically cover 100s of km^2. The area of potential disturbance is, therefore, significantly larger for offshore wind farms.
- **Location**: The landform behind the Project slopes sharply to approximately 20 m higher than the quay level where the cranes will be operating. Against the levels of the land immediately behind this would be 60 m above quay level (within 1 km of the quay). Therefore, the entirety of all cranes will not be viewed against the skyline but against surrounding landform. UK marine wind farms are typically located far offshore in isolated locations.
- **Operation**: Wind turbines are permanent and (near) constantly operating, predominately at speeds greater than that of a crane rotation/slewing. The use of cranes at the Project site is time-limited: in summer cranes are likely to be active between 8 – 20 days per month, and in winter 2 – 5 days per month. In summer, mobile cranes will typically be stored onsite, and in winter either stored onsite or taken offsite if they are required elsewhere. Mobile cranes when not in use will be lowered with booms retracted and placed horizontally (approx. 5 m in height). Lifting operations in winter will typically be carried out in daylight hours. The duration and nature of crane operations is, therefore, significantly different to offshore wind turbines.

In correspondence regarding this application, NatureScot advised referring to Guidance Note 8: Guidance to Support Offshore Wind Applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects on marine birds. Although the use of offshore wind guidance is not considered directly applicable, it has been considered as a proxy based on NatureScot advice for vessel disturbance, due to the novelty of this activity at the Project site and the relatively nearshore distribution of black-throated diver. It is not, however, considered appropriate to use this guidance when assessing the response of black-throated divers to mobile cranes. While evidence (Jarrett *et al*., 2018) suggest that divers show evasive actions as a result of a moving vessel, this is significantly different to potential impacts from land-based cranes. Whilst it is agreed that there would be an energetic cost to stopping feeding and flying considerable distances, this does not correspond with findings from the Jarrett *et al.* (2018) study where disturbance from vessels resulted in not a single flight response (evasive action comprises a dive or swim away), and no flight responses of black-throated diver were recorded during the three years of surveys. Responses from black-throated divers significantly favoured swim or dive responses to passing vessels. It is nevertheless possible that black-throated divers will avoid areas where marine activities take place. The 2 km response of black-throated diver from structures in the marine environment is based on flying around a turbine array (avoidance around a windfarm that is large in area), which is very different to a land-based crane in a coastal setting and viewed against a land-based background.

Black-throated diver are considered to have a very high sensitivity to disturbance and displacement from vessels (Table 10-11). In the absence of any evidence of divers being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of disturbance when compared with mobile vessels at sea: while they nonetheless present a tall structure which can be moving, they move slowly, within confined bounds limited by the crane height and jib length.

Additional project-specific evidence indicates that black-throated divers exhibit relatively limited behavioural responses to vessel activity, as mentioned in Section 10.2.1.3.6. During the ornithological surveys, black-throated divers generally exhibited low-level responses to vessel activity. Of the recorded interactions, half of the resulted in birds swimming slowly away, two birds responded by diving, two showed no observable response, and only one bird displayed an alert response. These observations are consistent with Jarrett *et al.* (2021), who found that black-throated divers exposed to ferry traffic in Scapa Flow responded by swimming,

[12] Rampion: 140 m tall; Hornsea One: 190 m tall; East Anglia ONE: 167 m tall.

diving, or indicated no observable response. The behavioural responses observed and recorded indicate that black-throated divers can move away from the localised disturbance, associated with the Project activities.

There is no published evidence of the effect of cranes on black-throated diver. However, there is anecdotal evidence[13] and data records[14,15] of black-throated divers occurring within and close to harbours during the non-breeding period, including commercial harbours where cranes may be present. Sightings of black-throated divers during the non-breeding period are most frequently reported from bays and sea lochs, and sometimes from reservoirs. These sightings suggest that static vessels, even those with cranes, are not likely to pose a major disturbance impact on individuals of this species foraging close to the Project. Such records are generally uncommon and typically based on observations and photographs submitted by bird recorders and photographers (NBN Atlas, 2026).

NatureScot requested an assessment of black-throated diver disturbance up to 1 km (recommended disturbance buffer for this species; Goodship and Furness, 2022) from cranes during their flightless moult period (mid-September to end of December; Table 10-3). It is acknowledged that counts should be taken as a minimum, as they are of birds recorded to 1km from the Vantage Point and not 1 km from the development footprint, but it highlights a more realistic picture of the use of the site by these birds as opposed to peak numbers, which were recorded extremely infrequently during the surveys. To account for the fact that the VP is not 1 km from the Project, the average counts for the 2 km buffer have also been presented. Although peak counts are often required to be used for assessment purposes, a better barometer of importance should be the average peaks across all years of survey. This is 1.5 birds out to 1 km (Table 3 of EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report; EnviroCentre, 2023), or 2.6% of the SPA population. During the flightless moult period (mid-September to end of December), again the better barometer is average counts to 1km, which is 2.25 or 4% of the SPA population. It also demonstrates further that this species does utilise other areas of Scapa Flow successfully and that the Flow has sufficient capacity to support this species. The average seasonal peak count out to 2 km of the flightless moult period is 15 birds, which is the same as the seasonal average for the entirety of the survey period.

Given the infrequent nature of crane usage during the winter months, and particularly during the birds' flightless moult period, any disturbance to black-throated divers from vessel activity and crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 0.8 vessels per week in winter. For the majority of the non-breeding period, black-throated divers will not be disturbed by either cranes or vessels. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence as observed during surveys, no significant or sustained impact is anticipated.

10.4.3.1.1.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bund between the working area and the marine environment will result in construction sound dissipating to <35 dB(A) at 250 m, a typical baseline level at which there is no evidence for disturbance.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA has the capacity to accommodate displaced birds), to a distance where noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

10.4.3.1.1.4 Conclusion

As described above, Jarrett *et al.* (2018) found that disturbance from vessels did not result in regular flight responses from black-throated divers. The 2 km response of black-throated divers from structures in the marine

[13] https://www.birdsofpooleharbour.co.uk/sightings/harbour-update-07-01-25/
[14] NBN Atlas - Black-throated diver records
[15] EnviroCentre, 2024b – record of black-throated diver presence in working harbour area (Hatston)

environment is based on flying around a turbine array, which has a very different presence to land-based cranes in a coastal setting and viewed against a landform backdrop higher than the quayside cranes themselves.

This assessment presents mortality based on a displacement matrix approach which uses average peak counts as its basis. Although this constitutes a realistic worst-case scenario, given the natural variability in distribution of black-throated diver within Scapa Flow SPA, it is highly likely that disturbance on any given day of the non-breeding period for this species would affect fewer birds than this average peak number. Furthermore, while disturbance is possible, the consequences of disturbance are limited. Black-throated diver are widely distributed around nearshore areas of Scapa Flow, and have extensive access to alternative foraging habitat in the SPA where they target fish prey (as well as resting). Survey data demonstrates the widespread distribution of the species throughout coastal fringes of the site. Vessel movements and crane operations are not continuous pressures on this species during the non-breeding period when they are present in Scapa Flow SPA. These pressures are intermittent, temporary, and the disturbance ceases once the activity ceases (e.g. once a vessel has passed through black-throated diver nearshore habitat, or crane operations cease). When vessels are not transiting/cranes are not operating (i.e. the majority of the time, during the non-breeding period), black-throated will have unimpeded access to the locality of the Project, and therefore disturbance is neither continuous nor sustained.

The additional mortality of 0.135 deaths per year as a result of the Project is based around the conclusions of the displacement matrix assessment, which assumes that for 90% displacement of the average peak number of birds occurring within 2 km of the Project, there will be a 1% increase in mortality. Given the intermittent presence of disturbing factors (vessels, cranes), and the availability of alternative habitat within Scapa Flow SPA, these 90% displacement/1% increase in mortality assumptions are likely to be precautionary.

Against a reference population of 57 birds, this level of additional mortality equates to 0.24% of the SPA citation population per year. However, Scapa Flow SPA is not a closed population, and the wider population (from which birds migrate to spend the non-breeding period in Scapa Flow SPA) is likely to be much larger, as it comprises birds breeding in Scotland (ca. 200 pairs) and birds from the wider boreal North Atlantic region (e.g. Scandinavia) (NatureScot, 2022b). Measured against this wider population, the *per capita* impacts are greatly reduced. Furthermore, considering this mortality as a percentage of the population (i.e. 6% of the SPA citation population) is misleading, because it does not take into account replacement from the breeding population (either in Scotland or further afield), which is not well understood or clearly defined.

The natural, annual mortality among a population of 57 adult black-throated divers (based on an annual survival rate estimated to be 0.89 ±0.01; BTO, 2026) is ~6.2 adult birds per year; or more, if a proportion of the Scapa Flow SPA population is made up juveniles with a lower annual survival rate of 0.400. When considered over a 25-year period, a minimum of 155 birds associated with Scapa Flow SPA would die (natural mortality), based on adult survival of 0.89 and assuming that the population of 57 birds is comprised entirely of adults. If a proportion of this population is comprised of juveniles, this 25-year mortality estimate would be significantly higher, owing to lower juvenile survival. When considered over a period of 25 years, the cumulative mortality of 3.375 birds as a result of the Project is an extremely small perturbation within the range of natural variation. The mortality of <4 birds as a result of the Project (based on mortality of 0.135 individuals per year) is extremely unlikely to lead to long-term population reduction or sustained distribution change. Note that over a 25-year period, given an average 12-year lifespan for black-throated diver, the entire population will be replaced >2 times. The mortality of <4 birds as a result of the Project over a period of 25 years, against a background of natural interannual variability in a wintering population, is not distinguishable from natural variability and is not detectable by any monitoring programme that could realistically be deployed.

It is therefore concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the black-throated diver. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid adverse impacts on marine bird species, including black-throated divers; particularly, adherence to environmental mitigation measures described within

a VMP, which include vessels travelling at slow speeds, avoiding birds rafting on the water in line with the Scottish Marine Wildlife Watching Code, and staying on pre-determined vessel routes.

Furthermore, for the first three years of Project operations, during the flightless moult period (mid-September to end-December), an ornithologist will conduct structured observations of black-throated divers associated with selected crane activity. The Ornithological Observation Protocol will be included in the Operational Environmental Management Plan. This will include:

- Timing: Observations will take place two hours prior to, during, and two hours following crane operations (subject to adequate visibility).
- Data collection: Counts of individuals present and systematic recording of any behavioural responses indicative of disturbance (e.g. displacement, diving, directional swimming, or other changes in activity).
- Reporting: Data will be collated into a post-season summary at the end of each flightless moult period. Reports will be submitted to the Orkney Marine Environment Protection Forum.

The purpose of these observations is to improve the evidence base on black-throated diver responses to mobile crane operations.

Based on the evidence outlined above, in consideration of the inherent conservatism in the assessment, natural variability in the distribution of the species within Scapa Flow SPA, and when considering the mitigation measures committed to by the Project, it can be concluded that the predicted disturbance impacts on the black-throated diver qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

However, as advised by NatureScot through correspondence received to date (June 2026), NatureScot advise *'the development and associated operations will undermine Conservation Objective 2b [the distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance to the species] and therefore lead to adverse effect on site integrity for the black-throated diver'* in the Scapa Flow SPA.

10.4.3.1.2 Great northern diver (non-breeding)

10.4.3.1.2.1 Vessel disturbance

During construction, the number of vessel movements relevant to the great northern diver non-breeding period for which they are a qualifying feature (October-May, see Table 10-13) will see an average 0.12%[16] increase of vessel movements, over current winter baseline levels. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and, during the great northern diver non-breeding period (October-May), are expected to comprise an average monthly increase of 11 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 0.5%, from current baseline levels.

The study undertaken by Jarrett *et al,.*(2018) demonstrated that great northern diver do not typically fly in response to vessels, with all evasive methods recorded being a swim away or dive. Given the speeds of vessels within Scapa Flow and that vessels movements for the Project will adhere to a VMP.

Figure 10-2 shows an analysis of the mean density of great northern diver across Scapa Flow (taken from HiDef survey reporting). It does show that great northern divers are well represented within current shipping lanes, which does suggest a degree of habituation to vessels, contrary to reports that great northern divers are highly sensitive to vessel movements. This has also been demonstrated by a short study undertaken in 2015 (Gittings, e*t al,* 2015) that showed that great northern divers did not exhibit a "flush response" 89% of the time (57 out of 64 incidents), even when the survey boat passed within 10-20m of a bird.

[16] Note because great northern diver non-breeding period continues into May, this takes into account two additional months of 'summer' movements, which makes this value slightly different to the 0.5% increase in more typical *winter* months (October-March) which is stated elsewhere.

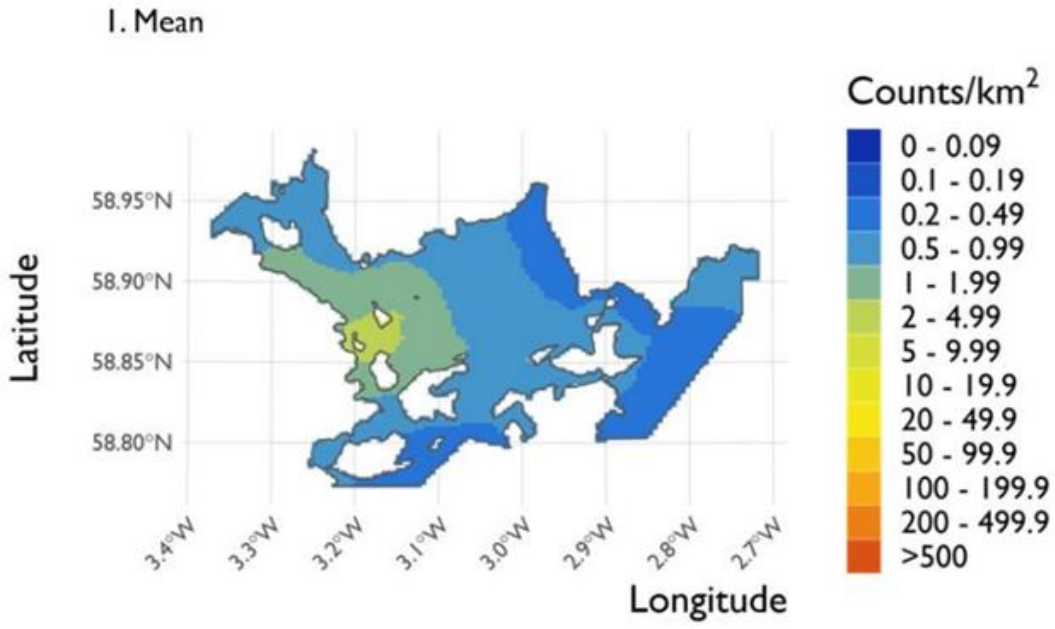


Figure 10-2: Modelled great northern diver densities across Scapa Flow SPA (taken from HiDef 2022/23 wintering bird survey report).

During the ornithological surveys undertaken between 2020 and 2022, bird and boat interactions were recorded. For great northern divers, there were 49 observations of interactions with boats. Of these, 24 resulted in no reaction, 10 resulted in birds swimming away slowly, 11 were of birds diving, and three caused an alert (sitting) response. There were no instances of boat movements causing a flight response. This correlates with the findings of Jarrett *et al* (2021), where at least 95% of reactions to vessels were either no response, slowly swimming away or diving. There were very few instances of vessels causing a flight response.

Despite the evidence from the Gittings, e*t al.* (2015) study mentioned previously, great northern divers are considered to display a high sensitivity to vessel disturbance (Table 10-11; Furness *et al.* 2012). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2). It is highly unlikely that the movement of vessels in the vicinity of the proposed Project (both during construction and operation) will provide a barrier effect to birds moving through the area, as vessel movements are likely to occur less than once per day across the construction and operational phase with vessel movements likely to be fewer than twice a week in the winter (taking the precautionary approach) as opposed to continuously.

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

The matrix model assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, based on mean seasonal peak count of 46 birds (

Table 10-2). This equates to 0.414 birds annually, or 0.08% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 10.4 birds, or 2% of the SPA population at designation, over 25 years. This equates to a mortality of one bird every 2.4 years as a result of an increase in 0.12% and 0.5% from current baseline levels in vessel movements during the construction and operational phase, respectively. During the flightless moult period, the mean seasonal peak count is 33 birds (Table 10-3), which would equate to a mortality of 0.3 birds annually, or 0.06% of the SPA population. Over 25 years, this would result in a mortality figure of 7.4 birds, or 1.5% of the SPA population.

10.4.3.1.2.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The differences between offshore windfarm structures and land-based cranes is provided in Section 10.4.3.1.1.2, providing justification for the caveats in sensitivity of divers to displacement and disturbance from quayside cranes and using offshore wind guidance.

Great northern diver are thought to have a high sensitivity to disturbance and displacement from vessels (Table 10-11). In the absence of any evidence of divers being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of disturbance when compared with mobile vessels at sea: while they nonetheless present a tall structure which is moving, they move slowly, within confined bounds limited by the crane height and jib length. There is no published evidence of the effect of cranes on great northern diver, however the common presence of great northern diver in harbours during the overwinter period suggests that static vessels, even those with cranes, are not likely to pose a major disturbance impact on individuals of this species foraging close to the Project.

Great northern divers are most sensitive during their flightless moult period (February to mid-April; dates provided by NatureScot in correspondence) as during this period they cannot take evasive action by flight. The average peak count of great northern divers during their flightless moult period out to 2 km is 33 birds (Table 10-3) or 6.5% of the SPA citation population. However, as per NatureScot correspondence, it is suitable to use survey data within 0-500m of the main vantage point to assess disturbance and displacement of great northern diver based on a disturbance distance of 100-300m as per Goodship and Furness (2022). The average peak count therefore demonstrates that the species does utilise other areas of Scapa Flow successfully, and that the Flow has sufficient capacity to support this species.

During construction, the number of vessel movements relevant to the great northern diver non-breeding period (October-May) will see an average 0.12% increase of vessel movements, over current baseline levels between October and May. Operational phase vessel movements are expected to comprise an average monthly increase of 11 vessel movements over the same period. This constitutes an average increase to the monthly vessel movements of 0.5%. Given the infrequent nature of crane usage during the winter months (2–5 days/month between October-March) and 8-20 days/month in April and May, any disturbance to great northern divers from vessel activity and crane use is expected to result only in temporary disturbance, particularly during the majority of the flightless moult period, with effects that are intermittent during cargo loading and unloading operations. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.4.3.1.2.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement, or reduce access to, preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Table 10-17 shows peak and average counts using the data collected over the 3 years of site surveys between the 0-500m distance band (based on survey area coverage).

Table 10-17: Peak and Average counts of great northern diver within 500 m of the Project site.

Distance band	Survey period	Peak month	Peak number	% SPA population (505 birds)	Average number (Oct/Nov to April)	% SPA population (505 birds)
0 – 500 m	Yr 1 - 2020/21	April	8	1.6%	2.04	0.4 %
	Yr 2 - 2021/22	March	9	1.8%	2.16	0.4 %
	Yr 3 - 2023/24	Nov	6	1.2%	2.13	0.4 %

The peak count of nine birds corresponds to a maximum of 1.8% of the SPA population, with average counts corresponding to 0.4% of the SPA population (at the time of citation). The average of the peak counts of 7.7 birds represents 1.5% of the SPA population. Using the count data from 2017/18 (Section 10.2.1.1.2), these numbers correspond to 1.1% and 0.26% respectively, and 0.8% and 0.2% respectively for the 2021/22 and 2022/23 HiDef survey population estimates. These are considered low.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including great northern diver.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the great northern diver. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA and the likelihood that disturbed birds will resume foraging elsewhere. Based on the evidence outlined above and when considering the mitigation measures committed to by the Project, it can be concluded that the predicted disturbance impacts on the great northern diver qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

10.4.3.1.3 Red-throated diver (breeding)

10.4.3.1.3.1 Vessel disturbance

During construction, the number of vessel movements relevant to the red-throated diver breeding period for which they are a qualifying feature (April-September, see Table 10-13) will see an average 0.58% increase of vessel movements over current summer baseline levels, with no vessel movements predicted for April or May. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and, during the red-throated diver breeding period (April-September), are expected to comprise an average monthly increase of 26 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 1.0% from current baseline levels.

Red-throated diver display a very high sensitivity to vessel disturbance (Table 10-11). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections

10.2.3.1 and 10.3.1.2). It is highly unlikely that the movement of vessels in the vicinity of the proposed Project (both during construction and operation) will provide a barrier effect to birds moving through the area, as vessel movements are likely to occur less than once per day across the construction and operational phase with vessel movements likely to be fewer than twice a week in the winter (taking the precautionary approach) as opposed to continuously.

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

This assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure based on a seasonal peak count of 3 birds assuming a disturbance distance of 1 km (Table 10-4). This equates to 0.027 birds annually, or 0.036% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 0.7 birds, or 0.9% of the SPA population.

10.4.3.1.3.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The differences between offshore windfarm structures and land-based cranes is provided in Section 10.4.3.1.1.2, providing justification for the caveats in sensitivity of divers to displacement and disturbance from quayside cranes and using offshore wind guidance.

Within 1 km of the Project site, during the breeding season, birds were present on 30% of surveys in 2021 and 37.5% in 2022. A peak count of 4 birds in 2021 represents 5.26% of the population (based on a citation level of 76 breeding pairs) (if all 4 birds were adult birds from different breeding pairs), and 2 birds in 2022 represents 2.6%. These figures for red-throated diver are considered low. Additional flight mapping surveys were undertaken, with a total of 13 birds recorded in 2021 and 54 birds recorded in 2022 (peak count of 19 birds in July).

Birds recorded within 1km of the Project site mainly use the area as a staging area (i.e. flying in and loafing, with occasional foraging before moving further away within the Flow). This is supported by the model used to calculate suitable foraging areas, finding the Project area as being in the lowest category for foraging suitability. Therefore, any displacement of red-throated divers from 1km around the Project site, and when cranes are in operation, would not result in an adverse effect as they utilise more preferable foraging habitat >1km. Hence, impacts from crane disturbance are not considered significant.

The evidence (Dierschke *et al.,* 2017) used to assert that divers are sensitive to towering structures in the marine environment relates primarily to offshore windfarms and provides no evidence that cranes in coastal developments result in the same disturbance/displacement. In the absence of any evidence of divers being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of disturbance to mobile vessels at sea: while they nonetheless present a tall structure which is moving, they typically move slowly, within confined bounds limited by the crane height and jib length. There is no published evidence of the effect of cranes on red throated diver, however the common presence of red throated diver in harbours during the breeding period (see Section 10.2.1.2 and below) suggests that static vessels, even those with cranes, are not likely to pose a major disturbance impact on individuals of this species foraging close to the Project.

The flight path maps for this species (EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report) show that there was at least one pair breeding inland to the east on moorland lochans and that on their outward flights they often alighted within the survey area as their first destination. Flight height

ranged between 20-100m, with the majority of observations between 50-100m. Most observations were out at sea rather than inland.

Red-throated divers are known to be sensitive to disturbance (Table 10-11), including during the chick-rearing period (June to mid-September; NatureScot, 2022b) where access to foraging areas is of particular importance. However, disturbance from vessel activity and limited-noise mobile cranes and large on-vessel crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 8 vessels per month in breeding months. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.4.3.1.3.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement or reduce access to preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including red-throated diver.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the red-throated diver. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project , it can be concluded that the predicted disturbance impacts on the red-throated diver qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

10.4.3.1.4 Long-tailed duck (non-breeding)

10.4.3.1.4.1 Vessel disturbance

During construction, the number of vessel movements relevant to the long-tailed duck non-breeding period for which they are a qualifying feature (September - April, see Table 10-13) will see an average 0.22% increase of vessel movements over current winter baseline levels, with no increase in vessel movements during March or April. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and during the long-tailed duck non-breeding period (September-April) are expected to comprise an average monthly increase of 11 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 0.5% from current baseline levels.

As noted in Section 10.3.2, Project vessels will follow established shipping routes. Maps in Appendix C show the survey data from both the project surveys and HiDef surveys, along with the proposed shipping routes for construction and dredging, and Figure 10-3 shows an analysis of the mean density of long-tailed duck across

Scapa Flow (taken from HiDef survey reporting). As can be seen, the density of long-tailed duck within the main shipping routes is low, and disturbance is considered unlikely.

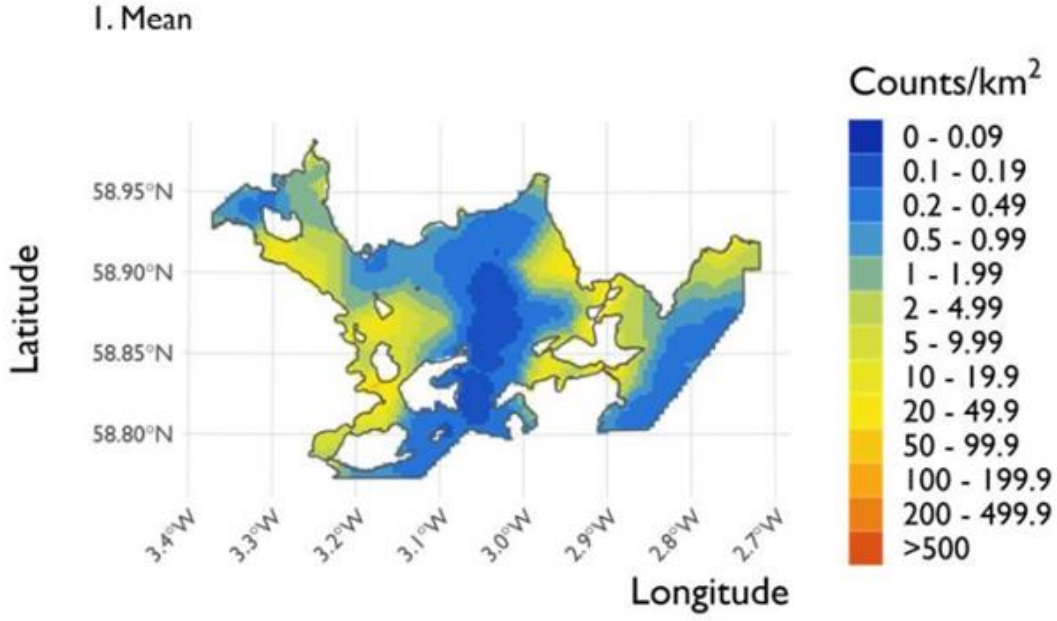


Figure 10-3: Modelled long-tailed duck densities across Scapa Flow SPA (taken from HiDef 2021/22 and 2022/23 wintering bird survey report).

While long-tailed duck display a low sensitivity to vessel disturbance (Table 10-11), there is the potential for increased disturbance during their pre-migration period where they concentrate in larger flocks. However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2).

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts. For long-tailed duck, reference will be made to the pre-migration period of March to May. The Vessel Management Plan will include specific measures to identify and actively avoid aggregation of birds on the water.

This assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, considering an average peak count of 387.6 birds (Table 10-8). This equates to 3.5 birds annually, or 0.69% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 87.2 birds, or 17.3% of the SPA population.

10.4.3.1.4.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The landform behind the Project slopes sharply to approximately 20m higher than the quay level where the cranes will be operating. Against the levels of the land immediately behind this would be 60m above quay level (within 1km of the quay). Therefore, the entirety of all cranes will not be viewed against the skyline but against the surrounding landform.

Given the infrequent nature of crane usage during the winter months, any disturbance to long-tailed duck from vessel activity and crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 0.8 vessels per week in winter. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence (as shown in Table 10-11) and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.4.3.1.4.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement or reduce access to preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including long tailed duck.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the long-tailed duck. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project , it can be concluded that the predicted disturbance impacts on the long-tailed duck qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

10.4.3.1.5 Eider (non-breeding)

10.4.3.1.5.1 Vessel disturbance

During construction, the number of vessel movements relevant to the eider duck non-breeding period for which they are a qualifying feature (September-March, see Table 10-13) will see an average 0.25% increase of vessel movements over current winter baseline levels, with no increase in March. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and in during the eider duck non-breeding period (September-March) are expected to comprise an average monthly increase of 9 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 0.4% from current baseline levels.

Eider duck display a high sensitivity to vessel disturbance (Table 10-11). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2.

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

This assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, considering an average peak count of 92 birds (Table 10-9). This equates to 0.828 birds annually, or 0.041% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 20.7 birds, or 1% of the SPA population.

10.4.3.1.5.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The landform behind the Project slopes sharply to approximately 20m higher than the quay level where the cranes will be operating. Against the levels of the land immediately behind this would be 60m above quay level (within 1km of the quay). Therefore, the entirety of all cranes will not be viewed against the skyline but against the surrounding landform.

Eider display a high sensitivity to vessel disturbance (Table 10-11). In the absence of any evidence of waterbirds being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of disturbance to mobile vessels at sea: while they nonetheless present a tall structure which is moving, they typically move slowly, within confined bounds limited by the crane height and jib length. Whilst there is no published evidence of the effect of cranes on eider duck, the common presence of this species in harbours during the overwinter period (see 10.2.1.5.1) suggests that static vessels, even those with cranes, are not likely to pose a major disturbance impact on individuals of this species foraging close to the Project.

Given the infrequent nature of crane usage during the winter months, any disturbance to eider duck from vessel activity and crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 0.8 vessels per week in winter. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.4.3.1.5.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement, or reduce access to, preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including eider duck.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is

small relative to alternative habitat within Scapa Flow SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for eider. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project , it can be concluded that the predicted disturbance impacts on the eider duck qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

10.4.3.1.6 Red-breasted merganser (non-breeding)

10.4.3.1.6.1 Vessel disturbance

During construction, the number of vessel movements relevant to the red-breasted merganser non-breeding period for which they are a qualifying feature (August-March, see Table 10-13) will see an average 0.39% increase of vessel movements over current winter baseline levels, with no increase in March. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and during the red-breasted merganser non-breeding period (August-March) are expected to comprise an average monthly increase of 11 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 0.5% from current baseline levels.

Given the paucity of red-breasted merganser in the locality of the proposed Project site, the magnitude of disturbance to this species is expected to be low.

Red-breasted merganser displays a medium sensitivity to vessel disturbance (Table 10-11). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2).

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

This assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, considering an average seasonal peak count of 2.7 birds (Section 10.2.1.6.3). This equates to 0.024 birds annually, or 0.005% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 0.6 birds, or 0.1% of the SPA population.

10.4.3.1.6.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The landform behind the Project slopes sharply to approximately 20 m higher than the quay level where the cranes will be operating. Against the levels of the land immediately behind this would be 60 m above quay level (within 1km of the quay). Therefore, the entirety of all cranes will not be viewed against the skyline but against the surrounding landform.

Red-breasted merganser are thought to have a moderate sensitivity to disturbance and displacement to vessels (Table 10-11). In the absence of any evidence of waterbirds being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of

disturbance to mobile vessels at sea: while they nonetheless present a tall structure which is moving, they typically move slowly, within confined bounds limited by the crane height and jib length. There is no published evidence of the effect of cranes on red-breasted merganser.

Given the infrequent nature of crane usage during the winter months, any disturbance to red-breasted merganser from vessel activity and crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 0.8 vessels per week in winter. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.4.3.1.6.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement or reduce access to preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including red-breasted merganser.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for red-breasted merganser. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project, it can be concluded that the predicted disturbance impacts on the red-breasted merganser qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

10.4.3.1.7 Shag (non-breeding)

10.4.3.1.7.1 Vessel disturbance

During construction, the number of vessel movements relevant to the shag non-breeding period for which they are a qualifying feature (September-February, see Table 10-13) will see an average 0.3% increase of vessel movements, over current winter baseline levels. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and during the shag non-breeding period (September-February) are expected to comprise an average monthly increase of 10 vessel movements from the Project. This constitutes an average increase to monthly vessel movements of 0.4%, from current baseline levels.

European shag display a medium sensitivity to vessel disturbance (Table 10-11) and therefore are not likely to be displaced due to vessel movements. However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2).

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts. The Vessel Management Plan will include specific measures to identify and actively avoid aggregation of birds on the water.

This assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, considering an average seasonal peak count of 61 birds (Section 10.2.1.7.3). This equates to 0.549 birds annually, or 0.019% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 13.7 birds, or 0.5% of the SPA population.

10.4.3.1.7.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The landform behind the Project slopes sharply to approximately 20m higher than the quay level where the cranes will be operating. Against the levels of the land immediately behind this would be 60m above quay level (within 1km of the quay). Therefore, the entirety of all cranes will not be viewed against the skyline but against the surrounding landform.

Given the infrequent nature of crane usage during the winter months, any disturbance to European shag from vessel activity and crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 0.8 vessels per week in winter. Should disturbance occur, it will be reversible following cessation of crane activities, and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.4.3.1.7.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement or reduce access to preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including European shag.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the European shag. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project, it can be concluded that the predicted disturbance impacts on the European shag qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

10.4.3.1.8 Slavonian grebe (non-breeding)

10.4.3.1.8.1 Vessel disturbance

During construction, the number of vessel movements relevant to the Slavonian grebe non-breeding period for which they are a qualifying feature (August-April, see Table 10-13) will see an average 0.35% increase of vessel movements over current winter baseline levels, with no increase in March or April. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and during the Slavonian grebe non-breeding period (August-April) are expected to comprise a monthly increase of 13 vessel movements from the Project. This constitutes an average increase to monthly vessel movements of 0.5%%, from current baseline levels.

Slavonian grebe is thought to be moderately sensitive to disturbance through vessel movements (Table 10-11). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2).

The potential displacement of a peak of 7 birds represents 5.2% of the SPA population, although it is acknowledged that the wider Scapa Flow area has the capacity to support these birds.

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

This assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, considering an average peak count of 5.67 birds (Table 10-10). This equates to 0.05 birds annually, or 0.038% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 1.3 birds, or 0.9% of the SPA population.

10.4.3.1.8.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The landform behind the Project slopes sharply to approximately 20 m higher than the quay level where the cranes will be operating. Against the levels of the land immediately behind this would be 60 m above quay level (within 1 km of the quay). Therefore, the entirety of all cranes will not be viewed against the skyline but against the surrounding landform.

Slavonian grebe are thought to have a very high sensitivity to disturbance and displacement to vessels (Table 10-11; Jarrett *et al.*, 2018). In the absence of any evidence of waterbirds being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of disturbance to mobile vessels at sea: while they nonetheless present a tall structure which is moving, they typically move slowly, within confined bounds limited by the crane height and jib length. During the inshore surveys undertaken in 2017/18, Slavonian grebes showed a strong preference for sheltered, relatively shallow parts of the survey area with only seven birds seen in all the boat-based surveys, suggesting the Scapa Flow is not a preferred foraging habitat for this species.

Given the infrequent nature of crane usage during the winter months, any disturbance to Slavonian grebe from vessel activity and crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 0.8 vessels per week in winter. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' minimal presence within the Scapa Flow area and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.4.3.1.8.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement or reduce access to preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including Slavonian grebe.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the Slavonian grebe. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project , it can be concluded that the predicted disturbance impacts on the Slavonian grebe qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

10.4.3.2 Disturbance to prey species and habitats of prey species (construction only)

As described in NatureScot's Conservation and Management Advice Document for Scapa Flow SPA (NatureScot, 2022b) supporting habitats refer to the characteristics of the seabed and water column relevant to their use by the qualifying features. It relates to wider oceanographic processes such as upwellings, tidal flows, hydrological movements which may be necessary for the habitat, and could affect nutrient cycling and prey distribution.

Hydrodynamic modelling summarised in Section 10.3.2 shows little impact on the surrounding water column and seabed due to the low-energy environment in this part of Scapa Flow. The impacts on prey species for the qualifying species are expected to be negligible, such that their abundance and general distribution remain unchanged from the baseline.

The dredge budget consists of approximately 17% gravel, 60% sand, and 23% silt and clay, which, with the weak tidal currents in the vicinity of the proposed dredge pockets, will result in very localised and short-term plumes from dredging. The magnitude of the sediment discharge and dispersion from dredging works will be low within the dredge area and its immediate vicinity, and negligible out with this area. No sediment transport will occur within the Scapa Flow SPA boundary. Thus, the supporting habitats for qualifying species beyond the development footprint will be maintained.

Drainage designs to ensure that there are no untreated surface water discharges directly to surrounding coastal waters, and the use of silt booms during land reclamation works will mitigate against pollution spills which could affect the qualifying interests of the SPA and their prey sources. In terms of water pollution from the pier and attendant vessels, adherence to strict Pollution Prevention controls will aim to prevent the release of pollutants to the water environment. With these measures in place, the supporting habitats for qualifying species will be maintained.

For dredging disposal at sea, no sediment transport will occur within the Scapa Flow SPA boundary because the sea disposal site is outwith the SPA. Therefore, the supporting habitats for the qualifying SPA species beyond the development footprint will be maintained.

10.4.3.2.1 Great northern diver (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.4.3.2, it can be concluded that the predicted impacts on the great northern diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.4.3.2.2 Red-throated diver (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.4.3.2, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.4.3.2.3 Black-throated diver (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.4.3.2, it can be concluded that the predicted impacts on the black-throated diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.4.3.2.4 Long-tailed duck (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.4.3.2, it can be concluded that the predicted impacts on the long-tailed duck qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.4.3.2.5 Eider (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.4.3.2, it can be concluded that the predicted impacts on the eider qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.4.3.2.6 Red-breasted merganser (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.4.3.2, it can be concluded that the predicted impacts on the red-breasted merganser qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.4.3.2.7 Shag (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.4.3.2, it can be concluded that the predicted impacts on the shag qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.4.3.2.8 Slavonian grebe (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.4.3.2, it can be concluded that the predicted impacts on the Slavonian grebe qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.4.3.3 Accidental release of contaminants or pollutants (all phases)

The Sections below present the conclusion of the assessment of effects on the Scapa Flow SPA qualifying species that have been screened in, based on the Project parameters outlined in Section 10.3.3.

During construction, there are proposed mitigation measures that will collectively minimise the risk of accidental pollutant release. The CEMD, supported by ECoW oversight, ensures that all activities follow approved methods designed to prevent spills, manage materials safely and maintain compliance with environmental commitments.

The Pollution Incident Response Plan provides clear spill-response procedures, emergency contacts and staff training so that any incident is contained quickly and effectively. The Pollution Prevention Plan (which will continue into the operational phase) will include pollution prevention measures that will include measures to deal with accidental spillages in the unlikely event of their occurrence.

Turbidity monitoring, silt booms and controlled dredging protocols help prevent sediment plumes and the mobilisation of contaminated materials, preserving water quality and reducing the risk of pollutants spreading. Ballast Water Management procedures ensure controlled and compliant ballast operations, preventing uncontrolled discharges. Best-practice measures ensure early detection of any environmental change resulting from pollution, allowing prompt corrective action. Together, these integrated controls establish a structured environmental management framework that substantially reduces the likelihood, magnitude and extent of accidental pollutant releases during both construction and operation.

In the unlikely event of a spill, residual pollutants would remain spatially local to the site due to prevailing circulation patterns and established best-practice spill management. In this manner, accidental release of potential contaminants from Project vessels will be strictly controlled and procedures will be in place to minimise the effect of any accidental release if it occurs.

An Operational Environmental Management Document will be adhered to throughout the operational phase, and best practice measures will be followed including SEPA Guidance for Pollution Prevention.

10.4.3.3.1 Great northern diver (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.4.3.3 above, it can be concluded that the predicted impacts on the great northern diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.4.3.3.2 Red-throated diver (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.4.3.3 above, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.4.3.3.3 Black-throated diver (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.4.3.3 above, it can be concluded that the predicted impacts on the black-throated diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.4.3.3.4 Long-tailed duck (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.4.3.3 above, it can be concluded that the predicted impacts on the long tailed duck qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.4.3.3.5 Eider (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.4.3.3 above, it can be concluded that the predicted impacts on the eider qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.4.3.3.6 Red-breasted merganser (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.4.3.3 above, it can be concluded that the predicted impacts on the red-breasted merganser qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.4.3.3.7 Shag (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.4.3.3 above, it can be concluded that the predicted impacts on the European shag qualifying feature of the Scapa Flow SPA from the Project alone

as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.4.3.3.8 Slavonian grebe (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.4.3.3 above, it can be concluded that the predicted impacts on the Slavonian grebe qualifying feature of the Scapa Flow SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.4.3.4 Ornithological habitat changes (operation and maintenance only)

The Project will result in the loss of 19.1 ha of the Scapa Flow SPA. This equates to 0.06% of the total SPA area which is considered to be a negligible fraction. The affected area is considered to be extremely localised, with the remainder of the SPA continuing to provide extensive foraging, roosting and commuting habitat to the qualifying species.

The habitat functions lost will relate primarily to marine foraging areas used by qualifying bird species. Given the SPA's vast size and heterogeneous habitat availability, the small proportion affected is unlikely to alter the overall ecological functioning of the site.

Scapa Flow provides large expanses of suitable foraging waters with similar depth, prey availability, and hydrodynamic characteristics, therefore the small area lost does not constitute a unique or limiting foraging resource. Mobile seabird species (e.g., divers, grebes, seaduck) typically have wide foraging ranges, enabling them to make use of abundant habitat elsewhere within and beyond the SPA.

Birds commuting between feeding areas, resting locations, and open water are not expected to be impeded; the operational Project footprint will not create a barrier to movement and does not alter the wider connectivity of habitats used by SPA species.

10.4.3.4.1 Great northern diver (non-breeding)

Given the number and distribution of great northern diver within Scapa Flow from the 2017/18 surveys and during the HiDef surveys of 2021/22 and 2022/23, the wider SPA site has the capacity to accommodate great northern divers that utilise the current Project site boundary for foraging.

Considering the localised area potentially disturbed or lost during operation of the Project, and the fact that sufficient alternative habitat for foraging and commuting for ornithological individuals outwith the Project site, the habitat change as a result of the Project is considered to be of negligible magnitude.

Considering the assessment outlined in Section 10.3.4 and Section 10.4.3.4 above, it can be concluded that the predicted impacts on the great northern diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of habitat changes would **not adversely affect the integrity of the site**.

10.4.3.4.2 Red-throated diver (breeding)

During the vantage point surveys and flight surveys undertaken between 2020 and 2022, at least one breeding pair of red-throated divers utilised the site and environs for foraging. Although the Project footprint provides suitable foraging habitat for red-throated diver, the wider SPA site has the capacity to accommodate this pair.

Considering the localised area potentially disturbed or lost during operation of the Project, and the fact that sufficient alternative habitat for foraging and commuting for ornithological individuals outwith the Project site, the habitat change as a result of the Project is considered to be of negligible magnitude.

Considering the assessment outlined in Section 10.3.4 and Section 10.4.3.4 above, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of habitat changes would **not adversely affect the integrity of the site**.

10.4.3.4.3 Black-throated diver (non-breeding)

The Project will result in the intermittent disturbance of 167 ha of suitable black-throated diver habitat during operation – i.e. the area branching east off the established route to the Project site that will experience a greater increase in vessel activity (although there are baseline vessel movements in this area – as shown in Appendix A: Heat Maps and HiDef Survey Data). This represents a 4.8% reduction in utilised suitable habitat (3,478 ha –

taken as all areas where Black-throated Divers have been recorded out of 2 km from land). As shown in Appendix A: Heat Maps and HiDef Survey Data, there are several areas where Black-throated Divers have been recorded in double-digit numbers, showing the ephemeral nature of distribution across the Scapa Flow and demonstrating that the Scapa Flow has the capacity to support displaced birds.

Considering the localised area potentially disturbed or lost during operation of the Project, and the fact that sufficient alternative habitat for foraging and commuting for ornithological individuals outwith the Project site, the habitat change as a result of the Project is considered to be of negligible magnitude.

Considering the assessment outlined in Section 10.3.4 and Section 10.4.3.4 above, it can be concluded that the predicted impacts on the black-throated diver qualifying feature of the Scapa Flow SPA from the Project alone as a result of habitat changes would **not adversely affect the integrity of the site**.

10.4.3.4.4 Long-tailed duck (non-breeding)

Although the Project footprint provides suitable foraging habitat for long-tailed duck, the wider SPA site has the capacity to accommodate these birds.

Considering the localised area potentially disturbed or lost during operation of the Project, and the fact that sufficient alternative habitat for foraging and commuting for ornithological individuals outwith the Project site, the habitat change as a result of the Project is considered to be of negligible magnitude.

Considering the assessment outlined in Section 10.3.4 and Section 10.4.3.4 above, it can be concluded that the predicted impacts on the long-tailed duck qualifying feature of the Scapa Flow SPA from the Project alone as a result of habitat changes would **not adversely affect the integrity of the site**.

10.4.3.4.5 Eider (non-breeding)

Although the Project footprint provides suitable foraging habitat for Eider, the wider SPA site has the capacity to accommodate these birds.

Considering the localised area potentially disturbed or lost during operation of the Project, and the fact that sufficient alternative habitat for foraging and commuting for ornithological individuals outwith the Project site, the habitat change as a result of the Project is considered to be of negligible magnitude.

Considering the assessment outlined in Section 10.3.4 and Section 10.4.3.4 above, it can be concluded that the predicted impacts on the eider qualifying feature of the Scapa Flow SPA from the Project alone as a result of habitat changes would **not adversely affect the integrity of the site**.

10.4.3.4.6 Red-breasted merganser (non-breeding)

The Project will result in the loss of 19.1 ha of the Scapa Flow SPA (0.06% of the SPA area). Given that nearly all Red-breasted Merganser are recorded within 500m of the shoreline, this equates to 0.4% of the utilised SPA area. Although the Project site footprint provides suitable foraging habitat for Red-breasted Merganser, the wider SPA site has the capacity to accommodate these birds.

Considering the localised area potentially disturbed or lost during operation of the Project, and the fact that sufficient alternative habitat for foraging and commuting for ornithological individuals outwith the Project site, the habitat change as a result of the Project is considered to be of negligible magnitude.

Considering the assessment outlined in Section 10.3.4 and Section 10.4.3.4 above, it can be concluded that the predicted impacts on the red-breasted merganser qualifying feature of the Scapa Flow SPA from the Project alone as a result of habitat changes would **not adversely affect the integrity of the site**.

10.4.3.4.7 Shag (non-breeding)

Although the Project footprint provides suitable foraging habitat for Shag, the findings from the 2017/18 surveys, which show a wide-ranging distribution across Scapa Flow demonstrates that the wider SPA site has the capacity to accommodate these birds (a peak of 73 birds).

Considering the localised area potentially disturbed or lost during operation of the Project, and the fact that sufficient alternative habitat for foraging and commuting for ornithological individuals outwith the Project site, the habitat change as a result of the Project is considered to be of negligible magnitude.

Considering the assessment outlined in Section 10.3.4 and Section 10.4.3.4 above, it can be concluded that the predicted impacts on the shag qualifying feature of the Scapa Flow SPA from the Project alone as a result of habitat changes would **not adversely affect the integrity of the site**.

10.4.3.4.8 Slavonian grebe (non-breeding)

The Project will result in the loss of 19.1 ha of the Scapa Flow SPA. Given that nearly all Slavonian Grebe are recorded within 500m of the shoreline, and none were recorded in the "Southern Approaches" part of the SPA, this equates to 0.4% of the utilised SPA area. Although the Project site footprint provides suitable foraging habitat for Slavonian Grebes, the 2017/18 survey demonstrates that there was some notable redistribution of birds during the winter period and that the wider SPA site has the capacity to accommodate a peak of 7 birds.

Considering the localised area potentially disturbed or lost during operation of the Project, and the fact that sufficient alternative habitat for foraging and commuting for ornithological individuals outwith the Project site, the habitat change as a result of the Project is considered to be of negligible magnitude.

Considering the assessment outlined in Section 10.3.4 and Section 10.4.3.4 above, it can be concluded that the predicted impacts on the Slavonian grebe qualifying feature of the Scapa Flow SPA from the Project alone as a result of habitat changes would **not adversely affect the integrity of the site**.

10.4.4 Assessment of Adverse Effects In-Combination

Table 10-14 provides a summary of the other developments considered within the in-combination assessment of effects.

10.4.4.1 Disturbance of birds from Project activities

There is the potential for in-combination disturbance from vessels during activities during the construction and/or operational phases of other plans, projects and developments (

Table 10-14). Vessels may pass through the Scapa Flow SPA from other plans and projects that may disturb birds within the SPA.

The majority of vessel movements from other plans and projects will be along established routes (i.e., the main shipping channels in/out of Scapa Flow from the south (between Flotta and South Ronaldsay) and the west (between Hoy/Graemsay and Stromness). Both of these routes experience moderate levels of existing vessel traffic, and the in-combination effect of small numbers of Project vessels will constitute only a minor departure from baseline levels of shipping. The only area that will experience a greater increase in vessel activity will be the 167 ha branching east off the established route, to the Project site, where they are not anticipated to be any other vessels from other plans and developments (although there are baseline vessel movements in this area – as shown in Appendix B: Heat Maps and Noise Contour Maps). Existing fish farms that have undergone variations are required to have seasonal limits and planned vessel routes under site specific advice for the Scapa Flow SPA (NatureScot, 2022b). It is anticipated that vessels will therefore avoid important foraging areas for the qualifying features, mitigating potential impacts.

Construction activities at the Hatston Pier expansion could result in an intermittent disturbance in available habitat for qualifying features of Scapa Flow SPA, however this is anticipated to be localised to the area and affecting a small proportion of the Scapa Flow SPA bird populations which may forage outside of the SPA.

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of:

- 5 red-throated diver (10.6% of the breeding population of North Orkney SPA);
- 31 great-northern diver (10% of the non-breeding population of North Orkney SPA); and
- 10 Slavonian grebe (6% of the non-breeding population of North Orkney SPA)

utilising the marine area adjacent to Hatston Pier. Furthermore, it is possible that other Scapa Flow SPA qualifying features (i.e., black-throated diver, long-tailed duck, eider, red-breasted merganser, and shag) may also use the locality of the Hatston proposed development.

It is plausible that individual birds may use both North Orkney SPA and Scapa Flow SPA for foraging at different times, and therefore could be subject to intermittent disturbance within foraging or roosting habitat. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined available habitat for these species within both Scapa Flow SPA and North Orkney SPA, it is not likely that disturbance to these birds will have an adverse effect on site integrity for those bird species for Hatston alone, nor in combination with the Project.

Any potential cumulative disturbance to any of the qualifying features of the Scapa Flow SPA as a result of project activities is deemed to be temporary, with any potential impacts temporary and reversible. Therefore, it can be concluded that the predicted effects on the qualifying features of the Scapa Flow SPA from the Project in-combination with other plans, projects, and development as a result of Project activities would **not adversely affect the integrity of the site**.

10.4.4.2 Disturbance to prey species and habitats of prey species

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to disturbance to prey species and habitats of prey species. Impacts are managed case by case, are rare and highly unlikely. The relevant plans and project which would affect the habitat within and in functionally linked habitat to Scapa Flow SPA include:

- Hatston Pier Expansion;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;

Construction activities at the Hatston Pier expansion could result in a disturbance to prey species and their habitats, however this is anticipated to be fairly localised to the area and affecting a small proportion of the Scapa Flow SPA.

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of:

- 5 red-throated diver (10.6% of the breeding population of North Orkney SPA);
- 31 great-northern diver (10% of the non-breeding population of North Orkney SPA); and
- 10 Slavonian grebe (6% of the non-breeding population of North Orkney SPA)

utilising the marine area adjacent to Hatston Pier. Furthermore, it is possible that other Scapa Flow SPA qualifying features (i.e., black-throated diver, long-tailed duck, eider, red-breasted merganser, and shag) may also use the locality of the Hatston proposed development.

It is plausible that individual birds may use both North Orkney SPA and Scapa Flow SPA for foraging at different times, and therefore could be subject to impacts from disturbance to prey species and habitats. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined habitat for these species within both Scapa Flow SPA and North Orkney SPA, it is not likely that disturbance to prey species and habitats of prey species will have an adverse effect on site integrity for those bird species for Hatston alone, nor in combination with the Project.

The aquaculture sites are included based on minor changes to existing aquaculture infrastructure, therefore the effect will be negligible. The construction-phase impacts on marine bird prey resources are expected to be short-term, temporary, reversible and recoverable, with any changes remaining transient and confined to a small spatial extent relative to the extensive alternative foraging habitat available to seabirds. Taking into consideration the embedded mitigation measures applied to other plans and developments, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.4.4.3 Accidental release of contaminants or pollutants

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to accidental release of contaminants or pollution. Impacts which are mitigated to negligible levels and are managed case by case, are rare and highly unlikely. Taking into consideration the embedded mitigation measures applied to other plans and developments, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.4.4.4 Ornithological habitat change

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to ornithological habitat change. The relevant plans and project which would affect the habitat within and in functionally linked habitat to Scapa Flow SPA include:

- Hatston Pier Expansion;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;

Construction activities at the Hatston Pier expansion could result in temporary or permanent habitat change for qualifying features of Scapa Flow SPA, however this is anticipated to be localised to the area and affecting a small proportion of the Scapa Flow SPA bird populations which may forage outside of the SPA (i.e. close to Hatston Pier).

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of:

- 5 red-throated diver (10.6% of the breeding population of North Orkney SPA);
- 31 great-northern diver (10% of the non-breeding population of North Orkney SPA); and
- 10 Slavonian grebe (6% of the non-breeding population of North Orkney SPA)

utilising the marine area adjacent to Hatston Pier. Furthermore, it is possible that other Scapa Flow SPA qualifying features (i.e., black-throated diver, long-tailed duck, eider, red-breasted merganser, and shag) may also use the locality of the Hatston proposed development.

It is plausible that individual birds may use both North Orkney SPA and Scapa Flow SPA for foraging at different times, and therefore could be subject to disturbance within foraging or roosting habitat. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined available habitat for these species within both Scapa Flow SPA and North Orkney SPA, it is not likely that disturbance to these birds will have an adverse effect on site integrity for those bird species for Hatston alone, nor in combination with the Project.

The aquaculture sites are included based on minor changes to existing aquaculture infrastructure, therefore the ornithological habitat change will be negligible. Considering that the remainder of the SPA is continuing to provide extensive foraging, roosting and commuting habitat to all of the qualifying species, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.4.5 Summary

It is therefore concluded that the potential disturbance effects resulting from the Project, in combination with other plans and projects, will not result in significant barriers to movement, and will not reduce access to preferred foraging, roosting or prey species and habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the cumulative zones of disturbance are small relative to alternative habitat within Scapa Flow SPA and functionally linked habitats. There is no evidence that the areas affected by port operations at the Project, or any other plan or project in combination, are disproportionately important for prey availability for any of the qualifying features of Scapa Flow SPA. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow SPA or functionally-linked habitat, and the likelihood that disturbed or displaced birds will resume foraging elsewhere.

Therefore, there will be no adverse effects on site integrity on any of the qualifying features of the Scapa Flow SPA either for the Project alone or in-combination with other projects, plans and developments.

10.5 North Orkney SPA

10.5.1 Site Description and Qualifying Features

The North Orkney SPA (UK9020314) lies north of Mainland Orkney (NatureScot, 2022c), stretching from Deerness to Eynhallow and incorporating Wide Firth, sheltered bays such as Deer Sound, Inganess Bay and the Bay of Firth, as well as Shapinsay Sound and the tidal channels around Gairsay, Rousay, Egilsay and Wyre, where shallow waters of generally less than 20 metres support mixed sediment habitats, including extensive maerl beds that sustain rich invertebrate communities and in turn attract significant concentrations of wintering and breeding seabirds.

These productive marine conditions regularly support European-important non-breeding populations of great northern diver, Slavonian grebe and velvet scoter, and a nationally important breeding population of red-throated diver. The site covers 211.73 km² and is located 4 km from the Project Site. As per Table 6-6, velvet scoter is screened out of further assessment for the North Orkney SPA.

Table 10-18 Protected feature and condition for the North Orkney SPA (NatureScot, 2022c)

Protected feature	Feature condition	Assessment date	Broader conservation status*
Great northern diver (non-breeding)	Favourable	Not yet assessed	UK: Amber European region: Least Concern
Red-throated diver (breeding)	Favourable	Not yet assessed	UK: Green European region: Least Concern

Slavonian grebe (non-breeding)	Favourable	Not yet assessed	UK: Red European region: Near Threatened
Velvet scoter (non-breeding)	Favourable	Not yet assessed	UK: Red European region: Vulnerable
***UK Broader conservation status based on Birds of Conservation Concern 5 (BoCC5) and European region is based on BirdLife International, 2021.**			

10.5.2 Conservation Objectives

The Conservation Objectives of the North Orkney SPA are:

1. To ensure that the qualifying features of the North Orkney SPA are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status.
2. To ensure that the integrity of the North Orkney SPA is maintained in the context of environmental changes by meeting objectives 2a, 2b and 2c for each qualifying feature:

- 2a. The populations of qualifying features are viable components of the site.
- 2b. The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species.
- 2c. The supporting habitats and processes relevant to qualifying features and their prey/food resources are maintained.

Supplementary conservation and management advice to support the achievement of the conservation objectives is provided by NatureScot (2022c) and is considered in the assessments below.

10.5.3 Assessment of Adverse Effects Alone

10.5.3.1 Disturbance of birds due to Project activities (all phases)

Although possible, there is no evidence of connectivity between overlapping SPA qualifying features (great northern diver and Slavonian grebe) of Scapa Flow SPA and North Orkney SPA. Survey data does not show flights of great northern diver and Slavonian grebe commuting over Kirkwall between sites (albeit it is acknowledged that Slavonian grebe most likely fly at night). Recent NatureScot responses to developments within North Orkney SPA (Quanterness Fish Farm – NatureScot response dated 21st August 2024 and subsequent email dated 26th March 2025) do not mention connectivity between the two SPA sites, highlighting the uncertainty of this.

For the purposes of this assessment, it is unreasonable to assume that all birds present at Scapa Flow SPA could also be birds as part of the North Orkney SPA, even as a precautionary principle. A more realistic precautionary estimate is that 10% of the birds cross over between North Orkney SPA and Scapa Flow SPA.

Using this criterion, the average seasonal peak count of 46 great northern diver (

Table 10-2) would therefore constitute 4.6 birds associated with North Orkney SPA. This represents 1.5% of the North Orkney SPA population. Similarly, the peak of 5.67 Slavonian grebe (Table 10-10) would constitute 0.567 birds associated with North Orkney SPA, which equates to 0.5% of the SPA population. The average seasonal peak count of 3 red-throated diver (Table 10-4) represents 0.3 birds associated with North Orkney SPA, which equates to 0.6% of the SPA population.

10.5.3.1.1 Great northern diver (non-breeding)

10.5.3.1.1.1 Vessel disturbance

During construction, the number of vessel movements relevant to the great northern diver non-breeding period for which they are a qualifying feature (October-May, see Table 10-13) will see an average 0.12% increase of vessel movements, over current winter baseline levels. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and, during the great northern diver non-breeding period (October-May), are expected to comprise an average monthly increase of 11 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 0.5%, from current baseline levels.

The study undertaken by Jarrett *et al.* (2018) demonstrated that great northern diver do not typically fly in response to vessels, with all evasive methods recorded being a swim away or dive. Given the speeds of vessels within Scapa Flow and that vessels movements for the Project will adhere to a VMP.

As described in Figure 10-2, an analysis of the mean density of great northern diver across Scapa Flow shows that great northern divers are well represented within current shipping lanes, which does suggest a degree of habituation to vessels, contrary to reports that great northern divers are highly sensitive to vessel movements.

During the ornithological surveys undertaken between 2020 and 2022, bird and boat interactions were recorded. For great northern divers, there were 49 observations of interactions with boats. Of these, 24 resulted in no reaction, 10 resulted in birds swimming away slowly, 11 were of birds diving, and three caused an alert (sitting) response. There were no instances of boat movements causing a flight response. This correlates with the findings of Jarrett *et al.* (2021), where at least 95% of reactions to vessels were either no response, slowly swimming away or diving. There were very few instances of vessels causing a flight response.

Despite the evidence from the Gittings, e*t al.* (2015) study mentioned previously, great northern divers are considered display a high sensitivity to vessel disturbance (Table 10-11; Furness *et al.* 2012). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2). It is highly unlikely that the movement of vessels in the vicinity of the proposed Project (both during construction and operation) will provide a barrier effect to birds moving through the area, as vessel movements are likely to occur every hour (taking the precautionary approach) as opposed to continuously.

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

The matrix model assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, based on mean seasonal peak count of 4.6 birds. This equates to 0.0414 birds annually, or 0.013% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 1.035 birds, or 0.34% of the SPA population at designation, over 25 years. This equates to a mortality of one bird over the lifetime of the Project as a result of an increase in 0.12% and 0.5% from current baseline levels in vessel movements during the construction and operational phase, respectively. During the flightless moult period, the mean seasonal peak count is 3.3 birds (i.e. 10% of the Scapa Flow SPA count; Table 10-3), which would equate to a mortality of 0.03 birds annually, or 0.01% of the SPA population. Over 25 years, this would result in a mortality figure of 0.7 birds, or 0.2% of the SPA population.

10.5.3.1.1.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in

summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The differences between offshore windfarm structures and land-based cranes is provided in Section 10.4.3.1.1.2, providing justification for the caveats in sensitivity of divers to displacement and disturbance from quayside cranes and using offshore wind guidance.

Great northern diver are thought to have a high sensitivity to disturbance and displacement from vessels (Table 10-11). In the absence of any evidence of divers being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of disturbance when compared with mobile vessels at sea: while they nonetheless present a tall structure which is moving, they move slowly, within confined bounds limited by the crane height and jib length. There is no published evidence of the effect of cranes on great northern diver, however the common presence of great northern diver in harbours during the overwinter period suggests that static vessels, even those with cranes, are not likely to pose a major disturbance impact on individuals of this species foraging close to the Project.

Great northern divers are most sensitive during their flightless moult period (February to mid-April; dates provided by NatureScot in correspondence) as during this period they cannot take evasive action by flight. The average peak count of great northern divers during their flightless moult period out to 2 km is 3.3 birds or 1.1% of the SPA citation population. However, as per NatureScot correspondence, it is suitable to use survey data within 0-500 m of the main vantage point to assess disturbance and displacement of great northern diver based on a disturbance distance of 100-300 m as per Goodship and Furness 2022. The average peak count therefore demonstrates that the species does utilise other areas of Scapa Flow successfully, and that the Flow has sufficient capacity to support this species from the North Orkney SPA.

During construction, the number of vessel movements relevant to the great northern diver non-breeding period (October-May) will see an average 0.12% increase of vessel movements, over current baseline levels between October and May. Operational phase vessel movements are expected to comprise an average monthly increase of 11 vessel movements over the same period. This constitutes an average increase to the monthly vessel movements of 0.5%. Given the infrequent nature of crane usage during the winter months (2–5 days/month between October-March) and 8-20 days/month in April and May, any disturbance to great northern divers from vessel activity and crane use is expected to result only in temporary disturbance, particularly during the majority of the flightless moult period, with effects that are intermittent during cargo loading and unloading operations. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated. Based on the very low number of birds from the North Orkney SPA anticipated to be within the Scapa Flow, this impact is considered to be insignificant.

10.5.3.1.1.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds present in the vicinity of the works will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA and the North Orkney SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement, or reduce access to, preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Disturbance distances for great northern diver are 100-350 m (Goodship and Furness, 2022). Table 10-17 shows peak and average counts using the data collected over the 3 years of site surveys between the 0-500m distance band. The peak count of 0.9 birds (Table 10-17) corresponds to a maximum of 0.3% of the SPA population (at the time of citation).

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including great northern diver.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow and the North Orkney SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the great northern diver. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow and the North Orkney SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project , it can be concluded that the predicted disturbance impacts on the great northern diver qualifying feature of the North Orkney SPA from the Project alone would **not adversely affect the integrity of the site**.

10.5.3.1.2 Red-throated diver (breeding)

10.5.3.1.2.1 Vessel disturbance

During construction, the number of vessel movements relevant to the red-throated diver breeding period for which they are a qualifying feature (April-September, see Table 10-13) will see an average 0.58% increase of vessel movements over current summer baseline levels, with no vessel movements predicted for April or May. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and, during the red-throated diver breeding period (April-September), are expected to comprise an average monthly increase of 26 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 1.0% from current baseline levels.

Red-throated diver display a very high sensitivity to vessel disturbance (Table 10-11). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2). It is highly unlikely that the movement of vessels in the vicinity of the proposed Project (both during construction and operation) will provide a barrier effect to birds moving through the area, as vessel movements are likely to occur less than once per day across the construction and operational phase with vessel movements likely to be fewer than twice a week in the winter (taking the precautionary approach) as opposed to continuously.

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

This assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure based on a seasonal peak count of 0.3 birds assuming a disturbance distance of 1 km (Table 10-4). This equates to 0.0027 birds annually, or 0.006% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 0.07 birds, or 0.14% of the SPA population.

10.5.3.1.2.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The differences between offshore windfarm structures and land-based cranes are provided in Section 10.4.3.1.1.2, providing justification for the caveats in sensitivity of divers to displacement and disturbance from quayside cranes and using offshore wind guidance.

Within 1 km of the Project site, during the breeding season, birds were present on 30% of surveys in 2021 and 37.5% in 2022. A peak count of 4 birds in 2021 represents 5.26% of the population (based on a citation level of 76 breeding pairs) (assuming that all 4 birds were adult birds from different breeding pairs), and 2 birds in 2022 represents 2.6%. These figures for red-throated diver are considered low. Additional flight mapping surveys were undertaken, with a total of 13 birds recorded in 2021 and 54 birds recorded in 2022 (peak count of 19 birds in July).

Birds recorded within 1km of the Project site mainly use the area as a staging area (i.e. flying in and loafing, with occasional foraging before moving further away within the Flow). This is supported by the model used to calculate suitable foraging areas, finding the Project area as being in the lowest category for foraging suitability. Therefore, any displacement of red-throated divers from 1km around the Project site, and in particular when cranes are in operation, would not result in an adverse effect as they utilise more preferable foraging habitat >1km. Hence, impacts from crane disturbance are not considered significant.

The evidence (Dierschke *et al.,* 2017) used to assert that divers are sensitive to towering structures in the marine environment relates primarily to offshore windfarms and provides no evidence that cranes in coastal developments result in the same disturbance/displacement. In the absence of any evidence of divers being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of disturbance to mobile vessels at sea: while they nonetheless present a tall structure which is moving, they typically move slowly, within confined bounds limited by the crane height and jib length. There is no published evidence of the effect of cranes on red throated diver, however the common presence of red throated diver in harbours during the breeding period (see Section 10.2.1.2 and below) suggests that static vessels, even those with cranes, are not likely to pose a major disturbance impact on individuals of this species foraging close to the Project.

The flight path maps for this species (EIAR Technical Appendix 5.3: Scapa Deep Water Quay Ornithology Technical Report) show that there was at least one pair breeding inland to the east on moorland lochans and that on their outward flights they often alighted within the survey area as their first destination. Flight height ranged between 20-100m, with the majority of observations between 50-100m. Most observations were out at sea rather than inland.

Red-throated divers are known to be sensitive to disturbance (Table 10-11), including during the chick-rearing period (June to mid-September; NatureScot, 2022b) where access to foraging areas is of particular importance. However, disturbance from vessel activity and limited-noise mobile cranes and large on-vessel crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 8 vessels per month in breeding months. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.5.3.1.2.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA and the North Orkney SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement or reduce access to preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including red-throated diver.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow and the North Orkney SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the red-throated diver. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow and the North Orkney SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project , it can be concluded that the predicted disturbance impacts on the red-throated diver qualifying feature of the Scapa Flow SPA from the Project alone would **not adversely affect the integrity of the site**.

10.5.3.1.3 Slavonian grebe (non-breeding)

10.5.3.1.3.1 Vessel disturbance

During construction, the number of vessel movements relevant to the Slavonian grebe non-breeding period for which they are a qualifying feature (August-April, see Table 10-13) will see an average 0.35% increase of vessel movements over current winter baseline levels, with no increase in March or April. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and during the Slavonian grebe non-breeding period (August-April) are expected to comprise a monthly increase of 13 vessel movements from the Project. This constitutes an average increase to monthly vessel movements of 0.5%%, from current baseline levels.

Slavonian grebe is thought to be moderately sensitive to disturbance through vessel movements (Table 10-11). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2). The potential displacement of an average seasonal peak count of 0.567 birds represents 0.004% of the SPA population.

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

This assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure, considering an average peak count of 0.567 birds. This equates to 0.005 birds annually, or 0.004% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 0.13 birds, or 0.1% of the SPA population.

10.5.3.1.3.2 Mobile cranes

The use of mobile cranes expected for the Project is outlined in Section 5.4 and Section 10.2.3.1. Crane activity at the Project will be intermittent, seasonal, and tied to vessel operations, with markedly higher activity in summer. Movements involve slow, limited-noise mobile cranes and large on-vessel cranes, with operations occurring over 8–20 days/month in summer and 2–5 days/month in winter. Booms can reach 60–125 m in height depending on crane type, but are retracted to ~5 m when stored. Winter operations are minimal due to high wind downtime and daylight-only working, reducing potential disturbance pressure during sensitive winter bird periods.

The landform behind the Project slopes sharply to approximately 20 m higher than the quay level where the cranes will be operating. Against the levels of the land immediately behind this would be 60 m above quay level

(within 1 km of the quay). Therefore, the entirety of all cranes will not be viewed against the skyline but against the surrounding landform.

Slavonian grebe are thought to have a moderate sensitivity to disturbance and displacement to vessels (Table 10-11). In the absence of any evidence of waterbirds being disturbed by quayside cranes, for the purposes of this assessment, the disturbance effect of vessels has been considered as a proxy for disturbance due to cranes, although it should be noted that cranes will operate from a static location on the quay itself, or on vessels berthed (i.e. not moving) at the quay. Both types of crane have a very different mechanism of disturbance to mobile vessels at sea: while they nonetheless present a tall structure which is moving, they typically move slowly, within confined bounds limited by the crane height and jib length. During the inshore surveys undertaken in 2017/18, Slavonian grebes showed a strong preference for sheltered, relatively shallow parts of the survey area with only seven birds seen in all the boat-based surveys, suggesting the Scapa Flow is not a preferred foraging habitat for this species.

Given the infrequent nature of crane usage during the winter months, any disturbance to Slavonian grebe potentially present in the Scapa Flow SPA from vessel activity and crane use is expected to result only in temporary disturbance, with effects that are intermittent during cargo loading and unloading operations and limited further by the very low operational vessel frequency of 0.8 vessels per week in winter. Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' minimal presence within the Scapa Flow area and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.5.3.1.3.3 Airborne noise

Based on the airborne noise modelling (see Section 10.3.1.1.2) which concludes that construction noise levels should be restricted below 70 dB, it is concluded that the main terrestrial works will not result in noise disturbance impacts to waterbirds based on conclusions from University of Hull (2013) and the fact that bunds around the working area will result in construction sound dissipating to <35 dB at 250 m.

It is highly likely that birds will be displaced from the working area (but acknowledging that the wider Scapa Flow SPA and North Orkney SPA has the capacity to accommodate displaced birds), at a sufficient distance that noise disturbance does not cause an impact. Disturbance would only be short-term (during certain periods of construction), temporary (the disturbance will cease once the activity ends), and reversible (the baseline will be restored rapidly following cessation of the activity).

None of these potential disturbance effects will result in barriers to movement or reduce access to preferred foraging and roosting habitats, resulting in a significant energy expenditure and possible reduction in body condition required for survival and subsequent migration.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including Slavonian grebe.

It is concluded that the potential disturbance effects resulting from the Project will not result in significant barriers to movement, and will not reduce access to preferred foraging and roosting habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the disturbance zone is small relative to alternative habitat within Scapa Flow and the North Orkney SPA. There is no evidence that the areas affected by port operations are disproportionately important for prey availability for the Slavonian grebe. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within Scapa Flow and the North Orkney SPA and the likelihood that disturbed birds will resume foraging elsewhere.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project, it can be concluded that the predicted disturbance impacts on the Slavonian grebe qualifying feature of the North Orkney SPA from the Project alone would **not adversely affect the integrity of the site**.

10.5.3.2 Disturbance to prey species and habitats of prey species (construction only)

As described in NatureScot's Conservation and Management Advice Document for North Orkney SPA (NatureScot, 2022c) supporting habitats refer to the characteristics of the seabed and water column relevant to their use by the qualifying features. It relates to wider oceanographic processes such as upwellings, tidal flows,

hydrological movements which may be necessary for the habitat, and could affect nutrient cycling and prey distribution.

Hydrodynamic modelling summarised in Section 10.3.2 shows little impact on the surrounding water column and seabed due to the low-energy environment in this part of Scapa Flow. The impacts on prey species for the qualifying species are expected to be negligible, such that their abundance and general distribution remain unchanged from the baseline.

The dredge budget consists of approximately 17% gravel, 60% sand, and 23% silt and clay, which, with the weak tidal currents in the vicinity of the proposed dredge pockets, will result in very localised and short-term plumes from dredging. The magnitude of the sediment discharge and dispersion from dredging works will be low within the dredge area and its immediate vicinity, and negligible out with this area. No sediment transport will occur within the Hoy SPA boundary. Thus, the supporting habitats for qualifying species beyond the development footprint will be maintained.

Drainage designs to ensure that there are no untreated surface water discharges directly to surrounding coastal waters, and the use of silt booms during land reclamation works will mitigate against pollution spills which could affect the qualifying interests of the SPA and their prey sources. In terms of water pollution from the pier and attendant vessels, adherence to strict Pollution Prevention controls will aim to prevent the release of pollutants to the water environment. With these measures in place, the supporting habitats for qualifying species will be maintained.

For dredging disposal at sea, no sediment transport will occur within the North Orkney SPA boundary because the sea disposal site is outwith the SPA. Therefore, the supporting habitats for the qualifying SPA species beyond the development footprint will be maintained.

10.5.3.2.1 Great northern diver (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.5.3.2, it can be concluded that the predicted impacts on the great northern diver qualifying feature of the North Orkney SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.5.3.2.2 Red-throated diver (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.5.3.2, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the North Orkney SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.5.3.2.3 Slavonian grebe (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.5.3.2, it can be concluded that the predicted impacts on the Slavonian grebe qualifying feature of the North Orkney SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.5.3.2.4 Velvet scoter (non-breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.5.3.2, it can be concluded that the predicted impacts on the velvet scoter qualifying feature of the North Orkney SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.5.3.3 Accidental release of contaminants or pollutants (all phases)

The Sections below present the conclusion of AEOSI on the North Orkney SPA qualifying species that have been screened in, based on the Project parameters outlined in Section 10.3.3.

During construction, there are proposed mitigation measures that will collectively minimise the risk of accidental pollutant release. The CEMD, supported by ECoW oversight, ensures that all activities follow approved methods designed to prevent spills, manage materials safely and maintain compliance with environmental commitments. The Pollution Incident Response Plan provides clear spill-response procedures, emergency contacts and staff training so that any incident is contained quickly and effectively. The Pollution Prevention Plan (which will continue into the operational phase) will include pollution prevention measures that will include measures to deal with accidental spillages in the unlikely event of their occurrence.

Turbidity monitoring, silt booms and controlled dredging protocols help prevent sediment plumes and the mobilisation of contaminated materials, preserving water quality and reducing the risk of pollutants spreading. Ballast Water Management procedures ensure controlled and compliant ballast operations, preventing uncontrolled discharges. Best-practice measures ensure early detection of any environmental change resulting from pollution, allowing prompt corrective action. Together, these integrated controls establish a structured environmental management framework that substantially reduces the likelihood, magnitude and extent of accidental pollutant releases during both construction and operation.

In the unlikely event of a spill, residual pollutants would remain spatially local to the site due to prevailing circulation patterns and established best-practice spill management. In this manner, accidental release of potential contaminants from Project vessels will be strictly controlled and procedures will be in place to minimise the effect of any accidental release if it occurs.

An Operational Environmental Management Document will be adhered to throughout the operational phase, and best practice measures will be followed including SEPA Guidance for Pollution Prevention.

10.5.3.3.1 Great northern diver (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.5.3.3 above, it can be concluded that the predicted impacts on the great northern diver qualifying feature of the North Orkney SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.5.3.3.2 Red-throated diver (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.5.3.3 above, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the North Orkney SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.5.3.3.3 Slavonian grebe (non-breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.5.3.3 above, it can be concluded that the predicted impacts on the Slavonian grebe qualifying feature of the North Orkney SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.5.3.4 Ornithological habitat changes (operation and maintenance only)

The Project will result in the loss of 19.1 ha of the Scapa Flow SPA, in which qualifying features of North Orkney SPA may be present. This equates to 0.06% of the total SPA area which is considered to be a negligible fraction. The affected area is considered to be extremely localised, with the remainder of the Scapa Flow SPA and North Orkney SPA continuing to provide extensive foraging, roosting and commuting habitat to the qualifying species.

The habitat functions lost will relate primarily to marine foraging areas used by qualifying bird species that may be foraging within the Scapa Flow SPA. Given the Scapa Flow SPA's vast size and heterogeneous habitat availability, as well as the availability of habitat within the North Orkney SPA, the small proportion affected is unlikely to alter the overall ecological functioning of the site.

The Scapa Flow provides large expanses of suitable foraging waters with similar depth, prey availability, and hydrodynamic characteristics, therefore the small area lost does not constitute a unique or limiting foraging resource. Mobile seabird species (e.g., divers, grebes, seaduck) typically have wide foraging ranges, enabling them to make use of abundant habitat elsewhere within and beyond the SPA, including in the North Orkney SPA.

Birds commuting between feeding areas, resting locations, and open water are not expected to be impeded; the operational Project footprint will not create a barrier to movement and does not alter the wider connectivity of habitats used by North Orkney SPA species foraging in the Scapa Flow SPA.

10.5.3.4.1 Great northern diver (non-breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.5.3.4 above, it can be concluded that the predicted impacts on the great northern diver qualifying feature of the North Orkney SPA from the Project alone as a result of impacts from habitat changes would **not adversely affect the integrity of the site**.

10.5.3.4.2 Red-throated diver (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.5.3.4 above, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the North Orkney SPA from the Project alone as a result of impacts from habitat changes would **not adversely affect the integrity of the site**.

10.5.3.4.3 Slavonian grebe (non-breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.5.3.4 above, it can be concluded that the predicted impacts on the Slavonian grebe qualifying feature of the North Orkney SPA from the Project alone as a result of impacts from habitat changes would **not adversely affect the integrity of the site**.

10.5.4 Assessment of Adverse Effects In-Combination

Table 10-14 provides a summary of the other developments considered within the in-combination assessment of effects.

10.5.4.1 Disturbance of birds from Project activities

There is the potential for in-combination disturbance from vessels during activities during the construction and/or operational phases of the plans, projects and developments listed in

Table 10-14. Vessels may pass through the North Orkney SPA from other plans and projects that may disturb birds within the SPA. The North Orkney SPA is functionally linked to the Scapa Flow SPA; therefore effects may occur on qualifying species outwith the North Orkney SPA.

The majority of vessel movements from other plans and projects will be along established routes (i.e., the main shipping channels in/out of Scapa Flow from the south (between Flotta and South Ronaldsay) and the west (between Hoy/Graemsay and Stromness). Both of these routes experience moderate levels of existing vessel traffic, and the in-combination effect of small numbers of Project vessels will constitute only a minor departure from baseline levels of shipping. The only area that will experience a greater increase in vessel activity will be the 167 ha branching east off the established route, to the Project site, where they are not anticipated to be any other vessels from other plans and developments (although there are baseline vessel movements in this area – as shown in Appendix B: Heat Maps and Noise Contour Maps). Existing fish farms that have undergone variations are required to have seasonal limits and planned vessel routes to avoid important foraging areas under site specific advice for the North Orkney SPA (NatureScot, 2022c). It is anticipated that vessels will therefore avoid important foraging areas for the qualifying features, mitigating potential impacts.

Construction activities at the Hatston Pier expansion could result in an intermittent disturbance in available habitat for qualifying features of North Orkney SPA, however this is anticipated to be localised to the area and affecting a small proportion of the North Orkney SPA bird populations which may forage outside of the SPA (e.g. within Scapa Flow SPA).

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of:

- 5 red-throated diver (10.6% of the breeding population of North Orkney SPA);
- 31 great-northern diver (10% of the non-breeding population of North Orkney SPA);
- 10 Slavonian grebe (6% of the non-breeding population of North Orkney SPA); and
- 38 velvet scoter (25% of the non-breeding population of North Orkney SPA).

Utilising the marine area adjacent to Hatston Pier.

It is plausible that individual birds may use both North Orkney SPA and the locality of the Project for foraging at different times, and therefore could be subject to intermittent disturbance within foraging or roosting habitat. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined available habitat for these species within North Orkney SPA (and Scapa Flow SPA), it is not likely that disturbance to these birds will have an adverse effect on site integrity for those bird species for Hatston alone, nor in combination with the Project.

Any potential cumulative disturbance to the qualifying features of the North Orkney SPA as a result of project activities are deemed to be temporary, with any potential impacts temporary and reversible. Therefore, it can be concluded that the predicted effects on the qualifying features of the North Orkney SPA from the Project in-combination with other plans, projects, and development as a result of Project activities would **not adversely affect the integrity of the site**.

10.5.4.2 Disturbance to prey species and habitats of prey species

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to disturbance to prey species and habitats of prey species. Impacts are managed case by case, are rare and highly unlikely. The relevant plans and project which would affect the habitat within the North Orkney SPA and in functionally-linked habitat include:

- Backaland Pier, Eday;
- Scammalin Bay Pier;
- Hatston Pier Expansion;
- Eynhallow Sound aquaculture site;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;

- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;
- Bay of Cleat, Westray aquaculture site;
- Wyre aquaculture site;
- Puldrite aquaculture site;
- East of Skelwick Skerry, Westray aquaculture site;
- Vestness, Westray aquaculture site;
- Hunda, Scapa Flow aquaculture site;
- Scarfhall Point, Westray aquaculture site;
- Lober Salmon Farm, Scapa Flow aquaculture site;
- East Moclett, North Sound aquaculture site;
- Bringhead, Scapa Flow aquaculture site;
- Quanterness aquaculture site;
- Veantrow Bay, Shapinsay aquaculture site;
- Chalmers Hope aquaculture site;
- Bay of Cleat (south) aquaculture site;
- Bay of Ham aquaculture site;
- Bay of Vady aquaculture site;
- Kirknoust aquaculture site; and
- Meil Bay aquaculture site.

Construction activities at Backaland Pier and Scammalin Bay Pier could result in a disturbance to prey species and their habitats, however this is anticipated to be localised to the area and affecting a small proportion of the available foraging habitat within the North Orkney SPA and functionally linked habitat.

Construction activities at the Hatston Pier expansion could result in disturbance to prey species and habitats for qualifying features of North Orkney SPA, however this is anticipated to be localised to the area and affecting a small proportion of the habitat of North Orkney SPA bird populations which may forage outside of the SPA (e.g. within Scapa Flow SPA).

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of:

- 5 red-throated diver (10.6% of the breeding population of North Orkney SPA);
- 31 great-northern diver (10% of the non-breeding population of North Orkney SPA);
- 10 Slavonian grebe (6% of the non-breeding population of North Orkney SPA); and
- 38 velvet scoter (25% of the non-breeding population of North Orkney SPA).

utilising the marine area adjacent to Hatston Pier.

It is plausible that individual birds may use both North Orkney SPA and the locality of the Project for foraging at different times, and therefore could be subject to disturbance to prey species and habitats. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined available habitat for these species within North Orkney SPA (and Scapa Flow SPA), it is not likely that disturbance to a limited area of habitat will have an adverse effect on site integrity for those bird species for Hatston alone, nor in combination with the Project.

The aquaculture sites are included based on minor changes to existing aquaculture infrastructure, therefore the effect will be negligible. The construction-phase impacts on marine bird prey resources are expected to be short-term, temporary, reversible and recoverable, with any changes remaining transient and confined to a small spatial extent relative to the extensive alternative foraging habitat available to seabirds. Taking into

consideration the embedded mitigation measures applied to other plans and developments, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.5.4.3 Accidental release of contaminants or pollutants

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to accidental release of contaminants or pollution. Impacts are managed case by case, are rare and highly unlikely. Taking into consideration the embedded mitigation measures applied to other plans and developments, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.5.4.4 Ornithological habitat change

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to ornithological habitat change. The relevant plans and project which would affect the habitat within the North Orkney SPA and in functionally-linked habitat include:

- Backaland Pier, Eday;
- Scammalin Bay Pier;
- Hatston Pier Expansion;
- Eynhallow Sound aquaculture site;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;
- Bay of Cleat, Westray aquaculture site;
- Wyre aquaculture site;
- Puldrite aquaculture site;
- East of Skelwick Skerry, Westray aquaculture site;
- Vestness, Westray aquaculture site;
- Hunda, Scapa Flow aquaculture site;
- Scarfhall Point, Westray aquaculture site;
- Lober Salmon Farm, Scapa Flow aquaculture site;
- East Moclett, North Sound aquaculture site;
- Bringhead, Scapa Flow aquaculture site;
- Quanterness aquaculture site;
- Veantrow Bay, Shapinsay aquaculture site;
- Chalmers Hope aquaculture site;
- Bay of Cleat (south) aquaculture site;
- Bay of Ham aquaculture site;
- Bay of Vady aquaculture site;
- Kirknoust aquaculture site; and
- Meil Bay aquaculture site.

Construction activities at the Backaland Pier and Scammalin Bay Pier could result in a loss in available foraging habitat, however this is anticipated to be localised to the area and affecting a small proportion of the available foraging habitat within the North Orkney SPA and functionally linked habitat.

Construction activities at the Hatston Pier expansion could result in temporary or permanent habitat change for qualifying features of North Orkney SPA, however this is anticipated to be localised to the area and affecting a small proportion of the North Orkney SPA bird populations which may forage outside of the SPA (e.g. within Scapa Flow SPA).

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of:

- 5 red-throated diver (10.6% of the breeding population of North Orkney SPA);
- 31 great-northern diver (10% of the non-breeding population of North Orkney SPA);
- 10 Slavonian grebe (6% of the non-breeding population of North Orkney SPA); and
- 38 velvet scoter (25% of the non-breeding population of North Orkney SPA).

utilising the marine area adjacent to Hatston Pier.

It is plausible that individual birds may use both North Orkney SPA and the locality of the Project for foraging at different times, and therefore could be subject to disturbance within foraging or roosting habitat. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined available habitat for these species within North Orkney SPA (and Scapa Flow SPA), it is not likely that disturbance to these birds will have an adverse effect on site integrity for those bird species for Hatston alone, nor in combination with the Project.

The aquaculture sites are included based on minor changes to existing aquaculture infrastructure, therefore the ornithological habitat change will be negligible. Considering that the remainder of the SPA is continuing to provide extensive foraging, roosting and commuting habitat to the qualifying species, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.5.5 Summary

It is therefore concluded that the potential disturbance effects resulting from the Project, in combination with other plans and projects, will not result in significant barriers to movement, and will not reduce access to preferred foraging, roosting or prey species and habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the cumulative zones of disturbance are small relative to alternative habitat within North Orkney SPA and functionally linked habitats. There is no evidence that the areas affected by port operations at the Project, or any other plan or project in combination, are disproportionately important for prey availability for any of the qualifying features of North Orkney SPA. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within North Orkney SPA or functionally-linked habitat, and the likelihood that disturbed or displaced birds will resume foraging elsewhere.

Therefore, there will be no adverse effects on site integrity on any of the qualifying features of the North Orkney SPA either for the Project alone or in-combination with other projects, plans and developments.

10.6 Orkney Mainland Moors SPA

10.6.1 Site Description and Qualifying Features

The Orkney Mainland Moors SPA (UK9002311) comprises a total area of 5,324 ha, (NatureScot, *undated*) and comprises four extensive moorland areas on Mainland Orkney. It is characterised by blanket bog, acid grassland, wet and dry heath, acidic raised-mire and calcareous valley mire, with predominantly acidic conditions but enriched by locally alkaline flushes, while sheltered valleys support willow scrub, tall-herb vegetation and several small oligotrophic lochs. The SPA is designated for supporting populations of European importance of hen harrier—one of Britain's largest and densest breeding populations—as well as red-throated diver and short-eared owl, with the moorland landscape providing essential breeding habitat for these raptors and upland species. While hen harrier and short-eared owl are qualifying features of the Orkney Mainland Moors SPA, they are screened out of further assessment as there was no potential for LSE concluded (Table 6-6).

The SPA was originally classified in 2000 and extended in 2008. The SPA aligns with the boundaries of West Mainland Moorlands, Glims Moss & Durkadale, Orphir & Stenness Hills, and Keelylang & Swartabeck Burn SSSIs.

Table 10-19 Protected feature and condition for the Orkney Mainland Moors SPA (NatureScot, undated)

Protected feature	Feature condition	Assessment date	Broader conservation status*
Red-throated diver (breeding)	Favourable, maintained	Not yet assessed	UK: Green European region: Least Concern
Hen harrier (breeding and non-breeding)	Favourable, maintained	Not yet assessed	UK: Red European region: Vulnerable
Short-eared owl (breeding)	Favourable, maintained	Not yet assessed	UK: Amber European region: Least Concern
***UK Broader conservation status based on Birds of Conservation Concern 5 (BoCC5) and European region is based on BirdLife International, 2021.**			

10.6.2 Conservation Objectives

The Conservation Objectives of the Orkney Mainland Moors SPA are:

1. To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained.
2. To ensure for the qualifying species that the following are maintained in the long term:
    - Population of the species is a viable component of the site;
    - Distribution of the species within the site;
    - Distribution and extent of habitats supporting the species;
    - Structure, function and supporting processes of habitats supporting the species;
    - No significant disturbance of the species.

10.6.3 Assessment of Adverse Effects Alone

The breeding population of red-throated diver are the only qualifying species screened into this assessment, as outlined in Section 6.4.

10.6.3.1 Disturbance of birds due to Project activities (all phases)

10.6.3.1.1 Red-throated diver (breeding)

10.6.3.1.1.1 Vessel disturbance

During construction, the number of vessel movements relevant to the red-throated diver breeding period for which they are a qualifying feature (April-September, see Table 10-13) will see an average 0.58% increase of vessel movements over current summer baseline levels, with no vessel movements predicted for April or May. This increase will be temporary over the 26-month construction period.

Operational phase vessel movements are detailed in section 5.4 and 10.3.1.2 and, during the red-throated diver breeding period (April-September), are expected to comprise an average monthly increase of 26 vessel movements from the Project. This constitutes an average increase to the monthly vessel movements of 1.0% from current baseline levels.

Red-throated diver display a very high sensitivity to vessel disturbance (Table 10-11). However, the increase in vessel use along the route to the Project is not considered significant relative to the baseline (see Sections 10.2.3.1 and 10.3.1.2). It is highly unlikely that the movement of vessels in the vicinity of the proposed Project (both during construction and operation) will provide a barrier effect to birds moving through the area, as vessel movements are likely to occur less than once per day in the breeding season (taking the precautionary approach) as opposed to continuously. This constitutes a transient and temporary effect which is unlikely to be discernible from the baseline.

A Vessel Management Plan will be produced, with input from NatureScot, for both the Construction and Operational phases, which will detail vessel routes, speeds, etc., to minimise and, where possible, avoid any disturbance impacts through implementation of specific measures to identify and actively avoid aggregation of birds on the water.

The assessment concludes that the Project will result in a 1% mortality increase annually (Appendix D: Mortality Matrix Model) as a precautionary figure based on a seasonal peak count of 15 birds assuming a disturbance distance of 1 km (Table 10-4). This equates to 0.018 birds annually, or 0.1% of the SPA population. This is not considered significant. Taken over a 25-year operational period (a period agreed with NatureScot), this would result in a mortality figure of 0.45 birds, or 3% of the SPA population. This assumes that all birds from the Orkney Mainland Moors SPA are experiencing disturbance from each vessel.

10.6.3.1.1.2 Mobile cranes

Divers are sensitive to towering structures in the marine environment (Dierschke et al., 2017), however the evidence relates primarily to offshore windfarms and provides no evidence that cranes in coastal developments result in the same disturbance/displacement.

As outlined in Section 10.2.1.2, the bulk of the breeding pairs are located the northern part of the Orkney Mainland Moors SPA. There are no known Orkney Mainland Moors SPA breeding sites within 14 km of the Project site (i.e. beyond the 9 km foraging range for the species, per Woodward *et al.*, 2019) and very few foraging trips from there would be expected towards Scapa Flow. Even with a potential for a larger range of visual disturbance from the towering cranes, it is highly unlikely that red-throated diver from the Orkney Mainland Moors SPA will be present in an area where they are susceptible to disturbance from cranes associated with the Project.

Should disturbance occur, it will be reversible following cessation of crane activities, and given the species' demonstrated tolerance to vessel presence and the implementation of a Vessel Management Plan to minimise interactions, no significant or sustained impact is anticipated.

10.6.3.1.1.3 Airborne noise

As outlined in Section 10.2.1.2, the bulk of the breeding pairs are located the northern part of the Orkney Mainland Moors SPA. There are no known Orkney Mainland Moors SPA breeding sites within 14 km of the Project site (i.e. beyond the 9 km foraging range for the species, per Woodward *et al.*, 2019) and very few foraging trips from there would be expected towards Scapa Flow. Even with a potential for a larger range of visual disturbance from the towering cranes, it is highly unlikely that red-throated diver from the Orkney Mainland Moors SPA will be present in an area where they are susceptible to airborne noise associated with the Project.

Section 7 and Section 10.2.3.4 details mitigation measures to avoid any significant impacts on marine bird species, including red-throated diver.

Based on the evidence outlined above and when considering the mitigation measures committed to by the Project , it can be concluded that the predicted disturbance impacts on the red-throated diver qualifying feature of the Orkney Mainland Moors SPA from the Project alone would **not adversely affect the integrity of the site**.

10.6.3.2 Disturbance to prey species and habitats of prey species (construction only)

Red-throated divers from Orkney Mainland Moors SPA may forage within the Scapa Flow SPA. As described in NatureScot's Conservation and Management Advice Document for Scapa Flow SPA (NatureScot, 2022b) supporting habitats refer to the characteristics of the seabed and water column relevant to their use by the qualifying features. It relates to wider oceanographic processes such as upwellings, tidal flows, hydrological movements which may be necessary for the habitat, and could affect nutrient cycling and prey distribution.

Hydrodynamic modelling summarised in Section 10.3.2 shows little impact on the surrounding water column and seabed due to the low-energy environment in this part of Scapa Flow. The impacts on prey species for the qualifying species are expected to be negligible, such that their abundance and general distribution remain unchanged from the baseline.

The dredge budget consists of approximately 17% gravel, 60% sand, and 23% silt and clay, which, with the weak tidal currents in the vicinity of the proposed dredge pockets, will result in very localised and short-term

plumes from dredging. The magnitude of the sediment discharge and dispersion from dredging works will be low within the dredge area and its immediate vicinity, and negligible out with this area. No sediment transport will occur within the Hoy SPA boundary. Thus, the supporting habitats for qualifying species beyond the development footprint will be maintained.

Drainage designs to ensure that there are no untreated surface water discharges directly to surrounding coastal waters, and the use of silt booms during land reclamation works will mitigate against pollution spills which could affect the qualifying interests of the SPA and their prey sources. In terms of water pollution from the pier and attendant vessels, adherence to strict Pollution Prevention controls will aim to prevent the release of pollutants to the water environment. With these measures in place, the supporting habitats for qualifying species will be maintained.

For dredging disposal at sea, no sediment transport will occur within the functionally-linked Scapa Flow SPA boundary because the sea disposal site is outwith the SPA. Therefore, the supporting habitats for the qualifying SPA species beyond the development footprint will be maintained.

Considering the assessment outlined above and in Section 10.3.2, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Orkney Mainland Moors SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.6.3.3 Accidental release of contaminants or pollutants (all phases)

Red-throated divers from Orkney Mainland Moors SPA may forage within the Scapa Flow SPA and therefore there may be an effect from the accidental release of contaminants or pollutants. During construction, there are proposed mitigation measures that will collectively minimise the risk of accidental pollutant release. The CEMD, supported by ECoW oversight, ensures that all activities follow approved methods designed to prevent spills, manage materials safely and maintain compliance with environmental commitments. The Pollution Incident Response Plan provides clear spill-response procedures, emergency contacts and staff training so that any incident is contained quickly and effectively. The Pollution Prevention Plan (which will continue into the operational phase) will include pollution prevention measures that will include measures to deal with accidental spillages in the unlikely event of their occurrence.

Turbidity monitoring, silt booms and controlled dredging protocols help prevent sediment plumes and the mobilisation of contaminated materials, preserving water quality and reducing the risk of pollutants spreading. Ballast Water Management procedures ensure controlled and compliant ballast operations, preventing uncontrolled discharges. Best-practice measures ensure early detection of any environmental change resulting from pollution, allowing prompt corrective action. Together, these integrated controls establish a structured environmental management framework that substantially reduces the likelihood, magnitude and extent of accidental pollutant releases during both construction and operation.

In the unlikely event of a spill, residual pollutants would remain spatially local to the site due to prevailing circulation patterns and established best-practice spill management. In this manner, accidental release of potential contaminants from Project vessels will be strictly controlled and procedures will be in place to minimise the effect of any accidental release if it occurs.

An Operational Environmental Management Document will be adhered to throughout the operational phase, and best practice measures will be followed including SEPA Guidance for Pollution Prevention.

Considering the assessment outlined above and in Section 10.3.3, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Orkney Mainland Moors SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.6.3.4 Ornithological habitat changes (operation and maintenance only)

As outlined in Section 10.2.1.2, the bulk of the breeding pairs are located the northern part of the Orkney Mainland Moors SPA. There are no known Orkney Mainland Moors SPA breeding sites within 14 km of the Project site (i.e. beyond the 9 km foraging range for the species, per Woodward *et al.*, 2019) and very few foraging trips from there would be expected towards Scapa Flow. It is therefore highly unlikely that red-throated diver from the Orkney Mainland Moors SPA will be present in an area where they are susceptible to

ornithological habitat changes associated with the Project. It can therefore be concluded that effects of ornithological habitat changes on the red-throated diver qualifying feature of the Orkney Mainland Moors SPA from the Project alone would **not adversely affect the integrity of the site**.

10.6.4 Assessment of Adverse Effects In-Combination

Table 10-14 provides a summary of the other developments considered within the in-combination assessment of effects.

10.6.4.1 Disturbance of birds from Project activities

There is the potential for in-combination disturbance from vessels during activities during the construction and/or operational phases of the plans, projects and developments listed in

Table 10-14. Vessels may pass through the Scapa Flow SPA from other plans and projects that may disturb birds from the Orkney Mainland Moors SPA.

The majority of vessel movements from other plans and projects will be along established routes (i.e., the main shipping channels in/out of Scapa Flow from the south (between Flotta and South Ronaldsay) and the west (between Hoy/Graemsay and Stromness). Both of these routes experience moderate levels of existing vessel traffic, and the in-combination effect of small numbers of Project vessels will constitute only a minor departure from baseline levels of shipping. The only area that will experience a greater increase in vessel activity will be the 167 ha branching east off the established route, to the Project site, where they are not anticipated to be any other vessels from other plans and developments (although there are baseline vessel movements in this area – as shown in Appendix B: Heat Maps and Noise Contour Maps). Existing fish farms that have undergone variations are required to have seasonal limits and planned vessel routes to avoid important foraging areas under site specific advice for the Scapa Flow SPA (NatureScot, 2022b). It is anticipated that vessels will therefore avoid important foraging areas for the qualifying features, mitigating potential impacts.

Construction activities at the Hatston Pier expansion could result in an intermittent disturbance in available habitat for the red-throated diver feature of Orkney Mainland Moors SPA, however this is anticipated to be localised to the area and affecting a small proportion of the Orkney Mainland Moors SPA population (18 breeding pairs) which may forage either in the Scapa Flow SPA or close to Hatston Pier Expansion.

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of 5 red-throated diver utilising the marine area adjacent to Hatston Pier.

It is plausible that individual red-throated diver may use both North Orkney SPA and Scapa Flow SPA for foraging at different times, and therefore could be subject to disturbance within foraging or roosting habitat. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined available habitat for these species within North Orkney SPA and Scapa Flow SPA, based on the breeding foraging range of the red-throated diver (~9 km), it is not likely that disturbance to these birds will have an adverse effect on the species from Hatston alone, nor in combination with the Project.

Any potential cumulative disturbance to the qualifying features of the Orkney Mainland Moors SPA as a result of project activities are deemed to be temporary, with any potential impacts temporary and reversible. Therefore, it can be concluded that the predicted effects on the qualifying features of the Orkney Mainland Moors SPA from the Project in-combination with other plans, projects, and development as a result of Project activities would **not adversely affect the integrity of the site**.

10.6.4.2 Disturbance to prey species and habitats of prey species

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to disturbance to prey species and habitats of prey species. Impacts are managed case by case, are rare and highly unlikely. The relevant plans and project which would affect the habitat within the Scapa Flow SPA used by red-throated diver from the Orkney Mainland Moors SPA include:

- Hatston Pier Expansion;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;

Construction activities at the Hatston Pier expansion could result in disturbance to prey species and habitats for the red-throated diver feature of Orkney Mainland Moors SPA, however this is anticipated to be localised to the area and affecting a small proportion of the Orkney Mainland Moors SPA population (18 breeding pairs) which may forage either in the Scapa Flow SPA or close to Hatston Pier Expansion.

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of 5 red-throated diver utilising the marine area adjacent to Hatston Pier.

It is plausible that individual red-throated diver may use both North Orkney SPA and Scapa Flow SPA for foraging at different times, and therefore could be subject to disturbance of prey species and habitats. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined available habitat for these species within North Orkney SPA and Scapa Flow SPA, based on the breeding foraging range of the red-throated diver (~9 km), it is not likely that disturbance to these birds will have an adverse effect on the species from Hatston alone, nor in combination with the Project.

The aquaculture sites are included based on minor changes to existing aquaculture infrastructure, therefore the effect will be negligible. The construction-phase impacts on marine bird prey resources are expected to be short-term, temporary, reversible and recoverable, with any changes remaining transient and confined to a small spatial extent relative to the extensive alternative foraging habitat available to seabirds. Taking into consideration the embedded mitigation measures applied to other plans and developments, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.6.4.3 Accidental release of contaminants or pollutants

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to accidental release of contaminants or pollution. Impacts are managed case by case, are rare and highly unlikely. Taking into consideration the embedded mitigation measures applied to other plans and developments, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.6.4.4 Ornithological habitat change

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to ornithological habitat change. The relevant plans and project which would affect the habitat within the Scapa Flow SPA used by red-throated diver from the Orkney Mainland Moors SPA include:

- Hatston Pier Expansion;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;

Construction activities at the Hatston Pier expansion could result in temporary or permanent habitat change for the red-throated diver feature of Orkney Mainland Moors SPA, however this is anticipated to be localised to the area and affecting a small proportion of the Orkney Mainland Moors SPA population (18 breeding pairs) which may forage either in the Scapa Flow SPA or close to Hatston Pier Expansion.

The HRA Report for Hatston Pier Expansion reported peak counts from vantage point surveys of 5 red-throated diver utilising the marine area adjacent to Hatston Pier.

It is plausible that individual red-throated diver may use both North Orkney SPA and Scapa Flow SPA for foraging at different times, and therefore could be subject to disturbance of prey species and habitats. However, it is worth noting that Hatston is already an active port in Kirkwall Bay, and given the combined available habitat for these species within North Orkney SPA and Scapa Flow SPA, based on the breeding foraging range of the red-throated diver (~9 km), it is not likely that habitat changes with respect to this species will have an adverse effect on the species from Hatston alone, nor in combination with the Project.

The aquaculture sites are included based on minor changes to existing aquaculture infrastructure, therefore the ornithological habitat change will be negligible. Considering that the remainder of the SPA is continuing to

provide extensive foraging, roosting and commuting habitat to the qualifying species, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.6.5 Summary

It is therefore concluded that the potential disturbance effects resulting from the Project, in combination with other plans and projects, will not result in significant barriers to movement, and will not reduce access to preferred foraging, roosting or prey species and habitats in a continuous or sustained manner for red-throated diver. Any distributional changes are likely within the range of natural variability, and the cumulative zones of disturbance are small relative to alternative habitat within the foraging range of the species. There is no evidence that the areas affected by port operations at the Project, or any other plan or project in combination, are disproportionately important for prey availability for the breeding red-throated diver feature of Orkney Mainland Moors SPA. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within the foraging range of red-throated diver, and the likelihood that disturbed or displaced birds will resume foraging elsewhere.

Therefore, there will be no adverse effects on site integrity on the breeding red-throated diver feature of the Orkney Mainland Moors SPA either for the Project alone or in-combination with other projects, plans and developments.

10.7 Hoy SPA

10.7.1 Site Description and Qualifying Features

The Hoy SPA is located on the island of Hoy in Orkney and is located approximately 16.5 km west of the Project site (NatureScot, 2024). Hoy is a mountainous island at the south-western end of the Orkney archipelago. Hoy SPA covers the northern and western two-thirds of Hoy Island, which is formed of Old Red Sandstone and contains Orkney's highest hills, and adjacent coastal waters. The SPA supports an extremely diverse mixture of mire, heath and alpine vegetation and Britain's most northerly native woodland. These upland areas and the high sea cliffs at the coast support an important assemblage of moorland breeding birds and breeding seabirds.

The boundary of Hoy SPA overlaps with that of Hoy SSSI, and the seaward extension extends approximately 2 km into the marine environment to include the seabed, water column and surface. The Hoy SPA was classified on 7th December 2000, with marine extension classified on 25th September 2009, due to its populations of breeding seabirds. While peregrine is a qualifying feature of the Hoy SPA, it is screened out of further assessment as there was no potential for LSE concluded (Table 6-6).

Table 10-20 Protected feature and condition for the Hoy SPA (NatureScot, 2024)

Protected feature	Feature condition	Assessment date	Broader conservation status*
Arctic skua (breeding)	Unfavourable, no change	2019	UK: Red European region: Endangered
Atlantic puffin (breeding)	Unfavourable, no change	2017	UK: Red European region: Endangered
Black-legged kittiwake (breeding)	Unfavourable, no change	2017	UK: Red European region: Endangered
Common guillemot (breeding)	Unfavourable, no change	2017	UK: Amber European region: Least concern
Great black backed gull (breeding)	Unfavourable, declining	2023	UK: Red European region: Near threatened
Great skua (breeding)	Unfavourable, declining	2023	UK: Red European region: Least concern
Northern fulmar (breeding)	Unfavourable, no change	2019	UK: Amber European region: Vulnerable

Peregrine (breeding)	Favourable, maintained	2013	UK: Green European region: Least concern
Red-throated diver (breeding)	Favourable, maintained	2007	UK: Green European region: Least concern
***UK Broader conservation status based on Birds of Conservation Concern 5 (BoCC5) and European region is based on BirdLife International, 2021.**			

10.7.2 Conservation Objectives

The Conservation Objectives of the Hoy SPA are:

1. To ensure that the qualifying features of Hoy SPA are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status.
2. To ensure that the integrity of Hoy SPA is restored in the context of environmental changes by meeting objectives 2a, 2b and 2c for each qualifying feature:

- 2a. The populations of the qualifying features are viable components of the Hoy SPA.
- 2b. The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species.
- 2c. The supporting habitats and processes relevant to qualifying features and their prey resources are maintained, or where appropriate restored, at Hoy SPA.

10.7.3 Assessment of Adverse Effects Alone

10.7.3.1 Disturbance of birds due to Project activities (all phases)

Disturbance may occur through dredging activities and airborne noise through terrestrial works during the construction phase. Empirical data specifically linking marine bird response to noise disturbance (and underwater noise in particular), separate from other sources of disturbance (e.g. vessel movement or human presence), is limited, and this source of disturbance on marine birds is not yet well understood. Recent research generally suggests that diving seabirds could be more sensitive to underwater noise than previously assumed. For example, hearing thresholds for Great Cormorant were found to be comparable to seals and toothed whales in the frequency band 1 to 4 kHz (Hansen et al., 2017). A number of assessments have been conducted, based on the limited information available, and the similar frequency ranges between seabirds and phocid pinniped and cetacean species, applied methodologies developed for pinnipeds or low-frequency cetaceans in assessing seabird sensitivity to underwater noise (Teachout, 2012). Underwater noise modelling (Technical Appendix 5.6 of the EIAR) for dredging shows a TTS range of up to 250m and a PTS range of 50m or less for prolonged exposure (8 hours).

The Construction activities have been highlighted in the Airborne Noise Report (Technical Appendix 9.1 of the EIAR), and noise contour maps have been prepared (see Appendix B in relation to Scapa Flow SPA qualifying species) as having noise creation levels of between 70 and 90dB at 10m from the source, with noise levels decreasing over distance. With the creation of a 6m bund on the seaward side of the working area, the noise maps demonstrate that noise levels beyond the seaward bund would be between 40-50dB in the immediate vicinity of the bund and dissipate to <35dB at 250m, A study compiled by the IECS, University of Hull (2013) found that construction noise emissions below 50 dB had a low effect and no impact on waterbirds. Disturbance noise above 70 dB resulted in a moderate to high effect on birds, resulting in movement within the feeding zone.

Terrestrial blasting associated with the construction phase could cause disturbance via noise associated with terrestrial blasting. However, routine blasting operations regularly generate air overpressure levels at the closest point to blast area of around 120 dB but the intensity of these noise levels experienced at a distance from the blast site are affected by a range of meteorological conditions (wind speed and direction, temperature, cloud cover and humidity) and in general reduce by 6 dB reduction as the distance from the source doubles, when sound waves pass a given position, the pressure of the air rises very rapidly then falls more slowly then returns to the ambient value after a number of oscillations. This will occur once a week over a 35-week period. The CEMD (Appendix I of the SEIR May 2025) details mitigation measures to avoid any significant impacts on marine bird species. This includes the presence of an ornithologist to monitor for the presence of SPA qualifying species within 500m of the Proposed Development and record behavioural responses within this zone. If impacts are recorded, then the disturbance zone shall be increased.

In terms of potential disturbance from vessel movements, the maximum number of vessel movements is 112 over the 26-month construction phase (see Section 5.3.8 and Section 10.2.3).

10.7.3.1.1 Arctic skua (breeding)

Small numbers of Arctic skua were recorded flying past very infrequently during the summer months, with a peak of five birds in June 2022. The closest known breeding areas are on the East Mainland, ~10km distance, supporting only one or a few pairs at each location. The five birds recorded represents 4.2% of the Hoy SPA population (59 pairs).

Considering the assessment outlined in Section 10.3.1 and Section 10.7.3.1 above, it can be concluded that the predicted impacts on the Arctic Skua qualifying feature of the Hoy SPA from the Project alone as a result of impacts disturbance of birds due to Project activities would **not adversely affect the integrity of the site**.

10.7.3.1.2 Atlantic puffin (breeding)

This species was recorded on 7 out of 48 watch days during 2020 and 2022, with a peak of 3 birds. It is possible that these birds are from Hoy SPA but the area in the vicinity of the proposed Project site is not considered to be of importance to this species. The peak of three birds represents 0.04% of the Hoy SPA citation population (3,500 pairs).

Considering the assessment outlined in Section 10.3.1 and Section 10.7.3.1 above, it can be concluded that the predicted impacts on the Atlantic puffin qualifying feature of the Hoy SPA from the Project alone as a result of impacts disturbance of birds due to Project activities would **not adversely affect the integrity of the site**.

10.7.3.1.3 Black-legged kittiwake (breeding)

Small numbers were recorded flying past during the summer months, with a peak of 7/hr in June 2022. A peak count of 83 birds on the water within 2 km was also recorded. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Project site. The peak of 83 birds represents 1.4% of the Hoy SPA citation population (3,000 pairs).

Considering the assessment outlined in Section 10.3.1 and Section 10.7.3.1 above, it can be concluded that the predicted impacts on the black-legged kittiwake qualifying feature of the Hoy SPA from the Project alone as a result of impacts disturbance of birds due to Project activities would **not adversely affect the integrity of the site**.

10.7.3.1.4 Common guillemot (breeding)

Small numbers were recorded, with a peak of 27 birds within 1km of the Project site and 87 within 2 km. Small numbers were also recorded flying past the Project site, with a peak of 6/hr in June 2022. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Project site. The peak of 87 birds represents 0.3% of the Hoy SPA citation population (13,400 pairs).

Considering the assessment outlined in Section 10.3.1 and Section 10.7.3.1 above, it can be concluded that the predicted impacts on the common guillemot qualifying feature of the Hoy SPA from the Project alone as a result of impacts disturbance of birds due to Project activities would **not adversely affect the integrity of the site**.

10.7.3.1.5 Great black-backed gull (breeding)

A peak of 11 birds were recorded during the summer, and up to 7 birds per hour were recorded flying past at its peak. One pair recorded nesting close to the Project site. It is unlikely that the birds recorded were part of the Hoy SPA complex. The peak of 11 birds represents 0.96% of the Hoy SPA citation population (570 pairs).

Considering the assessment outlined in Section 10.3.1 and Section 10.7.3.1 above, it can be concluded that the predicted impacts on the great black-backed gull qualifying feature of the Hoy SPA from the Project alone as a result of impacts disturbance of birds due to Project activities would **not adversely affect the integrity of the site**.

10.7.3.1.6 Great skua (breeding)

Small numbers, with a peak of 4 birds/hr flying past in July 2021. Numbers in 2022 were significantly lower, probably due to the prevalence of avian flu, which has decimated the local and national populations. The 4 birds/hr represents 0.1% of the Hoy SPA citation population (1,900 pairs).

Considering the assessment outlined in Section 10.3.1 and Section 10.7.3.1 above, it can be concluded that the predicted impacts on the great skua qualifying feature of the Hoy SPA from the Project alone as a result of impacts disturbance of birds due to Project activities would **not adversely affect the integrity of the site**.

10.7.3.1.7 Northern fulmar (breeding)

Sizable numbers were recorded flying past during the summer months, with a peak of 56/hr in July 2022. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Project site. The peak of 56 birds/hr represents 0.08% of the Hoy SPA citation population (35,000 pairs).

Considering the assessment outlined in Section 10.3.1 and Section 10.7.3.1 above, it can be concluded that the predicted impacts on the northern fulmar qualifying feature of the Hoy SPA from the Project alone as a result of impacts disturbance of birds due to Project activities would **not adversely affect the integrity of the site**.

10.7.3.1.8 Red-throated diver (breeding)

The vessel movements to and from the dredging site will pass through an area that is a favoured foraging area for breeding red-throated diver, which will overlap with the important foraging period during the red-throated diver breeding cycle (June-August), and importantly, the critical chick rearing period.

A total of 42 vessel movements over 12 a week period are anticipated (i.e. 3.5 vessel movements per week), which is not a significant increase in comparison to the baseline vessel movements in the area. Mitigation measures, as outlined in Table 7-1, includes adherence to a Vessel Management Plan which will include measures to minimise and where possible, avoid any disturbance impacts. This includes adherence to slow vessel speeds and staying on defined routes, and adherence to Scottish Marine Wildlife Watching code, in order to minimise the potential for any disturbance. Mitigation measures of standard best practice in relation to navigational protocols and the CEMD will be issued to all vessel operators. Transiting vessels will avoid the marine portion of the Hoy SPA in order to reduce impacts to foraging red-throated diver during this period, as given the proximity to red-throated diver breeding sites on Hoy, it is likely that this is where red-throated divers foraging within the marine portion of Hoy SPA originate.

As per the Hoy SPA Conservation and Management advice (NatureScot, 2024), breeding red-throated divers at Hoy SPA commute between breeding sites on the margins of, or on small islands within, freshwater lochs and lochans, typically in remote upland moorlands (such as the hills of Hoy), to foraging grounds in adjacent coastal waters within 10 km of their nest site. Therefore, vessels passing through or near to the marine portion of Hoy SPA have the potential to disturb breeding red-throated divers. As the vessel route will not enter the SPA, and given that red-throated divers have a strong preference for shallow, coastal areas e.g. bays, and vessels transiting adjacent to the SPA will be following pre-determined routes at constant, slow speeds, there is very limited potential for disturbance to red-throated divers foraging at sea, other than short-duration, temporary and reversible impacts. Divers are sensitive to towering structures in the marine environment (Dierschke *et al*., 2017), however the intervening distance between the Hoy SPA and the Project site is greater than the 9 km foraging range for the species (Woodward *et al*., 2019), therefore there is no possibility for effect from disturbance from cranes.

As such, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Hoy SPA from the Project alone as a result of impacts disturbance of birds due to Project activities would **not adversely affect the integrity of the site**.

10.7.3.2 Disturbance to prey species and habitats of prey species (construction only)

As described in NatureScot's Conservation and Management Advice Document for Hoy SPA (NatureScot, 2024) supporting habitats refer to the characteristics of the seabed and water column relevant to their use by the qualifying features. It relates to wider oceanographic processes such as upwellings, tidal flows, hydrological movements which may be necessary for the habitat, and could affect nutrient cycling and prey distribution.

Hydrodynamic modelling summarised in Section 10.3.2 shows little impact on the surrounding water column and seabed due to the low-energy environment in this part of Scapa Flow. The impacts on prey species for the qualifying species are expected to be negligible, such that their abundance and general distribution remain unchanged from the baseline.

The dredge budget consists of approximately 17% gravel, 60% sand, and 23% silt and clay, which, with the weak tidal currents in the vicinity of the proposed dredge pockets, will result in very localised and short-term

plumes from dredging. The magnitude of the sediment discharge and dispersion from dredging works will be low within the dredge area and its immediate vicinity, and negligible out with this area. No sediment transport will occur within the Hoy SPA boundary. Thus, the supporting habitats for qualifying species beyond the development footprint will be maintained.

Drainage designs to ensure that there are no untreated surface water discharges directly to surrounding coastal waters, and the use of silt booms during land reclamation works will mitigate against pollution spills which could affect the qualifying interests of the SPA and their prey sources. In terms of water pollution from the pier and attendant vessels, adherence to strict Pollution Prevention controls will aim to prevent the release of pollutants to the water environment. With these measures in place, the supporting habitats for qualifying species will be maintained.

For dredging disposal at sea, no sediment transport will occur within the Hoy SPA boundary because the sea disposal site is outwith the SPA. Therefore, the supporting habitats for the qualifying SPA species beyond the development footprint will be maintained.

10.7.3.2.1 Arctic skua (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.7.3.2, it can be concluded that the predicted impacts on the Arctic skua qualifying feature of the Hoy SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.7.3.2.2 Atlantic puffin (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.7.3.2, it can be concluded that the predicted impacts on the Atlantic puffin qualifying feature of the Hoy SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.7.3.2.3 Black-legged kittiwake (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.7.3.2, it can be concluded that the predicted impacts on the black-legged kittiwake qualifying feature of the Hoy SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.7.3.2.4 Common guillemot (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.7.3.2, it can be concluded that the predicted impacts on the common guillemot qualifying feature of the Hoy SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.7.3.2.5 Great black-backed gull (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.7.3.2, it can be concluded that the predicted impacts on the great black-backed gull qualifying feature of the Hoy SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.7.3.2.6 Great skua (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.7.3.2, it can be concluded that the predicted impacts on the great skua qualifying feature of the Hoy SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.7.3.2.7 Northern fulmar (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.7.3.2, it can be concluded that the predicted impacts on the Northern fulmar qualifying feature of the Hoy SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.7.3.2.8 Red-throated diver (breeding)

Considering the assessment outlined in Section 10.3.2 and Section 10.7.3.2, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Hoy SPA from the Project alone as a result of impacts to prey species would **not adversely affect the integrity of the site**.

10.7.3.3 Accidental release of contaminants or pollutants (all phases)

The Sections below present the conclusion of AEOSI on the Hoy SPA qualifying species that have been screened in, based on the Project parameters outlined in Section 10.3.3.

During construction, there are proposed mitigation measures that will collectively minimise the risk of accidental pollutant release. The CEMD, supported by ECoW oversight, ensures that all activities follow approved methods designed to prevent spills, manage materials safely and maintain compliance with environmental commitments. The Pollution Incident Response Plan provides clear spill-response procedures, emergency contacts and staff training so that any incident is contained quickly and effectively. The Pollution Prevention Plan (which will continue into the operational phase) will include pollution prevention measures that will include measures to deal with accidental spillages in the unlikely event of their occurrence.

Turbidity monitoring, silt booms and controlled dredging protocols help prevent sediment plumes and the mobilisation of contaminated materials, preserving water quality and reducing the risk of pollutants spreading. Ballast Water Management procedures ensure controlled and compliant ballast operations, preventing uncontrolled discharges. Best-practice measures ensure early detection of any environmental change resulting from pollution, allowing prompt corrective action. Together, these integrated controls establish a structured environmental management framework that substantially reduces the likelihood, magnitude and extent of accidental pollutant releases during both construction and operation.

In the unlikely event of a spill, residual pollutants would remain spatially local to the site due to prevailing circulation patterns and established best-practice spill management. In this manner, accidental release of potential contaminants from Project vessels will be strictly controlled and procedures will be in place to minimise the effect of any accidental release if it occurs.

An Operational Environmental Management Document will be adhered to throughout the operational phase, and best practice measures will be followed including SEPA Guidance for Pollution Prevention.

10.7.3.3.1 Arctic skua (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.7.3.3 above, it can be concluded that the predicted impacts on the Arctic skua qualifying feature of the Hoy SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.7.3.3.2 Atlantic puffin (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.7.3.3 above, it can be concluded that the predicted impacts on the Atlantic puffin qualifying feature of the Hoy SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.7.3.3.3 Black-legged kittiwake (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.7.3.3 above, it can be concluded that the predicted impacts on the black-legged kittiwake qualifying feature of the Hoy SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.7.3.3.4 Common guillemot (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.7.3.3 above, it can be concluded that the predicted impacts on the common guillemot qualifying feature of the Hoy SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.7.3.3.5 Great black-backed gull (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.7.3.3 above, it can be concluded that the predicted impacts on the great black-backed gull qualifying feature of the Hoy SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.7.3.3.6 Great skua (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.7.3.3 above, it can be concluded that the predicted impacts on the great skua qualifying feature of the Hoy SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.7.3.3.7 Northern fulmar (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.7.3.3 above, it can be concluded that the predicted impacts on the Northern fulmar qualifying feature of the Hoy SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.7.3.3.8 Red-throated diver (breeding)

Considering the assessment outlined in Section 10.3.3 and Section 10.7.3.3 above, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Hoy SPA from the Project alone as a result of impacts from accidental release of pollutants would **not adversely affect the integrity of the site**.

10.7.3.4 Ornithological habitat changes (operation and maintenance only)

The Project will result in the loss of 19.1 ha of the Scapa Flow SPA, in which qualifying features of Hoy SPA may be present. This equates to 0.06% of the total SPA area which is considered to be a negligible fraction. The affected area is considered to be extremely localised, with the remainder of the Scapa Flow SPA and Hoy SPA continuing to provide extensive foraging, roosting and commuting habitat to the qualifying species.

The habitat functions lost will relate primarily to marine foraging areas used by qualifying bird species that may be foraging within the Scapa Flow SPA. Given the Scapa Flow SPA's vast size and heterogeneous habitat availability, as well as the availability of habitat within the Hoy SPA, the small proportion affected is unlikely to alter the overall ecological functioning of the site.

The Scapa Flow provides large expanses of suitable foraging waters with similar depth, prey availability, and hydrodynamic characteristics, therefore the small area lost does not constitute a unique or limiting foraging resource. Mobile seabird species (e.g., divers, grebes, seaduck) typically have wide foraging ranges, enabling them to make use of abundant habitat elsewhere within and beyond the SPA, including in the Hoy SPA.

Birds commuting between feeding areas, resting locations, and open water are not expected to be impeded; the operational Project footprint will not create a barrier to movement and does not alter the wider connectivity of habitats used by Hoy SPA species foraging in the Scapa Flow SPA.

10.7.3.4.1 Arctic skua (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.7.3.4 above, it can be concluded that the predicted impacts on the Arctic skua qualifying feature of the Hoy SPA from the Project alone as a result of impacts from ornithological habitat changes would **not adversely affect the integrity of the site**.

10.7.3.4.2 Atlantic puffin (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.7.3.4 above, it can be concluded that the predicted impacts on the Atlantic puffin qualifying feature of the Hoy SPA from the Project alone as a result of impacts from ornithological habitat changes would **not adversely affect the integrity of the site**.

10.7.3.4.3 Black-legged kittiwake (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.7.3.4 above, it can be concluded that the predicted impacts on the black-legged kittiwake qualifying feature of the Hoy SPA from the Project alone as a result of impacts from ornithological habitat changes would **not adversely affect the integrity of the site**.

10.7.3.4.4 Common guillemot (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.7.3.4 above, it can be concluded that the predicted impacts on the common guillemot qualifying feature of the Hoy SPA from the Project alone as a result of impacts from ornithological habitat changes would **not adversely affect the integrity of the site**.

10.7.3.4.5 Great black-backed gull (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.7.3.4 above, it can be concluded that the predicted impacts on the great black-backed gull qualifying feature of the Hoy SPA from the Project alone as a result of impacts from ornithological habitat changes would **not adversely affect the integrity of the site**.

10.7.3.4.6 Great skua (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.7.3.4 above, it can be concluded that the predicted impacts on the great skua qualifying feature of the Hoy SPA from the Project alone as a result of impacts from ornithological habitat changes would **not adversely affect the integrity of the site**.

10.7.3.4.7 Northern fulmar (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.7.3.4 above, it can be concluded that the predicted impacts on the Northern fulmar qualifying feature of the Hoy SPA from the Project alone as a result of impacts from ornithological habitat changes would **not adversely affect the integrity of the site**.

10.7.3.4.8 Red-throated diver (breeding)

Considering the assessment outlined in Section 10.3.4 and Section 10.7.3.4 above, it can be concluded that the predicted impacts on the red-throated diver qualifying feature of the Hoy SPA from the Project alone as a result of impacts from ornithological habitat changes would **not adversely affect the integrity of the site**.

10.7.4 Assessment of Adverse Effects In-Combination

Table 10-14 provides a summary of the other developments considered within the in-combination assessment of effects.

10.7.4.1 Disturbance of birds due to Project activities (all phases)

There is the potential for in-combination disturbance from vessels during activities during the construction and/or operational phases of the plans, projects and developments listed in

Table 10-14. Vessels may pass through or close to the Hoy SPA from other plans and projects that may disturb birds within the SPA.

The seabird qualifying features of the Hoy SPA are not considered sensitive to vessel disturbance due the mobile nature of the species. While there is the potential for birds foraging outside the Hoy SPA to be affected by other vessels, vessel traffic will be occurring in habitat already disturbed by other vessels.

The vessel movements to and from the dredging site will pass through an area that is a favoured foraging area for breeding red-throated diver, however, as discussed in section 10.7.3.1.8, any disturbance will be temporary and short-lived. It is assumed that all vessels for other plans, projects and developments will follow VMPs which also aim to minimise passage of vessels through the marine portion of Hoy SPA, thus avoiding disturbance of foraging red-throated diver during the sensitive breeding period (June-August), when birds will be foraging within the SPA on foraging trips from their Hoy nest sites.

There are no projects that would have the same effect pathway from mobile cranes, therefore there is no potential for an in-combination effect on any of the qualifying features of the SPA as a result of crane operations.

Any potential cumulative disturbance to the qualifying features of the Hoy SPA as a result of project activities are deemed to be short-lived, with any potential impacts temporary and reversible. Therefore, it can be concluded that the predicted effects on the qualifying features of the Hoy SPA from the Project in-combination with other plans, projects, and development as a result of Project activities would **not adversely affect the integrity of the site**.

10.7.4.2 Disturbance to prey species and habitats of prey species (construction only)

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to disturbance to prey species and habitats of prey species. Impacts are managed case by case, are rare and highly unlikely. The relevant plans and project which would have the greatest potential to act in-combination with the Project are the ones located in Scapa Flow SPA, namely:

- Hatston Pier Expansion;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site;

Construction activities at the Hatston Pier expansion could result in a disturbance to prey species and their habitats, however this is anticipated to be localised to the area and affecting a small proportion of the Scapa Flow SPA. The aquaculture sites are included based on minor changes to existing aquaculture infrastructure, therefore the effect will be negligible. The construction-phase impacts on marine bird prey resources are expected to be short-term, temporary, reversible and recoverable, with any changes remaining transient and confined to a small spatial extent relative to the extensive alternative foraging habitat available to birds. Taking into consideration the embedded mitigation measures applied to other plans and developments, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.7.4.3 Accidental release of contaminants or pollutants

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to accidental release of contaminants or pollution. Impacts are managed case by case, are rare and highly unlikely. Taking into consideration the embedded mitigation measures applied to other plans and developments, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.7.4.4 Ornithological habitat change

It was concluded that the project alone would not have an adverse effect on site integrity arising from the Project in relation to ornithological habitat change. The relevant plans and project which would have the greatest potential to act in-combination with the Project are the ones located in Scapa Flow SPA, namely:

- Hatston Pier Expansion;
- Hunda aquaculture site;
- Lober salmon farm;
- Bringhead aquaculture site;
- Westerbister aquaculture site;
- Toyness aquaculture site;
- West Fara aquaculture site.

Construction activities at the Hatston Pier expansion could result in a loss in available foraging habitat, however this is anticipated to be localised to the area and affecting a small proportion of the Scapa Flow SPA. The aquaculture sites are included based on minor changes to existing aquaculture infrastructure, therefore the ornithological habitat change will be negligible. Considering that the remainder of the SPA is continuing to provide extensive foraging, roosting and commuting habitat to the qualifying species, there will be **no adverse effect on site integrity** in-combination with other plans, projects, and development.

10.7.5 Summary

It is therefore concluded that the potential disturbance effects resulting from the Project, in combination with other plans and projects, will not result in significant barriers to movement, and will not reduce access to preferred foraging, roosting or prey species and habitats in a continuous or sustained manner. Any distributional changes are likely within the range of natural variability, and the cumulative zones of disturbance are small relative to alternative habitat within the foraging range of seabird qualifying features of Hoy SPA. There is no evidence that the areas affected by port operations at the Project, or any other plan or project in combination, are disproportionately important for prey availability for any of the qualifying features of Hoy SPA. Any resulting increase in energy expenditure and subsequent reduction in body condition would be short-lived and of a negligible magnitude, given the availability of alternative foraging habitat within the foraging range of the seabird qualifying features of Hoy SPA, and the likelihood that disturbed or displaced birds will resume foraging elsewhere.

Therefore, there will be no adverse effects on site integrity on any of the qualifying features of Hoy SPA either for the Project alone or in-combination with other projects, plans and developments.

11 Conclusions

11.1 Overview

This Report has been prepared to provide the Competent Authorities (the Scottish Government Marine Directorate – Licensing Operations Team (MD-LOT) and Orkney Islands Council (OIC)) with the information necessary to enable them to undertake an Appropriate Assessment (AA) of the Scapa Deep Water Quay Project under the Conservation (Natural Habitats &c.) Regulations 1994 (as amended). It comprises both a Likely Significant Effect (LSE) Screening exercise (Section 6) and the Information to Inform Appropriate Assessment for those European Sites and qualifying features for which LSE could not be excluded (Sections 8 to 10). The assessment considers the Project both alone and in combination with other plans and projects, and has been updated to respond to the requests for Additional Information received to date, including the advice provided by NatureScot on 11 November 2025 and the further information requested by MD-LOT on 15 January 2026. Consultation has also taken place with NatureScot during revision of this HRA (March to June 2026) to ensure it provides all the necessary information.

The responsibility for undertaking the AA, and for reaching the conclusions of that assessment, rests with the Competent Authorities. The conclusions presented in this Report reflect the Applicant's assessment of the available evidence and are provided to support, but not to pre-empt, that determination.

11.2 LSE Screening

The LSE Screening (Section 6) identified the European Sites and qualifying features with connectivity to the Project, and determined for each relevant impact pathway whether the potential for an LSE could be excluded. On the basis of that exercise, six European Sites were taken forward to the Information to Inform Appropriate Assessment stage:

• Loch of Stenness SAC, in respect of its Annex I coastal lagoon feature, limited to the impact pathways associated with the introduction and spread of invasive non-native species (INNS) and the accidental release of pollutants;

- Sanday SAC, in respect of its harbour seal (Phoca vitulina) qualifying feature;
- Scapa Flow SPA, in respect of all of its qualifying ornithological features;
- North Orkney SPA, in respect of its qualifying features with the exception of velvet scoter;
- Orkney Mainland Moors SPA, in respect of its breeding red-throated diver feature only; and
- Hoy SPA, in respect of its breeding seabird features only.

The potential for an LSE was excluded at the Screening stage for European Sites designated for grey seal, harbour porpoise, bottlenose dolphin and otter, on the basis that there is no connectivity between those sites and the Project. European Sites designated for diadromous fish were not considered further, consistent with the advice of MD-LOT and NatureScot regarding the uncertainty in apportioning effects to individual sites. The terrestrial features of the screened-in SPAs (hen harrier and short-eared owl at the Orkney Mainland Moors SPA, and peregrine at the Hoy SPA), the velvet scoter feature of the North Orkney SPA, and the remaining impact pathways at the Loch of Stenness SAC, were likewise screened out for the reasons set out in Table 6-6.

11.3 Information to Inform an Appropriate Assessment

The Information to Inform Appropriate Assessment (Sections 8 to 10) considered the potential for the Project, alone and in combination with other plans and projects, to adversely affect the integrity of each screened-in European Site, having regard to its qualifying features and Conservation Objectives, and taking account of the mitigation measures committed to by the Project (Section 7). These embedded measures include, among others, the Construction Environmental Management Document (and the Biosecurity Plan, Pollution Incident Response Plan, Pollution Prevention Plan and turbidity controls secured through it), the Marine Mammal

Protection Plan and Seal Protection Plan, and the Vessel Management Plans for the construction and operational phases.

On the basis of the assessment presented in this Report, and subject to the implementation of those mitigation measures, it is concluded that the Project, both alone and in combination with other plans, projects and activities, will **not adversely affect the integrity** of Loch of Stenness SAC, Sanday SAC, North Orkney SPA, Orkney Mainland Moors SPA or Hoy SPA, in respect of the qualifying features of each site taken forward to assessment. The site-level conclusions are summarised in Table 11-1.

Table 11-1 Summary of the conclusions of the Information to Inform Appropriate Assessment

European Site	Qualifying feature(s) assessed	Conclusion (alone and in-combination)
Loch of Stenness SAC	Annex I coastal lagoon	No adverse effect on site integrity
Sanday SAC	Harbour seal	No adverse effect on site integrity
Scapa Flow SPA	All qualifying ornithological features	No adverse effect on site integrity (see paragraphs below regarding the outstanding advice of NatureScot in respect of the diver features)
North Orkney SPA	Qualifying features (excluding velvet scoter)	No adverse effect on site integrity
Orkney Mainland Moors SPA	Red-throated diver (breeding)	No adverse effect on site integrity
Hoy SPA	Breeding seabird features	No adverse effect on site integrity

11.4 Scapa Flow SPA and the outstanding advice of NatureScot

For the Scapa Flow SPA, the Applicant's assessment concludes that the Project, alone and in combination with other plans and projects, will not adversely affect the integrity of the site in respect of any of its qualifying ornithological features. This conclusion is reached with the benefit of the additional information now provided, including the assessment of disturbance and displacement arising from the operation of mobile and vessel-mounted cranes, which has been extended to the black-throated diver, great northern diver and red-throated diver features in response to NatureScot's advice, together with the expanded in-combination assessment.

It is acknowledged that, in its advice of 11 November 2025, NatureScot was unable to conclude no adverse effect on the integrity of the Scapa Flow SPA in respect of the black-throated diver feature, on the basis of the potential disturbance and displacement associated with crane operations, and considered that this effect could not be fully mitigated. NatureScot was likewise unable, at that time, to conclude no adverse effect for the great northern diver and red-throated diver features of the Scapa Flow SPA, and for the relevant features of the North Orkney and Orkney Mainland Moors SPAs, pending the assessment of crane operations now provided. This Report has been prepared to address those matters and to provide the Competent Authorities with the further information necessary to inform their determination.

Consultation with NatureScot during preparation of the revised HRA Report (letter dated 30th June 2026) has confirmed that they agree with the conclusion of no AEoSI for North Orkney SPA, Orkney Mainland Moors SPA and Hoy SPA. However, with regards to Scapa Flow SPA NatureScot consider '*the development and associated operations will undermine Conservation Objective 2b [The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species] and therefore lead to AEoSI for black-throated-diver'*.

11.5 Overall conclusion and next steps

Subject to the implementation of the mitigation measures set out in Section 7, the Applicant's assessment is that the Project will not adversely affect the integrity of any of the six European Sites taken forward to Appropriate Assessment, whether alone or in combination with other plans, projects and activities. On this basis, the Applicant does not consider a need for the further stages of the HRA process: the assessment of alternative solutions and of imperative reasons of overriding public interest (IROPI), and the identification of compensatory measures.

The Competent Authorities (MD-LOT and OIC) remain responsible for undertaking the Appropriate Assessment and for reaching a conclusion on site integrity. Should the Competent Authorities, having regard to the advice of NatureScot, be unable to ascertain that the Project will not adversely affect the integrity of a European Site, for example in respect of the black-throated diver feature of the Scapa Flow SPA, the subsequent stages of the Habitats Regulations process would need to be considered in relation to the affected feature.

12 References

BirdLife International (2021) European Red list of birds. Accessed at: https://www.birdlife.org/wp-content/uploads/2022/05/BirdLife-European-Red-List-of-Birds-2021.pdf.pdf

BTO. (2026). BirdFacts Black-throated diver: profiles of birds occurring in the United Kingdom. BTO, Thetford. www.bto.org/birdfacts. [Accessed 19/05/2026]

Camphuysen, C.J. & Gear, S.C. (2022). Great Skuas and Northern Gannets on Foula, summer 2022 - an unprecedented, H5N1 related massacre. NIOZ Report 2022-02, NIOZ Royal Netherlands Institute for Sea Research: Texel. 66pp. https://doi.org/10.25850/nioz/7b.b.gd

Dillon I. A., Smith T. D., Williams S. J., Haysom S. and Eaton M. A. (2009). Red-throated Divers in Britain in 2006. Bird Study 56, 147-157.

Del-Hoyo, J., Elliott, A. & Sargatal, J. (eds., 1992-2013). Handbook of the Birds of the World. Vol I: Ostrich to Ducks. Lynx Editions, Barcelona. ISBN 84-87334-10-5.

Duckworth et al (2024). Linking Foraging Behaviour and Habitat Preferences During Moult Across Multiple Populations of Red-Throated Diver. Ecology and Evolution, 2024; 14:e70733. Available at: https://doi.org/10.1002/ece3.70733

CIEEM (2019). Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine.

Cheney, B.J., Arso Civil, M., Hammond, P.S. and Thompson, P.M. 2024. Site Condition Monitoring of bottlenose dolphins within the Moray Firth Special Area of Conservation 2017-2022. NatureScot Research Report 1360.

Dierschke, V., Furness, R.W., Gray, C.E., Petersen, I.K., Schmutz, J., Zydelis, R. & Daunt, F. 2017. Possible Behavioural, Energetic and Demographic Effects of Displacement of Red- throated Divers. JNCC Report No. 605. JNCC, Peterborough.

EnviroCentre (2023). Scapa Deep Water Quay. Volume 1: Environmental Impact Assessment. Available at : https://marine.gov.scot/?q=node/24419

EnviroCentre (2024a). Scapa Deep Water Quay. Additional Information. Available at : https://marine.gov.scot/?q=node/25697

EnviroCentre (2024b). Hatston Pier - Ornithological Technical Report. August 2024.

EnviroCentre (2025a). Scapa Deep Water Quay. Supplementary Environmental Information Report – May 2025. Available at : https://marine.gov.scot/?q=data/additional-information-2025-scapa-deep-water-quay

EnviroCentre (2025b). Scapa Deep Water Quay. Supplementary Environmental Information Report – October 2025. Available at : https://marine.gov.scot/?q=node/26879

European Commission (2000). Managing and protecting Natura 2000 sites. Available at: https://environment.ec.europa.eu/topics/nature-and-biodiversity/natura-2000/managing-and-protecting-natura-2000-sites_en

European Commission (2018). Managing Natura 2000 sites – The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. Available at: https://op.europa.eu/en/publication-detail/-/publication/2c9f4a14-8f97-43ac-a274-4946c142b541

European Commission (2021). Assessment of plans and projects in relation to Natura 2000 sites – Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC. Available at: https://eur-

lex.europa.eu/resource.html?uri=cellar:2b6c4b16-e867-42da-b604-f67ee6fe60c3.0002.03/DOC_2&format=PDF

Furness, R. W., Wade, H. M., Robbins, A. M. C., Masden, E. A. (2012). Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. - ICES Journal of Marine Science, 69: 1466-1479.

Garthe, S. and Hüppop, O. (2004). Scaling Possible Adverse Effects of Marine Wind Farms on Seabirds: Developing and Applying a Vulnerability Index. Journal of Applied Ecology, 41(4), 724-734

Gittings, I. et al. Disturbance response of Great Northern Divers Gavia immer to boat traffic in Inner Galway Bay. Irish Birds 10: 163–166 (2015)

Goodship, N.M. and Furness, R.W. (2022). Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species. NatureScot Research Report 1283.

Hansen. A, Kirstin & Maxwell, Alyssa & Siebert, Ursula & Larsen, Ole & Wahlberg, Magnus. (2017). Great cormorants (Phalacrocorax carbo) can detect auditory cues while diving. The Science of Nature. 104. 10.1007/s00114-017-1467-3.

Hüppop O, Wurm S (2000) Effects of winter fishery activities on resting numbers, food and body condition of large gulls Larus argentatus and L. marinus in the south-eastern North Sea. Mar Ecol Prog Ser 194:241-247 https://doi.org/10.3354/meps194241

Institute of Estuarine and Coastal Studies, University of Hull. (2013). Available at: https://gat04-live-1517c8a4486c41609369c68f30c8-aa81074.divio-media.org/filer_public/8f/bd/8fbdd7e9-ea6f-4474-869f-ec1e68a9c809/11367.pdf

Jackson, D. 2018. Scapa Flow proposed Special Protection Area (pSPA) – inshore wintering waterfowl survey 2017/18. Scottish Natural Heritage Research Report No. 1075.

Jarrett, A S C P Cook, I Woodward, K Ross, C Horswill, D Dadam and E M Humphreys. (2018) . Short-Term Behavioural Responses of Wintering Waterbirds to Marine Activity: Quantifying the Sensitivity of Waterbird Species during the Non-Breeding Season to Marine Activities in Orkney and the Western Isles. Scottish Marine and Freshwater Science Vol 7 No 9, 88pp. DOI: 10.7489/12096-1

Jarret et al (2021). Behavioural responses of non-breeding waterbirds to marine traffic in the near shore environment. Bird Study, Vol 68, p443-454.

JNCC (2003–2013), Red-throated diver marine SPA identification: data collection and analysis. Joint Nature Conservation Committee, Open Data. Available at: https://data.jncc.gov.uk/data/4bf39157-852c-4a27-87eb-fb44e6f55b32/sas-identification-breeding-red-throated-divers.pdf [en.wikipedia.org]

JNCC (n.d.), Identification of Marine Special Protection Areas (SPAs). Joint Nature Conservation Committee, Open Data. Available at: https://data.jncc.gov.uk/data/4bf39157-852c-4a27-87eb-fb44e6f55b32/identification-of-marine-spas.pdf

JNCC Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise (2010) available at: http://jncc.defra.gov.uk/pdf/JNCC_Guidelines_Piling%20protocol_August%202010.pdf [Accessed January 2026]

JNCC. (2021). Sanday SAC. https://sac.jncc.gov.uk/site/UK0030069 [Accessed on 10/03/2026].

JNCC (2022). Scapa Flow SPA (Site UK9020321) Standard Data Form for sites within the 'UK national site network of European sites'. Accessed online [March 2026]: UK9020321.pdf (jncc.gov.uk)

JNCC Guidelines for minimising the risk of injury to marine mammals from explosive use in the marine environment (2025) available at: https://data.jncc.gov.uk/data/24cc180d-4030-49dd-8977-a04ebe0d7aca/jncc-guidelines-marine-mammals-and-explosive-use.pdf [Accessed January 2026]

Kjelland, M.E., Woodley, C.M., Swannack, T.M. et al. A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioural, and transgenerational implications. Environ Syst Decis 35, 334–350 (2015). https://doi.org/10.1007/s10669-015-9557-2

Marine Scotland (2016) Fine-scale harbour seal at-sea usage mapping around Orkney and the North coast of Scotland Scottish Marine and Freshwater Science Vol 7 No 27, available at: https://data.marine.gov.scot/sites/default/files/SMFS%200727_0.pdf

NatureScot (2009). Hoy SPA – Citation for Special Protection Area. Available at: https://www.nature.scot/sites/default/files/special-protection-area/8513/spa-citation.pdf

NatureScot (2014a). North Orkney - Red-throated diver - Maximum curvature and predicted feeding distribution (NatureScot WMS). Available at: https://marine.gov.scot/maps/1281

NatureScot (2014b). Scapa Flow - Black-throated diver – Distribution. (NatureScot WMS). Available at: https://marine.gov.scot/maps/1274

NatureScot (2020). Seasonal Periods for Birds in the Scottish Marine Environment. Available at: https://www.nature.scot/sites/default/files/2020-10/Guidance%20note%20-%20Seasonal%20definitions%20for%20birds%20in%20the%20Scottish%20Marine%20Environment.pdf

NatureScot (2022a). European Site Casework Guidance: How to consider plans and projects affecting Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). Available at: https://www.nature.scot/doc/european-site-casework-guidance-how-consider-plans-and-projects-affecting-special-areas-conservation

NatureScot (2022b). Scapa Flow SPA – Conservation and Management Advice. Available at: https://www.nature.scot/sites/default/files/special-protection-area/10510/conservation-and-management-advice.pdf

NatureScot (2022c). North Orkney SPA – Conservation and Management Advice. Available at: https://www.nature.scot/sites/default/files/special-protection-area/10481/conservation-and-management-advice.pdf

NatureScot (2023a). Habitats Regulations Appraisal of Plans. Guidance for Plan-making Bodies in Scotland. Available at: https://www.nature.scot/sites/default/files/2023-11/Habitats%20Regulations%20Appraisal%20of%20Local%20Development%20Plans%20-%20Guidance%20for%20planning%20authorities%20in%20Scotland.pdf

NatureScot (2023b). Guidance Note 4: Guidance to Support Offshore Wind Applications: Ornithology - Determining Connectivity of Marine Birds with Marine Special Protection Areas and Breeding Seabirds from Colony SPAs in the Non-Breeding Season. Available at: https://www.nature.scot/doc/guidance-note-4-guidance-support-offshore-wind-applications-ornithology-determining-connectivity

NatureScot (2024). Hoy SPA – Conservation and Management Advice. Available at: https://www.nature.scot/sites/default/files/special-protection-area/8513/conservation-and-management-advice.pdf

NatureScot (2025a). NatureScot Guidance Note - The handling of mitigation in Habitats Regulations Appraisal – the People Over Wind CJEU judgement. Available at: https://www.nature.scot/doc/naturescot-guidance-note-handling-mitigation-habitats-regulations-appraisal-people-over-wind-cjeu

NatureScot (2025b). Loch of Stenness SAC – Conservation and Management Advice. Available at: https://www.nature.scot/sites/default/files/special-area-conservation/8303/conservation-and-management-advice.pdf

NatureScot (2025c). Sanday SAC – Conservation and Management Advice. Available at: https://www.nature.scot/sites/default/files/special-area-conservation/8372/conservation-and-management-advice.pdf

NatureScot (*undated).* Conservation Objectives for Orkney Mainland Moors SPA. Available at: https://www.nature.scot/sites/default/files/special-protection-area/8562/conservation-objectives.pdf

NBN Atlas (2026). Available at: https://nbnatlas.org/

NMPi (2026). National Marine Plan Interactive. Available online at: https://marinescotland.atkinsgeospatial.com/nmpi/

N J O'Hanlon, C B Thaxter, G D Clewley, J G Davies, E M Humphreys, P I Miller, C J Pollock, J Shamoun-Baranes, E Weston and A S C P Cook (2024). Challenges in quantifying the responses of Black-legged Kittiwake Rissa tridactyla to habitat variables and local stressors due to individual variation. Bird Study, Vol. 71, part 1 48-64.

Onoufriou, J., Jones, E., Hastie, G. and Thompson, D. (2016) Investigations into the interactions between harbour seals (Phoca vitulina) and vessels in the inner Moray Firth. Scottish Marine and Freshwater Science Report, 7(24). Marine Scotland Science. https://doi.org/10.7489/1805-1

Orkney Islands Council (n.d.), Habitats Regulations Appraisal – Scapa Flow pSPA and Hoy SPA (Appendix 1). Available at: https://www.orkney.gov.uk/media/3z5gqj3e/i04_02_app1_habitats_regulations_appraisal.pdf

Peters-Grundy, R., Thompson, K., Humphries, G., Harvey, J., Semple, M., Tyler, K., Harker, A.J., Pavat, D., Thomson, R., Olley, N. and Macleod, K. (2026). Scapa Flow and North Orkney Special Protection Areas (SPAs) - Inshore wintering waterfowl surveys 2021/22 and 2022/2023. Report for NatureScot

Quick, N., Arso, M., Cheney, B., Islas, V., Janik, V., Thompson, P.M. & Hammond, P.S. (2014). The east coast of Scotland bottlenose dolphin population: improving understanding of ecology outside the Moray Firth SAC.

Reid, J.B., Evans, P.G.H. & Northridge, S.P. 2003. Atlas of Cetacean distribution in north-west European waters, JNCC, Peterborough, ISBN 1 86107 550 2. Available at: https://jncc.defra.gov.uk/resources/a5a51895-50a1-4cd8-8f9d-8e2512345adf

Schwemmer P., Mendel B., Sonntag N, Dierschke V and Garthe S. (2011). Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21: 1851-1860.

SCOS (2024). Scientific Advice on Matters Related to the Management of Seal Populations: 2024. Natural Environment Research Council. Available at: https://www.smru.st-andrews.ac.uk/files/2025/05/SCOS-2024.pdf

Scottish Natural Heritage (2016). Assessing Connectivity with Special Protection Areas

Scottish Government (2020). EU Exit: habitats regulations in Scotland. Available at: https://www.gov.scot/publications/eu-exit-habitats-regulations-scotland-2/pages/2/

SOWEC 2025. Application of precaution in ornithology impact assessments for offshore wind project applications: Evaluation of current approaches. SLR report to SOWEC and Scottish Renewables.

Teachout, E. (2012). Evaluating the effects of underwater sound from pile driving on the marbled murrelet and the bull trout. Prepared by the U.S. Fish and Wildlife Service's Washington Fish and Wildlife Office

Appendix A: Heat Maps and HiDef Survey Data

Appendix B: Bird Heat Maps and Noise Contour Maps

Appendix C: Bird Heat Maps and HiDef Data Combined with Construction Vessel Routes

Appendix D: Mortality Matrix Model

Appendix E: Long List of In-Combination Projects

A HEAT MAPS AND HIDEF SURVEY DATA COMBINED

330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Number of records Survey month

1	November
2 - 4	December
5 - 8	January S01
9 - 14	January S02
15 - 21	February
22 - 27	March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23*- Showing HiDef results for Great-Northern Diver 2022-2023

Legend

- General routes of vessel movements
- Scapa Pier
- Proposed site extent
- Bird sightings from aerial observations (Feb 2022 and Jan 2023)

Average Bird Count Density per ha

- <0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3- 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023. Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movement,observations of Great Northern Diver 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS213	-	09 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials

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330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2027/18* - Showing Atlantic Ecology results for Great-Northern Diver 2017-2018

Legend

- General routes of vessel movements
- Scapa Pier
- Proposed site extent

Great northern diver

Round 1 records
- 1 - 3
- 3 - 12
- 12 - 35
- 35 - 76

Round 2 records
- 1 - 3
- 3 - 12
- 12 - 35
- 35 - 76

Round 3 records
- 1 - 3
- 3 - 12
- 12 - 35
- 35 - 76

Round 4 records
- 1 - 3
- 3 - 12
- 12 - 35
- 35 - 76

Legend taken from NatureScot report for Atlantic Ecology results*.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movements and observations of Great-Northern Diver 2017-2018

Status
DRAFT FOR COMMENT

Drawing No.	Revision	Date
674795-GIS257	-	29 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:60,000 @A3
0 300 600 1,200 1,800 Metres

Rev	Date	Amendment	Initials

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330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Number of records Survey month

1	November
2 - 5	December
6 - 10	January S01
11 - 15	January S02
16 - 20	March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23* - Showing HiDef results for Black-throated Diver 2022-2023

Legend

- Bird sightings from aerial observations (Feb 2022 and Jan 2023)
- General routes of vessel movements
- Scapa Pier
- Proposed site extent

Average Bird Count Density per ha

- <0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023.Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movement,observations of Black Throated Diver 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS217		25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials

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1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Orkney Islands

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2027/18* - Showing Atlantic Ecology results for Black-throated Diver 2017-2018

Legend

- General routes of vessel movements
- Scapa Pier
- Proposed site extent

Black-throated diver (no. birds)

Round 1 records
- 1 - 3
- 3 - 10
- 10 - 22

Round 2 records
- 1 - 3
- 3 - 10
- 10 - 22

Round 3 records
- 1 - 3
- 3 - 10
- 10 - 22

Round 4 records
- 1 - 3
- 3 - 10
- 10 - 22

Legend taken from NatureScot report for Atlantic Ecology results*.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movements and observations of Black-throated Diver 2017-2018

Status
DRAFT FOR COMMENT

Drawing No.	Revision	Date
674795-GIS256	-	29 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:60,000 @A3

0 300 600 1,200 1,800 Metres

Rev	Date	Amendment	Initials

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330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Number of records Survey month

1 2 3 25

November December January S0 January S02 February March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23 - Showing HiDef results for Slavonian Grebe for 2022-2023

Legend

- Bird sightings from aerial observations (Feb 2022 and Jan 2023)
- General routes of vessel movements
- Scapa Pier
- Proposed site extent

Average Bird Count Density per ha

- <0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023. Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movement,observations of Slavonian Grebe 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS218		25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials

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330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Orkney Islands

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2027/18* - Showing Atlantic Ecology results for Slavonian Grebe 2017-2018

Legend

- General routes of vessel movements
- Scapa Pier
- Proposed site extent

Slavonian grebe (no. birds)

Round 1 records
- 1 - 3
- 3 - 10
- 10 - 22

Round 2 records
- 1 - 3
- 3 - 10
- 10 - 22

Round 3 records
- 1 - 3
- 3 - 10
- 10 - 22

Round 4 records
- 1 - 3
- 3 - 10
- 10 - 22

Legend taken from NatureScot report for Atlantic Ecology results*.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movements and observations of Slavonian Grebe 2017-2018

Status
DRAFT FOR COMMENT

Drawing No.	Revision	Date
674795-GIS258	-	29 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:60,000 @A3

0 300 600 1,200 1,800 Metres

Rev	Date	Amendment	Initials

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330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Number of records
- 1
- 2 - 4
- 5 - 10
- 11 - 20
- 21 - 40

Survey month
- November
- December
- January S01
- January S02
- February
- March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23* - Showing HiDef results for Eider 2022-2023

Legend

- Bird sightings from aerial observations (Feb 2022 and Jan 2023)
- General routes of vessel movements
- Scapa Pier
- Proposed site extent

Average Bird Count Density per ha

- < 0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.30
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023. Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movement,observations of Eider 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS219		25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3

0 320 640 1,280 1,920 Metres

Rev	Date	Amendment	Initials

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1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2027/18* - Showing Atlantic Ecology results for Eider 2017-2018

Legend

- General routes of vessel movements
- Scapa Pier
- Proposed site extent

Eider (no. birds)

Round 1 records
- 1 - 10
- 10 - 50
- 50 - 200
- 200 - 850

Round 2 records
- 1 - 10
- 10 - 50
- 50 - 200
- 200 - 850

Round 3 records
- 1 - 10
- 10 - 50
- 50 - 200
- 200 - 850

Round 4 records
- 1 - 10
- 10 - 50
- 50 - 200
- 200 - 850

Legend taken from NatureScot report for Atlantic Ecology results*.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movements and observations of Eider 2017-2018

Status
DRAFT FOR COMMENT

Drawing No.	Revision	Date
674795-GIS260	-	29 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:60,000 @A3
0 300 600 1,200 1,800 Metres

Rev	Date	Amendment	Initials

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330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Stromness

Main vessel movement to and from Scapa Pier

Vessel movement - Bay of Deepdale

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Number of records Survey month

1
2 - 5
6 - 25
26 - 50
51 - 100
101 - 200

November
December
January S01
January S02
February
March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23* - Showing HiDef results for Long-tailed Duck 2022-2023

Legend

- General routes of vessel movements
- Scapa Pier
- Bird sightings from aerial observations (Feb 2022 and Jan 2023)
- Proposed site extent

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023. Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movement,observations of Long-tailed Duck 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS220		25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials

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330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Stromness

Vessel movement - Bay of Deepdale

Main vessel movement to and from Scapa Pier

Vessel movement - around west of Flotta

Vessel movement - around east of Flotta

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2027/18* - Showing Atlantic Ecology results for Long-tailed Duck 2017-2018

Legend

- General routes of vessel movements
- Scapa Pier
- Proposed site extent

Long-tailed duck

Round 1 records
- 1 - 10
- 10 - 50
- 50 - 200
- 200 - 850

Round 2 records
- 1 - 10
- 10 - 50
- 50 - 200
- 200 - 580

Round 3 records
- 1 - 10
- 10 - 50
- 50 - 200
- 200 - 580

Round 4 records
- 1 - 10
- 10 - 50
- 50 - 200
- 200 - 580

Legend taken from NatureScot report for Atlantic Ecology results*.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Current vessel movements and observations of Long-tailed Duck 2017-2018

Status
DRAFT FOR COMMENT

Drawing No.	Revision	Date
674795-GIS259	-	29 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:60,000 @A3

0 300 600 1,200 1,800 Metres

Rev	Date	Amendment	Initials

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B BIRD HEAT MAPS AND NOISE CONTOUR MAPS

342000 343000 344000 345000 346000 347000 348000 349000

1007000 1006000 1005000 1004000 1003000 1002000 1001000

N

Scapa Bay

S. Inner N
Avg/ha
= 0.0968

S. 13
Avg/ha
= 0.0162

S. 9
Avg/ha
= 0.0449

S. 5
Avg/ha
= 0.0498

S. 6
Avg/ha
= 0.0781

S. 14
Avg/ha
= 0.0403

S. 7
Avg/ha
= 0.0828

S. 8
Avg/ha
= 0.0649

S. 10
Avg/ha
= 0.053

S. 14
Avg/ha
= 0.022

S. 11
Avg/ha
= 0.0708

S. 12
Avg/ha
= 0.0693

S. 15
Avg/ha
= 0.0226

S. 16
Avg/ha
= 0.0416

S. Inner S
Avg/ha
= 0.0405

Cantagall
Bridge
New Haven
Queytahlia
East Garth
Newtagging
West Burnside
White Moss
Muckle Hunclett
Little Hunclett
Lynnfield
Greenmeadow Bungalow
Burrody's Hill
Lyrebrae
Wildemess Lodge
Muckleburn
Mucklehouse
East Moss
School House
Hall of Gorn
Little Millhouse
Meadowvale
Hillhead House
Quoyenyan
Skaigo Road
Greenmeadow Bungalow
Eastarcistar Cottage
West Greaves
Greenmeadow Cottage
Greenmeadow Farm
St Mary's
Loch of Greenmeadow
Bay of Ayre
Skaiscaudy Point

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Legend

Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 250m Distance Lines
- 6m High Earth Bund

Bird Data

- Survey Sectors
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Great-Northern Diver ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 1)

Status
FINAL

Drawing No.	Revision	Date
674795-GIS236	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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342000 343000 344000 345000 346000 347000 348000 349000

1007000 1006000 1005000 1004000 1003000 1002000 1001000

N

Scapa Bay

S. Inner N
Avg/ha
= 0.0968

S. 13
Avg/ha
= 0.0162

S. 9
Avg/ha
= 0.0449

S. 5
Avg/ha
= 0.0498

S. 6
Avg/ha
= 0.0781

S. 14
Avg/ha
= 0.0403

S. 14
Avg/ha
= 0.022

S. 10
Avg/ha
= 0.053

S. 7
Avg/ha
= 0.0828

S. 8
Avg/ha
= 0.0649

S. 11
Avg/ha
= 0.0708

S. 12
Avg/ha
= 0.0693

S. 15
Avg/ha
= 0.0226

S. 16
Avg/ha
= 0.0416

S. Inner S
Avg/ha
= 0.0405

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 6m High Earth Bund
- 250m Distance Lines

Bird Data

- Survey Sectors
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Great-Northern Diver ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 2)

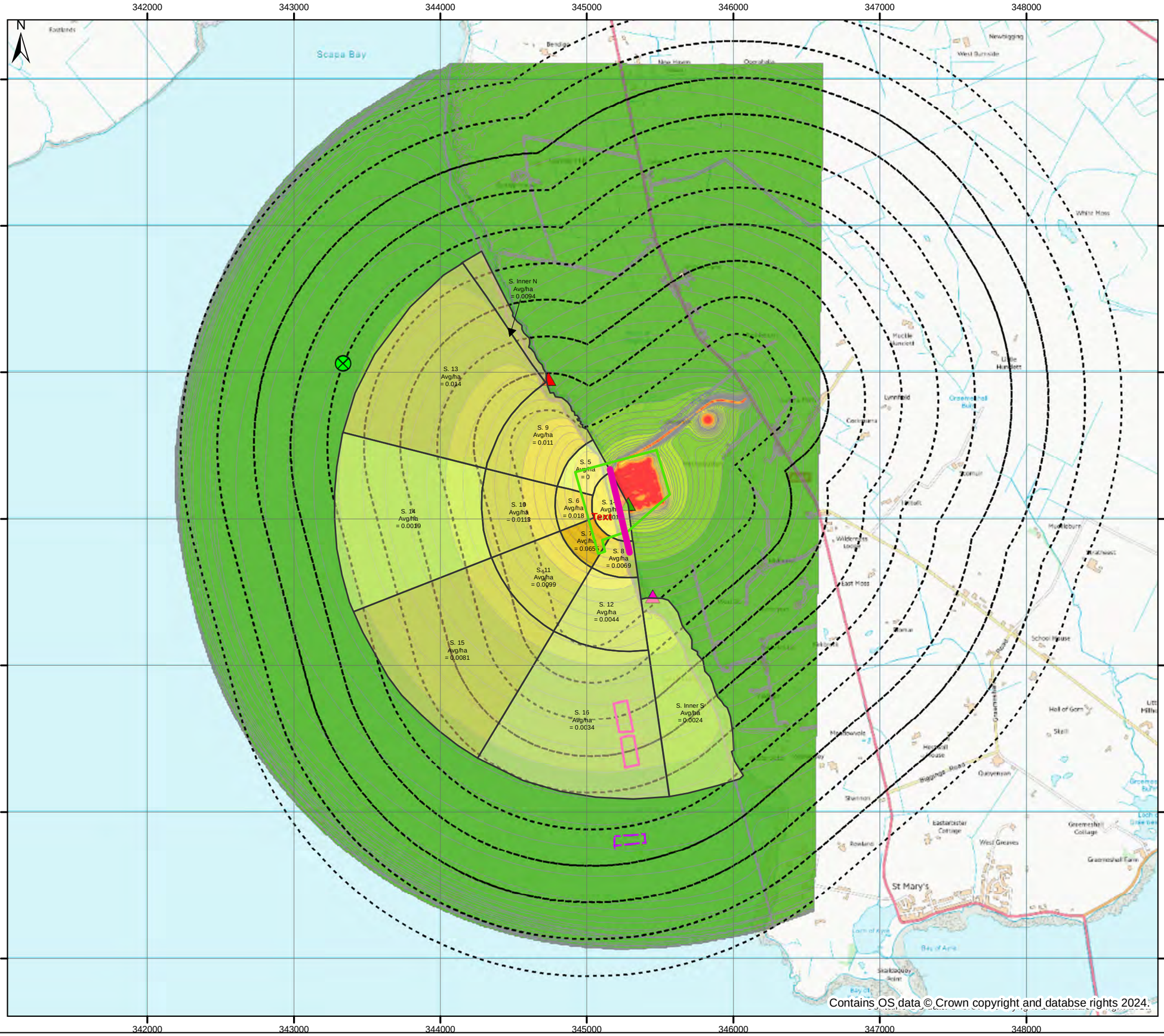
Status
FINAL

Drawing No.	Revision	Date
674795-GIS240	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 250m Distance Lines
- 6m High Earth Bund

Bird Data

- Survey Sectors
- Higher Elevation Vantage Point (HY 44943 04763)
- Original Vantage Point (HY 45274 04102)
- Southern Vantage Point (HY 44736 04954)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Black-throated Diver ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 1)

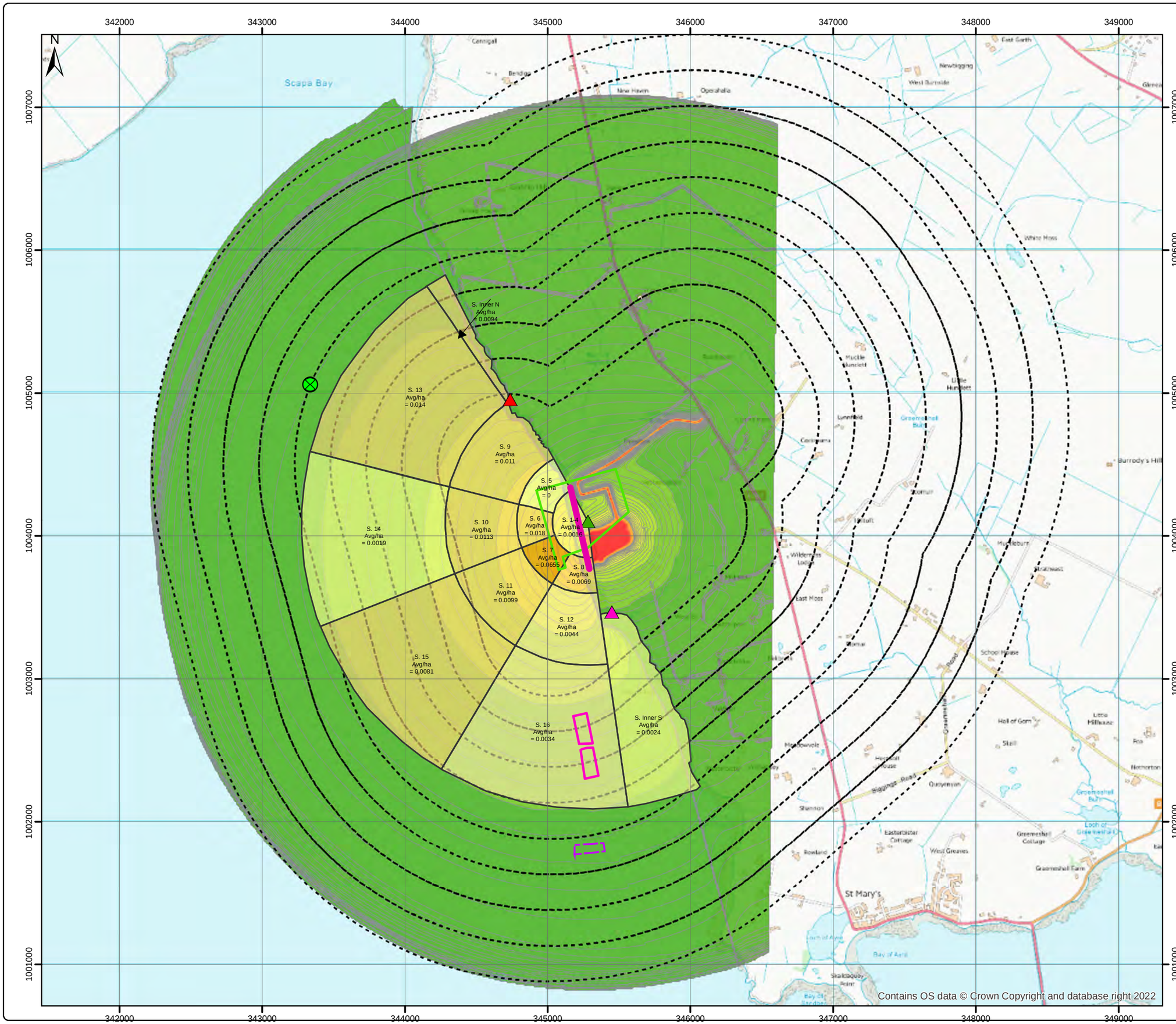
Status
FINAL

Drawing No.	Revision	Date
674795-GIS215	-	09 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 250m Distance Lines
- 6m High Earth Bund

Bird Data

- Survey Sectors
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Black-throated Diver ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 2)

Status
FINAL

Drawing No.	Revision	Date
674795-GIS241	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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342000 343000 344000 345000 346000 347000 348000 349000

1007000 1006000 1005000 1004000 1003000 1002000 1001000

N

Scapa Bay

S_Inner N
Avg/ha
= 0

S. 13
Avg/ha
= 0

S. 9
Avg/ha
= 0.0023

S. 5
Avg/ha
= 0.0521

S. 6
Avg/ha
= 0.0352

S. 1-4
Avg/ha
= 0.1036

S. 14
Avg/ha
= 0

S. 10
Avg/ha
= 0

S. 7
Avg/ha
= 0.0427

S. 8
Avg/ha
= 0.06

S. 11
Avg/ha
= 0.0013

S. 12
Avg/ha
= 0

S. 15
Avg/ha
= 0

S. 16
Avg/ha
= 0

S. Inner S
Avg/ha
= 0.0096

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 250m Distance Lines
- 6m High Earth Bund

Bird Data

- Survey Sectors
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Slavonian Grebe ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 1)

Status
FINAL

Drawing No.	Revision	Date
674795-GIS237	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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342000 343000 344000 345000 346000 347000 348000 349000

1007000 1006000 1005000 1004000 1003000 1002000 1001000

N

Scapa Bay

S. Inner N
Avg/ha
= 0

S. 13
Avg/ha
= 0

S. 9
Avg/ha
= 0.0023

S. 5
Avg/ha
= 0.0521

S. 14
Avg/ha
= 0

S. 10
Avg/ha
= 0

S. 6
Avg/ha
= 0.0352

S. 1-4
Avg/ha
= 0.1036

S. 7
Avg/ha
= 0.0427

S. 8
Avg/ha
= 0.06

S. 11
Avg/ha
= 0.0013

S. 12
Avg/ha
= 0

S. 15
Avg/ha
= 0

S. 16
Avg/ha
= 0

S. Inner S
Avg/ha
= 0.0096

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 6m High Earth Bund

Bird Data

- Survey Sectors
- 250m Distance Lines
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Slavonian Grebe ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 2)

Status
FINAL

Drawing No.	Revision	Date
674795-GIS242	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
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Rev	Date	Amendment	Initials
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1007000 1006000 1005000 1004000 1003000 1002000 1001000

N

Scapa Bay

Sinner N
Avg/ha
=0.1842

S13
Avg/ha
=0

S9
Avg/ha
=0.0221

S5
Avg/ha
=0.1194

S6
Avg/ha
=0.1229

S1-4
Avg/ha
=0.3939

S14
Avg/ha
=0.0098

S10
Avg/ha
=0.0006

S7
Avg/ha
=0.1842

S8
Avg/ha
=0.3989

S11
Avg/ha
=0.0104

S12
Avg/ha
=0.0594

S15
Avg/ha
=0

S16
Avg/ha
=0.0188

Sinner S
Avg/ha
=0.1301

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 250m Distance Lines
- 6m High Earth Bund

Bird Data

- Survey Sectors
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Eider ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 1)

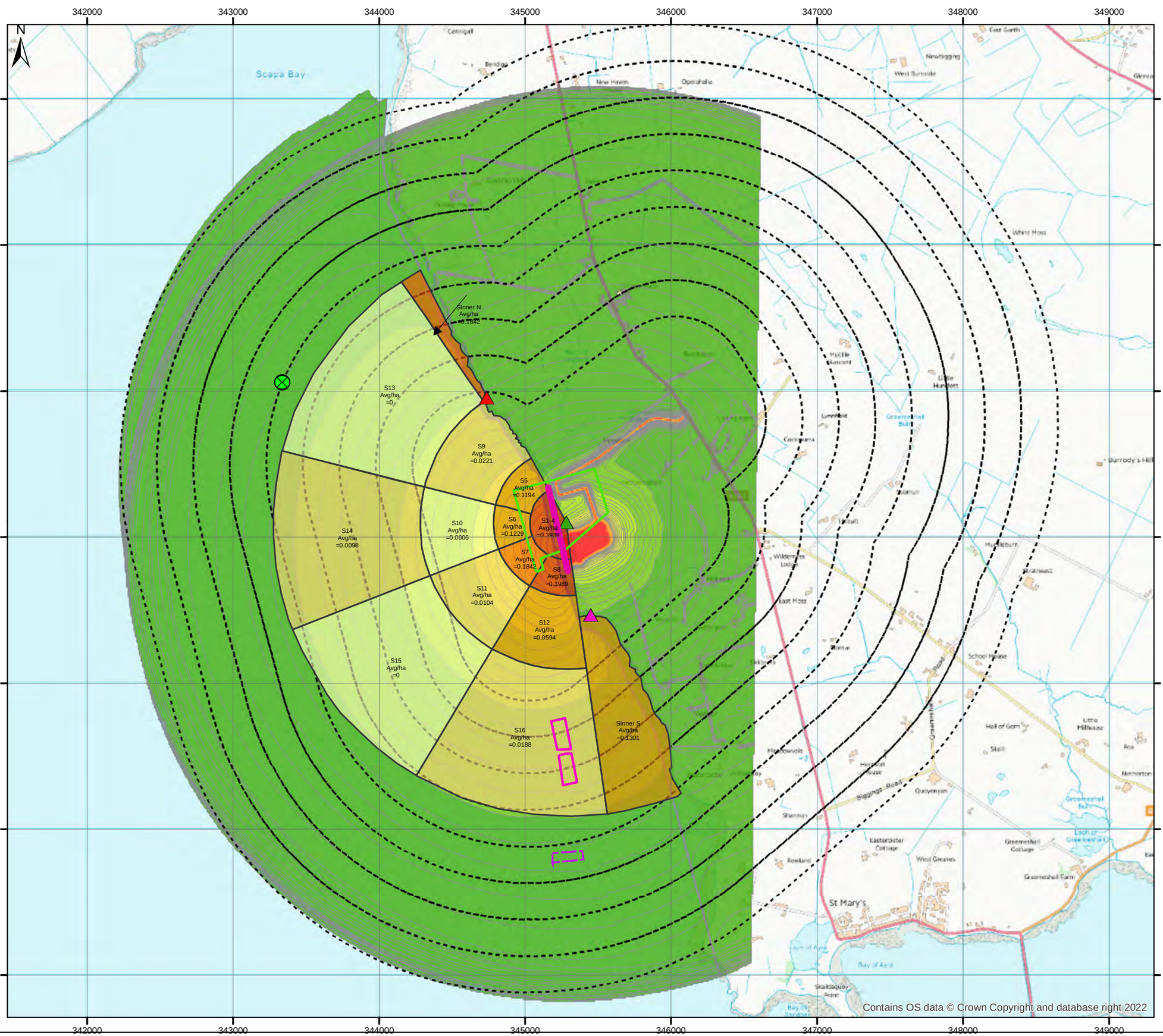
Status
FINAL

Drawing No.	Revision	Date
674795-GIS238	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 6m High Earth Bund
- 250m Distance Lines

Bird Data

- Survey Sectors
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Eider ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 2)

Status
FINAL

Drawing No.	Revision	Date
674795-GIS243	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
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342000 343000 344000 345000 346000 347000 348000 349000

1007000 1006000 1005000 1004000 1003000 1002000 1001000

N

Scapa Bay

S. Inner N
Avg/ha
= 0.0567

S. 13
Avg/ha
= 0.0008

S. 9
Avg/ha
= 0.0277

S. 5
Avg/ha
= 0.1696

S. 6
Avg/ha
= 0.1255

S. 1-4
Avg/ha
= 0.1891

S. 14
Avg/ha
= 0

S. 10
Avg/ha
= 0

S. 7
Avg/ha
= 0.3241

S. 8
Avg/ha
= 0.3478

S. 11
Avg/ha
= 0.0372

S. 12
Avg/ha
= 0.0623

S. 15
Avg/ha
= 0.0025

S. 16
Avg/ha
= 0.4422

S. Inner S
Avg/ha
= 0.0057

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 6m High Earth Bund
- 250m Distance Lines

Bird Data

- Survey Sectors
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Long-Tailed Duck ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 1)

Status
FINAL

Drawing No.	Revision	Date
674795-GIS239	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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342000 343000 344000 345000 346000 347000 348000 349000

1007000 1006000 1005000 1004000 1003000 1002000 1001000

N

Scapa Bay

S. Inner N
Avg/ha
= 0.0567

S. 13
Avg/ha
= 0.0008

S. 9
Avg/ha
= 0.0277

S. 5
Avg/ha
= 0.1696

S. 14
Avg/ha
= 0

S. 10
Avg/ha
= 0

S. 6
Avg/ha
= 0.1255

S. 1-4
Avg/ha
= 0.1891

S. 7
Avg/ha
= 0.3241

S. 8
Avg/ha
= 0.3478

S. 11
Avg/ha
= 0.0372

S. 12
Avg/ha
= 0.0623

S. 15
Avg/ha
= 0.0025

S. 16
Avg/ha
= 0.4422

S. Inner S
Avg/ha
= 0.0057

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Legend

- Proposed Site Extent

Noise Data

LAeq,1hr dB

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65
- 6m High Earth Bund
- 250m Distance Lines

Bird Data

- Survey Sectors
- Northern Vantage Point (HY 45447 03468)
- Southern Vantage Point (HY 44736 04954)
- Original Vantage Point (HY 45274 04102)
- Royal Oak Marker Buoy
- Emec Working Area
- Salmon Cages

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Long-Tailed Duck ObservationsAverage over 3 years (2020-2024) - Non Breeding and Noise Contours (6m Height - Construction Phase 2)

Status
FINAL

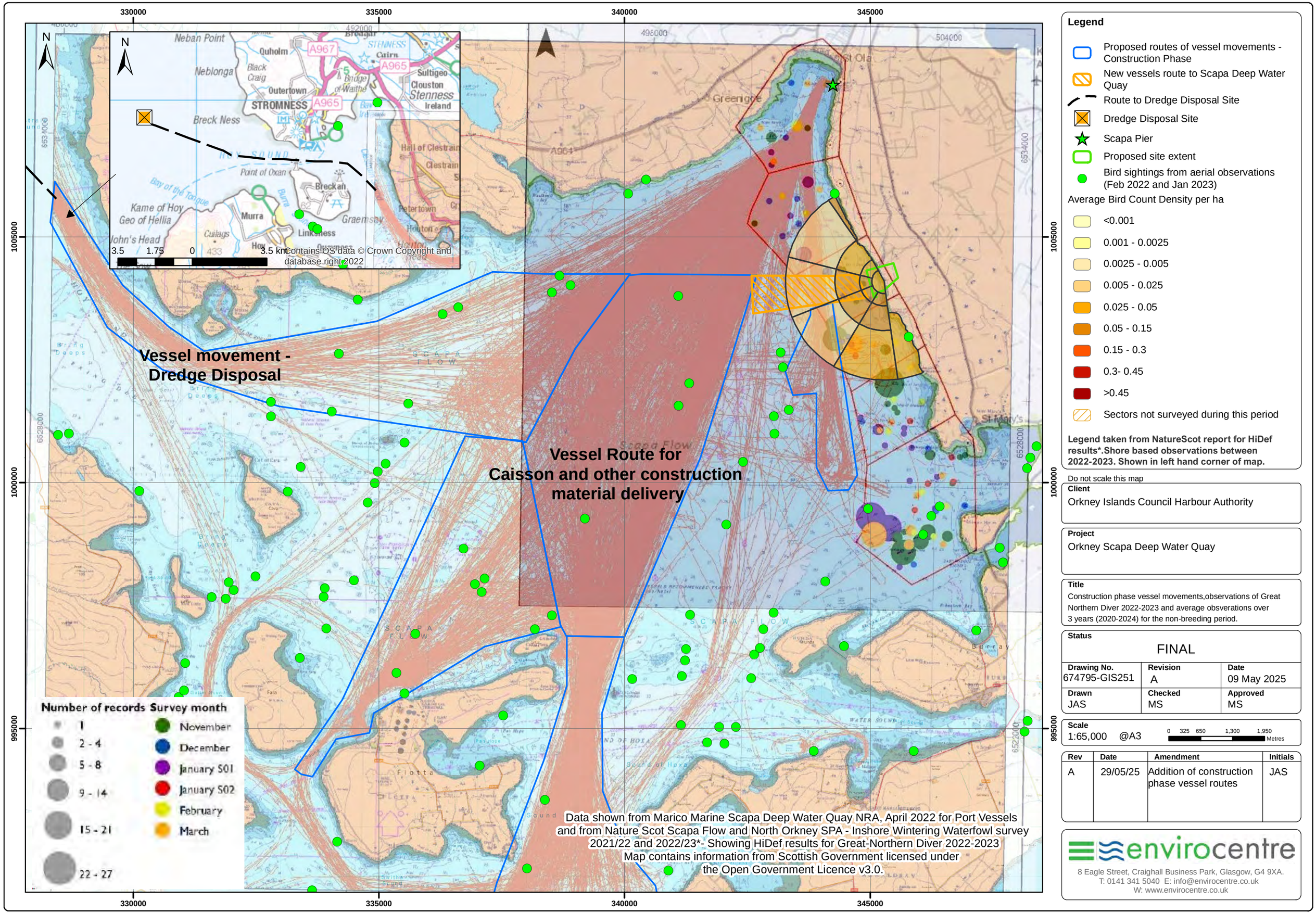
Drawing No.	Revision	Date
674795-GIS244	-	25 April 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:25,000 @A3
0 125 250 500 750 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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C BIRD HEAT MAPS AND HIDEF DATA COMBINED WITH CONSTRUCTION VESSEL ROUTES



Legend

- Proposed routes of vessel movements - Construction Phase
- New vessels route to Scapa Deep Water Quay
- Route to Dredge Disposal Site
- Dredge Disposal Site
- Scapa Pier
- Proposed site extent
- Bird sightings from aerial observations (Feb 2022 and Jan 2023)

Average Bird Count Density per ha

- <0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3- 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023. Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Construction phase vessel movements,observations of Great Northern Diver 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS251	A	09 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials
A	29/05/25	Addition of construction phase vessel routes	JAS

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330000 335000 340000 345000

1005000

1000000

995000

N

Vessel movement - Dredge Disposal

Vessel movement for Cassion and other construction material delivery

3.5 1.75 0 3.5 Km

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Number of records Survey month

1	November
2 - 5	December
6 - 10	January S01
11 - 15	January S02
16 - 20	March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23* - Showing HiDef results for Black-throated Diver 2022-2023

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Legend

- Proposed routes of vessel movements - Construction Phase
- New vessels route to Scapa Deep Water Quay
- Route to Dredge Disposal Site
- Dredge Disposal Site
- Scapa Pier
- Bird sightings from aerial observations (Feb 2022 and Jan 2023)
- Proposed site extent

Average Bird Count Density per ha

- <0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023.Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Construction phase vessel movements,observations of Black Throated Diver 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS252	A	09 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials
A	29/05/25	Addition of construction phase vessel routes	JAS

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330000 335000 340000 345000

1005000 1000000 995000

N

Vessel movement - Dredge Disposal

Vessel movement for Cassion and other construction material delivery

3 1.5 0 3 Km

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Number of records Survey month

1
2
3
25

November
December
January S0
January S0
February
March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23 - Showing HiDef results for Slavonian Grebe for 2022-2023.
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Legend

- Proposed routes of vessel movements - Construction Phase
- New vessels route to Scapa Deep Water Quay
- Route to Dredge Disposal Site
- Dredge Disposal Site
- Scapa Pier
- Bird sightings from aerial observations (Feb 2022 and Jan 2023)
- Proposed site extent

Average Bird Count Density per ha

- <0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023. Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Construction phase vessel movement,observations of Slavonian Grebe 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS253	A	09 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials
A	29/05/25	Addition of construction phase vessel routes	JAS

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330000 335000 340000 345000

1005000 1000000 995000

N

3.5 1.75 0 3.5 Km

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Vessel movement - Dredge Disposal

Main vessel movement for Cassion and other construction material delivery

Number of records Survey month

1	November
2 - 4	December
5 - 10	January S01
11 - 20	January S02
21 - 40	February
	March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23* - Showing HiDef results for Eider 2022-2023.
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Legend

- Proposed routes of vessel movements - Construction Phase
- New vessels route to Scapa Deep Water Quay
- Dredge Disposal Site
- Route to Dredge Disposal Site
- Scapa Pier
- Bird sightings from aerial observations (Feb 2022 and Jan 2023)
- Proposed site extent

Average Bird Count Density per ha

- < 0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.30
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023. Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Construction phase vessel movement,observations of Eider 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS254	A	09 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials
A	29/05/25	Addition of construction phase vessel routes	JAS

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330000 335000 340000 345000

1005000 1000000 995000

N

3.5 1.75 0 3.5 Km

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Vessel movement - Dredge disposal

Main vessel movement for Cassion and other construction material delivery

Number of records Survey month

- 1
- 2 - 5
- 6 - 25
- 26 - 50
- 51 - 100
- 101 - 200

- November
- December
- January S01
- January S02
- February
- March

Data shown from Marico Marine Scapa Deep Water Quay NRA, April 2022 for Port Vessels and from Nature Scot Scapa Flow and North Orkney SPA - Inshore Wintering Waterfowl survey 2021/22 and 2022/23* - Showing HiDef results for Long-tailed Duck 2022-2023

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Legend

- Proposed routes of vessel movements - Construction Phase
- New vessels route to Scapa Deep Water Quay
- Route to Dredge Disposal Site
- Dredge Disposal Site
- Scapa Pier
- Proposed site extent
- Bird sightings from aerial observations (Feb 2022 and Jan 2023)

Average Bird Count Density per ha

- < 0.001
- 0.001- 0.0025
- 0.0025 - 0.005
- 0.005 - 0.025
- 0.025 - 0.05
- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- >0.45
- Sectors not surveyed during this period

Legend taken from NatureScot report for HiDef results*.Shore based observations between 2022-2023. Shown in left hand corner of map.

Do not scale this map

Client
Orkney Islands Council Harbour Authority

Project
Orkney Scapa Deep Water Quay

Title
Construction phase vessel movement,observations of Long-tailed Duck 2022-2023 and average obsverations over 3 years (2020-2024) for the non-breeding period.

Status
FINAL

Drawing No.	Revision	Date
674795-GIS255	A	09 May 2025
Drawn	**Checked**	**Approved**
JAS	MS	MS

Scale
1:65,000 @A3
0 325 650 1,300 1,950 Metres

Rev	Date	Amendment	Initials
A	29/05/25	Addition of construction phase vessel routes	JAS

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ISLANDS COUNCIL



Scapa Deep Water Quay

Appendix D – Mortality Matrix Model

July 2026

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Orkney.gov.uk

Mortality - Applicant Case

Population count by site

	Great northern diver	Red-throated diver	Black-throated diver	Long-tailed duck	Eider	Red breasted merganser	Shag	Slavonian Grebe	Velvet Scoter	Arctic skua (p	Atlantic Puffin (pai	Black-legged kittiwake (pair	Common guillemot (p	Great black-backed gull (pa	Great skua (pairs)	Northern fulmar (p	Peregrine falcon (pairs)
Scapa Flow SPA	505	76	57	505	1997	539	2927	135	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
North Orkney SPA	308	47	N/A	N/A	N/A	N/A	N/A	120	147	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orkney Mainland Moors SPA	N/A	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hoy SPA	N/A	58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	59	3500	3000	13400	570	1900	35000	6

Average peak count by site

	Great northern diver	Red-throated diver	Black-throated diver	Long-tailed duck	Eider	Red breasted merganser	Shag	Slavonian Grebe	Velvet Scoter	Arctic skua	Atlantic Puffin	Black-legged kittiwake	Common guillemot	Great black-backed gull	Great skua	Northern fulmar	Peregrine falcon (Pairs)
	33	3	15	387.6	92	2.7	61	5.67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4.6	0.3	N/A	N/A	N/A	N/A	N/A	0.567	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	3	83	87	11	4	56	1

Annual mortality (assuming 90% displacement and 1% mortality)

	Great northern diver	Red-throated diver	Black-throated diver	Long-tailed duck	Eider	Red breasted merganser	Shag	Slavonian Grebe	Velvet Scoter	Arctic skua	Atlantic Puffin	Black-legged kittiwake	Common guillemot	Great black-backed gull	Great skua	Northern fulmar	Peregrine falcon
Scapa Flow SPA	0.297	0.027	0.135	3.4884	0.828	0.0243	0.549	0.05103	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A
North Orkney SPA	0.0414	0.0027	N/A	N/A	N/A	N/A	N/A	0.005103		N/A	N/A	N/A	N/A	N/A		N/A	N/A
Orkney Mainland Moors SPA	N/A	0.018	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A
Hoy SPA	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A								

Annual mortality by site as % of population (assuming 90% displacement and 1% mortality)

	Great northern diver	Red-throated diver	Black-throated diver	Long-tailed duck	Eider	Red breasted merganser	Shag	Slavonian Grebe	Velvet Scoter	Arctic skua	Atlantic Puffin	Black-legged kittiwake	Common guillemot	Great black-backed gull	Great skua	Northern fulmar	Peregrine falcon
Scapa Flow SPA	0.059%	0.036%	0.237%	0.691%	0.041%	0.005%	0.019%	0.038%	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A
North Orkney SPA	0.013%	0.006%	N/A	N/A	N/A	N/A	N/A	0.004%	0.000%	N/A	N/A	N/A	N/A	N/A		N/A	N/A
Orkney Mainland Moors SPA	N/A	0.100%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A
Hoy SPA	N/A	0.031%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.076%	0.001%	0.025%	0.006%	0.017%	0.002%	0.001%	0.150%

25-year mortality (assuming 90% displacement and 1% mortality)

	Great northern diver	Red-throated diver	Black-throated diver	Long-tailed duck	Eider	Red breasted merganser	Shag	Slavonian Grebe	Velvet Scoter	Arctic skua	Atlantic Puffin	Black-legged kittiwake	Common guillemot	Great black-backed gull	Great skua	Northern fulmar	Peregrine falcon
Scapa Flow SPA	7.4	0.7	3.4	87.2	20.7	0.6075	13.7	1.3	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A
North Orkney SPA	1.035	0.0675	N/A	N/A	N/A	N/A	N/A	0.127575		N/A	N/A	N/A	N/A	N/A		N/A	N/A
Orkney Mainland Moors SPA	N/A	0.45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A
Hoy SPA	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A								

25-year mortality by site as % of population (assuming 90% displacement and 1% mortality)

	Great northern diver	Red-throated diver	Black-throated diver	Long-tailed duck	Eider	Red breasted merganser	Shag	Slavonian Grebe	Velvet Scoter	Arctic skua	Atlantic Puffin	Black-legged kittiwake	Common guillemot	Great black-backed gull	Great skua	Northern fulmar	Peregrine falcon
Scapa Flow SPA	1.47%	0.9%	6%	17.27%	1%	0.1%	0.5%	0.9%	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A
North Orkney SPA	0.34%	0.14%	N/A	N/A	N/A	N/A	N/A	0.1%		N/A	N/A	N/A	N/A	N/A		N/A	N/A
Orkney Mainland Moors SPA	N/A	3%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A
Hoy SPA	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A								

Count data from EnviroCentre

Spcies		Distance band	Survey period	Peak month	Peak number	Average of peak count	% SPA populatio n	Average number (Oct/Nov to Mar)
Slavonian grebe	Non-breeding	0 – 500 m	Yr 1 - 2020/21	Feb	**7**		**3.45**	**2.5 %**
			Yr 2 - 2021/22	Dec/Feb	5	3.7 %	1.85	1.40%
			Yr 3 - 2023/24	March	5	3.70%	1.125	0.80%
		0 – 1 km	Yr 1 - 2020/21	Feb	**7**	**5.20%**	**3.55**	**2.60%**
			Yr 2 - 2021/22	Dec/Feb	5	3.70%	2.05	1.5 %
			Yr 3 - 2023/24	Nov	5	**3.70%**	1.625	1.2 %
		0 – 2 km	Yr 1 - 2020/21	Feb	**7**	**5.20%**	**3.55**	**2.60%**
			Yr 2 - 2021/22	Dec/Feb	5	3.7 %	2.05	1.5 %
			Yr 3 - 2023/24	March	5	3.7 %	1.625	1.2 %
Red-breasted Merganser		0 – 1 km	Yr 1 - 2020/21	Nov-Mar	**1**			
			Yr 2 - 2021/22	Dec/Feb	3			
			Yr 3 - 2023/24	Nov				
		0 – 2 km	Yr 1 - 2020/21	Feb				
			Yr 2 - 2021/22	Dec/Feb				
			Yr 3 - 2023/24	March	4			
Velvet Scoter		0 – 1 km	Yr 1 - 2020/21	Feb	0			
			Yr 2 - 2021/22	Dec/Feb	0			
			Yr 3 - 2023/24	Nov	0			
		0 – 2 km	Yr 1 - 2020/21	Feb	0			
			Yr 2 - 2021/22	Dec/Feb	0			
			Yr 3 - 2023/24	March	0			

The other species requested were not recorded in pairs, only peak counts of individuals, which were then used to assess against the Hoy SPA populations. See below, which is extracted from the HRA.
Arctic Skua – Small numbers were recorded flying past very infrequently during the summer months, with a peak of five birds in June 2022. The closest known breeding areas are on East Mainland, ~10km distance, supporting only one or a few pairs at each location. The five birds recorded represents 4.2% of the Hoy SPA population (59 pairs)

Great Skua – Small numbers, with a peak of 4 birds/hr flying past in July 2021. Numbers in 2022 were significantly lower, probably due to the prevalence of avian flu which has decimated the local, and national, populations. The 4 birds/hr represents 0.1% of the Hoy SPA population (1,900 pairs).

Great Black-backed Gull – a peak of 11 birds were recorded during the summer, and up to 7 birds and hour recorded flying past at its peak. One pair nesting close to the Proposed Development site. It is unlikely that birds recorded were part of the Hoy SPA complex. The peak of 11 birds represents 0.96% of the Hoy SPA population (570 pairs).
Fulmar – Sizable numbers were recorded flying past during the summer months, with a peak of 56/hr in July 2022. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Proposed Development site. The peak of 56 birds/hr represents 0.08% of the Hoy SPA population (35,000 pairs).
Kittiwake – Small numbers were recorded flying past during the summer months, with a peak of 7/hr in June 2022. A peak count of 83 birds on the water within 2km was also recorded. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Proposed Development site. The peak of 83 birds represents 1.4% of the Hoy SPA population (3000 pairs).
Guillemot – Small numbers were recorded, with a peak of 27 birds within 1km of the Proposed Development and 87 within 2km. Small numbers were also recorded flying past the Proposed Development site, with a peak of 6/hr in June 2022. It is considered that the vast majority, if not all, birds recorded were from the breeding colony to the north of the Proposed Development site. The peak of 87 birds represents 0.3% of the Hoy SPA population (13,
Puffin – This species was recorded on 7 out of 48 watch days during 2020 and 2022, with a peak of 3 birds. It is possible that these birds are from Hoy SPA but the area in the vicinity of the proposed SDWQ site is not considered to be of importance to this species. The peak of three birds represents 0.04% of the Hoy SPA population (3,500 pairs).

Peregrine

A Peregrine pair were present in 2022 at a traditional territory well to the north of the proposal site and fledged at least one youngster, which was seen occasionally later in the season from the main VP and walk-ins.

Great northern diver numbers during the flightless moult period

Month	No. count days	Average count <2km	Peak count <2km
Feb-21	4	6.5	16
Mar-21	4	9	12
Apr-21	2	24	26
2021 seasonal figures	10	11	26
Feb-22	4	17.25 [25.5]*	24
Mar-22	4	22 [27.25]	30
Apr-22	2	35 [36]	38
2022 seasonal figures	10	22.7 [28.3]	38
Feb-24	4	20.5 [23]	26
Mar-24	4	26.5 [28]	35
2024 seasonal figures	8	23.5 [24.25]	35
Average seasonal max peak count			**33**
Max Peak Count			**38**
Average of all peak counts			**25.875**

NS: Average of the peak counts
Applicant case: Average count

Black-throated diver numbers during the flightless moult period

Month	No. count days	Average count 0-1km	Peak count 1km	0- Average count 2km	Peak count <2km	
Nov-20	4	4.25	7	4.25	7	
Dec 2020*	4	0.75	2	2.25	6	
2020 seasonal figures	8	2.5	7	3.25	7	
Sep-21	2	1	2	1	2	
Oct-21	4	3	7	3	7	
Nov-21	4	0	0	0	0	
Dec-21	4	3	10	3.5	10	
2021 seasonal figures	14	1.9	10	2	10	
Oct-23	2	7	11	9.5	19	
Nov-23	4	0.5	1	16.5	28	
Dec-23	4	1.25	3	3.25	11	
2023 seasonal figures	10	2.1	11	9.8	28	***% of SPA (57 individuals)***
Original HRA as submitted						
Seasonal average across years		2.17				3.8%
Average counts across all years		2.31				4.0%
NatureScot Advice						
Peak count			11			19.30%
Xodus proposed methodology						
Average of all peak counts			4.77		10	8.4% ***17.54%***
Average of the max seasonal peak count				**9.33**	***16%***	**15** ***26.32%***
Peak Count				**11**	***19%***	**28** ***49.12%***
Average of all peak counts				**4.77**	***8%***	**10** ***17.54%***

Long-tailed duck numbers during the pre-migration congregation period

Month	No. count days	Average count <2km	Peak count <2km
Mar-21	4	35	60
Apr-21	4	134	176
May-21	2	310	414
2021 seasonal figures	10	130	414
Mar-22	4	73	234
Apr-22	4	42	75
May-22	1	58	58
2022 seasonal figures	9	58	234
Mar-24	4	374	515
Average peak count (Applicant case)			**387.7**
Peak Count (NS case)			**515**

Eider numbers during their flightless moult period

Month	No. count days	Average count <2km	Peak count <2km
Jul-21	4	1.25	3
Aug-21	4	51.75	93
Sep-21	2	51	71
2021 seasonal figures	10	31.4	93
Jul-22	4	72	80
Aug-22	4	64.75	91
Sep-22	2	50.5	57
2022 seasonal figures	10	**64.8**	91
Average peak count (Applicant case)			**92.0**
Average count (Applicant case)		**48.1**	
Peak Count (NS case)			**93**

Shag

Month	Year	Peak count <1km	Peak count 1-2km	Peak count <2km
Nov-Feb	1	38		
Oct-Feb	2	72		
Nov-Feb	3		48	73

Slavonian grebe

Distance band	Survey period	Peak month	Peak count	Average of peak count	Average number Oct/Nov to Mar (average peak)
0 – 500 m	Yr 1 - 2020/21	Feb	7		3.45
	Yr 2 - 2021/22	Dec/Feb	5	5.67	1.85
	Yr 3 - 2023/24	March	5		1.125
0 – 1 km	Yr 1 - 2020/21	Feb	7		3.55
	Yr 2 - 2021/22	Dec/Feb	5	5.67	2.05
	Yr 3 - 2023/24	Nov	5		1.625
0 – 2 km	Yr 1 - 2020/21	Feb	7		3.55
	Yr 2 - 2021/22	Dec/Feb	5	5.67	2.05
	Yr 3 - 2023/24	March	5		1.625
Average peak count (Applicant case)					
Peak Count (NS case)					

RTD nonbreeding

Month	Year	Peak count <1km	Peak count 1-2km	Peak count <2km
Nov-Mar	1	2	0	2
Oct-Mar	2	2	1	2
Oct-Mar	3	1	1	1

RTD breeding

Month	Year	Peak count <1km	Peak count 1-2km	Peak count <2km
Apr-Sept	1	4	0	4
	2	2	2	2

Scapa Flow Mortality

Great northern diver

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0033	0.0066	0.0099	0.0132	0.0165	0.033	0.066	0.099	0.132	0.165	0.33	0.495	0.66	0.99	1.32	1.65	1.98	2.31	2.64	2.97	3.3
	20%	0	0.0066	0.0132	0.0198	0.0264	0.033	0.066	0.132	0.198	0.264	0.33	0.66	0.99	1.32	1.98	2.64	3.3	3.96	4.62	5.28	5.94	6.6
	30%	0	0.0099	0.0198	0.0297	0.0396	0.0495	0.099	0.198	0.297	0.396	0.495	0.99	1.485	1.98	2.97	3.96	4.95	5.94	6.93	7.92	8.91	9.9
	40%	0	0.0132	0.0264	0.0396	0.0528	0.066	0.132	0.264	0.396	0.528	0.66	1.32	1.98	2.64	3.96	5.28	6.6	7.92	9.24	10.56	11.88	13.2
	50%	0	0.0165	0.033	0.0495	0.066	0.0825	0.165	0.33	0.495	0.66	0.825	1.65	2.475	3.3	4.95	6.6	8.25	9.9	11.55	13.2	14.85	16.5
	60%	0	0.0198	0.0396	0.0594	0.0792	0.099	0.198	0.396	0.594	0.792	0.99	1.98	2.97	3.96	5.94	7.92	9.9	11.88	13.86	15.84	17.82	19.8
	70%	0	0.0231	0.0462	0.0693	0.0924	0.1155	0.231	0.462	0.693	0.924	1.155	2.31	3.465	4.62	6.93	9.24	11.55	13.86	16.17	18.48	20.79	23.1
	80%	0	0.0264	0.0528	0.0792	0.1056	0.132	0.264	0.528	0.792	1.056	1.32	2.64	3.96	5.28	7.92	10.56	13.2	15.84	18.48	21.12	23.76	26.4
	90%	0	0.0297	0.0594	0.0891	0.1188	0.1485	0.297	0.594	0.891	1.188	1.485	2.97	4.455	5.94	8.91	11.88	14.85	17.82	20.79	23.76	26.73	29.7
	100%	0	0.033	0.066	0.099	0.132	0.165	0.33	0.66	0.99	1.32	1.65	3.3	4.95	6.6	9.9	13.2	16.5	19.8	23.1	26.4	29.7	33

Red-throated diver

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0003	0.0006	0.0009	0.0012	0.0015	0.003	0.006	0.009	0.012	0.015	0.03	0.045	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.3
	20%	0	0.0006	0.0012	0.0018	0.0024	0.003	0.006	0.012	0.018	0.024	0.03	0.06	0.09	0.12	0.18	0.24	0.3	0.36	0.42	0.48	0.54	0.6
	30%	0	0.0009	0.0018	0.0027	0.0036	0.0045	0.009	0.018	0.027	0.036	0.045	0.09	0.135	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.9
	40%	0	0.0012	0.0024	0.0036	0.0048	0.006	0.012	0.024	0.036	0.048	0.06	0.12	0.18	0.24	0.36	0.48	0.6	0.72	0.84	0.96	1.08	1.2
	50%	0	0.0015	0.003	0.0045	0.006	0.0075	0.015	0.03	0.045	0.06	0.075	0.15	0.225	0.3	0.45	0.6	0.75	0.9	1.05	1.2	1.35	1.5
	60%	0	0.0018	0.0036	0.0054	0.0072	0.009	0.018	0.036	0.054	0.072	0.09	0.18	0.27	0.36	0.54	0.72	0.9	1.08	1.26	1.44	1.62	1.8
	70%	0	0.0021	0.0042	0.0063	0.0084	0.0105	0.021	0.042	0.063	0.084	0.105	0.21	0.315	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.1
	80%	0	0.0024	0.0048	0.0072	0.0096	0.012	0.024	0.048	0.072	0.096	0.12	0.24	0.36	0.48	0.72	0.96	1.2	1.44	1.68	1.92	2.16	2.4
	90%	0	0.0027	0.0054	0.0081	0.0108	0.0135	0.027	0.054	0.081	0.108	0.135	0.27	0.405	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.7
	100%	0	0.003	0.006	0.009	0.012	0.015	0.03	0.06	0.09	0.12	0.15	0.3	0.45	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3

Black-throated diver

		Mortality level																				
Displacement level		**0%**	**0.10%**	**0.20%**	**0.30%**	**0.40%**	**0.50%**	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**15%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0015	0.0030	0.0045	0.0060	0.0075	0.015	0.0300	0.0450	0.0600	0.0750	0.1500	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50
	20%	0	0.0030	0.0060	0.0090	0.0120	0.0150	0.030	0.0600	0.0900	0.1200	0.1500	0.3000	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00
	30%	0	0.0045	0.0090	0.0135	0.0180	0.0225	0.045	0.0900	0.1350	0.1800	0.2250	0.4500	0.68	0.90	1.35	1.80	2.25	2.70	3.15	3.60	4.05	4.50
	40%	0	0.0060	0.0120	0.0180	0.0240	0.0300	0.060	0.1200	0.1800	0.2400	0.3000	0.6000	0.90	1.20	1.80	2.40	3.00	3.60	4.20	4.80	5.40	6.00
	50%	0	0.0075	0.0150	0.0225	0.0300	0.0375	0.075	0.1500	0.2250	0.3000	0.3750	0.7500	1.13	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
	60%	0	0.0090	0.0180	0.0270	0.0360	0.0450	0.090	0.1800	0.2700	0.3600	0.4500	0.9000	1.35	1.80	2.70	3.60	4.50	5.40	6.30	7.20	8.10	9.00
	70%	0	0.0105	0.0210	0.0315	0.0420	0.0525	0.105	0.2100	0.3150	0.4200	0.5250	1.0500	1.58	2.10	3.15	4.20	5.25	6.30	7.35	8.40	9.45	10.50
	80%	0	0.0120	0.0240	0.0360	0.0480	0.0600	0.120	0.2400	0.3600	0.4800	0.6000	1.2000	1.80	2.40	3.60	4.80	6.00	7.20	8.40	9.60	10.80	12.00
	90%	0	0.0135	0.0270	0.0405	0.0540	0.0675	0.135	0.2700	0.4050	0.5400	0.6750	1.3500	2.03	2.70	4.05	5.40	6.75	8.10	9.45	10.80	12.15	13.50
	100%	0	0.0150	0.0300	0.0450	0.0600	0.0750	0.150	0.3000	0.4500	0.6000	0.7500	1.5000	2.25	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15

Long-tailed duck

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.03876	0.07752	0.11628	0.15504	0.1938	0.3876	0.7752	1.1628	1.5504	1.938	3.876	5.814	7.752	11.628	15.504	19.38	23.256	27.132	31.008	34.884	38.76
	20%	0	0.07752	0.15504	0.23256	0.31008	0.3876	0.7752	1.5504	2.3256	3.1008	3.876	7.752	11.628	15.504	23.256	31.008	38.76	46.512	54.264	62.016	69.768	77.52
	30%	0	0.11628	0.23256	0.34884	0.46512	0.5814	1.1628	2.3256	3.4884	4.6512	5.814	11.628	17.442	23.256	34.884	46.512	58.14	69.768	81.396	93.024	104.652	116.28
	40%	0	0.15504	0.31008	0.46512	0.62016	0.7752	1.5504	3.1008	4.6512	6.2016	7.752	15.504	23.256	31.008	46.512	62.016	77.52	93.024	108.528	124.032	139.536	155.04
	50%	0	0.1938	0.3876	0.5814	0.7752	0.969	1.938	3.876	5.814	7.752	9.69	19.38	29.07	38.76	58.14	77.52	96.9	116.28	135.66	155.04	174.42	193.8
	60%	0	0.23256	0.46512	0.69768	0.93024	1.1628	2.3256	4.6512	6.9768	9.3024	11.628	23.256	34.884	46.512	69.768	93.024	116.28	139.536	162.792	186.048	209.304	232.56
	70%	0	0.27132	0.54264	0.81396	1.08528	1.3566	2.7132	5.4264	8.1396	10.8528	13.566	27.132	40.698	54.264	81.396	108.528	135.66	162.792	189.924	217.056	244.188	271.32
	80%	0	0.31008	0.62016	0.93024	1.24032	1.5504	3.1008	6.2016	9.3024	12.4032	15.504	31.008	46.512	62.016	93.024	124.032	155.04	186.048	217.056	248.064	279.072	310.08
	90%	0	0.34884	0.69768	1.04652	1.39536	1.7442	3.4884	6.9768	10.4652	13.9536	17.442	34.884	52.326	69.768	104.652	139.536	174.42	209.304	244.188	279.072	313.956	348.84
	100%	0	0.3876	0.7752	1.1628	1.5504	1.938	3.876	7.752	11.628	15.504	19.38	38.76	58.14	77.52	116.28	155.04	193.8	232.56	271.32	310.08	348.84	387.6

Eider

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0092	0.0184	0.0276	0.0368	0.046	0.092	0.184	0.276	0.368	0.46	0.92	1.38	1.84	2.76	3.68	4.6	5.52	6.44	7.36	8.28	9.2
	20%	0	0.0184	0.0368	0.0552	0.0736	0.092	0.184	0.368	0.552	0.736	0.92	1.84	2.76	3.68	5.52	7.36	9.2	11.04	12.88	14.72	16.56	18.4
	30%	0	0.0276	0.0552	0.0828	0.1104	0.138	0.276	0.552	0.828	1.104	1.38	2.76	4.14	5.52	8.28	11.04	13.8	16.56	19.32	22.08	24.84	27.6
	40%	0	0.0368	0.0736	0.1104	0.1472	0.184	0.368	0.736	1.104	1.472	1.84	3.68	5.52	7.36	11.04	14.72	18.4	22.08	25.76	29.44	33.12	36.8
	50%	0	0.046	0.092	0.138	0.184	0.23	0.46	0.92	1.38	1.84	2.3	4.6	6.9	9.2	13.8	18.4	23	27.6	32.2	36.8	41.4	46
	60%	0	0.0552	0.1104	0.1656	0.2208	0.276	0.552	1.104	1.656	2.208	2.76	5.52	8.28	11.04	16.56	22.08	27.6	33.12	38.64	44.16	49.68	55.2
	70%	0	0.0644	0.1288	0.1932	0.2576	0.322	0.644	1.288	1.932	2.576	3.22	6.44	9.66	12.88	19.32	25.76	32.2	38.64	45.08	51.52	57.96	64.4
	80%	0	0.0736	0.1472	0.2208	0.2944	0.368	0.736	1.472	2.208	2.944	3.68	7.36	11.04	14.72	22.08	29.44	36.8	44.16	51.52	58.88	66.24	73.6
	90%	0	0.0828	0.1656	0.2484	0.3312	0.414	0.828	1.656	2.484	3.312	4.14	8.28	12.42	16.56	24.84	33.12	41.4	49.68	57.96	66.24	74.52	82.8
	100%	0	0.092	0.184	0.276	0.368	0.46	0.92	1.84	2.76	3.68	4.6	9.2	13.8	18.4	27.6	36.8	46	55.2	64.4	73.6	82.8	92

Red breasted merganser

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.00027	0.00054	0.00081	0.00108	0.00135	0.0027	0.0054	0.0081	0.0108	0.0135	0.027	0.0405	0.054	0.081	0.108	0.135	0.162	0.189	0.216	0.243	0.27
	20%	0	0.00054	0.00108	0.00162	0.00216	0.0027	0.0054	0.0108	0.0162	0.0216	0.027	0.054	0.081	0.108	0.162	0.216	0.27	0.324	0.378	0.432	0.486	0.54
	30%	0	0.00081	0.00162	0.00243	0.00324	0.00405	0.0081	0.0162	0.0243	0.0324	0.0405	0.081	0.1215	0.162	0.243	0.324	0.405	0.486	0.567	0.648	0.729	0.81
	40%	0	0.00108	0.00216	0.00324	0.00432	0.0054	0.0108	0.0216	0.0324	0.0432	0.054	0.108	0.162	0.216	0.324	0.432	0.54	0.648	0.756	0.864	0.972	1.08
	50%	0	0.00135	0.0027	0.00405	0.0054	0.00675	0.0135	0.027	0.0405	0.054	0.0675	0.135	0.2025	0.27	0.405	0.54	0.675	0.81	0.945	1.08	1.215	1.35
	60%	0	0.00162	0.00324	0.00486	0.00648	0.0081	0.0162	0.0324	0.0486	0.0648	0.081	0.162	0.243	0.324	0.486	0.648	0.81	0.972	1.134	1.296	1.458	1.62
	70%	0	0.00189	0.00378	0.00567	0.00756	0.00945	0.0189	0.0378	0.0567	0.0756	0.0945	0.189	0.2835	0.378	0.567	0.756	0.945	1.134	1.323	1.512	1.701	1.89
	80%	0	0.00216	0.00432	0.00648	0.00864	0.0108	0.0216	0.0432	0.0648	0.0864	0.108	0.216	0.324	0.432	0.648	0.864	1.08	1.296	1.512	1.728	1.944	2.16
	90%	0	0.00243	0.00486	0.00729	0.00972	0.01215	0.0243	0.0486	0.0729	0.0972	0.1215	0.243	0.3645	0.486	0.729	0.972	1.215	1.458	1.701	1.944	2.187	2.43
	100%	0	0.0027	0.0054	0.0081	0.0108	0.0135	0.027	0.054	0.081	0.108	0.135	0.27	0.405	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.7

Shag

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0061	0.0122	0.0183	0.0244	0.0305	0.061	0.122	0.183	0.244	0.305	0.61	0.915	1.22	1.83	2.44	3.05	3.66	4.27	4.88	5.49	6.1
	20%	0	0.0122	0.0244	0.0366	0.0488	0.061	0.122	0.244	0.366	0.488	0.61	1.22	1.83	2.44	3.66	4.88	6.1	7.32	8.54	9.76	10.98	12.2
	30%	0	0.0183	0.0366	0.0549	0.0732	0.0915	0.183	0.366	0.549	0.732	0.915	1.83	2.745	3.66	5.49	7.32	9.15	10.98	12.81	14.64	16.47	18.3
	40%	0	0.0244	0.0488	0.0732	0.0976	0.122	0.244	0.488	0.732	0.976	1.22	2.44	3.66	4.88	7.32	9.76	12.2	14.64	17.08	19.52	21.96	24.4
	50%	0	0.0305	0.061	0.0915	0.122	0.1525	0.305	0.61	0.915	1.22	1.525	3.05	4.575	6.1	9.15	12.2	15.25	18.3	21.35	24.4	27.45	30.5
	60%	0	0.0366	0.0732	0.1098	0.1464	0.183	0.366	0.732	1.098	1.464	1.83	3.66	5.49	7.32	10.98	14.64	18.3	21.96	25.62	29.28	32.94	36.6
	70%	0	0.0427	0.0854	0.1281	0.1708	0.2135	0.427	0.854	1.281	1.708	2.135	4.27	6.405	8.54	12.81	17.08	21.35	25.62	29.89	34.16	38.43	42.7
	80%	0	0.0488	0.0976	0.1464	0.1952	0.244	0.488	0.976	1.464	1.952	2.44	4.88	7.32	9.76	14.64	19.52	24.4	29.28	34.16	39.04	43.92	48.8
	90%	0	0.0549	0.1098	0.1647	0.2196	0.2745	0.549	1.098	1.647	2.196	2.745	5.49	8.235	10.98	16.47	21.96	27.45	32.94	38.43	43.92	49.41	54.9
	100%	0	0.061	0.122	0.183	0.244	0.305	0.61	1.22	1.83	2.44	3.05	6.1	9.15	12.2	18.3	24.4	30.5	36.6	42.7	48.8	54.9	61

Slavonian Grebe

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.000567	0.001134	0.001701	0.002268	0.002835	0.00567	0.01134	0.01701	0.02268	0.02835	0.0567	0.08505	0.1134	0.1701	0.2268	0.2835	0.3402	0.3969	0.4536	0.5103	0.567
	20%	0	0.001134	0.002268	0.003402	0.004536	0.00567	0.01134	0.02268	0.03402	0.04536	0.0567	0.1134	0.1701	0.2268	0.3402	0.4536	0.567	0.6804	0.7938	0.9072	1.0206	1.134
	30%	0	0.001701	0.003402	0.005103	0.006804	0.008505	0.01701	0.03402	0.05103	0.06804	0.08505	0.1701	0.25515	0.3402	0.5103	0.6804	0.8505	1.0206	1.1907	1.3608	1.5309	1.701
	40%	0	0.002268	0.004536	0.006804	0.009072	0.01134	0.02268	0.04536	0.06804	0.09072	0.1134	0.2268	0.3402	0.4536	0.6804	0.9072	1.134	1.3608	1.5876	1.8144	2.0412	2.268
	50%	0	0.002835	0.00567	0.008505	0.01134	0.014175	0.02835	0.0567	0.08505	0.1134	0.14175	0.2835	0.42525	0.567	0.8505	1.134	1.4175	1.701	1.9845	2.268	2.5515	2.835
	60%	0	0.003402	0.006804	0.010206	0.013608	0.01701	0.03402	0.06804	0.10206	0.13608	0.1701	0.3402	0.5103	0.6804	1.0206	1.3608	1.701	2.0412	2.3814	2.7216	3.0618	3.402
	70%	0	0.003969	0.007938	0.011907	0.015876	0.019845	0.03969	0.07938	0.11907	0.15876	0.19845	0.3969	0.59535	0.7938	1.1907	1.5876	1.9845	2.3814	2.7783	3.1752	3.5721	3.969
	80%	0	0.004536	0.009072	0.013608	0.018144	0.02268	0.04536	0.09072	0.13608	0.18144	0.2268	0.4536	0.6804	0.9072	1.3608	1.8144	2.268	2.7216	3.1752	3.6288	4.0824	4.536
	90%	0	0.005103	0.010206	0.015309	0.020412	0.025515	0.05103	0.10206	0.15309	0.20412	0.25515	0.5103	0.76545	1.0206	1.5309	2.0412	2.5515	3.0618	3.5721	4.0824	4.5927	5.103
	100%	0	0.00567	0.01134	0.01701	0.02268	0.02835	0.0567	0.1134	0.1701	0.2268	0.2835	0.567	0.8505	1.134	1.701	2.268	2.835	3.402	3.969	4.536	5.103	5.67

North Orkney Mortality

Great northern diver

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0	0	0	0	0	0	0	0	0	0	0
	10%	0	5E-04	9E-04	0.001	0.002	0.002	0.0046	0.0092	0.0138	0.0184	0.0230	0.046	0.07	0.09	0.14	0.18	0.23	0.28	0.32	0.37	0.41	0.46
	20%	0	9E-04	0.002	0.003	0.004	0.005	0.0092	0.0184	0.0276	0.0368	0.0460	0.092	0.14	0.18	0.28	0.37	0.46	0.55	0.64	0.74	0.83	0.92
	30%	0	0.001	0.003	0.004	0.006	0.007	0.0138	0.0276	0.0414	0.0552	0.0690	0.138	0.21	0.28	0.41	0.55	0.69	0.83	0.97	1.1	1.24	1.38
	40%	0	0.002	0.004	0.006	0.007	0.009	0.0184	0.0368	0.0552	0.0736	0.0920	0.184	0.28	0.37	0.55	0.74	0.92	1.1	1.29	1.47	1.66	1.84
	50%	0	0.002	0.005	0.007	0.009	0.012	0.0230	0.0460	0.0690	0.0920	0.1150	0.23	0.35	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.3
	60%	0	0.003	0.006	0.008	0.011	0.014	0.0276	0.0552	0.0828	0.1104	0.1380	0.276	0.41	0.55	0.83	1.1	1.38	1.66	1.93	2.21	2.48	2.76
	70%	0	0.003	0.006	0.01	0.013	0.016	0.0322	0.0644	0.0966	0.1288	0.1610	0.322	0.48	0.64	0.97	1.29	1.61	1.93	2.25	2.58	2.9	3.22
	80%	0	0.004	0.007	0.011	0.015	0.018	0.0368	0.0736	0.1104	0.1472	0.1840	0.368	0.55	0.74	1.1	1.47	1.84	2.21	2.58	2.94	3.31	3.68
	90%	0	0.004	0.008	0.012	0.017	0.021	0.0414	0.0828	0.1242	0.1656	0.2070	0.414	0.62	0.83	1.24	1.66	2.07	2.48	2.9	3.31	3.73	4.14
	100%	0	0.005	0.009	0.014	0.018	0.023	0.0460	0.0920	0.1380	0.1840	0.2300	0.46	0.69	0.92	1.38	1.84	2.3	2.76	3.22	3.68	4.14	4.6

Red-throated diver

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	3E-05	6E-05	9E-05	1E-04	2E-04	0.0003	0.0006	0.0009	0.0012	0.0015	0.003	0	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03
	20%	0	6E-05	1E-04	2E-04	2E-04	3E-04	0.0006	0.0012	0.0018	0.0024	0.003	0.006	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.06
	30%	0	9E-05	2E-04	3E-04	4E-04	5E-04	0.0009	0.0018	0.0027	0.0036	0.0045	0.009	0.01	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.09
	40%	0	1E-04	2E-04	4E-04	5E-04	6E-04	0.0012	0.0024	0.0036	0.0048	0.006	0.012	0.02	0.02	0.04	0.05	0.06	0.07	0.08	0.1	0.11	0.12
	50%	0	2E-04	3E-04	5E-04	6E-04	8E-04	0.0015	0.003	0.0045	0.006	0.0075	0.015	0.02	0.03	0.05	0.06	0.08	0.09	0.11	0.12	0.14	0.15
	60%	0	2E-04	4E-04	5E-04	7E-04	9E-04	0.0018	0.0036	0.0054	0.0072	0.009	0.018	0.03	0.04	0.05	0.07	0.09	0.11	0.13	0.14	0.16	0.18
	70%	0	2E-04	4E-04	6E-04	8E-04	0.001	0.0021	0.0042	0.0063	0.0084	0.0105	0.021	0.03	0.04	0.06	0.08	0.11	0.13	0.15	0.17	0.19	0.21
	80%	0	2E-04	5E-04	7E-04	1E-03	0.001	0.0024	0.0048	0.0072	0.0096	0.012	0.024	0.04	0.05	0.07	0.1	0.12	0.14	0.17	0.19	0.22	0.24
	90%	0	3E-04	5E-04	8E-04	0.001	0.001	0.0027	0.0054	0.0081	0.0108	0.0135	0.027	0.04	0.05	0.08	0.11	0.14	0.16	0.19	0.22	0.24	0.27
	100%	0	3E-04	6E-04	9E-04	0.001	0.002	0.003	0.006	0.009	0.012	0.015	0.03	0.05	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.3

Slavonian grebe

		Mortality level																				
Displacement level		**0%**	**0.10%**	**0.20%**	**0.30%**	**0.40%**	**0.50%**	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**15%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0001	0.0001	0.0002	0.0002	0.0003	0.001	0.0011	0.0017	0.0023	0.0028	0.0057	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.05	0.05	0.06
	20%	0	0.0001	0.0002	0.0003	0.0005	0.0006	0.001	0.0023	0.0034	0.0045	0.0057	0.0113	0.02	0.02	0.03	0.05	0.06	0.07	0.08	0.09	0.10	0.11
	30%	0	0.0002	0.0003	0.0005	0.0007	0.0009	0.002	0.0034	0.0051	0.0068	0.0085	0.0170	0.03	0.03	0.05	0.07	0.09	0.10	0.12	0.14	0.15	0.17
	40%	0	0.0002	0.0005	0.0007	0.0009	0.0011	0.002	0.0045	0.0068	0.0091	0.0113	0.0227	0.03	0.05	0.07	0.09	0.11	0.14	0.16	0.18	0.20	0.23
	50%	0	0.0003	0.0006	0.0009	0.0011	0.0014	0.003	0.0057	0.0085	0.0113	0.0142	0.0284	0.04	0.06	0.09	0.11	0.14	0.17	0.20	0.23	0.26	0.28
	60%	0	0.0003	0.0007	0.0010	0.0014	0.0017	0.003	0.0068	0.0102	0.0136	0.0170	0.0340	0.05	0.07	0.10	0.14	0.17	0.20	0.24	0.27	0.31	0.34
	70%	0	0.0004	0.0008	0.0012	0.0016	0.0020	0.004	0.0079	0.0119	0.0159	0.0198	0.0397	0.06	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.40
	80%	0	0.0005	0.0009	0.0014	0.0018	0.0023	0.005	0.0091	0.0136	0.0181	0.0227	0.0454	0.07	0.09	0.14	0.18	0.23	0.27	0.32	0.36	0.41	0.45
	90%	0	0.0005	0.0010	0.0015	0.0020	0.0026	0.005	0.0102	0.0153	0.0204	0.0255	0.0510	0.08	0.10	0.15	0.20	0.26	0.31	0.36	0.41	0.46	0.51
	100%	0	0.0006	0.0011	0.0017	0.0023	0.0028	0.006	0.0113	0.0170	0.0227	0.0284	0.0567	0.09	0.11	0.17	0.23	0.28	0.34	0.40	0.45	0.51	1

Velvet scoter

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Orkney Mainland Moors Mortality

Red-throated diver

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	2E-04	4E-04	6E-04	8E-04	0.001	0.002	0.004	0.006	0.008	0.010	0	0	0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
	20%	0	4E-04	8E-04	0.001	0.002	0.002	0.004	0.008	0.012	0.016	0.020	0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4
	30%	0	6E-04	0.001	0.002	0.002	0.003	0.006	0.012	0.018	0.024	0.030	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6
	40%	0	8E-04	0.002	0.002	0.003	0.004	0.008	0.016	0.024	0.032	0.040	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8
	50%	0	0.001	0.002	0.003	0.004	0.005	0.010	0.020	0.030	0.040	0.050	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
	60%	0	0.001	0.002	0.004	0.005	0.006	0.012	0.024	0.036	0.048	0.060	0.1	0.2	0.2	0.4	0.5	0.6	0.7	0.8	1	1.1	1.2
	70%	0	0.001	0.003	0.004	0.006	0.007	0.014	0.028	0.042	0.056	0.070	0.1	0.2	0.3	0.4	0.6	0.7	0.8	1	1.1	1.3	1.4
	80%	0	0.002	0.003	0.005	0.006	0.008	0.016	0.032	0.048	0.064	0.080	0.2	0.2	0.3	0.5	0.6	0.8	1	1.1	1.3	1.4	1.6
	90%	0	0.002	0.004	0.005	0.007	0.009	0.018	0.036	0.054	0.072	0.090	0.2	0.3	0.4	0.5	0.7	0.9	1.1	1.3	1.4	1.6	1.8
	100%	0	0.002	0.004	0.006	0.008	0.01	0.020	0.040	0.060	0.080	0.100	0.2	0.3	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2

Hoy Mortality

Red-throated diver

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0002	0.0004	0.0006	0.0008	0.001	0.002	0.004	0.006	0.008	0.01	0.02	0.03	0.04	0.06	0.08	0.1	0.12	0.14	0.16	0.18	0.2
	20%	0	0.0004	0.0008	0.0012	0.0016	0.002	0.004	0.008	0.012	0.016	0.02	0.04	0.06	0.08	0.12	0.16	0.2	0.24	0.28	0.32	0.36	0.4
	30%	0	0.0006	0.0012	0.0018	0.0024	0.003	0.006	0.012	0.018	0.024	0.03	0.06	0.09	0.12	0.18	0.24	0.3	0.36	0.42	0.48	0.54	0.6
	40%	0	0.0008	0.0016	0.0024	0.0032	0.004	0.008	0.016	0.024	0.032	0.04	0.08	0.12	0.16	0.24	0.32	0.4	0.48	0.56	0.64	0.72	0.8
	50%	0	0.001	0.002	0.003	0.004	0.005	0.01	0.02	0.03	0.04	0.05	0.1	0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
	60%	0	0.0012	0.0024	0.0036	0.0048	0.006	0.012	0.024	0.036	0.048	0.06	0.12	0.18	0.24	0.36	0.48	0.6	0.72	0.84	0.96	1.08	1.2
	70%	0	0.0014	0.0028	0.0042	0.0056	0.007	0.014	0.028	0.042	0.056	0.07	0.14	0.21	0.28	0.42	0.56	0.7	0.84	0.98	1.12	1.26	1.4
	80%	0	0.0016	0.0032	0.0048	0.0064	0.008	0.016	0.032	0.048	0.064	0.08	0.16	0.24	0.32	0.48	0.64	0.8	0.96	1.12	1.28	1.44	1.6
	90%	0	0.0018	0.0036	0.0054	0.0072	0.009	0.018	0.036	0.054	0.072	0.09	0.18	0.27	0.36	0.54	0.72	0.9	1.08	1.26	1.44	1.62	1.8
	100%	0	0.002	0.004	0.006	0.008	0.01	0.02	0.04	0.06	0.08	0.1	0.2	0.3	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2

Arctic skua

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0005	0.001	0.0015	0.002	0.0025	0.005	0.01	0.015	0.02	0.025	0.05	0.075	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
	20%	0	0.001	0.002	0.003	0.004	0.005	0.01	0.02	0.03	0.04	0.05	0.1	0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
	30%	0	0.0015	0.003	0.0045	0.006	0.0075	0.015	0.03	0.045	0.06	0.075	0.15	0.225	0.3	0.45	0.6	0.75	0.9	1.05	1.2	1.35	1.5
	40%	0	0.002	0.004	0.006	0.008	0.01	0.02	0.04	0.06	0.08	0.1	0.2	0.3	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
	50%	0	0.0025	0.005	0.0075	0.01	0.0125	0.025	0.05	0.075	0.1	0.125	0.25	0.375	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5
	60%	0	0.003	0.006	0.009	0.012	0.015	0.03	0.06	0.09	0.12	0.15	0.3	0.45	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3
	70%	0	0.0035	0.007	0.0105	0.014	0.0175	0.035	0.07	0.105	0.14	0.175	0.35	0.525	0.7	1.05	1.4	1.75	2.1	2.45	2.8	3.15	3.5
	80%	0	0.004	0.008	0.012	0.016	0.02	0.04	0.08	0.12	0.16	0.2	0.4	0.6	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4
	90%	0	0.0045	0.009	0.0135	0.018	0.0225	0.045	0.09	0.135	0.18	0.225	0.45	0.675	0.9	1.35	1.8	2.25	2.7	3.15	3.6	4.05	4.5
	100%	0	0.005	0.01	0.015	0.02	0.025	0.05	0.1	0.15	0.2	0.25	0.5	0.75	1	1.5	2	2.5	3	3.5	4	4.5	5

Atlantic Puffin

		Mortality level																				
Displacement level		**0%**	**0.10%**	**0.20%**	**0.30%**	**0.40%**	**0.50%**	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**15%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0003	0.0006	0.0009	0.0012	0.0015	0.003	0.0060	0.0090	0.0120	0.0150	0.0300	0.05	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.30
	20%	0	0.0006	0.0012	0.0018	0.0024	0.0030	0.006	0.0120	0.0180	0.0240	0.0300	0.0600	0.09	0.12	0.18	0.24	0.30	0.36	0.42	0.48	0.54	0.60
	30%	0	0.0009	0.0018	0.0027	0.0036	0.0045	0.009	0.0180	0.0270	0.0360	0.0450	0.0900	0.14	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.90
	40%	0	0.0012	0.0024	0.0036	0.0048	0.0060	0.012	0.0240	0.0360	0.0480	0.0600	0.1200	0.18	0.24	0.36	0.48	0.60	0.72	0.84	0.96	1.08	1.20
	50%	0	0.0015	0.0030	0.0045	0.0060	0.0075	0.015	0.0300	0.0450	0.0600	0.0750	0.1500	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50
	60%	0	0.0018	0.0036	0.0054	0.0072	0.0090	0.018	0.0360	0.0540	0.0720	0.0900	0.1800	0.27	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80
	70%	0	0.0021	0.0042	0.0063	0.0084	0.0105	0.021	0.0420	0.0630	0.0840	0.1050	0.2100	0.32	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10
	80%	0	0.0024	0.0048	0.0072	0.0096	0.0120	0.024	0.0480	0.0720	0.0960	0.1200	0.2400	0.36	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16	2.40
	90%	0	0.0027	0.0054	0.0081	0.0108	0.0135	0.027	0.0540	0.0810	0.1080	0.1350	0.2700	0.41	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70
	100%	0	0.0030	0.0060	0.0090	0.0120	0.0150	0.030	0.0600	0.0900	0.1200	0.1500	0.3000	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3

Black-legged kittiwake

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0083	0.0166	0.0249	0.0332	0.0415	0.083	0.166	0.249	0.332	0.415	0.83	1.245	1.66	2.49	3.32	4.15	4.98	5.81	6.64	7.47	8.3
	20%	0	0.0166	0.0332	0.0498	0.0664	0.083	0.166	0.332	0.498	0.664	0.83	1.66	2.49	3.32	4.98	6.64	8.3	9.96	11.62	13.28	14.94	16.6
	30%	0	0.0249	0.0498	0.0747	0.0996	0.1245	0.249	0.498	0.747	0.996	1.245	2.49	3.735	4.98	7.47	9.96	12.45	14.94	17.43	19.92	22.41	24.9
	40%	0	0.0332	0.0664	0.0996	0.1328	0.166	0.332	0.664	0.996	1.328	1.66	3.32	4.98	6.64	9.96	13.28	16.6	19.92	23.24	26.56	29.88	33.2
	50%	0	0.0415	0.083	0.1245	0.166	0.2075	0.415	0.83	1.245	1.66	2.075	4.15	6.225	8.3	12.45	16.6	20.75	24.9	29.05	33.2	37.35	41.5
	60%	0	0.0498	0.0996	0.1494	0.1992	0.249	0.498	0.996	1.494	1.992	2.49	4.98	7.47	9.96	14.94	19.92	24.9	29.88	34.86	39.84	44.82	49.8
	70%	0	0.0581	0.1162	0.1743	0.2324	0.2905	0.581	1.162	1.743	2.324	2.905	5.81	8.715	11.62	17.43	23.24	29.05	34.86	40.67	46.48	52.29	58.1
	80%	0	0.0664	0.1328	0.1992	0.2656	0.332	0.664	1.328	1.992	2.656	3.32	6.64	9.96	13.28	19.92	26.56	33.2	39.84	46.48	53.12	59.76	66.4
	90%	0	0.0747	0.1494	0.2241	0.2988	0.3735	0.747	1.494	2.241	2.988	3.735	7.47	11.205	14.94	22.41	29.88	37.35	44.82	52.29	59.76	67.23	74.7
	100%	0	0.083	0.166	0.249	0.332	0.415	0.83	1.66	2.49	3.32	4.15	8.3	12.45	16.6	24.9	33.2	41.5	49.8	58.1	66.4	74.7	83

Common guillemot

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0087	0.0174	0.0261	0.0348	0.0435	0.087	0.174	0.261	0.348	0.435	0.87	1.305	1.74	2.61	3.48	4.35	5.22	6.09	6.96	7.83	8.7
	20%	0	0.0174	0.0348	0.0522	0.0696	0.087	0.174	0.348	0.522	0.696	0.87	1.74	2.61	3.48	5.22	6.96	8.7	10.44	12.18	13.92	15.66	17.4
	30%	0	0.0261	0.0522	0.0783	0.1044	0.1305	0.261	0.522	0.783	1.044	1.305	2.61	3.915	5.22	7.83	10.44	13.05	15.66	18.27	20.88	23.49	26.1
	40%	0	0.0348	0.0696	0.1044	0.1392	0.174	0.348	0.696	1.044	1.392	1.74	3.48	5.22	6.96	10.44	13.92	17.4	20.88	24.36	27.84	31.32	34.8
	50%	0	0.0435	0.087	0.1305	0.174	0.2175	0.435	0.87	1.305	1.74	2.175	4.35	6.525	8.7	13.05	17.4	21.75	26.1	30.45	34.8	39.15	43.5
	60%	0	0.0522	0.1044	0.1566	0.2088	0.261	0.522	1.044	1.566	2.088	2.61	5.22	7.83	10.44	15.66	20.88	26.1	31.32	36.54	41.76	46.98	52.2
	70%	0	0.0609	0.1218	0.1827	0.2436	0.3045	0.609	1.218	1.827	2.436	3.045	6.09	9.135	12.18	18.27	24.36	30.45	36.54	42.63	48.72	54.81	60.9
	80%	0	0.0696	0.1392	0.2088	0.2784	0.348	0.696	1.392	2.088	2.784	3.48	6.96	10.44	13.92	20.88	27.84	34.8	41.76	48.72	55.68	62.64	69.6
	90%	0	0.0783	0.1566	0.2349	0.3132	0.3915	0.783	1.566	2.349	3.132	3.915	7.83	11.745	15.66	23.49	31.32	39.15	46.98	54.81	62.64	70.47	78.3
	100%	0	0.087	0.174	0.261	0.348	0.435	0.87	1.74	2.61	3.48	4.35	8.7	13.05	17.4	26.1	34.8	43.5	52.2	60.9	69.6	78.3	87

Great black-backed gull

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0011	0.0022	0.0033	0.0044	0.0055	0.011	0.022	0.033	0.044	0.055	0.11	0.165	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.1
	20%	0	0.0022	0.0044	0.0066	0.0088	0.011	0.022	0.044	0.066	0.088	0.11	0.22	0.33	0.44	0.66	0.88	1.1	1.32	1.54	1.76	1.98	2.2
	30%	0	0.0033	0.0066	0.0099	0.0132	0.0165	0.033	0.066	0.099	0.132	0.165	0.33	0.495	0.66	0.99	1.32	1.65	1.98	2.31	2.64	2.97	3.3
	40%	0	0.0044	0.0088	0.0132	0.0176	0.022	0.044	0.088	0.132	0.176	0.22	0.44	0.66	0.88	1.32	1.76	2.2	2.64	3.08	3.52	3.96	4.4
	50%	0	0.0055	0.011	0.0165	0.022	0.0275	0.055	0.11	0.165	0.22	0.275	0.55	0.825	1.1	1.65	2.2	2.75	3.3	3.85	4.4	4.95	5.5
	60%	0	0.0066	0.0132	0.0198	0.0264	0.033	0.066	0.132	0.198	0.264	0.33	0.66	0.99	1.32	1.98	2.64	3.3	3.96	4.62	5.28	5.94	6.6
	70%	0	0.0077	0.0154	0.0231	0.0308	0.0385	0.077	0.154	0.231	0.308	0.385	0.77	1.155	1.54	2.31	3.08	3.85	4.62	5.39	6.16	6.93	7.7
	80%	0	0.0088	0.0176	0.0264	0.0352	0.044	0.088	0.176	0.264	0.352	0.44	0.88	1.32	1.76	2.64	3.52	4.4	5.28	6.16	7.04	7.92	8.8
	90%	0	0.0099	0.0198	0.0297	0.0396	0.0495	0.099	0.198	0.297	0.396	0.495	0.99	1.485	1.98	2.97	3.96	4.95	5.94	6.93	7.92	8.91	9.9
	100%	0	0.011	0.022	0.033	0.044	0.055	0.11	0.22	0.33	0.44	0.55	1.1	1.65	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9	11

Great skua

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0004	0.0008	0.0012	0.0016	0.002	0.004	0.008	0.012	0.016	0.02	0.04	0.06	0.08	0.12	0.16	0.2	0.24	0.28	0.32	0.36	0.4
	20%	0	0.0008	0.0016	0.0024	0.0032	0.004	0.008	0.016	0.024	0.032	0.04	0.08	0.12	0.16	0.24	0.32	0.4	0.48	0.56	0.64	0.72	0.8
	30%	0	0.0012	0.0024	0.0036	0.0048	0.006	0.012	0.024	0.036	0.048	0.06	0.12	0.18	0.24	0.36	0.48	0.6	0.72	0.84	0.96	1.08	1.2
	40%	0	0.0016	0.0032	0.0048	0.0064	0.008	0.016	0.032	0.048	0.064	0.08	0.16	0.24	0.32	0.48	0.64	0.8	0.96	1.12	1.28	1.44	1.6
	50%	0	0.002	0.004	0.006	0.008	0.01	0.02	0.04	0.06	0.08	0.1	0.2	0.3	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
	60%	0	0.0024	0.0048	0.0072	0.0096	0.012	0.024	0.048	0.072	0.096	0.12	0.24	0.36	0.48	0.72	0.96	1.2	1.44	1.68	1.92	2.16	2.4
	70%	0	0.0028	0.0056	0.0084	0.0112	0.014	0.028	0.056	0.084	0.112	0.14	0.28	0.42	0.56	0.84	1.12	1.4	1.68	1.96	2.24	2.52	2.8
	80%	0	0.0032	0.0064	0.0096	0.0128	0.016	0.032	0.064	0.096	0.128	0.16	0.32	0.48	0.64	0.96	1.28	1.6	1.92	2.24	2.56	2.88	3.2
	90%	0	0.0036	0.0072	0.0108	0.0144	0.018	0.036	0.072	0.108	0.144	0.18	0.36	0.54	0.72	1.08	1.44	1.8	2.16	2.52	2.88	3.24	3.6
	100%	0	0.004	0.008	0.012	0.016	0.02	0.04	0.08	0.12	0.16	0.2	0.4	0.6	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4

Northern fulmar

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0056	0.0112	0.0168	0.0224	0.028	0.056	0.112	0.168	0.224	0.28	0.56	0.84	1.12	1.68	2.24	2.8	3.36	3.92	4.48	5.04	5.6
	20%	0	0.0112	0.0224	0.0336	0.0448	0.056	0.112	0.224	0.336	0.448	0.56	1.12	1.68	2.24	3.36	4.48	5.6	6.72	7.84	8.96	10.08	11.2
	30%	0	0.0168	0.0336	0.0504	0.0672	0.084	0.168	0.336	0.504	0.672	0.84	1.68	2.52	3.36	5.04	6.72	8.4	10.08	11.76	13.44	15.12	16.8
	40%	0	0.0224	0.0448	0.0672	0.0896	0.112	0.224	0.448	0.672	0.896	1.12	2.24	3.36	4.48	6.72	8.96	11.2	13.44	15.68	17.92	20.16	22.4
	50%	0	0.028	0.056	0.084	0.112	0.14	0.28	0.56	0.84	1.12	1.4	2.8	4.2	5.6	8.4	11.2	14	16.8	19.6	22.4	25.2	28
	60%	0	0.0336	0.0672	0.1008	0.1344	0.168	0.336	0.672	1.008	1.344	1.68	3.36	5.04	6.72	10.08	13.44	16.8	20.16	23.52	26.88	30.24	33.6
	70%	0	0.0392	0.0784	0.1176	0.1568	0.196	0.392	0.784	1.176	1.568	1.96	3.92	5.88	7.84	11.76	15.68	19.6	23.52	27.44	31.36	35.28	39.2
	80%	0	0.0448	0.0896	0.1344	0.1792	0.224	0.448	0.896	1.344	1.792	2.24	4.48	6.72	8.96	13.44	17.92	22.4	26.88	31.36	35.84	40.32	44.8
	90%	0	0.0504	0.1008	0.1512	0.2016	0.252	0.504	1.008	1.512	2.016	2.52	5.04	7.56	10.08	15.12	20.16	25.2	30.24	35.28	40.32	45.36	50.4
	100%	0	0.056	0.112	0.168	0.224	0.28	0.56	1.12	1.68	2.24	2.8	5.6	8.4	11.2	16.8	22.4	28	33.6	39.2	44.8	50.4	56

Peregrine falcon

		Mortality level																				
Displacement level		0%	0.10%	0.20%	0.30%	0.40%	0.50%	1%	2%	3%	4%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	0.0001	0.0002	0.0003	0.0004	0.0005	0.001	0.002	0.003	0.004	0.005	0.01	0.015	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1
	20%	0	0.0002	0.0004	0.0006	0.0008	0.001	0.002	0.004	0.006	0.008	0.01	0.02	0.03	0.04	0.06	0.08	0.1	0.12	0.14	0.16	0.18	0.2
	30%	0	0.0003	0.0006	0.0009	0.0012	0.0015	0.003	0.006	0.009	0.012	0.015	0.03	0.045	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.3
	40%	0	0.0004	0.0008	0.0012	0.0016	0.002	0.004	0.008	0.012	0.016	0.02	0.04	0.06	0.08	0.12	0.16	0.2	0.24	0.28	0.32	0.36	0.4
	50%	0	0.0005	0.001	0.0015	0.002	0.0025	0.005	0.010	0.015	0.02	0.025	0.05	0.075	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
	60%	0	0.0006	0.0012	0.0018	0.0024	0.003	0.006	0.012	0.018	0.024	0.03	0.06	0.09	0.12	0.18	0.24	0.3	0.36	0.42	0.48	0.54	0.6
	70%	0	0.0007	0.0014	0.0021	0.0028	0.0035	0.007	0.014	0.021	0.028	0.035	0.07	0.105	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.7
	80%	0	0.0008	0.0016	0.0024	0.0032	0.004	0.008	0.016	0.024	0.032	0.04	0.08	0.12	0.16	0.24	0.32	0.4	0.48	0.56	0.64	0.72	0.8
	90%	0	0.0009	0.0018	0.0027	0.0036	0.0045	0.009	0.018	0.027	0.036	0.045	0.09	0.135	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.9
	100%	0	0.001	0.002	0.003	0.004	0.005	0.010	0.020	0.03	0.04	0.05	0.1	0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1

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Scapa Deep Water Quay

Appendix E – Long-List of In-Combination Projects

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Potential to impact protected site

			Protected Site															
			SACs		SPAs					Stage 2 assessment / refinement of shortlist								
Project type	**Development name**	**Status**	Loch of Stenness SAC (lagoons)	Sanday SAC (harbour seals)	Scapa Flow SPA	North Orkney SPA	Orkney Mainland Moors SPA	Hoy SPA	**Progress to Stage 2?**	**Is it within the qualifying feature(s)' range? Y/N**	**Justification**	**Relevant to the qualifying feature(s) within the published conservation objectives and relevant / appropriate conservation advice packages? Y/N**	**Justification**	**Does the intervening distance, or magnitude of the effect pathways render the plan or project insignificant in nature and scale with regard to the range of qualifying features? Y/N**	**Justification**	**Progress to In-combination Assessment? Y/N**
Offshore Wind	Ayre Offshore Wind Farm	Application	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Within range of foraging birds and harbour seal foraging range.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	N	The potential for vessels to enter the SPAs or be within the foraging range of seals mean there is a potential for effect.	Y
Tidal	Orbital Westray Tidal Array	Pre-Application (Scoping)	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Within foraging range of birds and harbour seals.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	N	The potential for vessels to enter the SPAs or be within the foraging range of seals mean there is a potential for effect.	Y
Tidal	EMEC Fall of Warness	Application	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Within foraging range of birds and harbour seals.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	N	The potential for vessels to enter the SPAs or be within the foraging range of seals mean there is a potential for effect.	Y
Wave	EMEC Billia Croo	Application	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Within foraging range of birds and harbour seals.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	N (Y for seals)	The intervening distance between Billia Croo and the Sanday SAC (>50km at sea distance) means that there is no pathway for effect with the Sanday SAC. Possibility of effect on birds of Scapa Flow SPA and North Orkney SPA.	Y
Wave	Mocean - East of Deerness	Pre-Application	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Located directly adjacent to Scapa Flow SPA. Within foraging range of birds and harbour seals.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	N	Vessels for maintenance are planned every 4 months. Decommissioning is anticipated to take 2 days using 1 vessel. Indicative vessel routes are north through the Scapa Flow SPA and around to Haston Pier (Kirkwall) through the North Orkney SPA.	Y
Cable	Orkney - Caithness	Under construction	Yes	No	Yes	Yes	Yes	Yes	Yes	Y	Located nearby to SAC (benthic features) and adjacent to Scapa Flow SPA, therefore potential impact for functionally linked birds of the North Orkney SPA.	Y	Project has the potential to affect the qualifying benthic feature of the SAC and the qualifying bird features of the SPAs.	N	Construction periods overlap. Construction of cable will have pathways for effect.	Y
Cable	SHEPD North Coast and Orkney cable route surveys (EPS Licence)	Consented	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Y	Located within/near to the relevant SPA and Sanday SAC.	Y	Project has the potential to affect the qualifying benthic and seal feature of the SAC and the qualifying bird features of the SPAs.	N	Surveys have a pathway for effect.	Y
Ports and harbours	Backaland Pier, Eday	Application	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Located near to North Orkney SPA	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	N	Construction and operation with potential for effect.	Y
Ports and harbours	Scammalin Bay (Faray)	Consented	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Located within/near to the relevant SPA and Sanday SAC.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	N	Construction and operation with potential for effect.	Y
Ports and harbours	Hatston Pier Expansion	Application	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Located inside North orkney SPA with connectivity to Scapa Flow. Also in range of Sanday SAC seals.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	N	Construction and operation with potential for effect.	Y
Aquaculture	Eynhallow Sound	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Within vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Bay of Cleat, Westray	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Within vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Wyre	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Within vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Puldrite	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Within vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	East of Skelwick Skerry, Westray	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Within vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Vestness, Westray	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Within vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Hunda, Scapa Flow	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Located inside Scapa Flow SPA, therefore functionally linked to North Orkney SPA.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Scarfhall Point, Westray	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Within vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Lober Salmon Farm, Scapa Flow	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Located inside Scapa Flow SPA, therefore functionally linked to North Orkney SPA.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y

Aquaculture	East Moclett, North Sound	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Within vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Bringhead, Scapa Flow	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Located inside Scapa Flow SPA, therefore functionally linked to North Orkney SPA.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Quanterness	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Inside North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Westerbister	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Located inside Scapa Flow SPA, therefore functionally linked to North Orkney SPA.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Veantrow Bay, Shapinsay	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Inside North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Chalmers Hope	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Located inside Scapa Flow SPA, therefore functionally linked to North Orkney SPA.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Toyness	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Located inside Scapa Flow SPA, therefore functionally linked to North Orkney SPA.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Bay of Cleat (south)	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Bay of Ham	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Vicinity of North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Bay of Vady	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Inside North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Kirknoust	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Inside North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	Meil Bay	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Inside North Orkney SPA, which is funcationally linked to Scapa Flow SPA. No effect on seals as part of the baseline.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Aquaculture	West Fara	Operational	No	No	Yes	Yes	Yes	Yes	Yes	Y	Located inside Scapa Flow SPA, therefore functionally linked to North Orkney SPA.	Y	Project has the potential to affect the qualifying bird features of the SPAs.	N	Operation with potential for effect.	Y
Dredging & disposal	Stronsay Harbour	Application	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Within range of foraging birds and harbour seal foraging range.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	Y	Operation with potential for effect.	Y
Dredging & disposal	Hatston, Kirkwall	Application	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Within range of foraging birds and harbour seal foraging range.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	Y	Operation with potential for effect.	Y
Dredging & disposal	Scammalin Bay (Faray)	Consented	No	Yes	Yes	Yes	Yes	Yes	Yes	Y	Within range of foraging birds and harbour seal foraging range.	Y	Project has the potential to affect the qualifying seal feature of the SAC and the qualifying bird features of the SPAs.	Y	Operation with potential for effect.	Y

B SEAL RISK ASSESSMENT

envirocentre

part of CuraTerrae

Scapa Deep Water Quay
Seal Risk Assessment



July 2026

CONTROL SHEET

Client: Orkney Island Council Harbour Authority
Project Title: Scapa Deep Water Quay
Report Title: Seal Risk Assessment
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EXECUTIVE SUMMARY

EnviroCentre Limited was commissioned by Orkney Islands Council Harbour Authority to undertake a Seal Risk Assessment to inform an Environmental Impact Assessment and Habitats Regulations Appraisal in relation to the construction and operational phases of the Scapa Deep Water Quay development, approximately 8km south of Kirkwall at Bay of Deepdale, Scapa Flow.

Both harbour seal and grey seal are priority marine features and Annex II species and can be seen all around Scotland, predominantly on many of the offshore islands and along much of the west mainland coast.

Two Special Areas of Conservation (SAC) and three Sites of Special Scientific Interest (SSSI) designated for harbour and grey seals and 60 haul out sites are considered within influence of the development site. However, due to distance, the development is not considered to directly impact any of these sites.

There is a clear decline in harbour seal populations based on reviews of data over the years. The cause for the decline has not yet been identified, however factors such as prey quality and availability, exposure to toxins/ harmful algae and competition for resources from grey seal, whose population size are considered to be at carrying capacity in Orkney waters, are currently considered to be the most likely critical drivers. Although no evidence for coastal developments or vessel movement have been identified, these can't be ruled out as also contributing to declines directly or indirectly.

The construction methods of the proposed development does not require underwater blasting, piling or drilling. Underwater noise modelling identified dredging activities have short risk ranges for seals, with Permanent Threshold Shift (PTS) of <50m. Temporary Threshold Shift (TTS) risk ranges from 70m – 250m dredging.

General disturbance to seals in water may occur as a result of works. It is expected that seals would be likely to exhibit a behavioural change due to the noise, when in water (fleeing from noise source/ vocalisations/ splashing), with physiological stress likely to also occur. This could impact seals energy and fitness levels through disturbing foraging or causing avoidance of feeding areas for periods of time. A precautionary 5km radius buffer for disturbance has been applied to quantify the number of individuals that may be disturbed as a result of construction works. Quantitative data identified a total of 148 grey seals and 33 harbour seals at sea within a 5km disturbance area of the construction works. However, given that 5km is a 'worst case' scenario, therefore the potential for disturbance is considered to be limited.

Disturbance of seals on land or when 'bottling', could also be caused by noise associated from terrestrial blasting, which could have a negative impact on seals. However, the nearest seal haul-out site is 7km west of SDWQ, a 6m high bund will be created and with a 6 dB reduction as the distance from the source doubles, it is considered unlikely that seals using regular haul out spots, or those at sea at the waters surface (bottling) will be negatively impacted to a population level from terrestrial noise associated with terrestrial blasting.

Due to protocols, controls and mitigation outlined in section 5 being implemented during dredging and the nearest seal haul out site being 7km west of SDWQ, it is considered unlikely that seals will be negatively impacted from dredging or vessel movements during the construction phase.

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Limited was commissioned by Orkney Islands Council Harbour Authority to undertake a Seal Risk Assessment (SRA) to inform an Environmental Impact Assessment (EIA) and Habitat Regulations Appraisal (HRA) in relation to the construction phase of Scapa Deep Water Quay (SDWQ), Scapa Flow.

1.2 Scope of Report

The SRA is required to identify known populations and records of seals and assess potential risks of causing injury and disturbance as a result of proposed construction activities.

- Collate existing data in relation to seals to establish which species are likely to be present within the development site and the wider zone of influence.
- Identify potential impacts to seals which could occur as a result of the proposed development; and
- Detail mitigation which will be employed to reduce the risk of negative impacts.

1.3 Project Overview

1.3.1 Background to the Project

SDWQ is a major strategic port infrastructure project proposed by Orkney Islands Council Harbour Authority (OICHA, 'the Applicant') for Scapa Flow, Orkney. It is designed to provide a deep-water berth capable of accommodating floating offshore wind (FOW) assembly, integration, operations and maintenance, alongside heavy-lift capacity for large-scale turbines and foundations. The quay will also support wider marine industries and future energy transition activities. Its location offers naturally deep, sheltered water adjacent to sufficient land for laydown, with safe navigation and minimal dredging - attributes that make Scapa Flow one of the few sites in the UK capable of hosting operations at this scale. The location of SDWQ is shown in Appendix A.

A marine licence application under the Marine (Scotland) Act 2010 and a planning permission application under the Town and Country Planning (Scotland) Act 1997 were submitted in September 2023 for determination by the marine regulators, Scottish Government's Marine Directorate – Licensing Operations Team (MD-LOT) and OIC Planning Department ('the Competent Authorities'). These applications were supported by an Environmental Impact Assessment (EIA) undertaken under both the Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 ('the Terrestrial EIA Regulations') and the Marine Works (Environmental Impact Assessment (Scotland) Regulations 2017 ('the Marine EIA Regulations'). The requirement for Additional Information under the Marine and Terrestrial EIA Regulations has since been triggered four times, with this document supporting the latest Additional Information submission.

1.3.2 Site Location

The site is located adjacent to the Bay of Deepdale, approximately 8 km south of Kirkwall. It is located on the eastern coastline within Scapa Flow, approximately 4 km south of the existing Scapa Pier. A Location Plan is provided in Appendix A.

1.3.3 Main Purpose and Associated Activities

SDWQ shall provide deep-water berthing facilities for a wide range of industrial activities with the main purpose upon completion, and in the medium to long term, being the storage of components, and assembly of wind turbines serving the floating offshore wind industry. SDWQ shall be complete with additional emergency berthing facilities for small vessels. SDWQ is also identified as a potential site for the storage and supply of future fuels for the marine industry.

SDWQ is a permanent addition to the Orcadian infrastructure, and therefore decommissioning is not a planned phase of the Project and has not been considered within the assessment presented in this report.

1.3.4 Construction Programme

The key construction stages, their indicative durations and projected periods for works to be carried out therein are outlines in Table 1-1 below.

Table 1-1: Outline construction programme

Works Description	Est. Duration	Est. Works Period
Access road construction, haul road, earthworks and A961 re-alignment	60 weeks	December 2027 – February 2029
Caisson fabrication (off-site)	24 weeks	December 2027 – June 2028
Caisson transport (off-site fabrication to Orkney)	8 weeks	June 2028 – August 2028
Dredging bund construction	32 weeks	December 2027 – July 2028
Dredging	12 weeks	June 2028 – August 2028
Caisson installation (placement only)*	8 weeks	August 2028 – September 2028
Landside earthworks – Overburden removal, rock blasting and excavation	100 weeks	October 2027 – September 2029
Quay finishings	52 weeks	January 2029 – January 2030
Demobilisation	12 weeks	January 2030 – February 2030
Completion	N/A	February 2030

*Completion of the quay wall, including infilling of caisson cells and backfill to the rear of the units shall continue on to February 2029. This may or may not involve the vessel movements detailed in Table 1-2 depending on availability of suitable material on island. Vessel movements shown in Table 1-2 which refer to caisson infilling are worst case.

Terrestrial blasting is anticipated to be completed within the first 59 weeks of the landside earthworks programme. However, ground conditions may dictate a change in the blasting pattern, which may extend the blasting programme to up to 100 weeks. No more than two blasts would be carried out in any one week.

1.3.5 Outline Design Criteria

The below criteria will ensure the design provides a robust, long-lasting marine structure, ensuring safety, stability, and durability under challenging environmental conditions.

- **Dredging Requirements:** The operational depths of -15.0m Chart Datum (CD) and -20.0m CD
- **Environmental conditions:** Consideration of climate change and sea-level rise scenarios (A projected sea level rise of 0.9 m by 2100 is considered, based on national climate projections), with tidal lag (normal conditions) and wave conditions (1 in 50-year, 1 in 200-year, 1 in 570-year return periods) integrated into the design.
- **Materials:** Concrete and reinforcement materials must comply with Eurocodes and British Standards, with specifications for exposure classes, cement types, and aggregate properties.

- **Caisson design:** The caissons are designed with a focus on durability, using concrete that is resistant to degradation in marine environments. Concrete properties, cement types, and aggregate characteristics have been carefully specified to ensure a long lifespan.
- **Caisson foundations and fill:** Crushed imported rock is used as the foundation layer, with strict controls on durability and strength. Fill materials inside and behind caissons are selected for high density and internal friction to ensure stability.
- **Scour protection:** Concrete scour protection mattresses and rock armour is installed to mitigate seabed erosion caused by vessel thrusters and propellers near the quay wall.

1.3.6 Site Establishment and Access

Site establishment and access will include:

- **Access road:** 8 m asphalt carriageway with 1.8 m hard verge/service strip, 1.8 m south-side path, 1.5 m north-side soft verge, and drainage swales on both sides.
- **Access point:** formed from the realigned A961 (under separate planning permission), with reflective signage and two-way lights as required.
- **Programme role:** critical early works item enabling site access, laydown, cut-and-fill operations, and construction of the dredge containment bund.
- **Early services:** temporary service connections required early to support blasting, quarrying and earthworks.
- **Construction works:** topsoil stripping, overburden removal, rock cut, and placement of subbase and surcharge to form a haul road.
- **Environmental control:** works to account for SEPA requirements to protect groundwater dependent terrestrial ecosystems.
- **Progressive installation:** service trenching, drainage and ducting installed as works progress.
- **Completion:** surcharge trimmed and final surfacing applied at the end of the project.

1.3.7 Dredging

The dredging and reclamation areas can be seen in Figure 1-1. All suitable dredged material will be placed in a reclamation area behind a pre-constructed bund (see Section 1.3.8), with any unsuitable material disposed at the licenced sea disposal site. The volumes of material to be dredged are presented in Table 1-2.

The dredging works extend along the entire quay alignment, including the main quay as well as the small vessel berths to the northern end, and are essential for preparing the seabed for subsequent caisson installation. The structures will be founded on hard bearing strata, requiring the removal of superficial soils and hard strata from approx. -15m CD down to a maximum depth of -20.5m CD. The dredged area edge slopes depend on the material type, ranging from 1:3 in superficial soils to 1:1 in engineering rock, whilst the dredging berth pockets are required to be operative for elevations of -15m CD and -20m CD.

Dredging works will be executed in a single campaign using a cutter suction dredger (CSD) specifically selected for its capacity to operate efficiently under the anticipated soil, sea and weather conditions at Scapa Flow.



Figure 1-1: Dredging and reclamation areas

The discharging process to the reclamation area shall be carried out through the integration of the dredger pumps with the designated discharge pipeline system where the dredged material will be transported into the reclamation area. This operation will be carried out in parallel with the dredging activities, beginning at the northwest portion of the reclamation.

Turbidity meters will be installed to detect any increase in turbidity outside the reclamation area, the details of which will be included within the supporting Construction Environmental Management Document (CEMD) (see Table 7-1 in the HRA for further details).

Through the early contractor involvement design stage, it has been identified that a significant reduction in material disposed at sea could be achieved from that which was originally defined in the exemplar design. There is, however, potential for up to 82,000m^3 of glacial till which may be unsuitable for re-use, to be disposed at sea (see Table 1-2).

A 4,000m^3 capacity barge(s) will be used to transport material to the licensed offshore deposit site **FI040**. If the maximum volume (82,000m^3) is deposited, there will be 21 round trips to the sea deposit site (42 vessel movements) over 12 a week period, typically this activity will be carried out between the beginning of June to the end of August (currently 2027).

Table 1-2: Proposed dredge volumes

Description	Total volume dredged (m^3)	Volume reused on site (m$^{3)}$	Volume disposed offshore (m^3)
Hard Dredge	72,653	72,653	0
Soft Dredge	306,754	306,754	0
Total	**379,407**	**379,407**	**0**
Disposal Contingency	379,407	297,407	82,000

1.3.8 Quay Wall Construction

The quay wall will be formed from reinforced concrete caissons installed on a rock bed foundation. The main quay is composed of nine large reinforced concrete caissons, with a smaller caisson at the south end that ties into the south revetment. At the north end, the small vessel berths are formed by four caissons.

Caissons Design Criteria

- **Main quay structure:** nine large reinforced concrete caissons, plus a smaller caisson at the southern return tied into the rock armour revetment.
- **Caisson design:** varied cross-sections along the quay to suit dredge depths and ground conditions.
- **Cope level:** fixed at **+7.00 m CD**.
- **General dredge depth:** to **–15.0 m CD**, including **1 m over-dredge** allowance.
- **Southern dredge pocket:** 140 m section dredged to **–20.5 m CD**, including **1 m over-dredge** allowance.
- **Northern berths:** small vessel berths formed by a series of smaller caissons.
- **Foundation design:** dredge slopes vary by soil type to achieve founding level in engineering rock.
- **Geotechnical checks:** caissons assessed for sliding, overturning, bearing capacity and overall stability.
- **Ballasting:** each caisson will be ballasted in accordance with the design to ensure stability during transport and installation.
- **Delivery programme:** the 14 caissons will be transported to site in four shipments.
- **Direct installation:** the first caissons in each delivery batch will be installed directly from the semi-submersible delivery vessel to their final quay positions.
- **Temporary wet storage:** remaining caissons from subsequent deliveries will be towed to a temporary wet storage area within the project boundary until final installation.
- **Transport:** caissons will be dry stored during transport from Spain, reducing the risk of introducing non-native species.
- **Biosecurity:** a Biosecurity Plan will be prepared as part of the CEMD (see Table 7-1 in the HRA).
- **Mitigation measures:** the plan will set out measures to prevent the introduction of invasive non-native species in line with relevant legislation and best practice.

Caisson Unloading at Scapa Flow

Unloading operation: caisson deliveries unloaded using 3 tugboats of at least 4,000 Horsepower (3,000kW) hired locally, with operation carried out in one to two good weather days per shipment. Caissons unloaded from semisubmersible vessel directly to the quay line or to a nearby storage area.

- **Auxillary equipment installation:** caissons fitted with auxiliary equipment (e.g. winches, mooring ropes and anchors, etc.).
- **Temporary securing:** After unloading, they will be temporarily secured either by tying them together alongside the partially constructed quay or by anchoring them to the seabed close to the project site. No piling or drilling is required for this operation, and underwater noise will be negligible.
- **Final Installation:** When weather conditions permit, the caissons will be sunk into their final positions.

Caisson Installation

- **Installation Duration and Conditions:** installation typically completed during daylight hours within 6–8 hours. Operations require suitable metocean conditions:
    - Mean wave height (Hm) < 0.5 m, peak wave period (Tp) < 7 s and wind speed at 10 m above sea level (U10) < 15 m/s
- **Towing to Installation Location**: caissons are towed individually from the semisubmersible vessel or temporary storage area to the quay line. Typically, one to three tugboats are used for towing and installation support.

- **Positioning and Controlled Sinking**: during sinking using tugs and winches. Installation continues until controlled touchdown on the prepared foundation.
- **Ballasting Operations:** caissons contain independent watertight cell groups, filled simultaneously with seawater using pumps or valves.
- **Tolerance Verification and Completion**: ballast water is sourced from Scapa Flow after placement. If the caisson is within tolerance, ballasting continues until full. If tolerances are not met, the caisson is de-ballasted, repositioned, and reinstalled, typically requiring only one attempt.

1.3.9 Landside Excavation Platform

- **Earthworks and Excavation:** Soft soils excavated using mechanical methods, with rock removal undertaken through drilling and terrestrial blasting. No marine blasting is planned.
- **Programme and Blasting Frequency:** scheduled over approximately 100 weeks (provisionally October 2027 to September 2029). Blasting will occur intermittently throughout the programme. Approximately 35 blasts are anticipated. No more than two blasts will take place per week. Blast timing will depend on construction progress and cannot be restricted to specific seasons.
- **Drainage and Site Preparation:** Pre-earthworks drainage installed to manage surface water runoff.
- **Noise and Sediment Control Bund:** 6 m high bund will be constructed at least 5 m from the cliff edge before blasting commences near the coast. The bund will act as a noise barrier for marine receptors and a retention wall for sediment runoff. The bund will be removed once final site levels are achieved.
- **Blasting Methodology:** blasting will progress in 70 m-wide strips from west to east across the site. Each strip will be divided into sections sized to accommodate up to two weekly blasts. Blasting activities will be undertaken simultaneously from both ends of each strip.
- **Material Processing and Fill Operations:** processing areas established at both ends of the site. Dual processing locations reduce haulage distances for blasted material. Fill operations will be supplied from both directions, improving material distribution efficiency.

1.3.10 Reclaimed Land (Sea Filling)

- **Initial Land Reclamation:** dredge bund and enclosed reclaimed area will be completed during the dredging campaign, forming the initial phase of land reclamation. General infilling will commence once the caissons have been installed, filled, and backfilled.
- **Perimeter Closure:** rock armour revetments constructed at the north and south ends of the quay wall after caisson installation. These revetments will close the reclamation perimeter and protect the site from wave action.
- **Rock Armour Revetments:** designed for a 60-year service life and 1-in-200-year wave conditions. Revetments will include appropriately sized underlayers and geotextiles.
- **Land Reclamation Fill Materials:** Reclamation will primarily use dredged material and suitable excavated material from landside works (screened on site to remove fines before placement). Imported quarry material placed behind the caissons to meet grading and compaction requirements for caisson stability.
- **Sediment Control:** marine containment substantially established before reclamation filling progresses. Containment bund will minimise sediment discharge beyond the construction area.

1.3.11 Pollution Control

Strict pollution prevention controls implemented during land reclamation works to minimise risk via drainage systems designed in accordance with best practice and regulatory requirements, no untreated surface water to be discharged directly to surrounding coastal waters and an outline Construction Environmental Management Document (CEMD) has been prepared for the project (see Table 7-1 in the HRA).

1.3.12 Vessel Movements During Construction

The construction phase will see the following vessel movements as outlined in Table 1-3 below. In total during the entire construction phase (26 months), there will be 112 vessel movements taking place over an eight-month period between June 2028 and February 2029, inclusive.

Table 1-3: Construction phase vessel movements

Vessel	Predicted Number of Movements	Timescales (provisional)
Caisson delivery, offloading and installation	20 movements (4 deliveries) using a semi-submersible vessel (3 tugs for offloading, 1 tug for installation) Tugs deployed from nearby Scapa Pier	July 2028 – September 2028
Scour protection	10 trips (20 movements)	August 2028 – September 2028
Caisson infilling	15 trips (30 movements)	August 2028 – February 2029
Dredging	21 trips (42 movements)	June 2028– August 2028
Total	**112**	

Baseline vessel movements (as informed by the Navigational Risk Assessment (NRA); see Technical Appendix 2.3 of EnviroCentre 2024) in Scapa Flow is characterised by a high level of diverse maritime traffic year-round, with Automatic Identification System (AIS) data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow—closest to the SDWQ site—current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents only ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

The construction phase vessel movements will therefore result in an additional 21.5 vessel movements per month on average (+0.16% from baseline) during winter months (October-March) and an additional 90.4 vessel movements per month on average (+0.5% from baseline) during summer months (April-September).

1.4 Operation

The Project is likely to operate as a marine facility 24 hours per day and 7 days per week, so there is the potential for activity at any time of the day or night. This will include:

- Flatbed lorries: delivering and uplifting from site.
- HGVs: delivering and uplifting from site.
- Light vans: delivering cargo or providing maintenance and servicing to site.
- Road Tankers: delivering bulk goods and liquids to site or removing liquids and waste from site; and
- Forklift trucks: loading and unloading vehicles servicing the site. In addition to the general cargo operations, there will be:
- Minibuses/ cars collecting/ returning people working on site - vehicles not allowed in working area.
- Security staff based within the site and undertaking patrols when appropriate.
- Staff looking after the facility maintenance and assisting with vessel moorings.
- Third Party Stevedore Companies loading and unloading vessels; and
- Coaches and taxis facilitating crew changes on vessels.

The internal roadways and footpaths will be demarcated with designated routes, and barriers will be installed where necessary. There will be a security fence around the working area perimeter to protect it as well as the

public, in addition to preventing access to breakwaters, rock armour revetments etc. (access gates will be provided for maintenance). The fence will be constructed in accordance with the requirements of the International Ship and Port Facility Security Code (ISPS).

Table 1-4 provides a summary of the indicative infrastructure likely to be present upon completion of the Project. The indicative locations of quayside infrastructure services are shown on Figure 1-2.

Table 1-4: Indicative operational infrastructure

Infrastructure Type	Qty	Description
Future Marine Fuels	TBC	Possible storage and supply to vessels of very low or zero carbon fuels. Note this will be subject to further assessments and approval.
Water Tanks	4	Four water storage tanks with built-in treatment systems (as required) will be installed as indicated on Figure 1-2 outside of the main working area to supply potable water to the whole site and vessels.
Sub-station	1	Located near to the water tanks will be a 33kV /11kV/415V substation for whole site supply, including shore power for vessels, as indicated on Figure 1-2 not in main working area.
Main gatehouse / Access building	1	As indicated on Figure 1-2 outside of main working area, may contain admin offices and is the security control for site.
Car park, cycle storage and bus stop	-	Vehicle parking spaces and bicycle racks. Bus stop for use by internal bus services (drop off and pick up only).



Figure 1-2: Proposed SDWQ operational layout

1.4.1 Vessel Movements During Operation

The project is designed to be flexible so that many types of vessels can berth, subject to draught and length. While the quay is a major strategic facility, its operational profile is characterised by the infrequent arrival of large vessels, likely to be aligned with the integration and deployment schedules of major offshore wind developments. Approximately 80% of vessel activity will take place in the summer months

There is significant existing vessel activity in the wider area around the proposed SDWQ site. There will be increased vessel activity introduced by the SDWQ project in the area from the existing shipping route to the site (EnviroCentre SEIR May 2025); however, there are some existing vessel movements in this area, as shown by the vessel tracks in EnviroCentre SEIR (May 2025), and in more detail in the NRA (Technical Appendix 2.3) submitted with the EnviroCentre EIAR (2024). Table 1-5 outlines the annual and seasonal operational vessel activity expected for the Project.

As per Section 1.3.12. there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; EnviroCentre EIAR 2024 (Technical Appendix 2.3) and summarised above in section 1.3.12, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

Table 1-5: Annual and seasonal operational vessel activity

	Per year		**Per winter season (October-March)**		**Per summer season (April-September)**	
	Vessel number	**Vessel movements (return trips)**	**Vessel number**	**Vessel movements (return trips)**	**Vessel number**	**Vessel movements (return trips)**
Large vessels	28	56	6	12	22	44
Smaller vessels	12	24	2	4	10	20
Pilot boats for large vessels	56	112	11	22	45	90
Total	**96**	**192**	**19**	**38**	**77**	**154**

1.4.2 Wet Storage

There is no planned wet storage of fully constructed turbines at the Project site. Any future proposals for wet storage will be conducted in accordance with the relevant regulations/consents.

1.4.3 Quayside Cranes

- **Crane Strategy:** no fixed or permanent cranes will be installed on site. Crane activity will generally coincide with vessel arrivals and departures.
- **Weather Constraints:** lifting operations are highly dependent on weather conditions, particularly wind. Less than 20% of lifting operations are anticipated to occur during winter.

- **Vessel Movements and Crane Activity:** approximately 30 vessel trips per year (60 vessel movements) will require crane operations. Expected seasonal distribution of 24 vessel trips (approximately one per week) in summer and 6 vessel trips (approximately one per month) in winter. Vessels will typically remain berthed for 2–5 days. Estimated crane operating days of 8–20 days per month in summer and 2–5 days per month in winter.
- **Number of Cranes on Site**: in summer up to four cranes operating simultaneously (typically one vessel crane and three mobile cranes) and in winter up to two smaller mobile cranes.
- **Storage and Visual Presence:** mobile cranes will generally be stored on site during summer. In winter, cranes may remain on site or be removed for use elsewhere. When not in use, crane booms will be retracted and lowered horizontally. Stored cranes will have a height of approximately 5 m.
- **Noise and Lighting:** mobile cranes move slowly and generate limited engine noise. Mobile cranes do not normally provide their own lighting. Winter lifting operations will typically be restricted to daylight hours.

1.5 Alternative Consideration

The project was identified as part of the Orkney Harbours Masterplan. At the start of the Masterplan development, optioneering was undertaken through stakeholder discussions / workshops, OICHA internal discussions with staff, market assessments in conjunction with desk-based research. A Strategic Environmental Assessment was used to inform a draft Orkney Harbours Masterplan Phase 1 with details of the process including alternatives considered, reasons for discounting or taking forward options and potential environmental impacts as reported in the Strategic Environmental Assessment – Environmental Report.

1.5.1 Do Nothing

SDWQ is proposed to be a nationally significant deepwater quay for offshore wind. Doing nothing will not allow the long-term future of Orkney, in particular looking at facilities that ensure the decarbonisation of the industry. By doing nothing, what is considered the UK's most significant marine energy infrastructure programme ever undertaken will not be possible and as a result the UK's position for marine-based renewables in Europe and internationally will be weakened.

1.5.2 Relocation

The siting of the proposed development was originally positioned in an area to the north of the Burn of Deepdale. However, following initial site investigations and preliminary ecological surveys it was decided to move the development to its current location. The move was a result of the engineering and environmental considerations as listed below:

- The quantity of overburden and unsuitable material (for development purposes) was determined to be greatly reduced by positioning the development on the land to the south of the burn;
- The current site selected avoided crossing the Burn of Deepdale; and
- Moving the development footprint to the south avoided encroachment into the Gaitnip Local Nature Reserve (LNR) which would have been the case if it was situated to the north of the Burn of Deepdale.

1.6 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre Limited.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre Limited for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

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2 METHODS

2.1 Baseline

In order to anticipate the potential ecological sensitivities in relation to seals at the site, a desk study was conducted. The following sources were checked:

- Marine Directorate National Marine Plan interactive (NMPi) for:
    - Seal haul out sites;
    - Distribution of Priority Marine Features (PMFs)
- Sea Watch Foundation (SWF) website for recent sightings of marine mammals from the Orkney region[1];
- Scottish Marine Animal Stranding Scheme (SMASS) for records of strandings between 2001 and 2024[2];
- MS Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals[3], which includes data obtained from the Sea Mammal Research Unit at St Andrews University[4];
- NatureScot Aerial surveys of seals in Scotland during the harbour moult season 2016-2019[5];
- Marine Scotland Regional Differences in the Abundance Trends Amongst Harbour Seal Populations[6];
- Special Committee on seals (SCOS) reports 2015 to 2022[7];
- Fine-scale harbour seal at-sea usage mapping around Orkney and the North coast of Scotland[8];
- Data of Orkney seal haul out counts 2016-2019 provided by SMRU[9];
- Carter et al (2025) Harbour seal and grey seals: distribution maps for Scotland[10]
- Sanday Special Area of Conservation (SAC) Conservation and Management Advice (2024)[11];
- JNCC Sanday SAC[12];
- Faray and Holm of Faray SAC Conservation and management Advice (2024)[13]
- JNCC Faray and Holm of Faray SAC[14];

[1] Sea Watch Foundation Recent Sightings Orkney available at: https://www.seawatchfoundation.org.uk/recentsightings/ (Accessed 12/12/2023)
[2] Species reported within a 10km (sea route) from 2001-2024 to Scottish Marine Animal Stranding Scheme (SMASS) available at: https://strandings.org/map/ (Accessed 05/03/2025)
[3] Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals, Scottish Marine and Freshwater Science, Vol 8 No 25, available at: https://data.marine.gov.scot/sites/default/files//SMFS%200825.pdf (Accessed 07/06/2024)
[4] St Andrews Sea Mammal Research Unit, available at: http://www.smru.st-andrews.ac.uk/ (Accessed 07/06/2024)
[5] NatureScot Aerial Surveys of Seals in Scotland during the Harbour Seal Moult, 2016-2019, available at: https://www.nature.scot/doc/naturescot-research-report-1256-aerial-surveys-seals-scotland-during-harbour-seal-moult-2016-2019 (Accessed 07/06/2024)
[6] Marine Scotland topic Sheet Number 33 (V2), Regional Differences in the Abundance Trends Amongst Harbour Seal Populations, available at: https://www.gov.scot/binaries/content/documents/govscot/publications/factsheet/2019/11/marine-scotland-topic-sheets-marine-mammals/documents/regional-differences-in-the-abundance-trends-amongst-harbour-seal-populations-updated-march-2017/regional-differences-in-the-abundance-trends-amongst-harbour-seal-populations-updated-march-2017/govscot%3Adocument/harbour-seal-populations.pdf (Accessed 27/05/2024)
[7] SCOS Reports | SMRU
[8] Fine-scale harbour seal at-sea usage mapping around Orkney and the North coast of Scotland | Marine Scotland Data Publications (Accessed 26/02/2025)
[9] Excel file detailing the latest SMRU seal data counts (2016-2019) for Orkney provided by John Baxter on 03/03/2025
[10] Carter, M. I. D, Bivins, M., Duck, C. D., Hastie, G. D., Morris, C. D., Moss, S. E. W., Thompson, D., Thompson, P. M., Vincent, C., Russell, D. J. F. (2025) Updated habitat-based distribution maps for harbour and grey seals in Scotland. Report to Scottish Government by Sea Mammal Research Unit, University of St Andrews. Available at: https://www.gov.scot/publications/updated-habitat-based-sea-distribution-maps-harbour-grey-seals-scotland/pages/6/
[11] Sanday - Conservation and Management Advice - Final Version (Accessed 26/02/2025)
[12] Sanday - Special Areas of Conservation (Accessed 26/02/2025)
[13] Faray and Holm of Faray - Conservation and Managment Advice - Final (Accessed 26/02/2025)
[14] Faray and Holm of Faray - Special Areas of Conservation (Accessed 26/02/2025)

- NatureScot Eynhallow Site of Special Scientific Interest (SSSI) Citation[15]
- Muckle and Little Green SSSI Site Management Statement[16];
- NatureScot Muckle and Little Green SSSI Citation[17];
- East Sanday Coast SSSI Site Management Statement[18];
- East Sanday Coast SSSI Citation[19].

2.2 Underwater Noise Modelling

Underwater noise modelling was commissioned as part of this assessment to assess noise levels generated by common construction methods.

Please refer to Irwin Carr Consulting report: 'SDWQ, UW Noise Modelling', Appendix B which details the methods and findings of the underwater noise modelling.

2.3 Calculating General Disturbance

In order to try and obtain an indicative numerical value for the number of individual seals that could be impacted when at sea, as a result of the noise related activities, a similar approach was undertaken to that adopted for the Marine Directorate European Protected Species (EPS) licensing applications.

To calculate the number of individuals, likely to be present within the behavioural impact ranges, the following process was used:

Step 1 – Obtaining at sea area of buffer distance for disturbance

The Underwater Noise Modelling in Section 7.1 shows received levels on moving animals at levels >120 dB from dredging activities, however, does not provide the distances that this model predicted for disturbance ranges. Therefore, values for the maximum distance over which disturbance for seals is predicted for each noise producing activity (dredging) is required. It was considered that a 5km disturbance range suggested by NatureScot would provide a worst-case scenario range, with the understanding that this is likely an overestimation for disturbance, for all noise producing elements.

A buffer of this distance is applied to the application site boundary and only the area (km^2) 'at sea' is taken.

Step 2: Obtain Seal density

Density values of seals present within the 'at sea' disturbance buffer distance were obtained using data from Carter et al 2025)[20], which provides density data in 5km x 5km (25km2) for at sea usage. The mean density values[21] from the number of $25km^2$ squares which fall within the disturbance buffer are added up and divided by the number of squares used (6 in this case). As values are provided by

[15] https://www.nature.scot/sites/default/files/site-special-scientific-interest/618/sssi-citation.pdf (Accessed 26/02/2025)
[16] https://www.nature.scot/sites/default/files/site-special-scientific-interest/1205/site-management-statement.pdf (Accessed 26/02/2025)
[17] https://www.nature.scot/sites/default/files/site-special-scientific-interest/1205/sssi-citation.pdf (Accessed 26/02/2025)
[18] https://www.nature.scot/sites/default/files/site-special-scientific-interest/1678/site-management-statement.pdf (Accessed 26/02/2025)
[19] https://www.nature.scot/sites/default/files/site-special-scientific-interest/1678/sssi-citation.pdf (Accessed 26/02/2025)
[20] Carter et al., 2025
[21] Due to the caveats associated with population scalars to convert relative to absolute abundances, the paper authors suggest using the relative density estimates. However, the absolute densities provide more accurate estimates of seal density in 2023 specifically and are less robust to changes in abundance in subsequent years (that is known to be occurring). Therefore, absolute densities have been utilised as they are likely to be precautionary considering decreasing numbers of harbour seals, particularly associated with Sanday SAC

25km^2, to calculate the number of individuals per km^2, the Carter et al absolute estimates were divided by 25 to obtain the estimated number of individuals impacted per km2.

Step 3: Individuals per km2

The estimated number of individuals per km^2 is then calculated as the seal density calculated in Step 2 multiplied by the area of the 'at sea' disturbance buffer distance in Step 1.

Where the calculated number of individuals is not an exact number, the figure has been rounded up as it would not be possible to cause disturbance to a fraction of an individual.

2.4 Disclaimer

It should be noted that the baseline is limited by the reliability of third party information and the geographical availability of biological and/or ecological records and data. The absence of species from biological records cannot be taken to represent actual absence. Species distribution patterns should be interpreted with caution as they may reflect survey/reporting effort rather than actual distribution.

3 BASELINE

3.1 Desk Study

Both harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) are PMFs and can be seen all around Scotland, predominantly on many of the offshore islands and along much of the west mainland coast.

3.1.1 Designated Sites: SAC and SSSI

Two SAC and three SSSI sites designated for harbour and grey seals are considered within influence of the development site and include:

- Sanday SAC (Harbour seal)
- Faray and Holm of Faray SAC (Grey seal)
- Eynhallow SSSI (Harbour seal)
- Muckle and Little Green Holm SSSI (Grey seal)
- East Sanday Coast SSSI (Harbour seal)

Sanday SAC

Sanday SAC is located 55km (via sea) north east of the SDWQ development site. The Sanday SAC has been designated to protect harbour seal, as well as intertidal mudflats and sandflats, reefs and subtidal sandbanks. The SAC comprises 10976.97 hectares (ha). Harbour seal feature as 'Unfavourable declining' in condition within the SAC. Based on counts from 1997-2019, there has been a decline of 95% at Sanday SAC, indicating it is one of the local areas hit hardest by the harbour seal declines observed in northern and eastern areas of Scotland. In the last count in 2019, the SAC represented 77 individuals (around 5% of the North Coast and Orkney Seal Management Unit (SMU)). Harbour seals from Sanday SAC are noted to forage 20-30km to over 100km from the SAC (however the majority of these will be at the shorter end of the range). The Sanday conservation management advice suggests that research is indicating that off-site factors such as predation, competition for prey, prey quality and availability, and toxin exposure from harmful algae are the most likely potential causes of the decline. For harbour seal at Sanday SAC, the reasons for the unfavourable condition appear to lie out with the SAC.

Faray and Holm of Faray SAC

Faray and Holm of Faray SAC is located 53 km (via sea) north of the SDWQ development site and comprises 781.33 ha. The Faray and Holm of Faray SAC is designated for grey seal, which currently feature as 'Unfavourable declining' in condition within the SAC. The unfavourable condition of grey seal at the SAC corresponds to a 43% decline in pup production in 2019 since the late 1990s with the SAC now accounting for 10% of the SMU production. The decrease in pup production does not reflect the trend of the North Coast and Orkney SMU with both grey seal population and pup production remaining stable. SMU pup production is stable (decline appearing to be due to changes in movement of pup activities to other locations within the SMA), accessibility of the site for pupping has not changed and disturbance is minimal during the breeding season, meaning no direct conservation measures can be taken at a site level to address the causes of the unfavourable condition of grey seal. Therefore, the focus of the Conservation Objectives for grey seal are ensuring that the conditions on site are suitable to support a recovery.

Eynhallow SSSI

Eynhallow SSSI is located 59km (via sea) north west of the SDWQ development site and comprises 97.22 ha. The Eynhallow SSSI is designated for harbour seal, which are considered 'Unfavourable declining' condition within the SSSI. The site is one of the two most important breeding and haul out sites for harbour seals in Orkney, and supports on average more than 10% of Orkney's total harbour seal population. The most recent count for the Eynhallow SSSI in 2019 was 76 individuals.

Muckle and Little Green Holm SSSI

Muckle and Little Green Holm SSSI is located 45km (via sea) north of the SDWQ development site and comprises 52.26 ha. The Muckle and Little Green Holm SSSI is designated for grey seal which are considered to be of a 'favourable, maintained' condition. The site regularly supports about 2% of the pups born in the UK and is one of the largest sites for breeding grey seals in Orkney and is therefore considered a nationally important colony for breeding grey seals. The pup survey for 2010 estimates that 900 pups were born on the Muckle and Little Green Holms SSSI.

East Sanday Coast SSSI

East Sanday Coast SSSI is located 57km (via sea) north east of the SDWQ development site and comprises 1607.56 ha. The East Sanday Coast SSSI lies within the Sanday SAC and is designated for harbour seal, as well as intertidal marine habitats and birds. Harbour seal currently features as 'Favourable, maintained' in condition within the SSSI. The SSSI site supports the largest colony in Orkney. The most recent count for the East Sanday Coast SSSI in 2019 was 78 individuals.

3.1.2 Designated Haul Out Sites

Section 117 of the Marine (Scotland) Act 2010 provided additional protection to seals. The Protection of Seals (Designation of Haul-out Sites) (Scotland) Act 2014 designates a total of 194 individual seal haul-out sites around Scotland, at which it will be an offence to harass seals. Seal haul-outs are locations on land where seals come ashore to rest, moult or breed.

A number of designated seal haul out sites are associated with Orkney, 60 have been identified as potentially relevant to the SDWQ development, due to being in commuting distances to both seal species and are detailed in Appendix C. Those haul out sites considered to be at most risk from disturbance through underwater noise or during vessel movement associated with the development, due to proximity are detailed in

Table 3-1 overleaf. It should be highlighted that the 'Breeding Colony' column in

Table 3-1 below (and in Appendix C) is based on the breeding sites on the NMPi, because they are discrete areas that are primarily used for breeding. No information is provided for harbour seals on the

NMPi, because they do not go to specific places to breed, they simply breed at their 'home' haul out sites and as such remain relatively dispersed during the breeding season. Therefore, all harbour seal haul sites are considered potential places where pups are born.

Note that all designated seal haul outs provide protection for both species of seal year round regardless of whether it was identified as a breeding colony.

Table 3-1: Seal haul out sites

Seal Haul Out Name	Distance* and Orientation	Species	No. seals (based on August counts)		NMPi Breeding Colony (Grey seal)
			Harbour seal	Grey seal	
Ve Ness	7km west	Harbour and Grey seal	0	8	No
North West Water Sound	7km south	Harbour seal	63	32	-
Calf of Flotta	9km south west	Grey seals	1	13	Yes
Barrel of Butter	10km west	Harbour seal	18	11	-
North Flotta	10km south east	Grey seal	0	228	Yes
Cava	12km west	Harbour seal	17	20	-
Flotta Oil Terminal	12km south west	Harbour seal	9	0	-
Holm of Houton	13km west	Harbour and Grey seal	21	24	No
North and East Fara	14km south west	Harbour and Grey seal	8	179	No
Switha	15km south west	Harbour and Grey seals	19	27	No
North east Hoy	16km west	Grey seals	0	3	Yes
Bay of Ireland	22km north west	Harbour seals	44	23	No
Selwick	22km west	Harbour and grey seals	17	117	No

*Direct route via sea

3.1.3 Grey Seal

Orkney is a stronghold for breeding grey seals and is part of the North Coast and Orkney Seal Management Unit (SMU). It is estimated that the Orkney colonies produced nearly a third of UK pups in 2019. The overall trend is for an increased numbers in the UK population but there was a slight reduction in the Orkney population estimate between 2016 and 2019. The latest estimate of the UK grey seal population is 129,100 with the Orkney and North Coast SMU being home to approx. 7% of that (based on most recent population estimates for grey seal from 2019-2021 for the North Coast and Orkney SMU of 8599).

From research undertaken and presented in SCOS 2021, it is considered that grey seal within the Orkney region are estimated to be close to carrying capacity when undertaking modelling. In addition, population estimates for seal management areas in Scotland suggest that due to sustained growth in the numbers of pups born over the last 30 years, this has resulted in all UK populations either increasing or (apparently) stabilising at the maximum levels ever recorded, which is being assumed to be at or close to their carrying capacities.

In general, grey seals are loyal to a pupping sites and frequent those places for a few months during the breeding season when the females give birth and wean their pups before mating again. During that period they do not move very far from the breeding sites. However, after the breeding season grey seals are much more mobile and disperse over very large areas and can travel large distances, frequently over 100km, to exploit various haul out sites and forage and prefer offshore feeding areas as well as exposed coasts and islands to come ashore, with the outer fringes of Orkney being classed as suitable. The waters surrounding the site offer habitat for various gadoids and flat fish which are grey seal prey species. From research undertaken by St Andrews Sea Mammal Research Unit on seal diets[22], in Orkney sandeels were the greatest prey resources, with gadoids (haddock, cod, whiting) being the second biggest contributor (harbour seal diet is yet to be studied as in depth).

A total of 60 designated haul out sites, including 22 breeding for grey seals (see Appendix C) are present within 100km of the SDWQ development, with 13 in vicinity of the development activities. The nearest seal haul out site from the development site is 7km west (Ve Ness) and the nearest breeding colony is located 9km south west (Calf of Flotta). Two SSSIs (Faray and Holm of Faray SSSI located 57km north and Muckle and Little Green Holm SSSI located 47km north) and two SACs (Sanday SAC 56km north east located and Faray and Holm of Faray SAC located 57km north) designated for grey seals are present within 100km of the site.

Seal haul out data counts for grey seal also show the important association with Orkney, as detailed in Figure 3-1.

[22] http://www.smru.st-andrews.ac.uk/documents/scotgov/CSD3-3_Grey_Seal_Diet_Composition_and_Prey_Consumption.pdf (Accessed 07/06/2024)

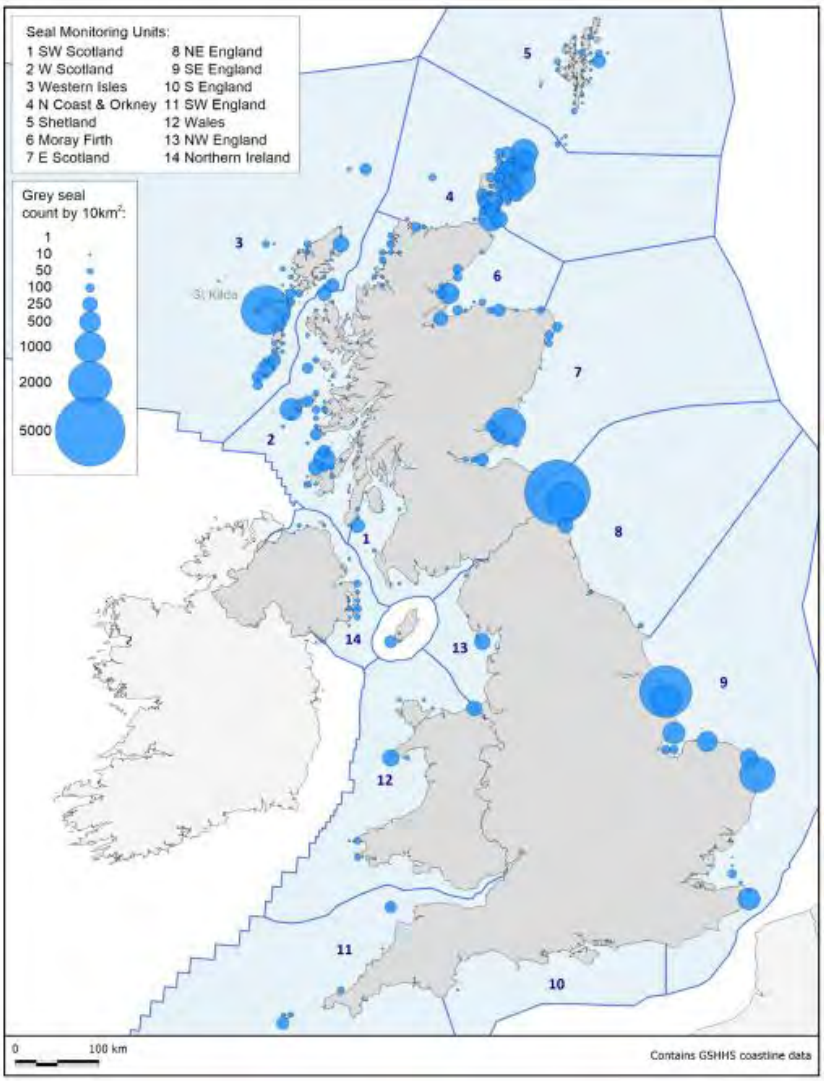


Figure 3-1: August distribution of grey seals around the British Isles by 10km squares based on the most recent available haul out count data collected up until 2021. Map obtained from SCOS 2022.

Records of 285 out of 355 tagged grey seals within UK waters (1988-2018) show a broad-scale distribution, with tagged grey seals utilising both coastal and offshore habitat, with Orkney being a key high-use area, as detailed in Figure 3-2. Grey seal distribution estimates show the mean number of grey seals estimated to be present in each 5 km by 5 km grid cell at any one time, with that around the development site estimated to be >50 individuals per 5km^2 as detailed in Figure 3-3.

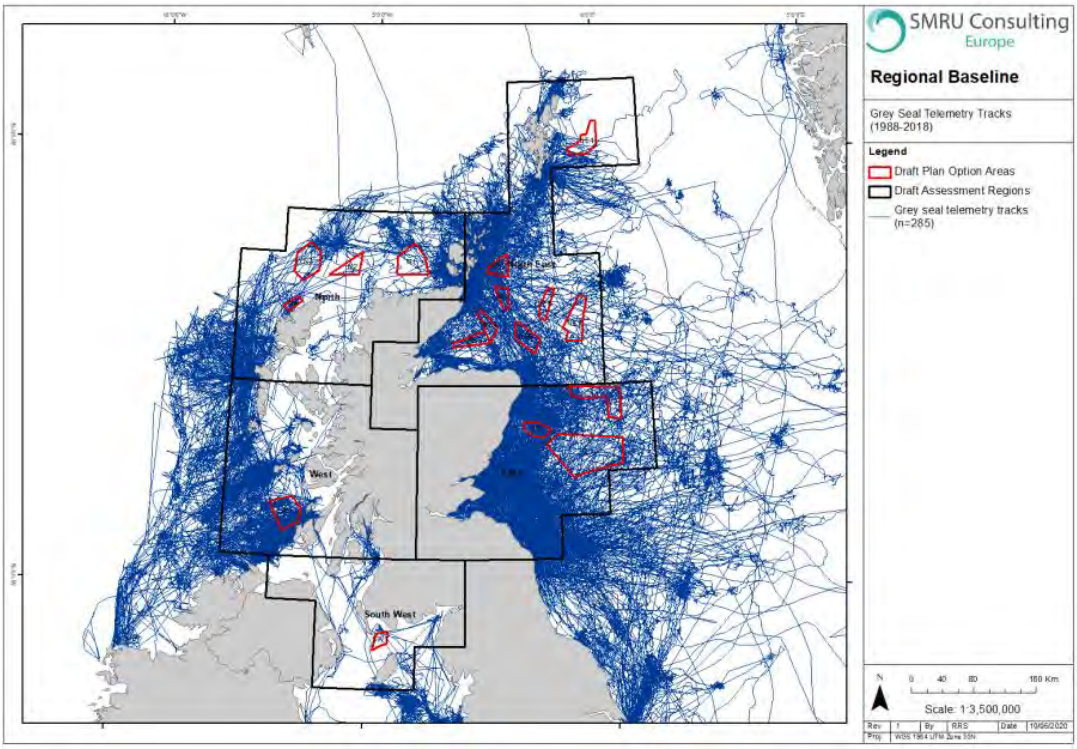


Figure 3-2: Telemetry tracked grey seals (1988-2018)

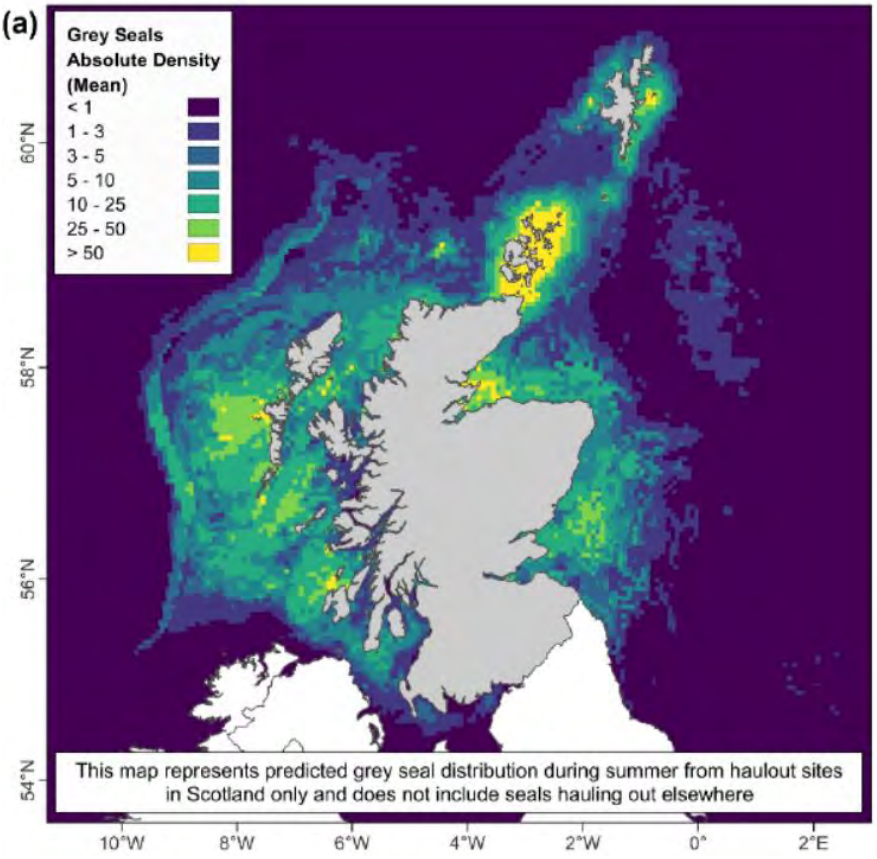


Figure 3-3: Map showing grey seal distribution estimates. The mean number of grey seals estimated to be present in each 5 km by 5 km grid cell at any one time. Image taken from Carter et al (2025).

Orcadian Wildlife[23] state that grey seals can be observed annually and SMASS have recorded 136 records of stranded grey seals between 1992-2024.

The development site and adjacent coastline is considered suitable (by report authors) for use as a haul out by grey seals due to the relatively low level of disturbance associated with the area and lack of human/ commercial/ vehicular activity. However, the site is near Scapa Pier, where vessels regularly commute to, past the site and the site is not within a designated haul out site for grey seal, as such is not considered that the habitat is suitable for use as a breeding or moulting haul out site. Therefore, grey seals may use the coastal waters within and adjacent to the site for commuting between haul outs (including breeding colonies) and/or foraging.

3.1.4 Harbour Seal

The latest estimate of the UK harbour seal population is 36,600 with the Orkney and North Coast SMU being home to approx. 4% of that (most recent population estimates for harbour seal from 2019-2021 for the North Coast and Orkney SMU of 1405). Whilst the overall trend for harbour seals within the UK is increasing, there has been a dramatic change in distribution. Counts within the Orkney and North Coast SMU have gone from 8,522 in 1997 to 1296 in 2019 (an 85% decline) for counts between 2016 and 2019 (see Figure 3-4 below). Orkney and Shetland were once proportionally the most important regions in Scotland for harbour seals in 1990s, whereas these regions only contribute to one sixth of the Scottish total. Within Scotland there is a general pattern of population increases in the west and losses along the east and north coasts.

The causes of decline for harbour seals in the east and north coasts have not been confirmed yet. Various causes have been speculated, some have been discounted but there is no evidence to support any one of these or indeed a combination of possible causes. SMRU have been working on resolving this problem for the last 15 years and are still no nearer to having a definitive answer[24]. A range of factors such as prey quality and availability, exposure to toxins/ harmful algae and competition for resources from grey seal, whose population size are considered to be at carrying capacity in Orkney waters, are currently considered to be the most likely critical drivers[25]. Although no evidence for coastal developments or vessel movement have been identified, these can't be ruled out as also contributing to declines directly or indirectly to harbour seal decline.

As stated above (Section 3.1.3) as grey seals are considered to be at carrying capacity and although there were limited harbour seal population estimates available before grey seal populations reached/ approached carrying capacity, it has been postulated that if grey seal populations are considered a major driver of harbour seal dynamics it may be that density related effects were already in place before monitoring began in Scotland.

[23] https://orcadianwildlife.co.uk/wPress/wildlife-to-enjoy/
[24] Email correspondence from John Baxter on 03/03/2025.
[25] Marine Scotland topic Sheet Number 33 (V2), Regional Differences in the Abundance Trends Amongst Harbour Seal Populations, available at: https://www.gov.scot/binaries/content/documents/govscot/publications/factsheet/2019/11/marine-scotland-topic-sheets-marine-mammals/documents/regional-differences-in-the-abundance-trends-amongst-harbour-seal-populations-updated-march-2017/regional-differences-in-the-abundance-trends-amongst-harbour-seal-populations-updated-march-2017/govscot%3Adocument/harbour-seal-populations.pdf (Accessed 27/05/2024)

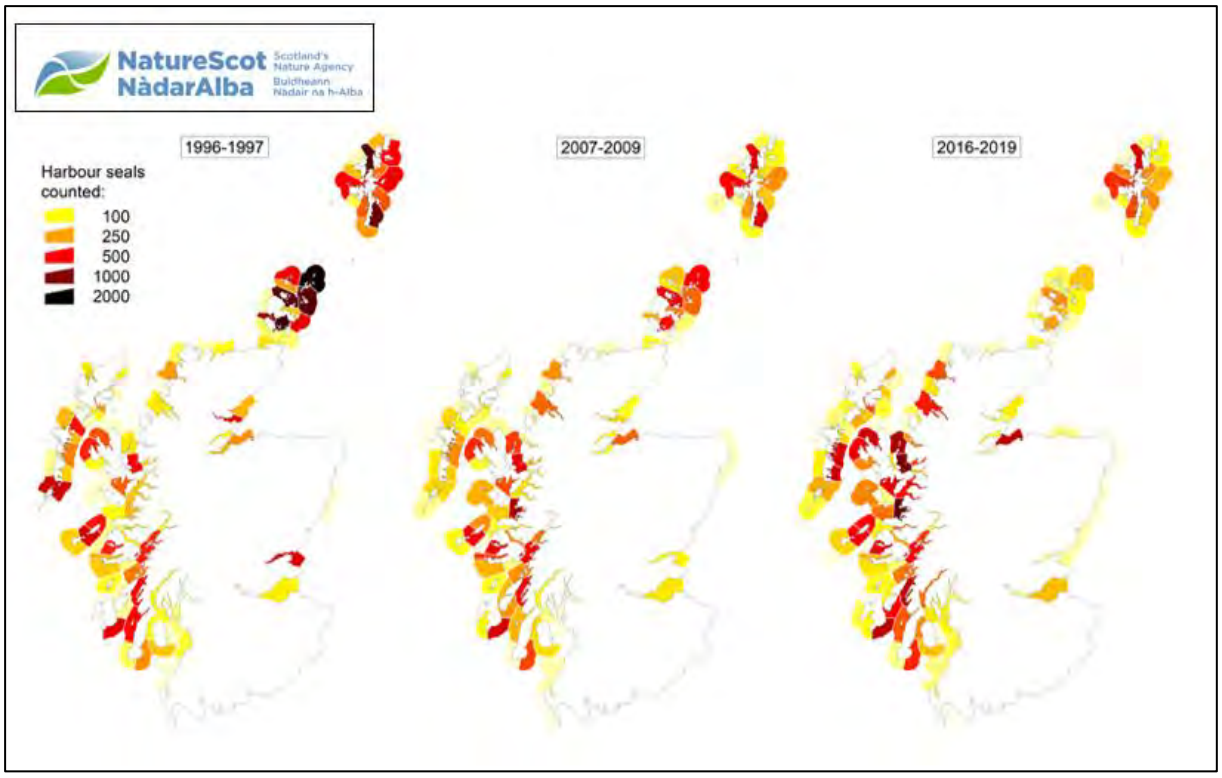


Figure 3-4: Maps showing the number of harbour seals counted during August over three time periods (1996-1997; 2007-2009 and 2016-2019) are detailed in NatureScot Research Report 1256

Harbour seals routinely travel 40-50km from their haul-out sites to forage and prefer more sheltered waters. In general, harbour seals are fairly loyal to a haul out site throughout the year and generally do not forage further than 50km from that site (although there are always exceptions to the rule). The waters within and surrounding the site are known to host fish and other suitable prey items for harbour seals. A total of 23 designated haul out sites for harbour seal (see Appendix C) are present within 50km of the SDWQ development, with 10 in the vicinity of the development activities. The nearest haul out site for harbour seals is 7km west of the site (Ve Ness). A SSSI (East Sanday Coast SSSI located 57km north east) and SAC (Sanday SAC located 56km north east) with harbour seal being a designated feature are located within 60km of the site. Although sat slightly greater distances than what harbour seals routinely travel, some individuals may therefore use the coastal waters within and adjacent to the site for commuting between haul outs and/or foraging.

Records of 420 out of 461 tagged harbour seals within UK waters (2001-2018) show a primarily coastal distribution, with concentrations of tagged seals in Hebrides, the Moray Firth, Orkney and Shetland, as detailed in Figure 3-5. However, telemetry data from 54 tagged harbour seals between 2003-2015 showed a lack of strong connectivity between sites they were tagged at (four from Sanday in 2003 and 12 from Eynhallow 2003-2015) and the SDWQ development site, as detailed in Figure 3-6.

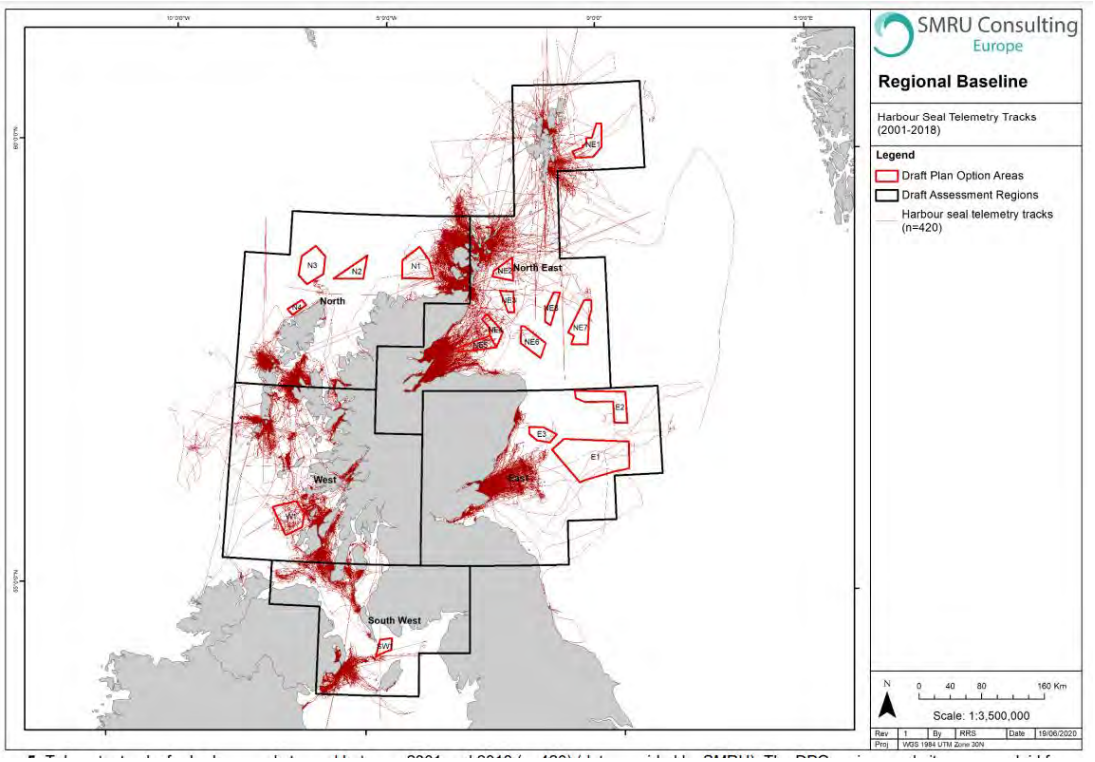


Figure 3-5: Telemetry tracked harbour seals (2001-2018)

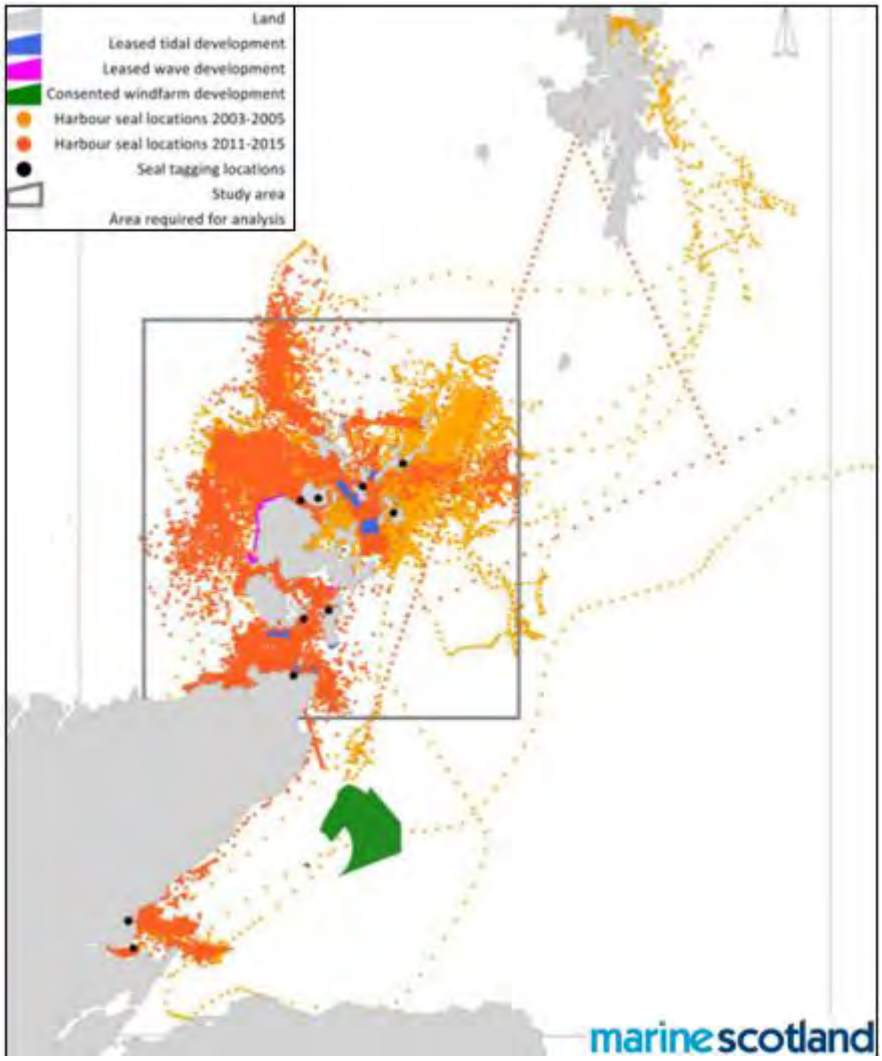


Figure 3-6: Map obtained from Marine Scotland and shows the tracks of 54 harbour seals included in the analysis (orange circles), their tagging locations (black circles)

Harbour seal distribution estimates show the mean number of harbour seals estimated to be present in each 5 km by 5 km grid cell at any one time, with that around the development site estimated to be 10-25 individuals per $5km^2$ as detailed in Figure 3-7.

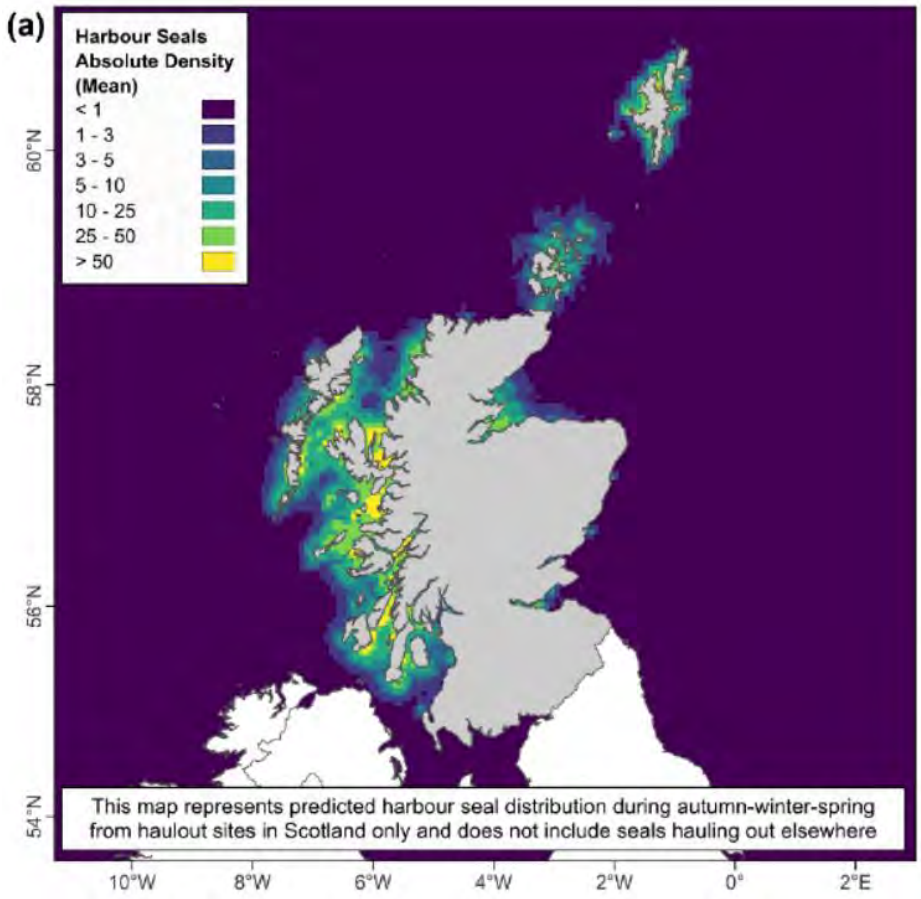


Figure 3-7: Map showing harbour seal distribution estimates. The mean number of harbour seals estimated to be present in each 5 km by 5 km grid cell at any one time. Image taken from Carter et al (2025).

Seal haul out data counts for harbour seal also show the important association with Orkney, as detailed in Figure 3-8.

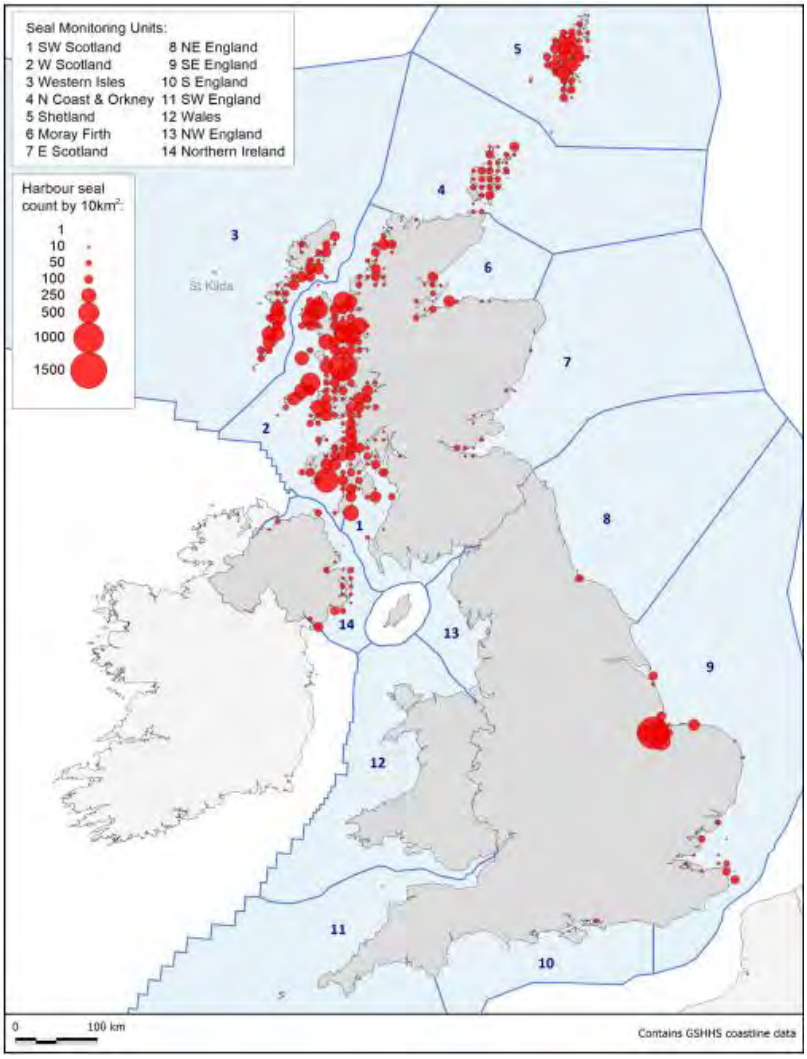


Figure 3-8: August distribution of harbour seals around the British Isles by 10km squares based on the most recent available haul out count data collected up until 2021. Map obtained from SCOS 2022.

SMASS have recorded 25 harbour seal strandings within 10km of the site between 1992-2023.

The site and adjacent coastline is considered suitable (by report authors) for use as a haul out by harbour seals due to the relatively low level of disturbance associated with the area and lack of human/ commercial/ vehicular activity. However, the site is near Scapa Pier, where vessels regularly commute to, past the site and the site is not within a designated site for harbour seal, as such is not considered that the habitat is suitable for use as a breeding or moulting haul out site. It is also considered to be too far from existing haul out sites (>7km) to cause disturbance. However, harbour seals may use the coastal waters within and adjacent to the site for commuting between haul outs and/or foraging, therefor there is a risk of disturbance to a small number from in water development works and vessel movements.

4 SEAL RISK ASSESSMENT

4.1 Activities Affecting Seals

4.1.1 Underwater Noise Producing Activities

The Marine Scotland 'Guidance for Scottish Inshore Waters: The Protection of Marine European Protected Species from Injury and Disturbance'[26] defines what disturbance means to marine mammals as: 'Changes in behaviour which may not appear detrimental in the short-term, but may have significant long-term consequences. Additionally the effects may be minor in isolation, but may become more significant in accumulation'. This is also considered applicable to seals. Therefore those disturbances which may be identified that are applicable to seals includes the following behaviour:

- Changes in (direction or speed of) swimming or diving behaviour;
- Certain surface behaviours such as increased alertness (head lifting); and
- Moving out of a previously occupied area.

The following negative effects are linked to disturbance:

- Displacement from important feeding areas;
- Disruption of feeding;
- Disruption of social behaviours such as communication, pupping, breeding, nursing, resting and feeding;
- Increased risk of injury or mortality;
- Increased vulnerability of an individual or population to predators or physical stress; and
- Changes to regular migration pathways to avoid human interaction.

At the time of underwater noise modelling being undertaken only exemplar tender designs were completed, with works originally involving dredging, piling and drilling, thus the exact details of the construction methodologies were unknown. However, to caveat for this the data used to inform the noise models was interpolated from equipment used on similar projects. Since the underwater noise modelling was undertaken, piling and associated drilling works have been removed from the design. Therefore, the construction method below is considered the most significant:

Dredging Method and Duration

Dredging for the project will involve a total of 379,407 m³ of material, comprising 72,653 m³ of hard dredge and 306,754 m³ of soft dredge, with up to 82,000 m³ of unsuitable glacial till potentially requiring sea disposal. A single dredge campaign is planned using a cutter suction dredger over an estimated twelve-week period from June to August 2028, covering the full quay alignment to depths of –15 m CD in most areas and –20 m CD in the deep pocket.

Dredged sediments will be pumped through a pipeline into a reclamation bund constructed to +4.0 m CD using screened site-won material, with an integrated weir box to manage overflow. Turbidity will be monitored outside the bund and silt booms deployed during infilling.

[26] https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2020/07/marine-european-protected-species-protection-from-injury-and-disturbance/documents/marine-european-protected-species-guidance-july-2020/marine-european-protected-species-guidance-july-2020/govscot%3Adocument/EPS%2Bguidance%2BJuly%2B2020.pdf

Ballast Water and Caisson Transport

Caissons will be transported to site on a semi-submersible vessel and kept dry during transit, which significantly reduces the risk of biofouling. After placement at Scapa Flow, ballasting operations will use local seawater, and some caissons may undergo temporary in-water wet storage before installation.

4.1.2 Increased vessel movement

Baseline Vessel Movements

Project have provided information on the current typical monthly vessel movements experienced within the eastern area of Scapa Flow. This baseline is derived from the Project NRA (see Appendix 2.3 of EnviroCentre, 2025a). Baseline vessel activity in Scapa Flow is characterised by a high level of diverse maritime traffic year-round, with AIS data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow—closest to the Project site—current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents only ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

Vessel Movements During Construction

As per Table 1-3, the construction phase will see a total of 112 vessel movements over the 26-month period. This includes: Caisson deliveries and tug operations; Scour protection trips; Caisson infill trips; and dredging disposal trips (barge to FI040).

Vessel movements during operation

As per Section 1.4.1. there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; see Technical Appendix 2.3 of EnviroCentre, 2024) and summarised in Section 1.4.1, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

4.1.3 Designated Sites

Harbour Seal from SACs and SSSIs

Harbour seals are not considered to be directly impacted whilst within the SAC and SSSI boundaries, due to the distance from the site. For example, the typical foraging ranges of harbour seals are in the range of 50km and with Sanday SAC, Eynhallow SSSI and East Sanday Coast SSSI all outside of this 50km buffer therefore harbour seal are at a low risk of being in the same vicinity of the impacts of the development. In addition, telemetry studies do not show strong connectivity between designated areas and the area for construction activities. Even where a seal from the SAC/SSSI was present in the

vicinity of the development (commuting/ foraging) it would likely not be exposed to injury and therefore disturbance would likely be limited as it is unlikely that the individual would be spending all of its time in that area, if it is returning to SAC/SSSI >50km away.

Grey Seal from SACs and SSSIs

Although grey seals can and do forage considerable distances, the Conservation Objectives for grey seal SACs (and SSSIs) are related to the protection of the breeding colony only. During this sensitive time, grey seals (especially females) do not tend to travel beyond 20km from these sites. Therefore, NatureScot advise screening in grey seal SACs and SSSIs for assessment only where a project site/impact radius is within 20km of the SAC or SSSI. As such, it is considered unlikely that grey seal individuals from the Fary and Holm of Faray SAC and Muckle and Little Green Holm SSSI would be exposed to injury and therefore disturbance would also be unlikely.

4.2 Cumulative Impacts

Other developments within Orkney are considered to have the potential to result in an in-combination effect for seals. The developments that have been considered for the in-combination assessment are listed in Section 9.2.2 and 9.3.3 of the HRA. Please refer to the HRA where this is discussed further.

4.3 Effects of Acoustic Impacts on Seals

The way in which noise affects marine mammals is dependent on several factors, including the type of noise generated, the noise level, the species of marine mammal and the distance between the animal and the source of the noise. The National Oceanic and Atmospheric Administration (NOAA) describes how different groups of marine mammals hear and are affected by sounds, which can be found in the *'Guidance for Assesing the Effects of Anthropogenic Sound on Marine Mammal Hearing'*[27]. The effects can be described as either a Permanent Threshold Shift (PTS), where an animal experiences irreversible damage to their hearing which can in turn affect their ability to forage and reproduce and in extreme circumstances result in death; or a Temporary Threshold Shift (TTS) which an animal can recover from but may experience 'masking' which reduces its ability to communicate with other animals and locate prey, resulting in fatigue[28].

Seals rely on their hearing for foraging, navigation, communication and locating threats. The impact of noise to a population level is difficult to determine, however the expected impact on an individual animal's hearing ability and potential damage that could be caused by noisy activities during construction is assessed by modelling representative scenarios, taking into account environmental variables and the animal's hearing capabilities.

Harbour seals are known to have the highest sensitivity to acoustic exposure of all tested pinniped species. Grey seals are also known to have a high sensitivity to acoustic exposure, however there is no published threshold audio data for grey seals, therefore it is assumed audio data for harbour seals to be the closest approximation for grey seals.

Both harbour and grey seals are vulnerable to increases in acoustic levels when underwater, from dredging, Harbour seals exhibit avoidance behaviour (haul out) when in close proximity to noise above background levels from vessel movement. Grey seals may exhibit avoidance behaviour by hauling out or creating distance from the underwater noise source.

[27] NOAA guidance available at: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm last accessed 05/03/2025
[28] JNCC UK Marine Noise Registry: Information Document available at: http://jncc.defra.gov.uk/pdf/MNR__Draft_InfoDoc_V1_20160808.pdf last accessed 05/03/2025

Two noise sources were considered for this assessment, but drilling was screened out as it was not considered loud enough to be meaningfully assessed in an environment with many vessels and general human activity. The underwater noise modelling provide a comparison of drilling noise with the other noise producing works and vessel noise which is depicted in Figure 4-1, below.

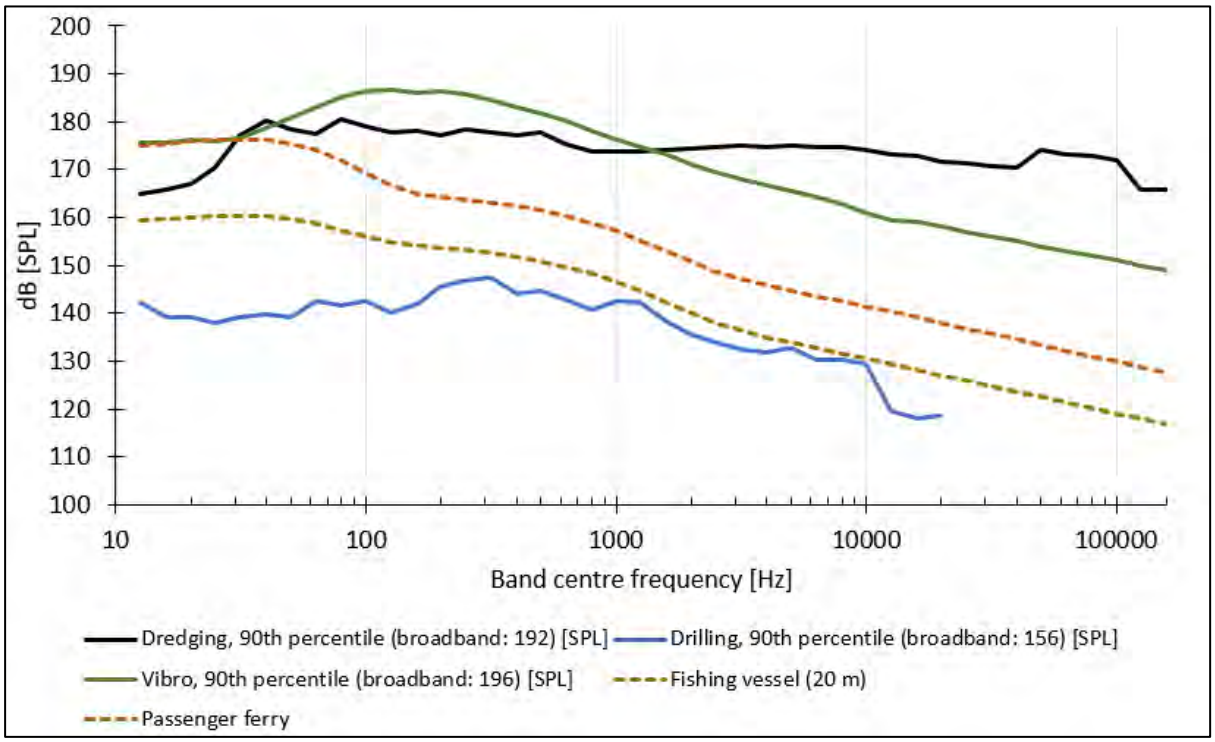


Figure 4-1: Underwater noise modelling figure 7.1 showing the three sound sources considered in the report, alongside a fishing boat and a small ferry for context.

Dredging

The noise from dredging, has short risk ranges for PTS for harbour and grey seal of <50m regardless of longevity (1-8hrs). There is no acute risk of noise related injury related to the dredging, and seals have time to swim away. TTS risk ranges span from 70 m to 250m from 1 to 8 hours dredging, respectively, however, this is only for animals staying close to the activity for extended periods (prolonged exposure). It is considered that any animals would move away from the noise source and so prolonged exposure is considered unlikely. Any effects will therefore be limited to temporary, short-range displacement of individuals, with normal behaviour quickly resuming once dredging ceases. Therefore, it is considered there is no acute risk of noise related injury related to dredging.

Additionally, the area around the Project site does not contain important breeding, mating or resting habitat for harbour seals (the nearest designated haul-out site is Selwick, located 4.5 km to the south), and alternative foraging habitat is widely available. Given that seals occur commonly in busy harbours, they are somewhat habituated to anthropogenic noise sources. As such, the consequences of disturbance are not thought to be significant and harbour seals are not considered to be sensitive to acoustic disturbance from continuous sound sources such as dredging.

Disposal of Dredged Materials

Following identification and screening of available disposal options by EnviroCentre[29], a combination of on land and at sea disposal were considered the most appropriate options. At sea disposal (within the disposal site) would only consist of material considered unsuitable for construction works i.e. material

with high silt content. At sea disposal was considered as it would require minimal transportation requirements and low environmental risk. The selected licensed marine waste disposal site which has been 'open' since 2020, is located 24km from the proposed SDWQ development site. It has been agreed that disposal of any dredge arising, to sea, will take place out with the SPA (disposal site FI040). It is assumed that 4,000m^3 capacity barge(s) will be used to transport material to the offshore disposal site.

The disposal site is < 4.5km from a designated seal haul out site (Selwick) for grey and harbour seals, therefore both seal species associated would likely forage and commute as well as haul out on land in proximity to the disposal site. However, the last counts for the Selwick haul out site recorded only 17 harbour seal and 117 grey seal, with numbers generally considered low. In addition, the disposal site has been active since 2020, and therefore it is likely that seals within the Selwick haul out site would have become relatively used to vessels travelling to and disposing dredge materials over the past five years it has been open.

Comparisons of dredging sound for all activities associated with dredging (dredging itself, transit, placement, pumping and rainbowing – aerial discharge of dredged material in a fountain) for a 2,000ha harbour extension of the Port of Rotterdam using modelling revealed that rainbowing had the second lowest sound levels recorded out of all elements of the dredging activities (sediment consisted of sand)[30]. As such, with dredge noise levels for the SDWQ project having short risk ranges of PTS (<50m) and TTS (250m), based on the modelling example, it could be assumed that disposal would have reduced risk ranges of noise output on seals.

General Disturbance

Disturbance to seals may occur as a result of the works occurring. The most likely disturbance to seals as a result of the noise related activities include both physiological (increased stress and cortisol levels, rapid heartbeat, increased breathing rate, coldwater shock (if on land)) and behavioural disturbance (increased vigilance, crash diving, flipper splashing and vocalisation)[31].

The National Marine Fisheries Service (NMFS) predicts that seals (and other marine mammals) are likely to be behaviourally harassed when exposed to underwater noise levels of 120dB during continuous sources such as vibratory piling or drilling, and 160dB for non-explosive, impulsive sources, such as impact pile driving, whilst for underwater explosive sources where multiple detonations occur within a 24 hour period, the behavioural threshold is -5dB from TTS onset[32]. It is important to note that there is no requirement for piling or drilling associated with the caisson design

It is expected that both seal species would be likely to exhibit a behavioural change as a result of the noise, when in water, predominantly fleeing away from the noise source, with vocalisations and splashing occurring. In addition, physiological stress is likely to also occur. This could impact seals energy and fitness levels through disturbing foraging or causing avoidance of feeding areas for periods of time.

Seals are considered to be more easily disturbed when on land. However, due to the distance of the nearest seal haul out to the development site, it is not considered that seals would be disturbed or exhibit behaviours such as tombstoning and stampeding, as the noise levels associated with the works would not extend this far.

[31] https://britishcanoeingawarding.org.uk/wp-content/files/Seal_Disturbance_Factsheet.pdf
[32] NMFS Summary of Marine Mammal Acoustic Thresholds

4.3.1 Individuals Impacted (Quantitative Data) - Disturbance

Based on the methods in Section 2.3 the estimated number of individuals that could be disturbed for grey and harbour seals are presented in Table 4-1.

Table 4-1: Individuals Impacted (General Disturbance)

Species	Step 1: Maximum Disturbance Buffer and No. grid Squares	Step 2: Density Estimates per km^2	Step 3: Individuals within 5km
Harbour seal	5km (6 grid squares)	Mean Absolute Density estimates of 6 grid squares equate to 99.289 per 25 km^2. 99.289/ 6 (grid squares)/ 25 (km^2) = 0.662 per km^2	At sea area covered by a 5km buffer equates to 49.42 km^2. 0.662 per km^2 X 49.42 km^2 buffer area = 32.71 (33 individuals)
Grey seal	5km (6 grid squares)	Mean Absolute Density estimates of 6 grid squares equate to 449.2 per 25 km^2. 449.2/ 6 (grid squares)/ 25 (km^2) = 2.99 per km^2	At sea area covered by a 5km buffer equates to 49.42 km^2. 2.99 per km^2 X 49.42 km^2 buffer area = 147.996 (148 individuals)

Conclusion

The quantitative data shows that a maximum of 33 harbour seals and 148 grey seals could be disturbed from noise related activities within a 5km buffer. However, the 5km disturbance buffer is a worst-case scenario and therefore actual numbers would likely be lower than calculated above and thus the potential for disturbance is limited.

4.4 Effects of Water quality in relation to dredging

Increases in suspended sediment concentration (SSC) arising from project dredging activities during construction have the potential to affect harbour seals indirectly by altering the availability or behaviour of their prey.

As outlined in section Technical Appendix 4.1, Volume 3 of the EIAR (EnviroCentre, 2023), the marine deposits within the dredge area comprise an approximate stratigraphic order of superficial marine deposits (loose to medium dense gravelly silty sands with shell fragments and occasional cobbles) overlying glacial till. A Dredging Best Practicable Environmental Option Report (BPEO) has been produced for the proposed development which identifies the dredge budget to consist of approximately 17% gravel, 60% sand, and 23% silt and clay.

Hydrodynamic modelling summarised in Technical Appendix 4.1, Volume 3 of the EIAR (EnviroCentre 2023) show little impact on the surrounding water column and seabed due to the low energy environment in this part of Scapa Flow. Therefore Section 8.4.1 of the EIAR (EnviroCentre, 2023) concluded that impacts on prey species for harbour seal are expected to be negligible such that their

abundance and general distribution remains unchanged from the baseline. In addition, the magnitude or the sediment discharge and dispersion from dredging works will be low within the dredge area and its immediate vicinity, and negligible out with this area. Thus, the supporting habitats for harbour seal beyond the development footprint will be maintained.

Proposed reclamation fill activities could also result in plumes and increased SSC, with a resultant impact on prey species. The fill material will be a mixture of sediment locally generated by quarries and dredging, the coarse nature of which, in combination with locally weak tidal currents, will limit the duration and spread of any plume generated.

Chapter 5 of the EIAR (EnviroCentre, 2023) states that impact on prey species will be temporary and spatially restricted (Section 5.6.3.1 of EnviroCentre, 2023) and confirmed that there is sufficient alternative habitat for foraging and commuting for harbour seal individuals.

Construction impacts to fish species, from underwater noise and pollution, was assessed as being of low magnitude and not significant in the EIAR (EnviroCentre, 2023), due to the limited spatial extent (i.e. restricted to discrete areas near the dredging and reclamation areas), the relatively short-term duration (as it is limited to the duration of the dredging activities), intermittent nature and high reversibility.

As a precautionary measure during construction, the project proposes to undertake turbidity monitoring to protect water quality and ensure minimal environmental impact. The project proposes to monitor sediment re-suspension levels to prevent damage to the local ecosystem and aquaculture as high sediment concentrations can contribute to suboptimal conditions and may harm aquaculture fish since it affects the overall ecological balance and the fish have restricted movement. By monitoring turbidity, the project can determine potential impacts on the environment and implement corrective actions. Furthermore, silt booms will be utilised to contain fine sediments while reclamation works are undertaken, to minimise the spread of sediments and thus disturbance to prey species in the marine environment.

Measures such as silt booms and careful dredging protocols will act to limit sediment disturbance and prevent the release and dispersal of sediments.

Any SSC increases will be confined to a very small spatial area and short-term duration and will not extend into wider foraging grounds used by harbour seals from the Sanday SAC. The supporting habitats for prey species beyond the project site will therefore remain unaffected. Based on this and the mitigation measures outlined above, there is no credible mechanism by which SSC arising from the project could lead to reduced foraging success or altered behaviour of harbour seals linked to the SAC by indirectly impacting prey species.

Overall, the associated risk of degradation of water quality directly associated with the proposed disposal and thus impacts to seals is considered to be low i.e. unlikely to cause a change in status of the waterbodies in question at both the dredge and disposal sites.

4.5 Effects of Terrestrial Noise from Blasting

Disturbance of seals on land or when ‘bottling’ (head above water at sea) could be caused by noise associated from terrestrial blasting, which could have a negative impact on seals.

Although the majority of energy generated within the atmosphere from any surface mineral blasting will be of a sub-audible nature, there will also be a component that is audible, i.e. at frequencies greater than 20 Hz, and as such can be heard as noise and measured in terms of dB(A).

Routine blasting operations regularly generate air overpressure levels at the closest point to blast area of around 120 dB and the NMFS predicts that harbour seals exposed to ≥ 90 dB (in-air) will be behaviourally harassed, with other species at ≥100 dB. However, the intensity of these noise levels experienced at a distance from the blast site are affected by a range of meteorological conditions (wind speed and direction, temperature, cloud cover and humidity). For example, if a blast is detonated in a motionless atmosphere in which the air temperature is constant, then the air overpressure intensity will decrease purely as a function of distance and will, once outside of the immediate vicinity of the blast, reduce by 6 dB as the distance from source doubles. Although such conditions are very rare, the overall result is that the nominal 6 dB reduction may be greater in some directions from the source and less in others.

A 6m high bund will be formed at the seaward boundary of the site by retaining the existing land and excavating behind, creating a natural noise screen from terrestrial blasting (and other works) and will only be removed once the site is excavated to the final profile. This would reduce the effects of noise on seals on land. Furthermore, a 10-minute pre-work search is to be implemented to ensure that no seals (or other marine mammals) in the marine environment are in the vicinity of the works that could be impacted.

In addition to bunding, a range of other controls and mitigation measures can and should be implemented when undertaking terrestrial blasting, including screens to further dampen sound, which would also reduce the effects of noise on seals on land or at the water's surface.

As the distance of the nearest seal haul-out site is 7km west of SDWQ, therefore due to the implementing of a 6m high bund and the 6 dB reduction as the distance from the source doubles, and that when sound waves pass a given position, the pressure of the air rises very rapidly then falls more slowly then returns to the ambient value after a number of oscillations, it is unlikely that seals using regular haul out spots, or those at sea at the water's surface will be negatively impacted to a population level from terrestrial noise associated with blasting.

4.6 Effects of Increased Vessel Movement on Seals

Vessel movements of approximately 42 vessel movements over a 12-week period (between June – August 2028) are expected for the dredge disposal for the Project. 70 vessel movements are expected for works associated with caisson delivery, scour protection and caisson installation. This equates to 112 vessel movements in total during construction, which is considered a relatively low number of vessel movements over the length of the period of works (26 months in total).

During the operational phase, the estimated number of vessels calling at the Project Quay in the operational phase is 96 per year (192 vessel movements), comprising 28 large vessels and 12 smaller vessels per year. Each of the 28 large vessels will have two associated pilot boat (2 vessel movements). In total, the estimated vessel movements per year is 192. The majority of these vessels (approximately 80 %) are expected to occur during the summer months (April – September), so there will be an increase of 26 vessel movements per month in summer and 6 per month in winter.

All vessels will follow designated shipping lanes, with the only area of increased vessel being the route of 2.9km (1.6 nautical miles) leading from the main shipping lane into the SDWQ.

Overall, there will be a small increase in the number of vessels in the SDWQ area, associated with the construction and operational phases of the project, with vessels mainly using existing shipping routes and the works are considered to be temporary in nature, however, more vessels increase the risk of collision with seals, potentially resulting in death or injury to individuals.

The construction phase will require a variety of vessels that differ in size, speed and operating procedure. This can result in seal collision risk levels for different vessels and SDWQ development activities. Although larger vessels have a greater footprint and therefore may be considered more likely to make encounters with seals, the speed at which smaller vessels travel can be more detrimental to seals.

Presence of vessels can induce a vigilance/alert response in seals, considered to be attributed to similar behavioural responses to predator detection, foraging, observation of conspecifics, kleptoparasitism avoidance, and social cohesion maintenance[33]. Not only does this result in physical disturbance but also other costs (rest, locomotion, not foraging, not mating etc.) to seals.

However, research undertaken by the Sea Mammal Research Unit involving a telemetry-based study of the swimming behaviour of seals was carried out in the Moray Firth to compare seal and vessel movements with the purpose of identifying potential areas with high spatial overlap. The observations of movements of individual seals and vessels did not show any apparent responses, with seals not appearing to react to close passing vessels (not moving towards nor away from them)[34].

In addition, a study undertaken by Cates, Kelly and Acevedo-Gutierrez, Alejandro (2017)[35] looked into harbour seal tolerance to vessels under different levels of boats and identified that harbour seals tended to respond by flushing more readily then at high activity sites. Harbour seals located in areas where vessel activity was low were less tolerant to passing vessels, whilst harbour seals located in areas where vessel activity was high. They found that harbour seal located at the sites with higher vessel activity appeared to have developed a tolerance to disturbances and were more likely to ignore passing vessels, unless closely approached. With Scapa Flow in general being a highly active area for vessel movements, it is likely that seals within these waters would be habituated to vessels and that an increase in numbers during construction or operation would likely cause limited disturbance.

As well as disturbance, mortality of seals can occur from vessel strikes. Using data of stranded harbour seals in the Salish Sea from 2002–2019, Olson et al identified 27 cases of fatal propeller strikes, with weaned pups being the most frequently affected (64% of cases)[36].

The likelihood of vessel collisions is dependent upon vessel speed, animal behaviour and vessel manoeuvrability[37]. Vessels travelling at slower speeds in general can allow time for seals and vessel operators to react to avoid collisions.

Therefore, the effects of these impacts from vessels will be highly localised around the established shipping routes. As the majority of the vessel routes will be using existing routes, seals will likely already be habituated to vessels in those areas and/ or avoid the area already. In the area of increased vessel activity close to the project site, there is a greater likelihood of vessel collision with seals, however, the vessel numbers in this area are very low, as stated above, and over time, seals would likely become habituated to vessels using this route. The SPP will be adhered to during operation. This includes limits on vessel speed.

Vessel movement protocols secured via adherence to the Vessel Management Plan would further mitigate risk of vessel collision to harbour seals.

[33] https://www.seawatchfoundation.org.uk/wp-content/uploads/2012/08/Kate-Lewis-thesis.pdf
[34] https://data.marine.gov.scot/sites/default/files/SMFS%20Vol%207%20No%2024.pdf
[35] Cates, Kelly and Acevedo-Gutierrez, Alejandro. (2017). Harbor Seal (*Phoca vitulina)* Tolerance to Vessels Under Different Levels of Boat. Aquatic Mammals. 43. 193-200. 10.1578/AM.43.2.2017.193
[36] J.K. Olson; D.M. Lambourn; J.L. Huggins; S. Raverty; A.A. Scott; J.K. Gaydos (2021) Trends in Propeller Strike-Induced Mortality in Harbor Seals (Phoca vitulina) of the Salish Sea. Journal of Wildlife Diseases. Vulme 57. Issue 3. Pages 689-693
[37] SEER U.S. Offshore Wind Synthesis of Environmental Effects Research: Presence of Vessels: Effects of Vessel Collision on Marine Life (2022): https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Effects-of-Vessel-Collision-on-Marine-Life.pdf

Overall, the risk of injury or disturbance from vessels is considered minimal, and any effects are expected to be highly localised. The introduction of project vessels during construction and operation is not considered to be a substantive increase to baseline vessel movements. As such, when considering the proposed mitigation measures, it can be concluded that the predicted impacts on seals would be limited.

4.7 Conclusion

There is a clear decline in harbour seal populations based on reviews of population data over the years. However, although the cause for the decline has not yet been identified, coastal developments or vessel movements are not considered to be linked.

Some of the activities associated with the SDWQ development (dredging and vessel movement) have the potential to cause disturbance, injury or in extreme circumstances, death to individual seals. For the most part the activities associated with the proposed development will result in temporary avoidance of a small area of habitat available to individuals. It is considered that with mitigation described in the following Seal Mitigation Plan (SMP) the risk of death and injury will be greatly decreased. It is not possible to rule out some level of disturbance to individuals which might be present within the area.

It is considered that due to the distance from designated sites and haul out sites, the relatively small area over which individuals are likely to be affected and the temporary nature of the works, there will not be an overall negative effect on the favourable conservation of the local seal population.

5 SEAL MITIGATION PLAN

The seal mitigation will comprise a standard Marine Mammal Observation Protocol (MMOP) as per JNCC guidance will be implemented during dredging operations in sea states less than 4 and during times of optimal visibility

5.1 Seal Observation Protocol

The Seal Observation Protocol (SOP) will be implemented so that the construction and dredging works do not cause injury or unnecessary disturbance to seals. This section has been designed with reference to current JNCC guidance 'Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise' (August 2010) [38] [39]. Note, no piling is required as a result of the caisson design.

5.1.1 Marine Mammal Observer

A suitably qualified Marine Mammal Observer (MMO), competent in the identification of seals at sea, will be present during the dredging. The MMO will undertake observation for seals within the mitigation zone before and during the dredging and will be dedicated to that one task for the duration of any watch. The MMO will advise the contractors and crews on the implementation of the procedures set out in the agreed protocol, to ensure compliance with those procedures.

The JNCC guidance provides the following definitions of an MMO:

MMO: Individual responsible for conducting visual watches for seals. It may be requested that observers are trained, dedicated and/or experienced.

Trained MMO: Has been on a JNCC recognised course.

Dedicated MMO: Trained observer whose role on board a vessel is to conduct visual watches for seals.

Experienced MMO: Trained observer with three years of field experience observing for seals, and practical experience of implementing the JNCC guidelines.

The MMO will be, positioned appropriately to cover the full mitigation zone and will be trained. The identity and credentials of the MMO will be agreed with Marine Directorate.

5.1.2 MMO Equipment

The MMO will be equipped with binoculars (10X42 or similar) and/or a spotting scope (20-60 zoom or equivalent), a copy of the agreed protocol and the Marine Mammal Recording Form (MMRF), which is a Microsoft Excel spreadsheet containing embedded worksheets named Cover Page, Operations, Effort and Sightings. A Microsoft Word document named Deck forms is also available, and the MMO may prefer to use this when observing before transferring the details to the Excel spreadsheets. Although these forms were developed for seismic surveys, they can be used for dredging operations,

[38] https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf

[39] It should be noted that these protocols do not document measures to mitigate disturbance effects but have been developed to reduce to negligible levels of risk of injury or death to marine mammals in close proximity to piling operations or explosives.

although many columns will not be applicable. The ability to determine the range of seals is a key skill for MMOs, therefore a hand-held rangefinder will be used to verify the range.

All MMO forms, including a guide to completing the forms; and instructions on how to make a rangefinder are available on the JNCC website: http://jncc.defra.gov.uk/marine/seismic_survey

5.1.3 Communication

The contractor will be responsible for the communication channels between those providing the mitigation service and the crews working on the dredging. A formal chain of communication from the MMO to the contractor, who will start/stop dredging, will be established. In order to confirm the chain of communication and command the MMO will attend any relevant pre-mobilisation meetings.

5.1.4 Mitigation Zone

Following appointment of contractor / Ecological Clerk of Works (ECoW), logistical information will be available/ updated to provide more detailed mitigation zones for the MMO. This may change throughout the construction period due to ground levels changing and depending on the area of works which need to be viewed.

The JNCC guidance defines the mitigation zone as a pre-agreed radius around dredging site prior to any works. This is the area where a MMO keeps watch for seals (and delays the start of activity should any seals be detected). The extent of this zone represents the area in which a seal could be exposed to sound/ disturbance that could cause injury. The MMO should be located on the most appropriate viewing platform to ensure effective coverage of the mitigation zone. The radius of the mitigation zone should be 800m (to account for all marine mammals and basking shark) for dredging to cover the PTS and TTS ranges of the activities.

5.1.5 Dredging Protocol

Following appointment of contractor / Ecological Clerk of Works (ECoW), logistical information will be available/ updated to provide more detail regarding dredging protocols.

The standard JNCC protocol is outlined below:

1. The MMO should be situated in a location that provides the best viewing platform and is likely to be closest to the dredging activities. For example, an elevated area of the coast or a vessels bridge that allows 360 degree cover (depending upon the size of the mitigation zone more than one MMO viewing platform (and therefore more than one vessel) may be required to ensure that the entire mitigation zone can be observed).

2. At least 30 minutes before any dredging, a visual watch, known as the ‘pre-works search’, should be carried out in the mitigation zone. The pre-works search should continue until the MMO advises that the mitigation zone is clear of seals, and the dredging works can start.

3. The MMO will scan the waters using binoculars or a spotting scope and by making visual observations. Sightings of seals will be appropriately recorded in terms of date, time, position, weather conditions, sea state, species, number, adult/juvenile, behavior, range etc. on the JNCC standard forms. Communication between the MMO and the contractor and the start/end times of the activities will also be recorded on the forms.

4. Dredging should not be undertaken within 20 minutes of a seal being detected within the mitigation zone.

5. If a seal is observed, within the mitigation zone, it should be monitored and tracked until it moves out of range. The MMO should notify the relevant chain of command of the detection and advise that the operation should be delayed. If the seal is not detected again within 20 minutes, it can be assumed that it has left the area and the works may commence.

6.The MMO or ECoW should periodically check the silt boom to ensure that no seals have been enclosed or interacted with the boom during works.

5.1.6 Reporting

As per the JNCC guidance, reports detailing the dredging activity and seal mitigation (the MMO reports) will be sent to Marine Directorate at the conclusion of these activities. Reports will include:

- Completed MMRFs;
- Date and location of the dredging activities;
- A record of all occasions when dredging occurred, including details of the duration of the pre-dredging search, and any occasions when dredging activity was delayed or stopped due to presence of seals;
- Details of watches made for seals, including details of any sightings, and details of the dredging activity during the watches;
- Details of any problems encountered during the dredging activities including instances of non-compliance with the agreed dredging protocols; and
- Any recommendations for amendment of the protocols.

5.1.7 Terrestrial Noise Considerations - Blasting

Following appointment of contractor logistical information will be available/ updated to provide more detail regarding terrestrial blasting protocols and blasting methods will be determined by the contractor once commissioned.

The MMO protocol implemented for dredging will also be undertaken for terrestrial blasting. However, a 10-minute pre-work search would be required rather than a 30-minute pre-works search.

In addition, the following mitigation methods should be considered to be implemented for terrestrial blasting:

During terrestrial blasting, minimising air overpressure at the source, such that, even under unfavourable weather conditions, all such energy is within acceptable criteria at distance, remains the best practicable approach. It is an approach that all surface mineral sites are obliged to follow under the provisions of The Quarries Regulations 1999.

Detonating cord should be used as sparingly as possible, and any exposed lengths covered with as much material as possible. Just a few feet of exposed cord can lead to significant amounts of audible energy and, hence, high air overpressure levels. Stemming release can be controlled by detonation technique, together with an adequate amount of good stemming material. It should be noted however that detonation cord and stemming release have been virtually eliminated with the use of in hole initiation techniques.

If the use of exposed detonating cord is avoided the characteristic noise of a blast is no longer a sharp crack but rather a dull thump. This is partly due to the detonating sequence and partly due to natural energy dissipation and reduction. Whilst some of the noise perceived by a neighbouring resident would be directly from the blast itself, the lower frequency components of the air overpressure might well induce secondary rattling of windows and ornaments within a property which could augment the overall effect.

Thus, in terms of noise control or reduction in the care and attention to blast design and subsequent implementation, including initiation, necessary for the control of air overpressure is equally applicable to noise.

BS 6472-2:2008 states that "The highest [air overpressure] levels normally measured in the United Kingdom are generally less than 1% of the levels known to cause structural damage." Therefore, by implementation of the best practice measures, effects due to air overpressure generation by the Proposed Development are anticipated to have a negligible effect on seals in terrestrial environments.

5.2 Vessel Movement Mitigation Protocol

The Harbour Authority implement speed restrictions on vessels within Orkney waters, additionally, leaflets can be created to provide additional advice to port users to avoid disturbance to and/or collision with seals during construction which should include, but is not limited to the following:

- A strict speed limit for marine traffic, including dredge disposal works, will be implemented to reduce risk of collision with seals (4 knots within the water).
- Implementation of a Vessel Management Plan including agreed routes, speed limits and incorporation of the Scottish Marine Wildlife Watching Code[40].
- Safe vessel operation to minimise risk of collision with seals to be promoted to users. Training courses such as those provided by the WiSe scheme[41] could be offered at regular intervals.

Additionally (where possible) leaflets can be created to provide additional advice to quay users to avoid disturbance to and/or collision with seals which should include, but is not limited to the following:

- Keep a safe distance from seals. Never get closer than 100m (200m if another boat is present), but if within 100m, switch the engine to neutral;
- Never drive head on to, or move between, scatter or separate seals. If unsure of their movements, simply stop and put the engine into neutral;
- Spend no longer than 15 minutes near the animals;
- Special care must be taken with mothers and young;
- Maintain a steady direction and a slow 'no wake' speed; and
- Avoid sudden changes in speed.

Wildlife code of conduct methods have been created by NatureScot and are available on their website[42].

[40] https://www.nature.scot/doc/scottish-marine-wildlife-watching-code-smwwc
[41] Information available at: https://www.wisescheme.org/ (accessed 02/06/2023)
[42] https://www.nature.scot/sites/default/files/2017-06/Publication%202017%20-%20The%20Scottish%20Marine%20Wildlife%20Watching%20Code%20SMWWC%20-%20Part%201%20-%20April%202017%20%28A2263518%29.pdf

5.3 Additional Good Practice Recommendations

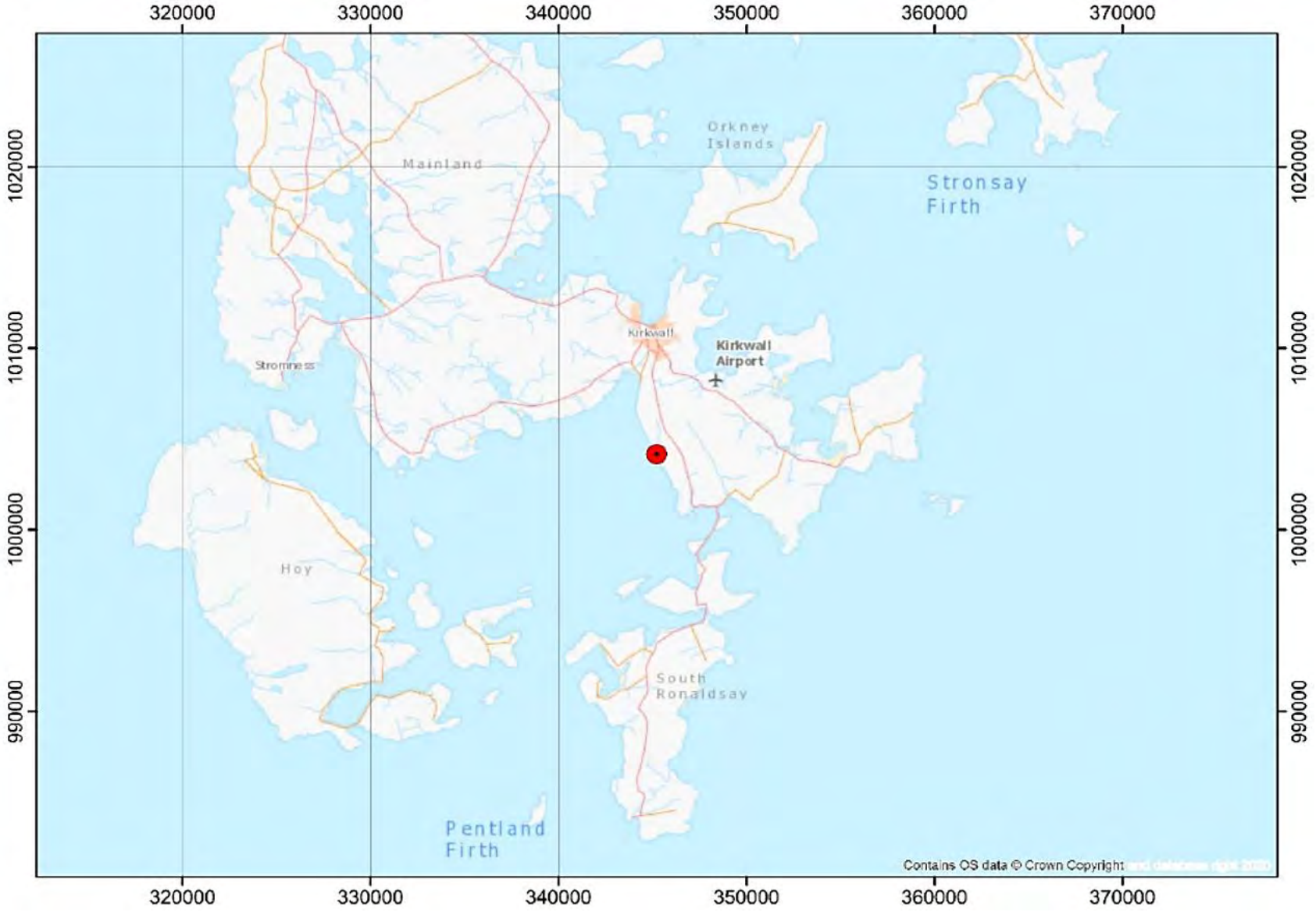
If any dead seal is anecdotally observed during construction, it should be reported to the Scottish Marine Animal Stranding Scheme (SMASS) (www.strandings.org) and live seals in distress will be reported to British Divers Marine Live Rescue (www.bdmlr.org.uk). All dead or distressed seals should also be reported to the local NatureScot office.

The MMO should keep a record of all seal sightings, whether in the mitigation zone or not, to be issued to NatureScot. An understanding of the location of species is essential to appropriately assess the impacts of a proposed development and plan and target effective mitigation, therefore this data could be used to inform future projects. Biodiversity data are extremely important as, aside from use in planning and decision making, they are key to delivering state of environment reporting, education, modelling trends in species and habitat distribution, and research and policy making.

APPENDICES

A PROPOSED SDWQ LOCATION AND DISPOSAL SITE FI040

Site Location



Location of Disposal Site FI040

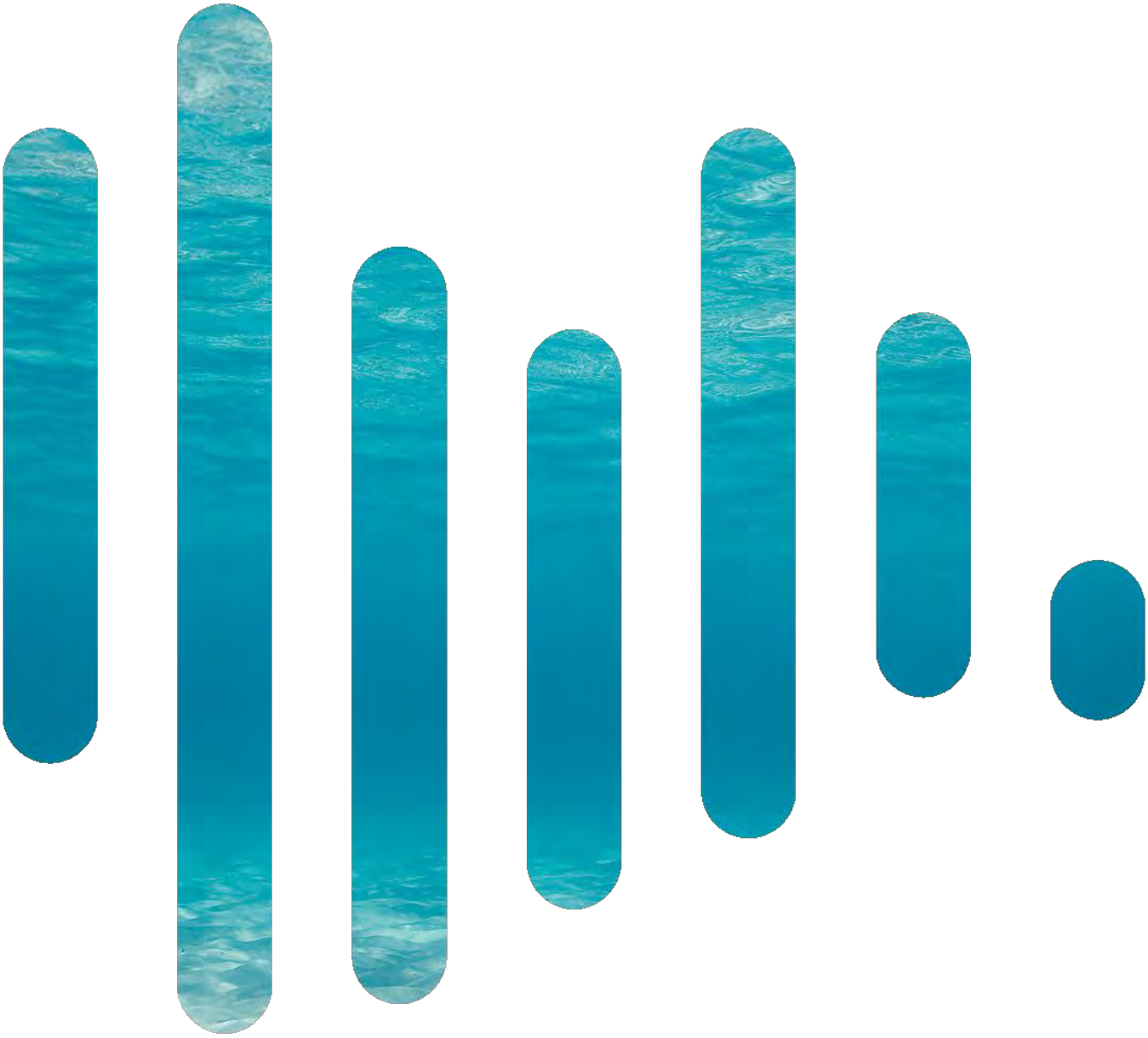


Source: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=712

B UNDERWATER NOISE MODELLING REPORT

Note – Piling and Associated Drilling No Longer Required for the Caisson Design)

IRWIN CARR
CONSULTING



Scapa Deep Water Quay, UW Noise Modelling

Kirkwall, Orkney

RP001 Rv4 2022248 (Scapa DWQ, UW Modelling)

19 May 2025

PROJECT: SCAPA DEEP WATER QUAY, UW NOISE MODELLING

PREPARED FOR: ENVIROCENTRE

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EXECUTIVE SUMMARY

BRIEF DESCRIPTION OF WORK

In relation to the construction of a deep-water port in Scapa Flow, both dredging, drilling and piling is planned. The noise from these activities can adversely affect local fauna either through direct injury of sensory systems or indirect harm from noise pollution drowning out communication and foraging sounds. Noise modelling has been carried out in respect to the various noise sources and local animals to estimate impact from noise and what mitigation can/needs to be employed to keep impacts below levels of significant harm to the local wildlife.

Source sources (dredging, piling and blasting) are modelled from a combination of empirical models (based on recorded data) and numerical models (calculated source levels from inputs).

CONCLUSION & RESULTS SUMMARY

Dredging

The noise from dredging, while presenting a significant Permanent Threshold Shift (PTS (hearing injury) risk to ranges <210 m for the Very High Frequency (VHF) group (e.g., porpoise), this is only for animals staying close to the activity for extended periods (> 1 hour) and assumes continuous dredging with the dredger level as given by the 90th percentile. For the best estimate (model mean) the PTS risk range is 210m after 8 hours exposure. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away. Further the area ensonified does not “block” access through a channel or strait.

Vibro piling

Prolonged exposure to vibro piling at close range (<50 m) carries some auditory risk for the animals assessed, specifically groups LF, VHF and P- (baleen whales, porpoises and salmon/trout), where the peak pressures in the noise have risk ranges up to 300 m for the VHF group. We therefore suggest surveillance takes place prior to piling to minimise the risk of impact on porpoises. While this is a significant risk for animals close to the activity, we stress that we have used a very conservative approach to estimating the source levels, and the realised emission will likely be significantly lower.

Further, animals will tend to move around, or away from noise, which will limit exposure. In Figure 16, p. 23 and Figure 18, p. 24 we show an example of the effect of using moving receivers (animats, modelled animals) to estimate what might be the effect of movement.

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Abbreviations and Definitions:

PTS	Permanent Threshold Shift
VHF	Very High Frequency
SOFAR	Sound Fixing And Ranging
SSP	Sound Speed Profile
SPL	Sound Pressure Level
Hearing group	Refers to the Southall 2019 hearing groups (Southall, et al., 2019).
"," and "."	Comma "," is used as thousands separator, while dot "." Is used as decimal separator.
TL, PL	Transmission Loss, Propagation Loss. Used interchangeably in this document.
Psu	Practical salinity unit, equivalent to parts per thousand as g/kg, mass of salts per mass of water.
Noise	Sound that causes, or is assumed to cause, annoyance or disadvantage. No automatic significance of impact is associated with this term.
Solver	Mathematical algorithm for calculating sound transmission losses in water.
[]	Square brackets are used throughout to denote units, e.g.: "Pressure [Pa]" means pressure in Pascals.
Degrees	Either angular degrees (0-360) or degrees Celsius
3rd octave, decidecade	Refers to the subdivision of octaves (doublings of frequency) and decades (10x frequency). Using the appropriate base frequency, the two are identical for practical purposes.
Worst case	Used as "reasonable worst case". E.g. use of MHWS instead of historical maximum for max water level. Or 90th percentile as representative of worst-case.
Mean case	The expected case, both median and mean values will inform this.
Signature, Impulse	When in relation to a sound, this refers to the time-pressure signal associated with that sound, normally as a time-series of pressures relative to ambient pressure, in pascals.
Vibro	Vibration pile driving
MSL	Mean Sea Level
β, Log multiplier	Symbol used to denote the factor multiplied by the base ten Log in equations like: "$TL = \beta \times Log_{10}(range)$"
SL, Source level	Apparent monopoint source level as viewed from the acoustic far field

1 INTRODUCTION

In relation to the construction of a deep-water port in Scapa Flow, both dredging, drilling and piling is planned. The noise from these activities can adversely affect local fauna either through direct injury of sensory systems or indirect harm from noise pollution drowning out communication and foraging sounds. Noise modelling has been carried out in respect to the various noise sources and local animals to estimate impact from noise and what mitigation can/needs to be employed to keep impacts below levels of significant harm to the local wildlife.

Source sources (dredging, piling and blasting) are modelled from a combination of empirical models (based on recorded data) and numerical models (calculated source levels from inputs).

1.1 Underwater Acoustics Basics

Underwater acoustics modelling is the application of physical models to characterise the behaviour of sound in environments under the surface of the sea and in the top layers of the seabed. As some familiarity with in-air acoustics is assumed the focus here is on key differences between in-air acoustics and underwater acoustics, making waterborne propagation more efficient than airborne propagation.

This chapter only gives reader a quick overview, please see APPENDIX B – Underwater Acoustics Basics APPENDIX *for more detail.*

1.1.1 SOUND SPEED

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[1] much as 340 m/s is in air.

The soundspeed changes with depth, “sound speed profile”, this is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR (Sound Fixing And Ranging) channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

1.1.2 SPREADING LOSS

Most of the propagation loss (loss in dB from source to receiver, “PL”) that occurs initially is governed by “spreading loss”. It is the simple “thinning out” of acoustic energy as it spreads away from the source, usually in all directions – spherically. This means a reduction in received level of 6 dB per doubling of distance

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Here we expect spreading loss to be ~3 dB per doubling of distance.

1.1.3 ABSORPTION

Besides the “thinning out” of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is salinity dependant. Frequencies under 1 kHz experiences almost no absorption, while high frequencies, over 10 kHz, can be attenuated by over 10 dB / km.

Small bubbles, wind or wave induced, will further attenuate especially the high frequencies.

1.1.4 SEDIMENT

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

[1] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies.

1.1.5 SOUND LEVEL UNITS

All references to sound pressure levels (SPL), peak pressure levels (L_p) and sound exposure levels (L_e) refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 1: Definitions.

Unit	Definition	Comments
SPL (dB_{RMS}) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p ($dB_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}}^2$
$L_{p\text{-}p}$ ($dB_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[2] equivalent to $L_P + 6.02\ dB$
L_E (dB_{SEL}) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-}"time"}$ or $L_{E\text{-single blow}}$.

If the averaging period for SPL is equal to the total even duration then SPL is equal to "Leq" the "equivalent constant level".

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

[2] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

2 SITE AND LOCAL ENVIRONMENT

The site is located in Orkney, Scotland:

- Scapa DWQ at Lat: 58.920345, Lon: -2.965084. Mean water depths 5-30 m.

The site is sheltered from oceanic swell, with little current and with no major outflows from rivers, meaning that the conditions important for sound propagation are quite stable. The sediment is generally a soft upper layer of mud/silt and gravel overlaid a layer of weathered sedimentary rock, before a stronger layer of sedimentary rock (silt-/mud-/sand-/lime-stone).

Figure 1. General location of Scapa DWQ development (in red circle) on Main Island of the Orkney Islands. Hatston site (just north west of Kirkwall, shown for completeness).

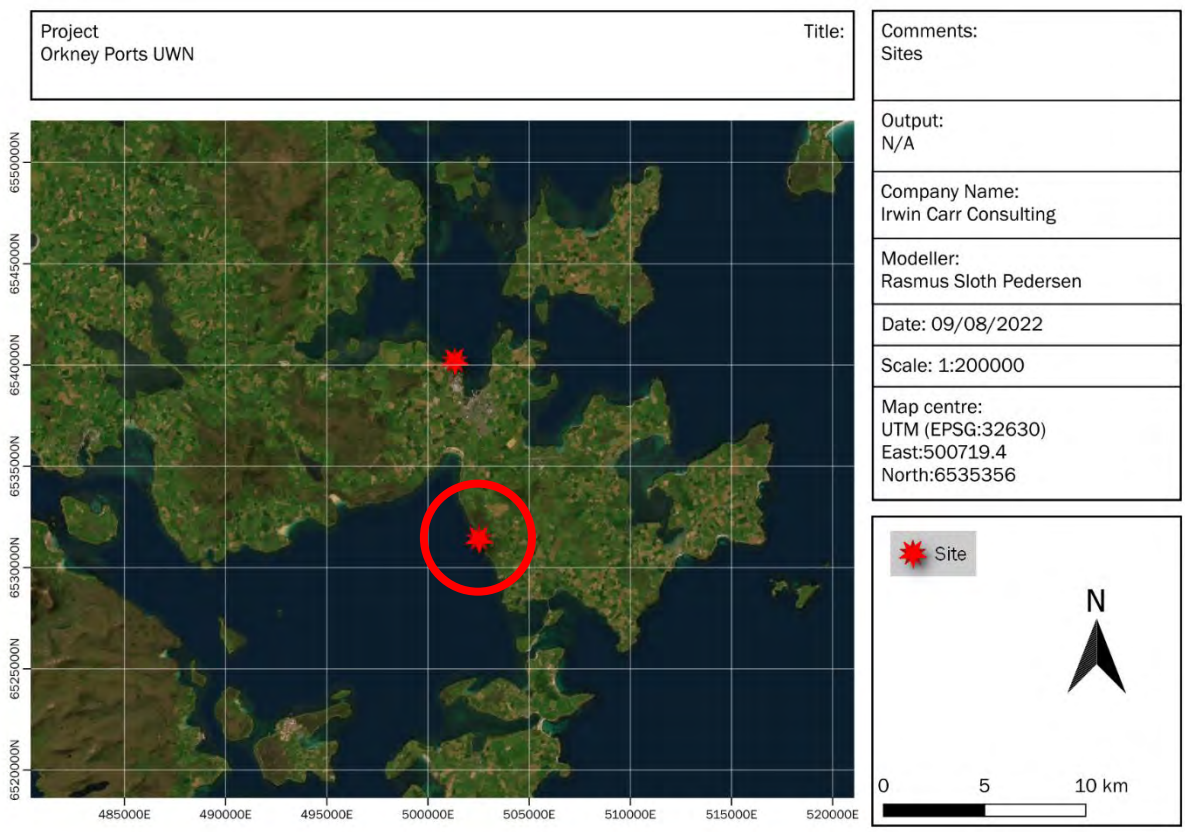
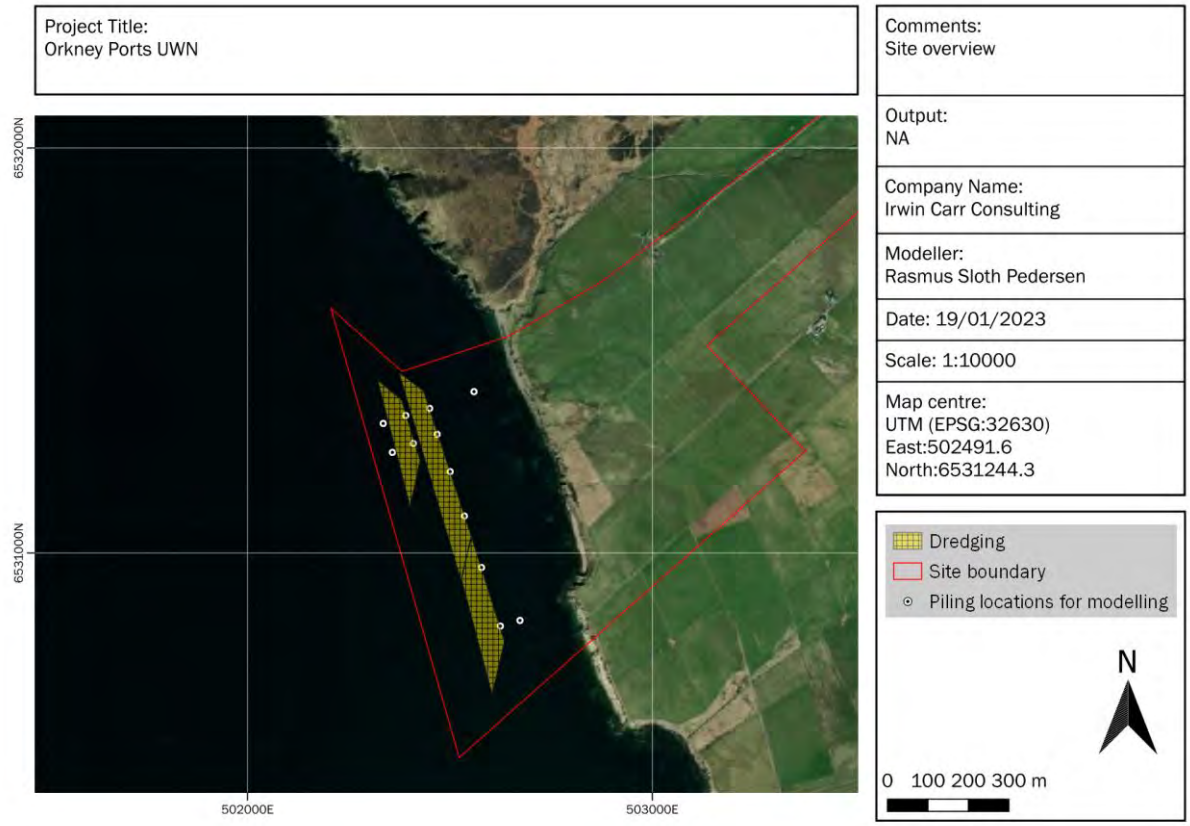


Figure 2. Overview of piling locations for modelling and approximate areas to be dredged.



2.1 Depth, Bathymetry

Depth data for the sites were collected from 3 sources:

- The proponent, detailed data near the site, 4 m resolution.
- EMODNet (European Marine Observation and Data Network, 2019), long range data, ~90 m resolution.
- Nautical charts such as http://fishing-app.gpsnauticalcharts.com, medium range data, variable resolution.

These were corrected to MSL and combined (using a mosaic method) to give the best possible total cover of the area.

For the "worst case" scenario the MHWS (Mean High Water Spring) level is used (deeper water decreases sound transmission loss).

2.2 Water properties

The water properties are important for the sound propagation. Generally the two sites have no major outflows of fresh water so salinity is expected to be near 35 psu (confirmed by (Marine Scotland, 2022)).

2.2.1 TEMPERATURE

The temperature was measured with the inbuilt thermometer of the Soundtrap hydrophone (used for on-site measurements).

Average water temperature at Scapa site during monitoring: 8.9 °C

The water columns are assumed to be well-mixed, given lack of nearby freshwater outflows, windy location, evaporation and generally shallow depths (<30 m).

2.2.2 SOUNDSPEED PROFILE

Given the water properties presented above, we assume the water soundspeed to be constant at all depths, with no significant deviations from the expected values.

The sound speed calculation is based on a widely used model for sound speed in water (Leroy, Robinson, & Goldsmith, 2008), with input of temperature, depth and salinity.

Sound speed in the water is calculated as 1486 m/s

2.3 Sediment properties

Given the project is a construction project there are sediment cores available for sediment characterisation provided by "Causeway Geotech". These give good coverage in the areas close to the Scapa DWQ. For general sediment outside the development area, we have used data from British geological survey (British Geological Survey, 2022).

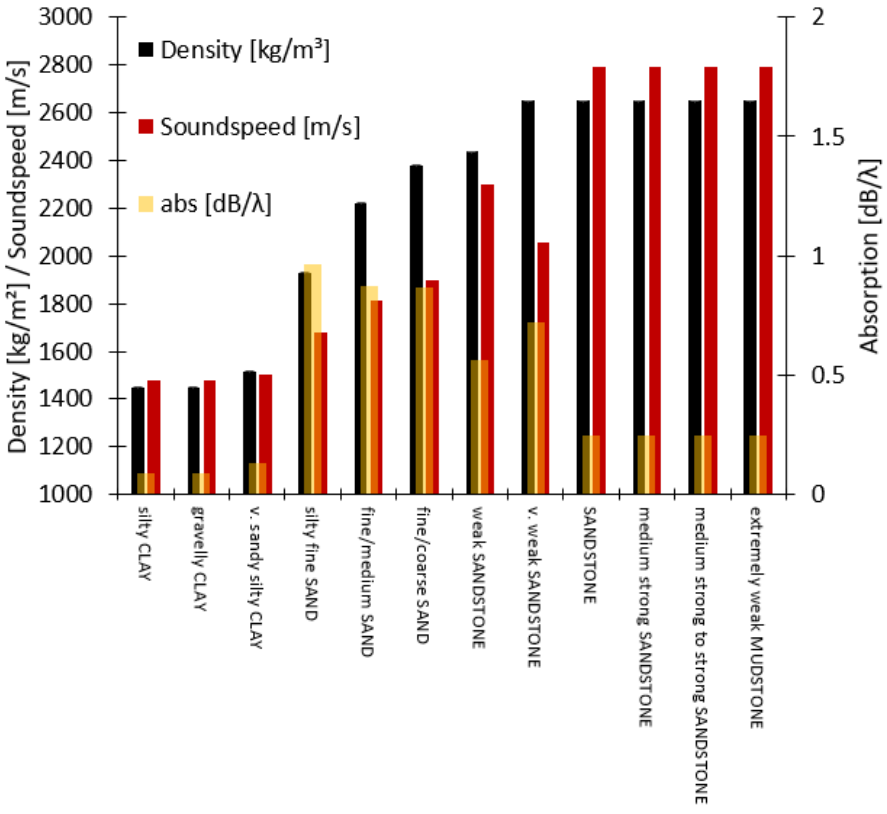
Where samples were taken we mapped the descriptions in the sediment core reports in relation to their Udden-Wentworth or Folk sediment description where these matched the nomenclature well. For other sediment types, e.g. sandstone/mudstone/limestone we have used given values for nominal "sandstone" (Jensen, Kuperman, Porter, & Schmidt, 2011; Boyce, 1981). The cores also contain classifications such as "weak sandstone" this was interpreted as loose, sandy sandstone, and we characterised this with density and soundspeed between that of sandstone and sand. This interpolation was based on an assumption that the scale "very weak-, weak-, medium weak-, sandstone" corresponds to linear interpolation between sand and sandstone (see Table 2 below). We have not changed the properties for categories indicating harder than usual sediments, such as "medium strong", "very strong".

Table 2. Example of interpolation scheme for Sand-sandstone.

Material	Interpolation value	Density [kg/m³]
Sand	0	1931
Very weak sandstone	0.25	2111
Weak sandstone	0.5	2291
Medium weak sandstone	0.75	2470
Sandstone	1	2650

Where we had no direct properties (density, sound speed, absorption) for the sediment we have used a modelling approach to estimate them, following (Ainslie, 2010).

Figure 3. Sediment types. Note that absorption is read on the right vertical axis.



2.4 Background/Ambient Noise

Baseline noise monitoring was carried out on 29-30 November 2022. On both days the weather was very calm (< sea state 1) with no detectable current. The Scapa site was unexpectedly noisy with ~130 dB SPL for all measurements (unaffected by range to our vessel). There were multiple other vessels in the bay, but all far away (> 1km). The most likely source was the small oil platform stationed a few km to the south. This could have some active machinery causing the noise, indicated by the tonal components (seen as horizontal bands in spectrogram in Figure 4).

Note that ambient noise here excludes noise from nearby vessel passes, it is meant as the ambient noise with no identifiable noise sources.

Table 3. Typical background noise levels.

Site	SPL [dB]
Scapa	129.9
Hatston	107.2

Figure 4. Spectrogram of ambient noise at Scapa.

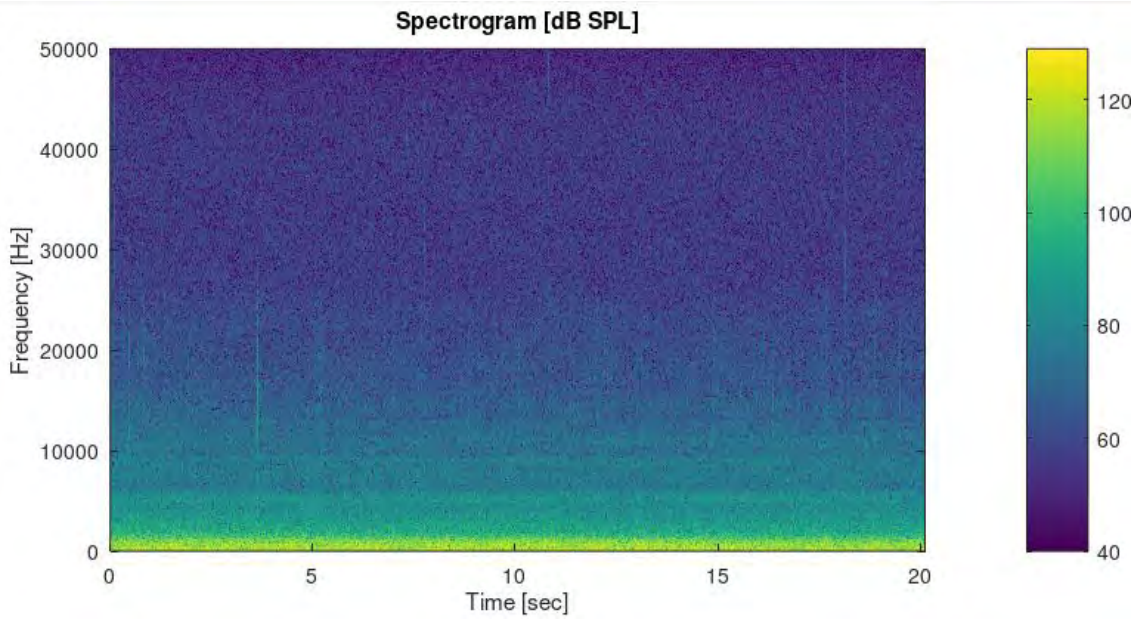


Figure 5. Spectrogram of ambient noise at Hatston.

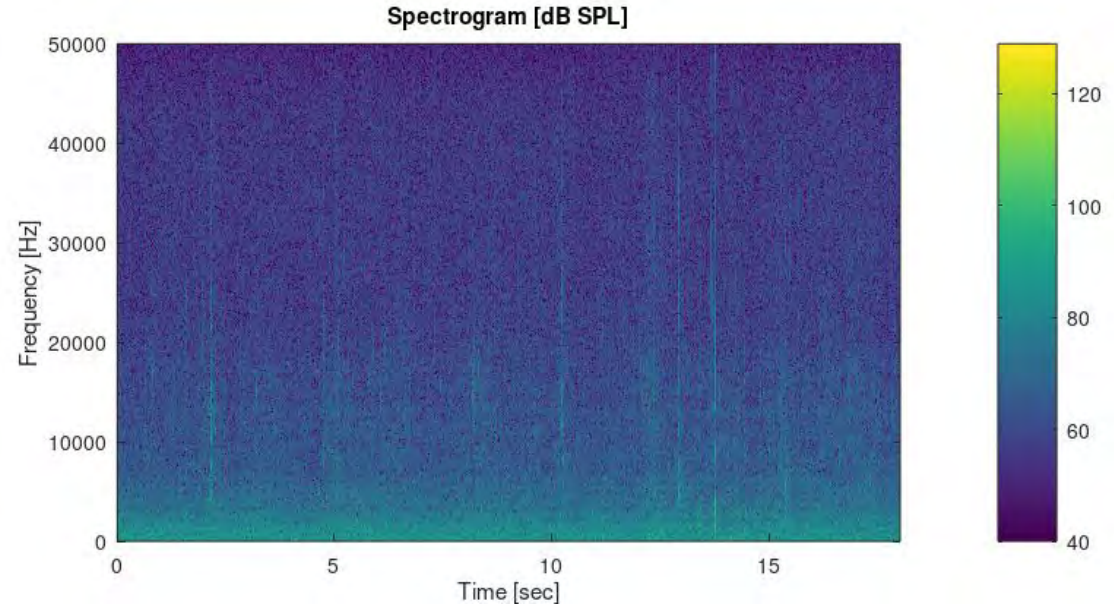
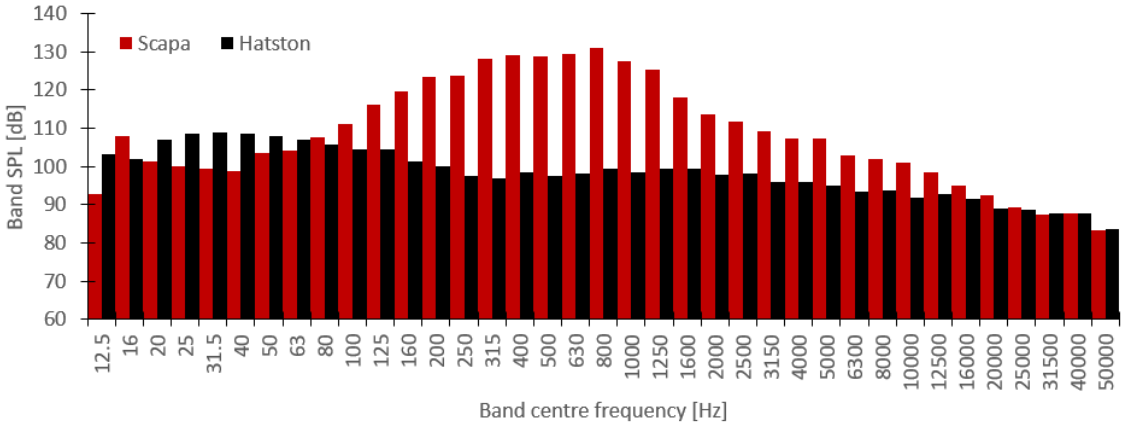


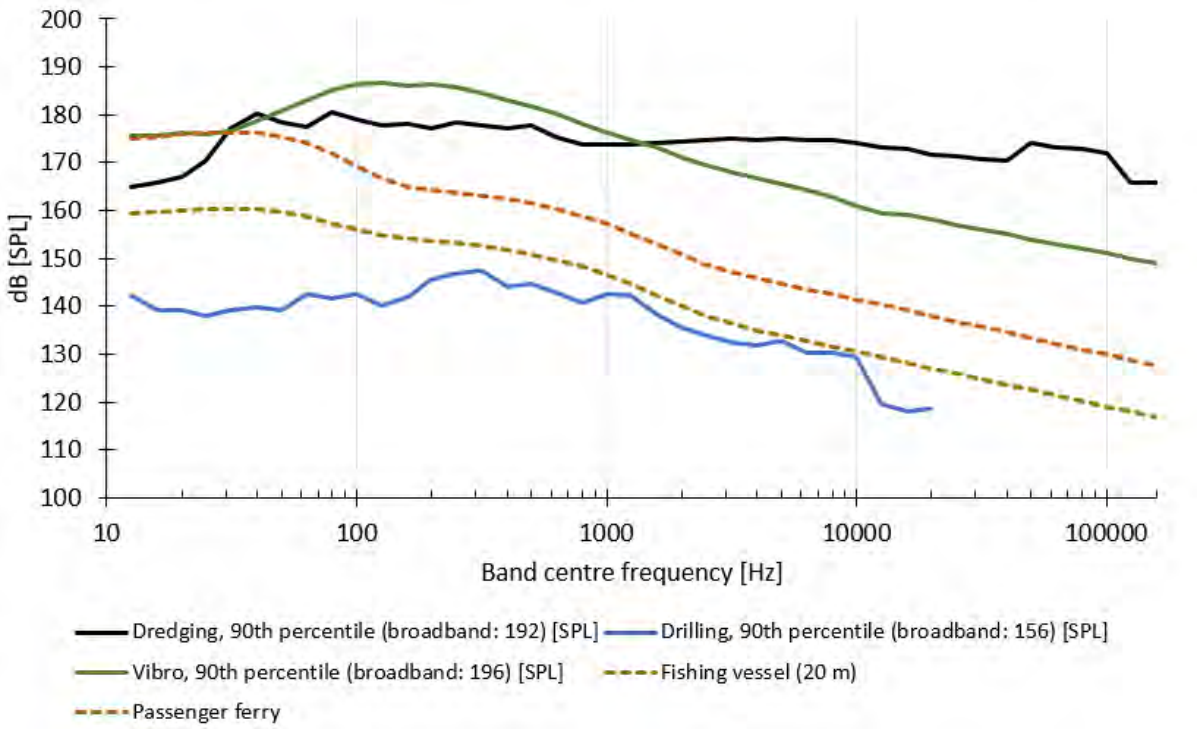
Figure 6. Typical band levels of ambient noise at Scapa and Hatston.



3 SOUND SOURCE MODELLING

We have considered three noise sources for this assessment, but have screened out the drilling as it is not loud enough to meaningfully assess in an environment with many vessels and general human activity (compare with vessel noise in Figure 7, below).

Figure 7. The three sound sources considered in this report. A fishing boat and a small ferry has been added for context.

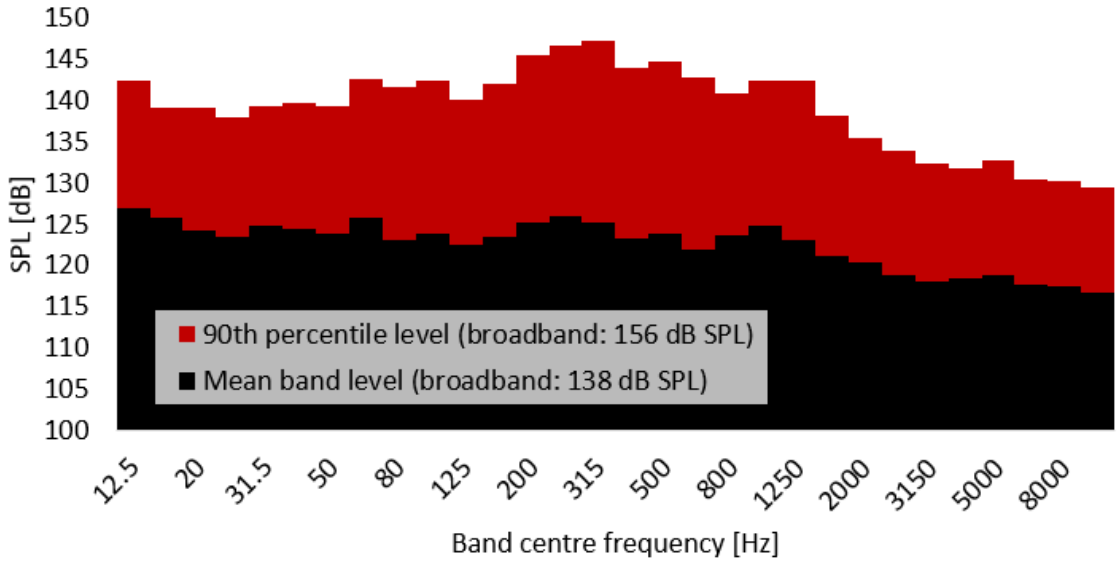


3.1 Drilling

As some hard sediment is expected round piles might be placed in pre-drilled holes, based on the range of noise levels presented in Figure 8, the drilling noise is assumed to be insignificant to the marine life.

The measured levels presented are a summary of 13 different recorded drilling episodes shows noise levels to vary considerably between sites and equipment, and there is no clear connection between drill size, power or sediment type to the emitted noise level. However, given the modest broadband level of even the 90th percentile level (156 dB SPL) this noise source can be ignored.

Figure 8. Example of drilling noise band levels. Data from various drills, diameter 0.1-1.2 m and various rock types.



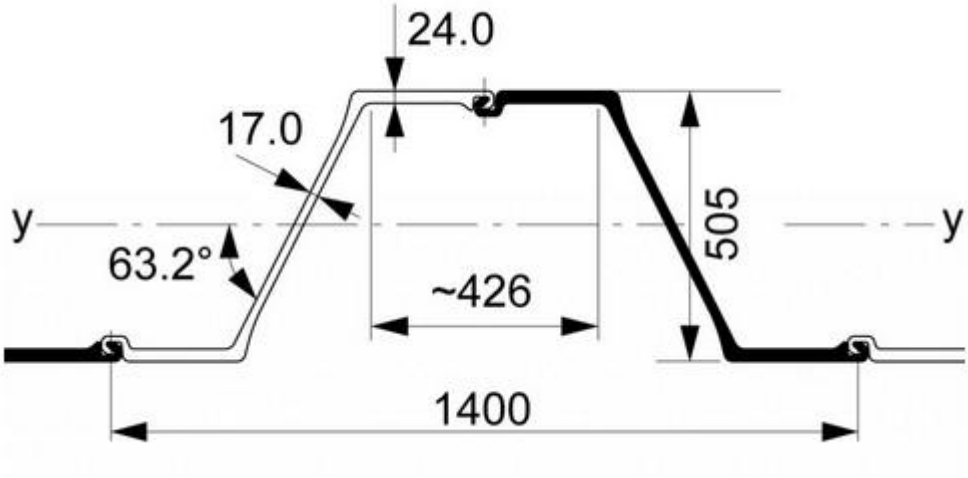
3.2 Vibration Piling Model

Two types of piles are expected to be used:

1. Tubular piles, expected to have a diameter of 2.1 m
2. Sheet piles (Arcelor Mittal AZ52-700[3]).

Both will be vibrated into the sediment or into holes left by the drilling campaign.

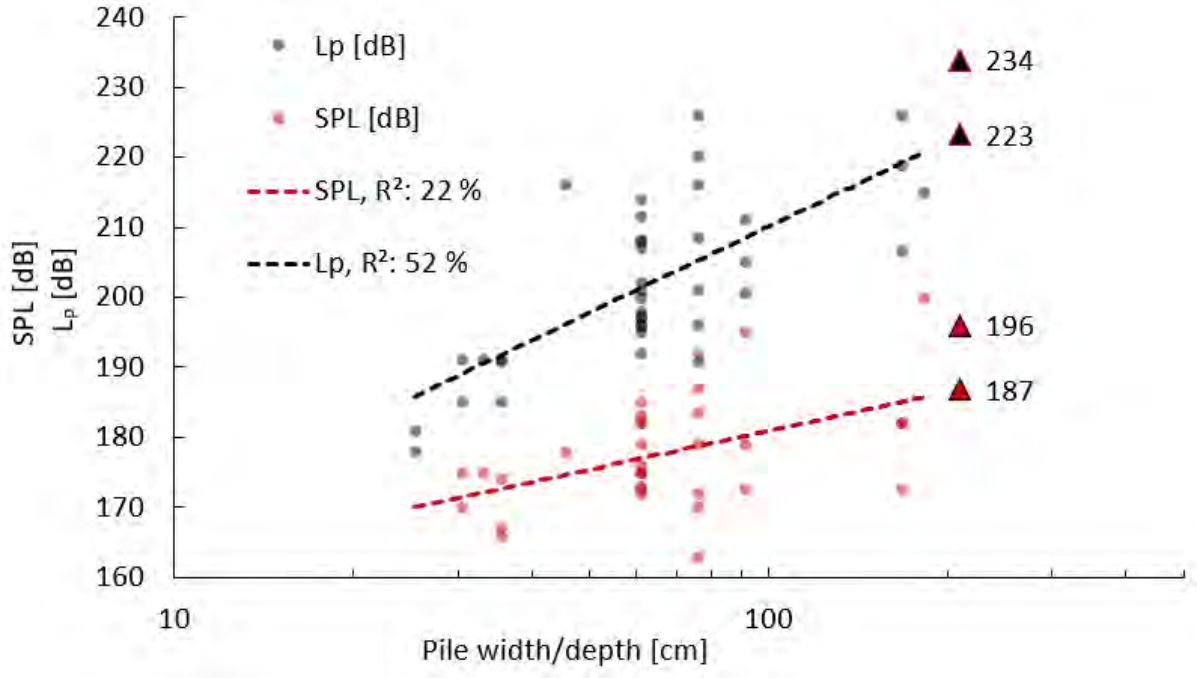
Figure 9. Schematic of the sheet piles.



The diameter of the tubular pile (210 cm) is used a basis for an empirical model based on 50 recorded levels as from CalTrans (CalTrans, 2015).

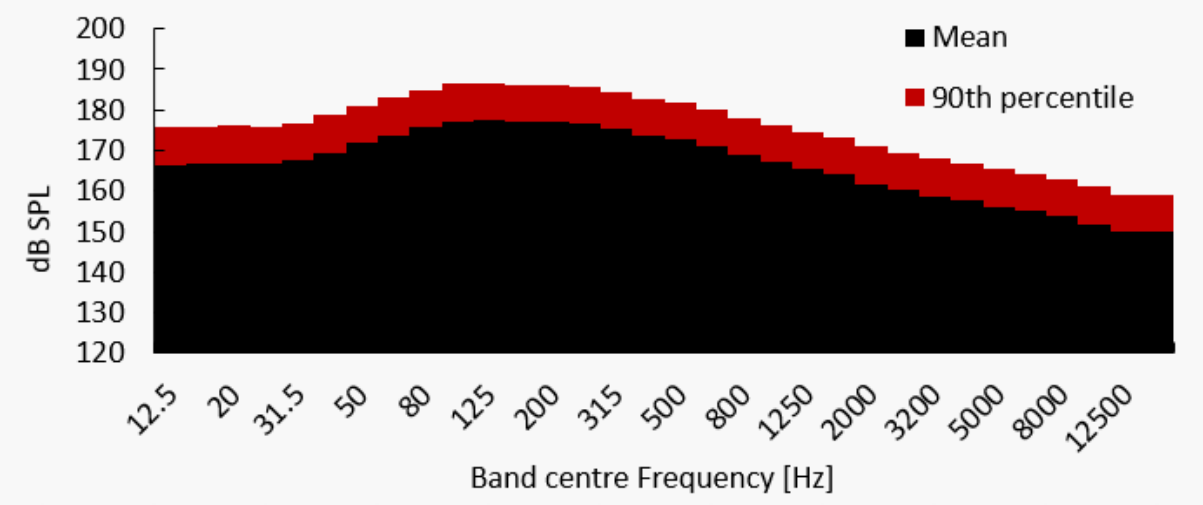
[3] https://sheetpiling.arcelormittal.com/products/az-52-700/

Figure 10. Basis of vibro piling broad band source level as a function of pile size (210 cm diameter).



Given the low confidence we have in this approach (low R^2 values) we use the 90th percentile level as the broadband source level. L_P is estimated to be 234 dB and SPL 196 dB. The frequency content is assumed to be identical to that of the impact piling.

Figure 11. Band levels for vibro-piling.



3.3 Dredging

Dredging is done to chart Datum -15 metres, meaning this will likely be done with a cutter suction dredger (Max reach 15 m) and possible assistance from a backhoe dredger. For the cutter suction dredger a cutter power of 540 kW is assumed, equivalent to the Boskalis "Seine"[4] cutter suction dredger. For cumulative modelling it's assumed that the dredging is potentially active 24 hours per day. The Backhoe dredging is quieter and has been ignored in favour of using the louder method for the assessment.

[4] https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwibnqWF-sH8AhUQg1wKHfYmBVoQFnoECB8QAQ&url=https%3A%2F%2Fboskalis.com%2Fmedia%2Fqbjnfdlv%2Fseine_cutter_suction_dredger.pdf&usg=AOvVaw1bBD75xRPcFc3H0TUXTFkD

Figure 12. Approximate extent of dredging campaign (yellow hatched area).

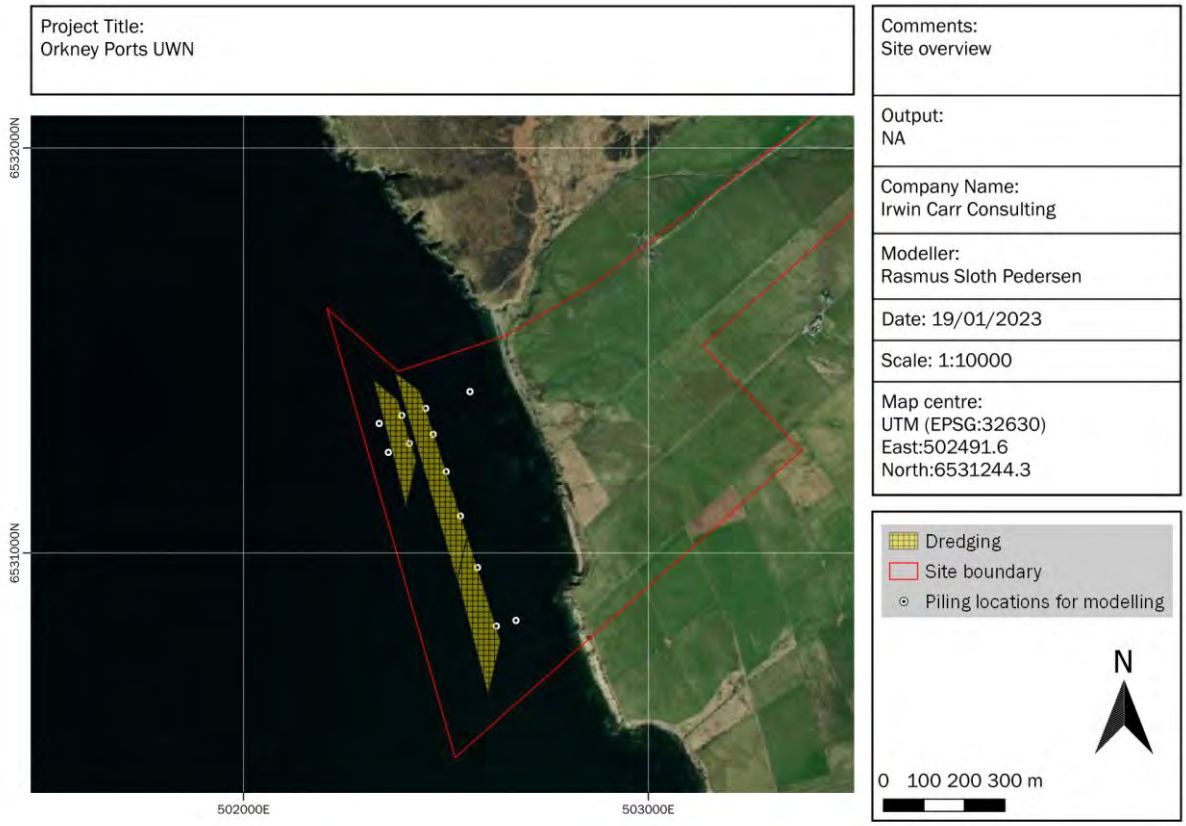
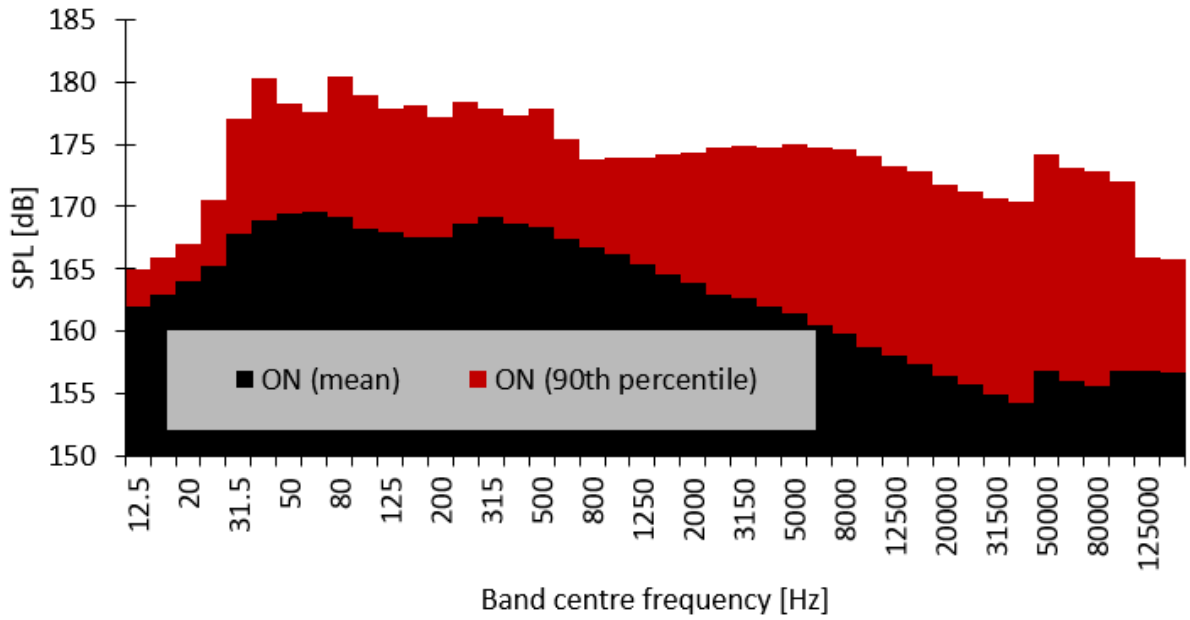


Figure 13. Band levels as modelled for a 540 kW cutter suction dredger with coarse sediment. "ON" refers to active dredging.



4 TRANSMISSION LOSS MODELLING

Transmission loss modelling is done using dBSea underwater noise modelling software.

This software is partially developed by us and can model frequencies from 10 Hz to 168 kHz, normally as 3rd octave bands, but any logarithmic band-spacing can be used. All solvers are range dependent (meaning all conditions can change with range not just depth).

Further details of this modelling software package can be found in APPENDIX A - dBSea.

The sound sources from section 3, Sound Source Modelling, p. 14, was used sources for the model, both as band levels when modelling energy transmission losses (L_E, SPL) and as timeseries/impulse for modelling peak pressure (L_P).

Previous to this assessment measurements of the actual transmission loss for the two sites were measured along two transects for each site. The modelling has been calibrated to match the measurements of these recordings (details in APPENDIX D – MODEL CALIBRATION).

The measurements show a broadband transmission loss consistent with ~12 × Log_{10}(range) at Scapa. However, these are frequency specific, and these losses are not consistent across all frequencies. We have matched the frequency-wise transmission losses to the extend that they are less than 20 × Log_{10}(range) as we find it unlikely that a transmission loss, even for higher frequencies, of > 20 × Log_{10}(range) is sufficiently representative for the site as a whole.

5 ASSESSMENT CRITERIA

5.1 Reporting units

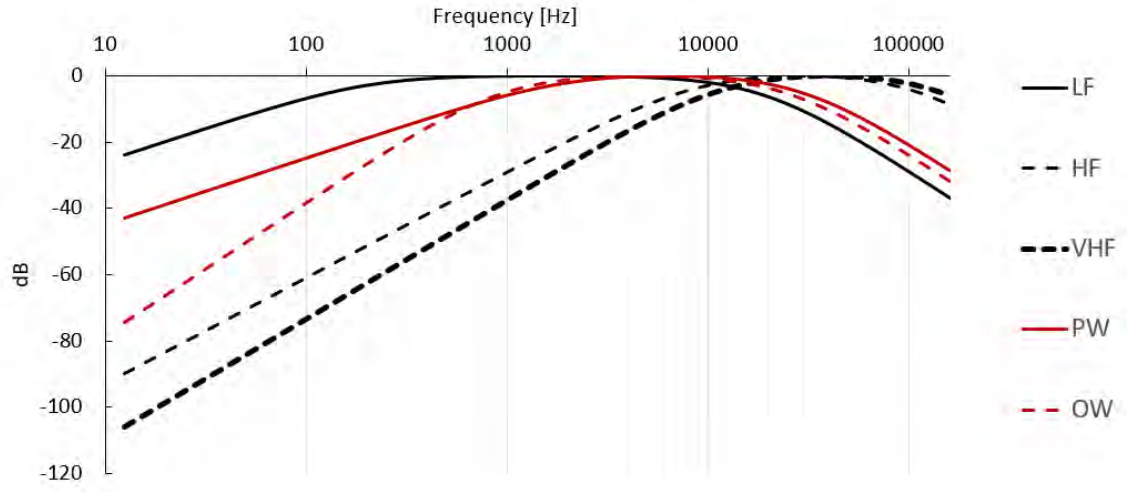
See 1.1.5, p. 8 for definitions.

5.2 Weighting of Noise Levels

When not reporting L_p or $L_{p\text{-}p}$ levels, the noise levels are often weighted according to a generalised hearing sensitivity profile for up to ten different hearing groups. This is done to better reflect the actual impact on the species in question, much like dB(C) level unit for humans.

See Table 4, for full group names and limits.

Figure 14. Weightings for various hearing groups. For L_E levels, the weightings are applied to the noise level to give the weighted noise level (similar to dB(A) or dB(C)-weighted noise for humans).



5.2.1 MARINE MAMMAL WEIGHTINGS

For the marine/aquatic mammals present we will adhere to the thresholds described in “Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing” (National Marine Fisheries Service, 2018), which determines impact from an assessment of area wherein the noise will induce either

"Temporary Threshold Shift" (TTS) or "Permanent Threshold Shift" (PTS)[5] as judged by the weighted SEL level (L_{E-24}) over a typical 24-hour period or by L_P levels, for the different hearing groups.

Please note that the Southall 2019 thresholds and weightings are identical to the NMFS 2018 criteria, only the nomenclature has changed (Southall, et al., 2019; National Marine Fisheries Service, 2018).

Thresholds for behavioural disruption are set by NOAA fisheries[6]. These are 120 dB RMS[7] for continuous noise and 160 dB SPL[8] for impulsive noise.

The hearing groups from the Southall 2019 and the NMFS 2018 guidance were specified by collating available information on marine mammal hearing and generalising their hearing sensitivity into representative groups. This grouping represents a significant research effort and are reviewed by the leading experts (academic, industrial and conservation) on the topic. Because of the large amount of work this represents and the widespread acceptance of the method, the thresholds and the methodology associated, have become de-facto standards for assessing noise impact on marine mammals and represents best available knowledge and practise.

Along with weighting curves, similar in function to the human dB(C) curves, a set of thresholds for hearing impact and injury is associated with the framework and allows for conversion of threshold exceedance into ranges with risk of impact. E.g. we might see that the PW group (true seals) has a risk of PTS at ranges shorter than 50 meters, and a risk of TTS at ranges shorter than 200 meters.

All marine mammal species are covered by the hearing groups and a full list of species in the different groups can be found in the "Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects" (Southall, et al., 2019), but in general the groups cover the following species:

Table 4. Summary of Southall 2019 thresholds and groups with species examples. For full species list see source (National Marine Fisheries Service, 2018; Southall, et al., 2019)

Hearing group	Species examples	Non-impulsive TTS/PTS threshold [$L_{E-24\ hours}$]	Impulsive TTS/PTS threshold [$L_{E-24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
PW	Harbour seal, Grey seal	181/201	170/185	212/218
OW	Otters	199/219	188/203	226/232
LF	Minke whale, Humpback whale	179/199	168/183	213/219
HF	Sperm whale, Common dolphin, Bottlenose dolphin, Killer whale, Risso's dolphin, Pilot whales	178/198	170/185	224/230
VHF	Porpoise	153/173	140/155	196/202

It's important to note that the assessment is thus based on the received level of receptors with the above-described auditory sensitivity and not based on the sensitivity of the individual species.

[5] TTS/PTS. A temporary/permanent change in hearing sensitivity caused by acoustic stimuli.

[6] Available from: https://archive.fisheries.noaa.gov/wcr/protected_species/marine_mammals/threshold_guidance.html

[7] Here taken as meaning "SPL"

[8] Assumed to be SPL of 90 % of energy in one impulse or SPL of total duration (L_{EQ}).

5.3 Fishes etc.

Impacts of noise on fishes is less well established than for marine mammals, but a review from 2014 (Popper, et al., 2014) provides guidelines on exposure limits for fish and turtles. The report does not directly use the PTS nomenclature (as above for mammals) as many fish have the capacity to repair structural damage to their ear, and even structural damage then cannot be said to be "permanent".

We use "PTS" here to cover the categories "Mortality and potential mortal injury" and "Recoverable injury".

Note that we use the impulsive limits from piling for all impulsive sources as the information for explosions is rather less well documented (and limits are significantly higher).

TTS is directly used in the report, and we use it in the same way here.

As there are no TTS/PTS limits for non-impulsive noise, we apply the limits for cumulative impulsive noise.

Table 5. Overview of Impact piling thresholds from (Popper, et al., 2014) (Table 7.3). We use these for all impulsive noise, even though explosions have separate thresholds (Table 7.2 in report)).

Hearing group	Species examples	Impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
P* (Fish with no swim bladder)	Sharks, Rays	186/216	TTS not specified/213
P- (Fish with swim-bladder, but not involved in hearing)	Salmon, Trout, Cod, Herring	186/203	TTS not specified/207
P+ (swim-bladder used in hearing)	Carp, Catfish	186/203	TTS not specified/207

5.4 Threshold Interpretation

5.4.1 THRESHOLD TYPES

The three threshold types refer to different ways that sound can affect the hearing of an animal and are ***important to keep in mind*** when evaluating the results of this report:

5.4.1.1 Non-impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***continuous***[9] sound received by the animal over a typical 24-hour period as sound exposure, L_E.

When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within the zone. Alternatively this can be thought of as the total sound-dose limit over 24 hours.

Weightings are applied for non-impulsive L_E (for mammals only[10]).

5.4.1.2 Impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal over a typical 24-hour period as sound exposure, L_E.

[9] Please see (National Marine Fisheries Service, 2018) for definitions of "non-impulsive" and "impulsive". For quick reference, if a sound is shorter than 1 second and is clearly intermittent in nature, it is impulsive – otherwise, it's continuous.

[10] When assessing for fish groups levels are not weighted.

When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within this zone.
Alternatively this can be thought of as the total sound-dose limit over 24 hours.

5.4.1.2.1 Impulsive $L_{E\ single\ impulse}$ / $L_{E\ \#\ impulses}$

It is sometimes useful to assess the impact of a single/a number of impulse(s). When we do this, we will refer to it as "LE single impulse / LE # impulses".
Like for the Lp, when single-impulse LE is presented as an impact zone, this refers to the area, within which, an animal would suffer the effect acutely/instantly.

Weightings are applied for Impulsive L_E (for mammals only).

5.4.1.3 Impulsive, L_p

The threshold over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal at any instant as maximal peak pressure.
When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect acutely/instantly and from just one exposure.
Weightings are ***not*** applied for Impulsive L_P.

5.4.2 MASKING

Levels that are not over threshold can still cause significant impact, if that noise makes foraging, navigation or communication harder due to masking or where biologically relevant sounds are "drowned out" by the anthropogenic noise. Continuous noise is more likely than impulsive noise to cause this form of impact.

5.4.3 DISPERSAL

Many animals can recognise sounds and might be dispersed from an area at noise levels well below TTS limits. Quantifying a level of dispersal from desk-spaced studies is very challenging and not done here.

6 CONCLUSION & RESULTS SUMMARY

Dredging

The noise from dredging, while presenting a significant PTS risk to ranges >500 m for the VHF group, this is only for animals staying close to the activity for extended periods (> 1 hour) and assumes continuous dredging with the dredger level as given by the 90th percentile. For the best estimate (model mean) the PTS risk range is 450 m after 8 hours exposure. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away. Further the area ensonified does not "block" access through a channel or strait.

There is no issue identified for species outside the VHF range.

Vibro piling

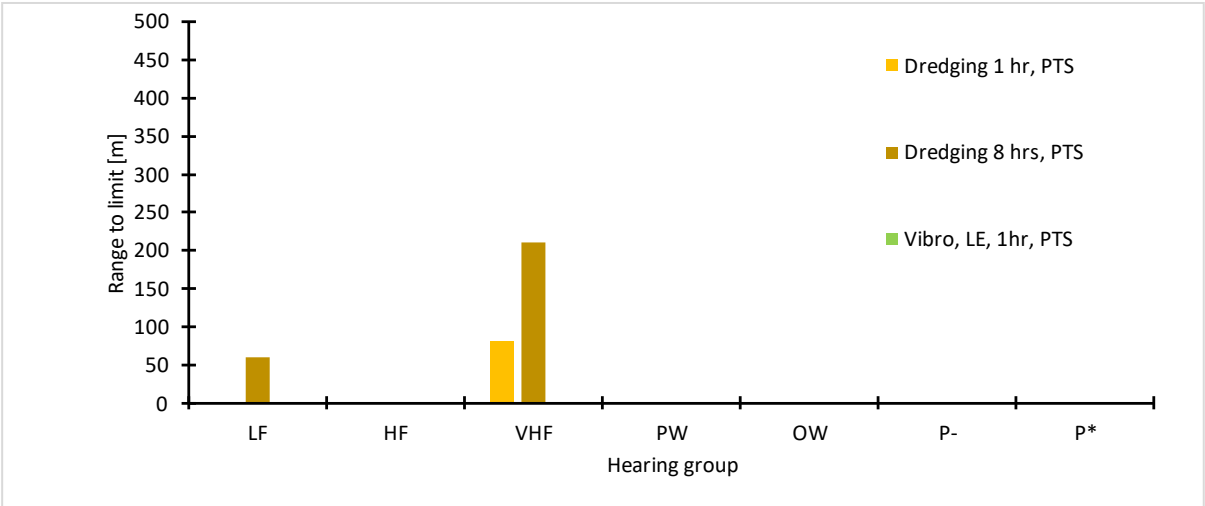
Prolonged exposure to vibro piling at close range (<100 m) carries some auditory risk for the animals assessed, specifically groups LF, VHF and P- (baleen whales, porpoises and salmon/trout), where the peak pressures in the noise have risk ranges up to 300 m for the VHF group. We therefore suggest surveillance takes place prior to piling to minimise the risk of impact on porpoises. While this is a significant risk for animals close to the activity, we stress that we have used a very conservative approach to estimating the source levels, and the realised emission will likely be significantly lower.

Further, animals will tend to move around, or away from noise, which will limit exposure. In Figure 16 and Figure 18 we show an example of the effect of using moving receivers (animats, modelled animals) to estimate what might be the effect of movement.

Table 6. Overview of maximal ranges to limits [m].

Activity	Dredging				Vibro piling			
Dose	1 hr L_E		8 hrs L_E		1 hr L_E		Peak pressure L_P	
Hearing group	TTS	PTS	TTS	PTS	TTS	PTS	TTS	PTS
LF	230	<50	1250	60	760	<50	<50	<50
HF	60	<50	160	<50	<50	<50	<50	<50
VHF	620	80	1350	210	180	<50	550	300
PW	70	<50	250	<50	100	<50	100	<50
OW	<50	<50	<50	<50	<50	<50	<50	<50
P-	120	<50	600	<50	390	<50	<50	125
P*	120	<50	600	<50	390	<50	<50	<50

Figure 15. Overview of PTS risk ranges



7 RESULTS

The noise maps for each activity and hearing group are presented in APPENDIX E – Results.

7.1 Dredging

While exposure to 8 hours of dredging has significant PTS risk ranges (< 210 m) for 2 hearing groups: LF (baleen whales) and VHF (porpoises), but only after prolonged exposure (> 1 hour). The relatively low (compared to limits) source level of the dredging means that there is not acute risk from noise and animals have time to swim away.

Using a model approach to have moving receivers (animats, see Figure 18, p. 24) we can estimate the impact on moving animals. The animats in the model move 0.5-4 m/s depending on the received level and evade levels >120 dB.

Figure 16. Summary of total exposure (L_E) of 225 animats of the VHF group in the soundfield of the dredging. 44 exceeded TTS limit (20 %), none exceeded the PTS limit.

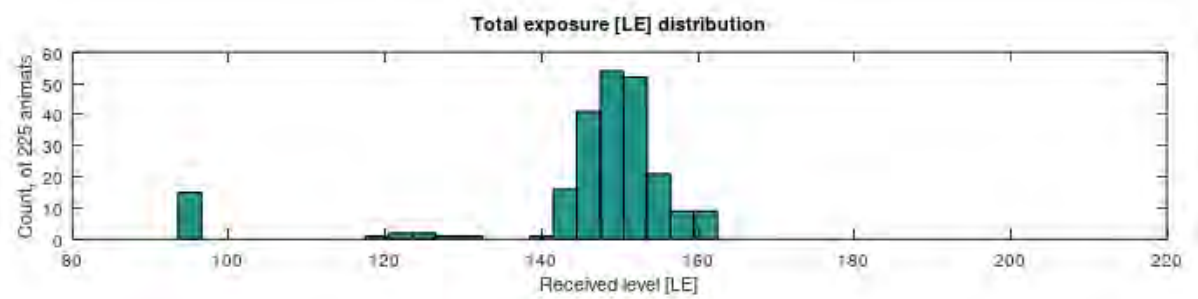


Figure 17. TTS and PTS risk ranges for all groups.

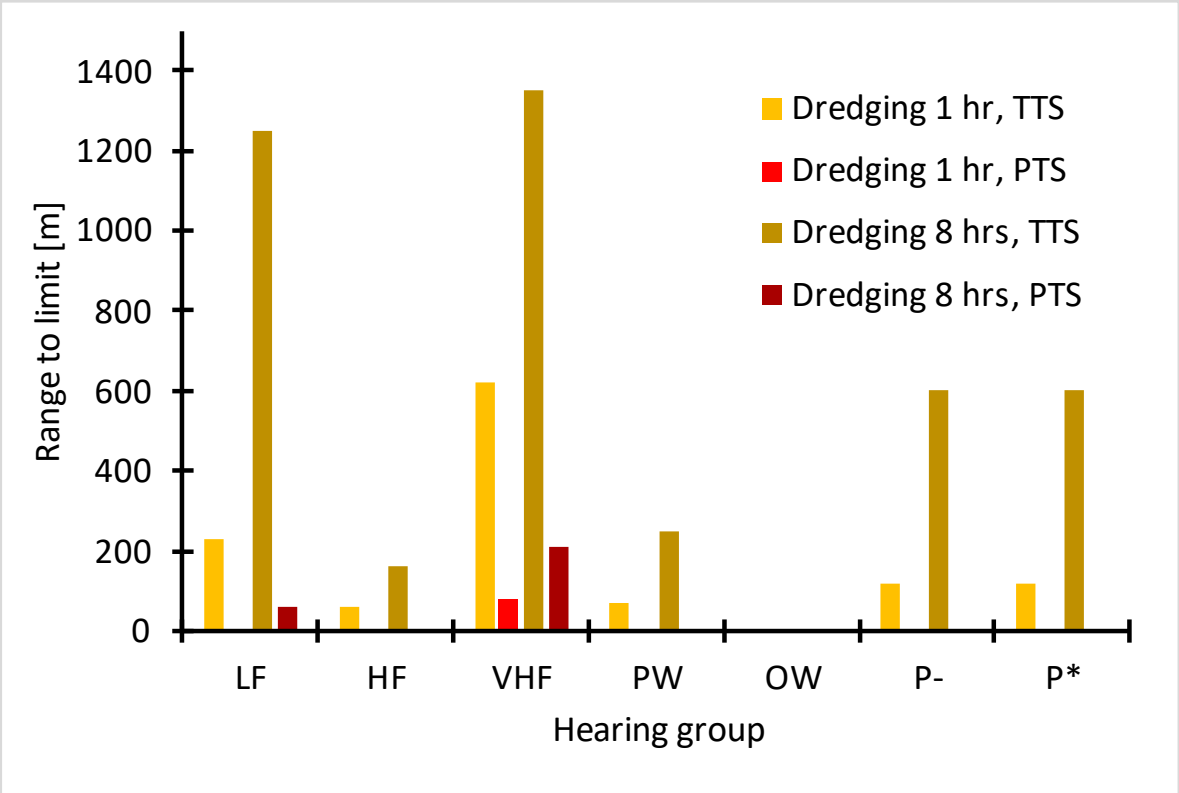
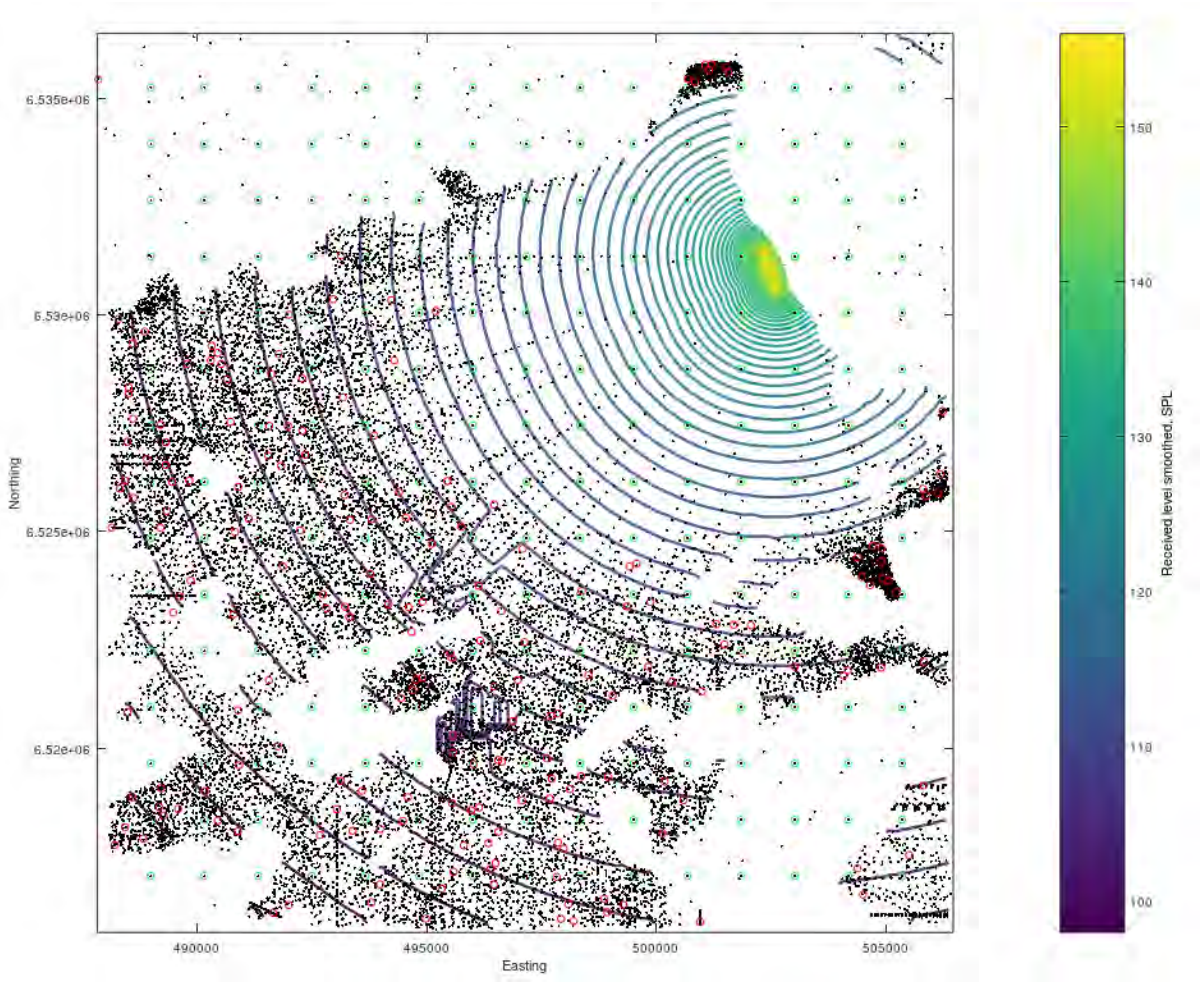


Figure 18. 225 “animats” in the dredger soundfield for 8 hours. Green spots are starting points, and red spots end points. Area covers Scapa Flow.a



7.2 Vibro piling

Longer exposures (> 1 hour) lead to significant PTS risk zones within 50 for all groups, but the proposed duration of vibro piling on this site is less than 1-hour per day.

The peak pressures in the vibro piling have a PTS risk zone max range of 50m. While the risk for the LF and P- groups is only for prolonged exposure, the risk to the VHF group is acute, i.e. the animal has no chance to swim away to avoid the risk.

Figure 19. TTS and PTS risk ranges for all groups.

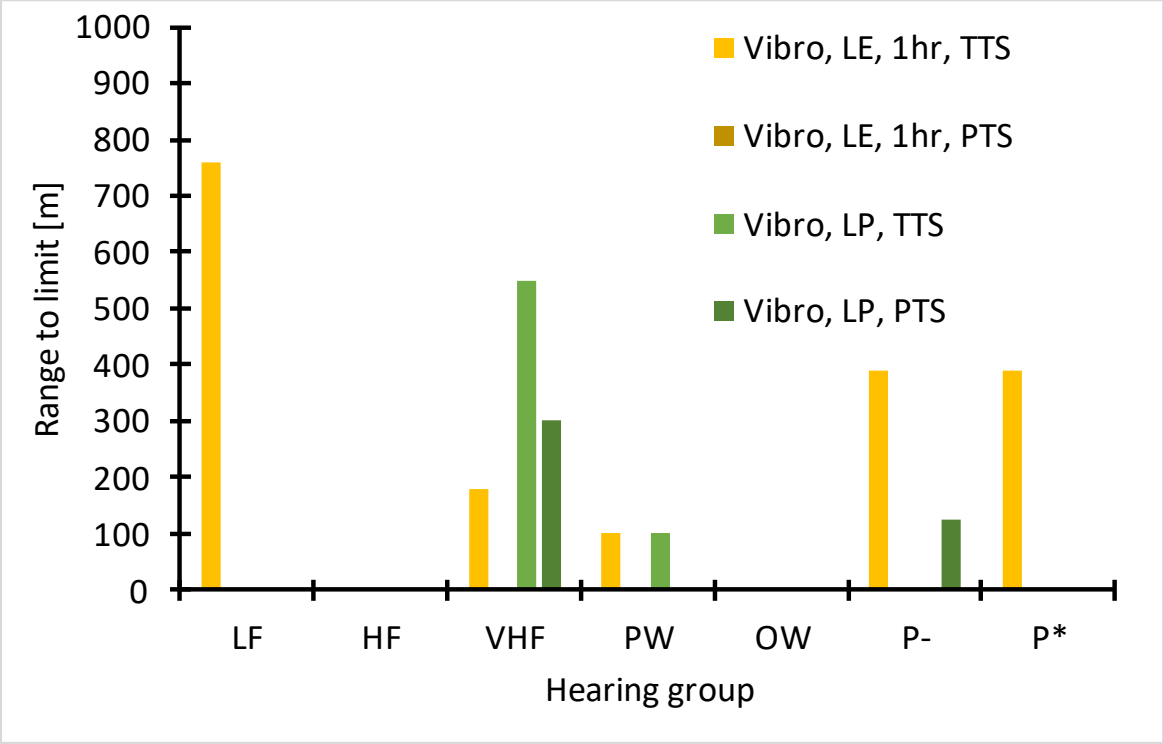
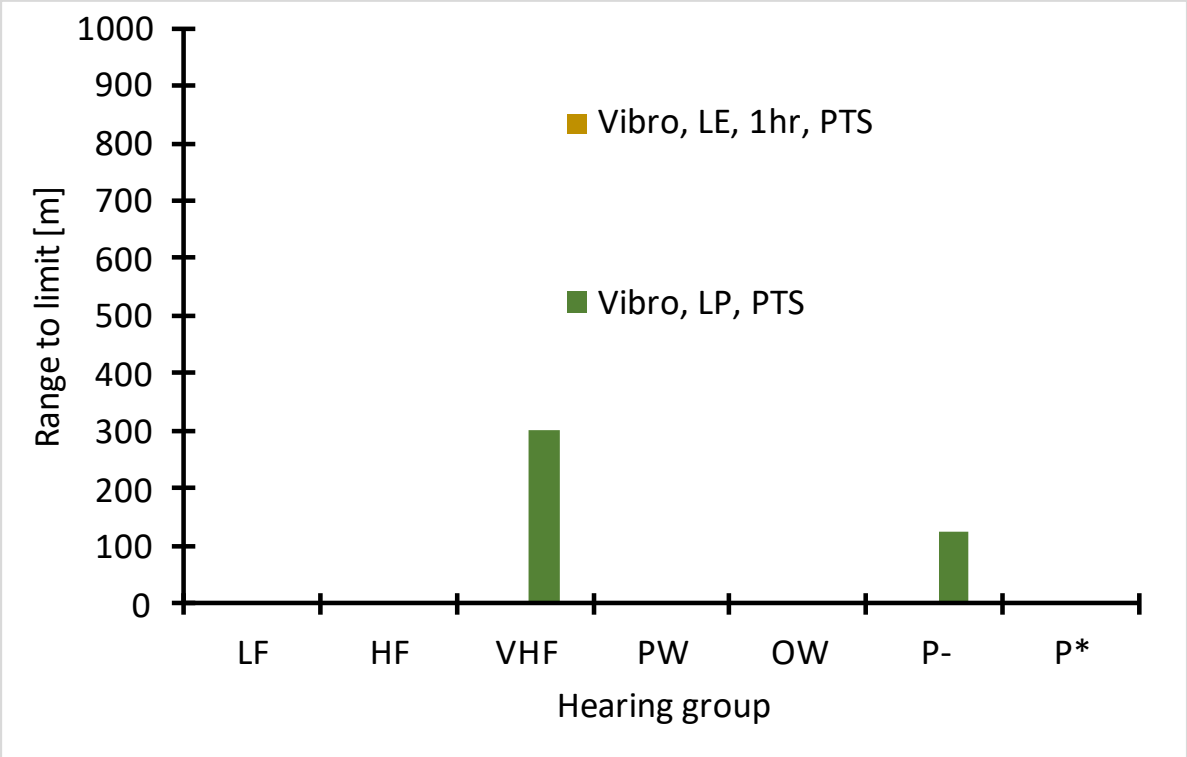


Figure 20. PTS risk ranges for all hearing groups.



8 BIBLIOGRAPHY

Ainslie, M. A. (2010). *Principles of Sonar Performance Modelling.* Heidelberg: Springer. doi:10.1007/978-3-540-87662-5

Audoly, V. M. (2020). Accounting for sea floor properties in the assessment of underwater noise radiated from ships in shallow water. *Proceedings of Meetings on Acoustics* .

Boyce, R. E. (1981). *LABORATORY-DETERMINED SOUND VELOCITY, POROSITY, WET-BULK DENSITY, ACOUSTIC IMPEDANCE, ACOUSTIC ANISOTROPY, AND REFLECTION COEFFICIENTS FOR CRETACEOUS-JURASSIC TURBIDITE SEQUENCES AT DEEP SEA DRILLING PROJECT SITES 370 AND 416 OFF THE COAST OF MOROCCO.* La Jolla: Scripps institution of Oceanography.

British Geological Survey. (2022, June 30). *Geology of Britain Viewer*. Retrieved from British Geological Survey: https://mapapps2.bgs.ac.uk/geoindex/home.html

CalTrans. (2015). *Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish, CALTRANS.* Sacramento: California Department of Transportation.

European Marine Observation and Data Network. (2019, May 01). *Bathymetry portal*. Retrieved from EMODnet: http://portal.emodnet-bathymetry.eu/

Jensen, F. B., Kuperman, W. A., Porter, M. B., & Schmidt, H. (2011). *Computational Ocean Acoustics, Second Edition.* Springer. doi:10.1007/978-1-4419-8678-8

Leroy, C. C., Robinson, S. P., & Goldsmith, M. J. (2008). A new equation for the accurate calculation of sound speed in all oceans. *The Journal of the Acoustical Society of America*, 2774-2782.

Marine Scotland. (2022, 12 12). *Salinity*. Retrieved from Marine Scotland: https://marine.gov.scot/sma/assessment/salinity

National Marine Fisheries Service. (2018). *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0).* Silver Spring: U.S. Department of Commerce.

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J., . . . Travolga, W. (2014). Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. *Springer Briefs in Oceanography, S3*.

Southall, B. L., Finneran, J. J., Reichmuth, C., E.Nachtigall, P., Ketten, D. R., Bowles, A. E., . . . Tyack, P. L. (2019). Marine Mammal Noise Exposure Criteria:Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals*, 125-232. doi:10.1578/AM.45.2.2019.125

APPENDIX A - DBSEA

A summary of dBSea's models in standard scenarios can be found in the document (online):
http://www.dbsea.co.uk/media/30782/dBSea-Benchmark-Testing.pdf
(also see Figure 23, p. 29 for one example).

All solvers in dBSea are based on Jensen et al. 2011 (Jensen, Kuperman, Porter, & Schmidt, 2011)

dBSea has four primary models of calculation:

- **Range dependent Parabolic Equation model - dBSeaPE**
  dBSeaPE uses a split-step, wide angle parabolic equation method. It uses either Greene's approximation or several Padé terms (as set by user) to get very wide propagation with low phase error.

  dBSeaPE is best suited to deeper scenarios (>50 m) or where sediment interaction is not dominant relative to sound speed profile. The model is very efficient for low frequencies and only suffers a small efficiency penalty for higher frequencies.

  dBSeaPE will generally be used for deeper/long range scenarios in the frequency interval 10-1000 Hz.
- **Range dependent Normal Modes model - dBSeaModes**
  dBSeaModes is especially suited to shallower and sediment dependent scenarios and will typically be used where water is shallower than 50 m and depth changes are a large proportion of the total depth, or where sediment effects are thought to play a significant role. dBSeaModes incurs a significant efficiency-penalty at high frequencies and will normally be used in the frequency range 10-1000 Hz.
- **Ray tracing**
  dBSea uses a Gaussian raytracing method, dBSeaRay, to calculate transmission losses for higher frequencies (scenario dependent, but normally from 500 Hz). dBSeaRay compares favourably with the opensource BELLHOP model, in that it is accurate to lower frequencies and agrees well with PE and NM models.
- **Full waveform propagation**
  dBSeaRay also supports full waveform propagation in the frequency range 10 Hz to 168 kHz (limited by the waveform sample rate). Used in this way dBSeaRay takes into account all scenario range dependence (as models above) as well as the arrival time, phase information and transmission loss of all significant paths to any number of receivers in the scenario (the results grid).

General notes:

- dBSea is an "Nx2D" solver, meaning it models transmission losses in "N" number of vertical radial slices from the source (Figure 22, p. 28). There is no backwards propagation towards the source, and no sideways reflection/refraction (We're testing dBSea with full 3D solvers currently).

- dBSea models the sediment propagation only for compressional waves, not for shear waves. This generally means that the transmission loss will be slightly underestimated as no energy is transferred into shear waves, and also means that dBSeaRay does not propagate into the sediment, but relies on a complex reflection coefficient (calculated from the sediment layers) to calculate the reflection/refraction properties of the sediment. Given that dBSeaRay is generally only used for higher frequencies, this has very little practical effect, as higher frequencies will only interact weakly with deeper layers of the sediment.

- The individual sources in a scenario are modelled radially (radial coordinates) from the source at several depths. In post-processing levels are transferred to a cartesian "results grid". This results grid stores levels from all sources so that the cumulative level at any point in the scenario can be investigated immediately.

- Levels can be, and are often post-processed to apply a conservative margin and smooth results (Figure 21, p. 28). Radial smoothing (triangular kernel of variable width) is carried out to mitigate modelling artefacts arising from low environment sampling density or chance occurrences. Levels are often made to decrease monotonically from the source to make general trends more visible and decrease the risk of misinterpreting impact ranges.

- When refereeing to a level at a certain range, this usually refers to the greatest level at any depth at that range (unless specifically mentioned otherwise).

Figure 21. Post-processing to eliminate artefacts and ease interpretation. Level are radially smoothed by default, and are made to be monotonically decreasing with increasing range from the source.

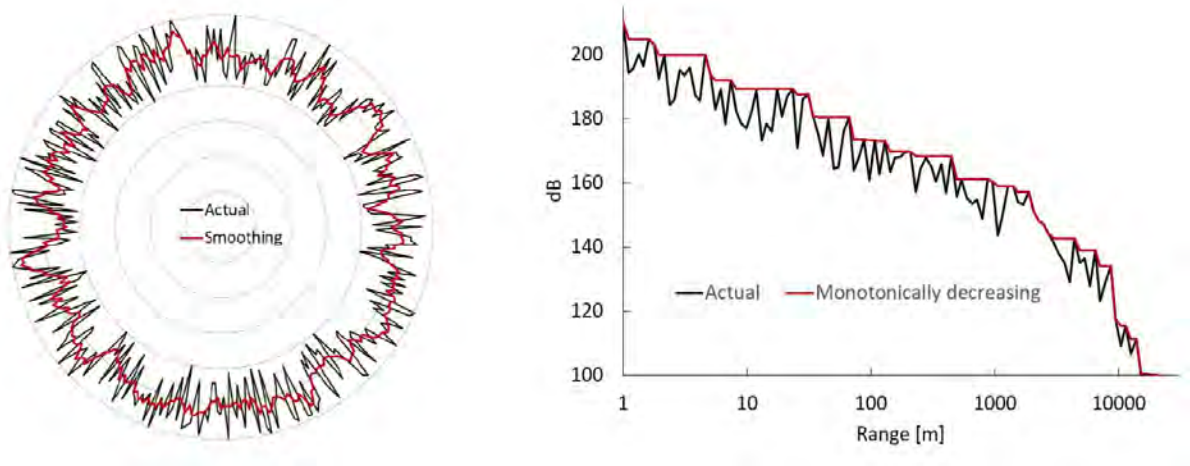


Figure 22. Low resolution schematic of the dBSea modelling space. Source transmission loss is modelled radially from the sources at a number of depths. Results are extracted from a "square" 3D grid that hold cumulative levels from all sources in the scenario.

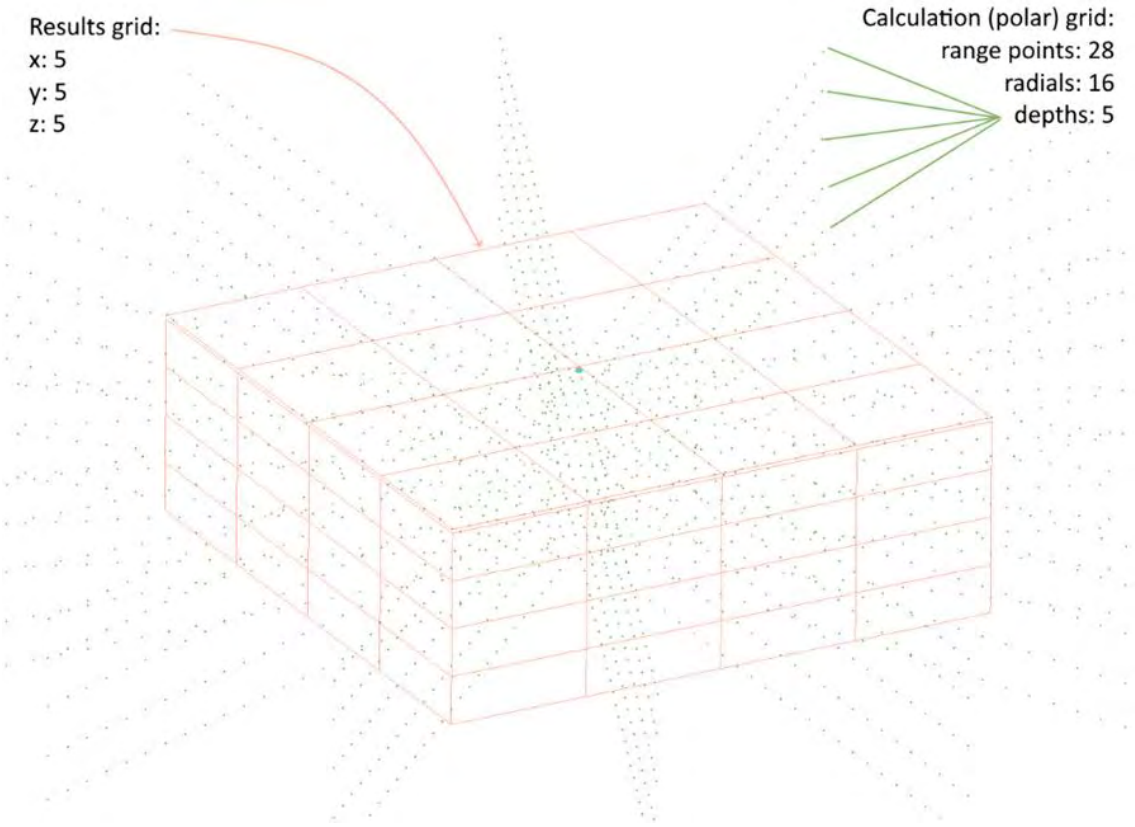
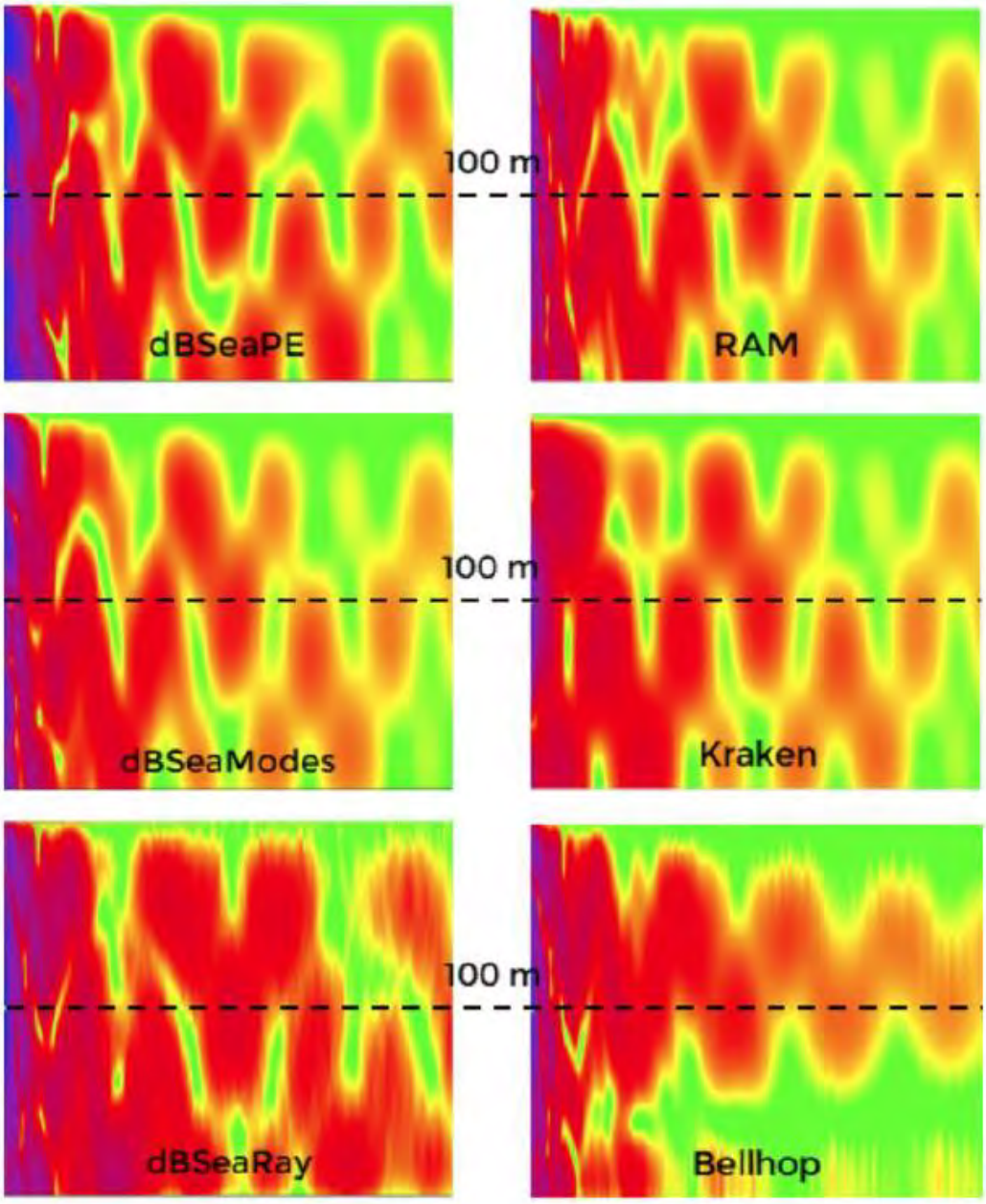


Figure 23. the "Pekeris" standard problem, a low frequency problem. Note that due to sediment effects, neither dBSeaRay nor Bellhop should be relied upon for low frequency problems, and are only include for completeness.



APPENDIX B – UNDERWATER ACOUSTICS BASICS

Sound Speed

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[11] much as 340 m/s is in air. Soundspeed is given by the following equation:

$$c = \frac{Z}{\rho}$$

$$Soundspeed\ [m/s] = \frac{Acoustic\ impedance\ \left[\frac{kg}{m^2 \cdot s}\right]}{Specific\ density\ [kg/m^3]}$$

Because changes to pressure, salinity and temperature occur with changes in depth, the specific density and acoustic impedance of water changes with depth, and thus the soundspeed changes as well.

The soundspeed profile is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. This change is quantified in "Snell's Law" and results in sound being "bent" towards the depth of minimal soundspeed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

Spreading loss

Most of the propagation loss (loss in dB from source to receiver, "PL") that occurs initially is governed by "spreading loss". It is the simple "thinning out" of acoustic energy as it spreads away from the source, usually in all directions – spherically.

For a sound source in an unbound medium the initial PL will be dominated by spherical PL:

$$Received\ level = Source\ level_{at\ reference\ range} - 20 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction in received level of 6 dB per doubling of distance and explains the rapid reduction in received levels often seen close to the source, e.g.: with a reference range of 1 m, at 16 meters range, there has been 4 doublings of distance, and thus 24 dB loss (4×6 dB).

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Also, at greater ranges a doubling of distance is no longer trivial as the PL from spherical spreading loss from 500 m to 1000 m is also just 6 dB.

Sound Channels and Wave guides

In bounded mediums where the sound energy is confined to cylindrical spreading, the PL (ignoring absorption) is often well-characterised by:

$$Received\ level = Source\ level_{at\ reference\ range} - 10 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction of received level of 3 dB per doubling of distance. Depending on the sediment this kind of "waveguide" can sustain efficient transmission of sound over long ranges, provided the sediment is acoustically hard and there is low absorption (such as is the case for low frequencies or in low salinity).

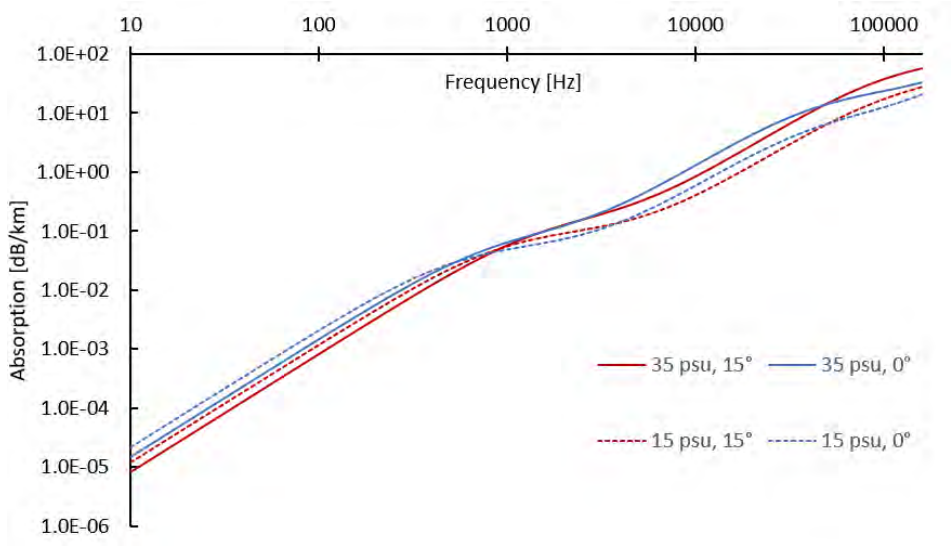
In absence of a bounding from the surface or the seabed, a soundspeed profile with a clear low-speed region, surrounded by higher soundspeeds can act a sound channel, by focusing the sound towards a single depth (with lower soundspeed), limiting the PL from spherical to cylindrical (a SOFAR channel is formed).

[11] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

Absorption

Besides the "thinning out" of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is mostly governed by the concentration of boric acid and magnesium sulphate and is very dependent on the frequency, with lower frequencies, <1 kHz, experiencing almost no absorption, while high frequencies, > 10 kHz, can be attenuated by over 10 dB / km.

Figure 24. Absorption comparison at salinities of 35 psu & 15 psu and temperatures of 0° and 15°. Both scales are logarithmic. Note how increased salinity increases high-frequency absorption (solid v dashed lines), while a decrease in temperature increases absorption at lower frequencies (red v blue lines).



Small bubbles, wind or wave induced, will further attenuate especially the high frequencies, but as modelling is often done to estimate a worst-reasonable case, or for weather sensitive activities, fair weather with little wind and waves are assumed, thus ignoring this attenuation effect.

Sediment

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies. This effect coupled with the high absorption at high frequencies often leads to the soundscape being dominated by frequencies from a few hundred hertz to a few thousand hertz. In deeper water, or with an upward refracting soundspeed profile, low frequencies will tend to dominate the soundscape away from sound sources, as there is no efficient mechanism for attenuating them.

A "cut-off[12]" frequency, below which, there will be high sediment-associated attenuation can be approximated by:

$$f_{cut-off} = \frac{c_{water}}{4 \cdot D \cdot \sqrt{1 - \left(\frac{c_{water}}{c_{sediment}}\right)^2}}$$

With "C_{water}" and "$C_{sediment}$" being the soundspeed in the water and the sediment respectively, and "D" the local depth (Jensen, Kuperman, Porter, & Schmidt, 2011).

[12] The cut-off is not an immediate loss of energy in frequencies under this frequency, but rather something like a high pass, 1st-order, Butterworth filter (Audoly, 2020).

In water with lower salinity and less absorption, the soundscape will tend to have a relatively higher content of high frequencies as these are absorbed much less efficiently when the salinity is lower.

Sound transmission Across Interfaces

Sound waves are reflected and refracted (Snell's law) as they travel through interfaces. Also, depending on acoustic impedance and interface angles only a proportion of the incident acoustic energy is transmitted through that interface (the rest is reflected).

In the following: W: Watt; Pa: Pascal; s: second; m: metre; N: Newton; J: Joule; θ: angle; v: soundspeed; Z: acoustic impedance; p: pressure from ambient;

Snell's law:

$$\frac{\sin\theta_{in}}{\sin\theta_{out}} = \frac{v_{in}}{v_{out}}$$

- rearranged to give transmission angle from incidence angle and soundspeeds:

$$\sin^{-1}\left(\frac{\sin\theta_{in}}{\frac{v_{in}}{v_{out}}}\right) = \theta_{out}$$

Transmission fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{2\cdot Z_{out}\cdot\cos\theta_{in}}{Z_{out}\cdot\cos\theta_{in} + Z_{in}\cdot\cos\theta_{out}}$$

Reflection fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{Z_{out}\cdot\cos\theta_{in} - Z_{in}\cdot\cos\theta_{out}}{Z_{out}\cdot\cos\theta_{in} + Z_{in}\cdot\cos\theta_{out}}$$

It follows from these relations that for transmission from an acoustically relatively slow medium like water to an acoustically faster medium here exists an incident angle above which there is total reflection, and thus no transmission of acoustic energy through the interface (real interfaces are rugged and lumpy, and perfect reflection is not realistic).

For the water/sediment interface presented here (sediment is sand with a soundspeed of 2000 m/s) this occurs at 0.84 radians (~48.5 degrees) from normal incidence.

The fraction of pressure transmission from water (soundspeed 1500 m/s) to sediment (2000 m/s) is around 146 % at normal incidence and drops as the incidence angle increases away from normal, much faster for water-to-sediment than for sediment-to-water.

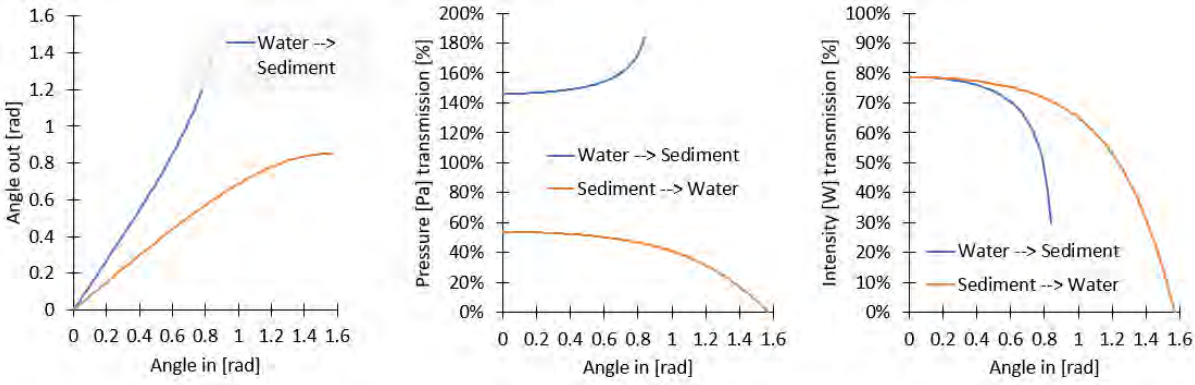
While it may seem counter-intuitive that pressure can increase after transmission over an interface, remember that the energy in the sound is a function of pressure *and* acoustic impedance:

$$I = \frac{p^2}{Z}$$

$$With\ units: [W] = \frac{[Pa]^2}{\left[\frac{Pa\cdot s}{m^3}\right]} = \frac{\frac{N^2}{m^4}}{\frac{N}{m^2}\cdot s} = \frac{N^2\cdot m^3}{m^4\cdot\frac{N}{m^2}\cdot s} = \frac{N}{m\cdot m^{-2}\cdot s} = \frac{J\cdot m}{m^{-1}\cdot s} = \frac{J}{s} = W$$

Thus, if the transmitted intensity fraction is 80 % then the reflected intensity is 20 %; there is energy conservation.

Figure 25. Transmission angles [radians] and fractions as function of incident angle between water and sediment (sand). Note that total reflection from water to sediment occurs around incident angle of 0.84 [rad] (48.5 degrees), meaning there is no transmission of sound at greater incidence angles.



Simplified Propagation Loss Model

Taking all the above into account we can construct a simplified model, that will give a good indication of the expected propagation loss (PL) in scenarios of constant depth:

$$PL = \begin{Bmatrix} r < D \ : & -20 \cdot \log_{10}\left(\frac{r}{r_0}\right) \\ r > D \ : & -20 \cdot \log_{10}\left(\frac{D}{r_0}\right) - 10 \cdot \log_{10}\left(\frac{D}{r_0}\right) \end{Bmatrix} - \alpha(f) \cdot r - l(f) \cdot r$$

Where:

- "r" is horizontal range from source.
- "D" depth at source.
- "r_0" the reference range of the source (often 1 m).
- "f" the frequency,
- "l" the frequency specific leakage loss to the sediment.
- "α" the frequency specific absorption.

Sound Level Units

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 7: Definitions.

Unit	Definition	Comments
SPL (dB_{RMS}) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p ($dB_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}{}^2}$
$L_{p\text{-}p}$ ($dB_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[13] equivalent to $L_P + 6.02\ dB$
L_E (dB_{SEL}) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-}"time"}$ or $L_{E\text{-}single\ blow}$.

If the averaging period for SPL is equal to the total even duration, then SPL is equal to "Leq" the "equivalent constant level".

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

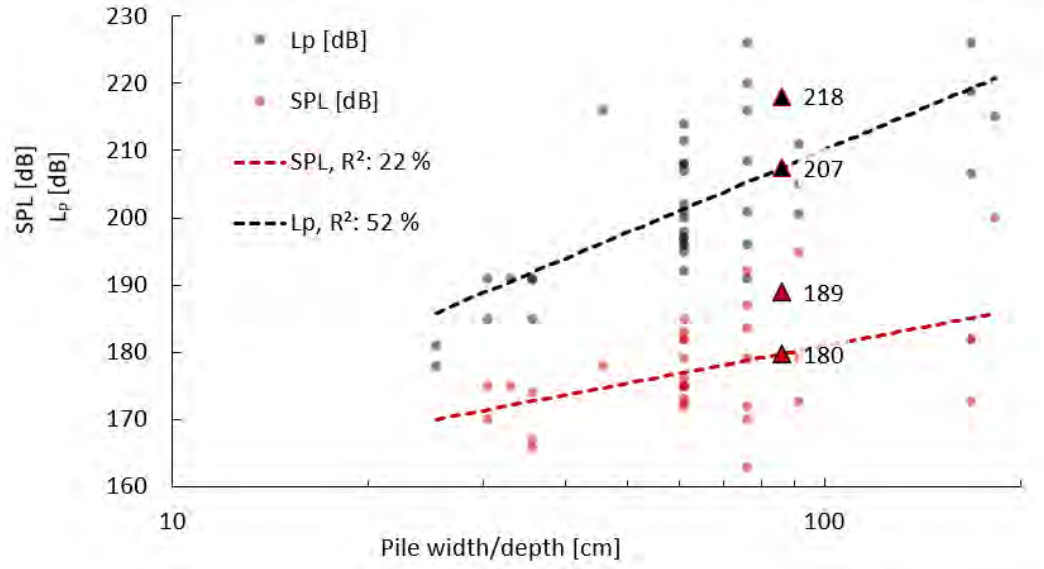
[13] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

APPENDIX C – SOURCE MODELS

Vibration piling model

We only have a few recordings (50) from vibration piling and have no dedicated source model for this type of piling. Instead, we rely on published recorded levels as from CalTrans (CalTrans, 2015).

Figure 26. Basis of vibro piling broad band source level as a function of pile size.



Given the low confidence we have in this approach (low R^2 values) we use the 90th percentile level as the broadband source level. L_P is estimated to be 218 dB and SPL 189 dB. The frequency content is assumed to be identical to that of the impact piling.

Table 8. Sources decidecade band levels.

Band centre frequency [Hz]	Dredging, Mean (broadband: 182) [SPL]	Dredging, 90th percentile (broadband: 192) [SPL]	Drilling, Mean (broadband: 138) [SPL]	Drilling, 90th percentile (broadband: 156) [SPL]	Vibro, Mean (broadband: 187) [SPL]	Vibro, 90th percentile (broadband: 196) [SPL]
12.5	162	165	127	142	166	176
16	163	166	126	139	167	176
20	164	167	124	139	167	176
25	165	170	123	138	167	176
31.5	168	177	125	139	168	177
40	169	180	124	140	169	179
50	169	178	124	139	172	181
63	170	178	126	143	174	183
80	169	180	123	142	176	185
100	168	179	124	142	177	186
125	168	178	123	140	178	187
160	168	178	123	142	177	186
200	168	177	125	146	177	186
250	169	178	126	147	177	186
315	169	178	125	147	175	184
400	169	177	123	144	174	183
500	168	178	124	145	173	182
630	167	175	122	143	171	180

800	167	174	124	141	169	178
1000	166	174	125	142	167	176
1250	165	174	123	142	165	175
1600	165	174	121	138	164	173
2000	164	174	120	135	162	171
2500	163	175	119	134	160	169
3150	163	175	118	132	159	168
4000	162	175	118	132	158	167
5000	162	175	119	133	156	165
6300	161	175	118	130	155	164
8000	160	175	117	130	154	163
10000	159	174	117	129	152	161
12500	158	173	110	120	150	159
16000	157	173	109	118	150	159
20000	156	172	109	119	149	158
25000	156	171			148	157
31500	155	171			147	156
40000	154	170			146	155
50000	157	174			145	154
63000	156	173			144	153
80000	156	173			143	152
100000	157	172			142	151
125000	157	166			141	150
160000	157	166			140	149

APPENDIX D – MODEL CALIBRATION

Recorded Transmission losses

Scapa

Broadband transmission losses for exposure levels (L_E) show good consistency between measurements and a transmission loss consistent with -14.7 × Log_{10}(range), suggesting a sediment with some ability to reflect sound back into the water column and form a waveguide.

Transmission loss for peak pressure levels (L_P) were near spherical spreading loss which is consistent with a poorly reflecting bottom resulting in little overlap in arrival times for the source impulse.

There was a clear pattern in the transmission losses versus frequency, with higher frequencies experiencing much higher losses, likely due to interaction with a rough sediment resulting in a lot of scattering.

*Note that for the bands 50 – 1250 Hz the ambient noise at Scapa was above the source level, while we have tried to compensate for this, those values are still subject to considerable uncertainty (*Figure 28*).*

Figure 27. Broadband transmission losses at Scapa. L_P losses follow a near spherical loss pattern while L_E shows a tendency to follow a waveguide with some absorption losses. Thick lines are best fit of logarithmic loss, while thin lines are for loss accounting for the depth at the source. Error bars are expected 95 % of measurements.

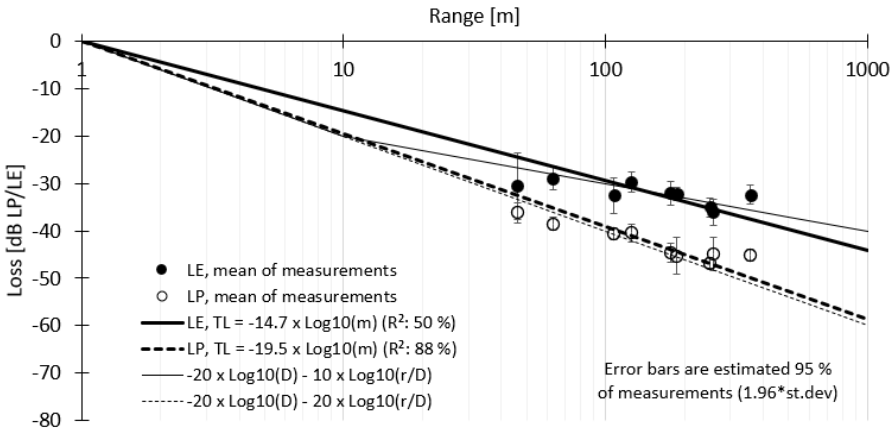
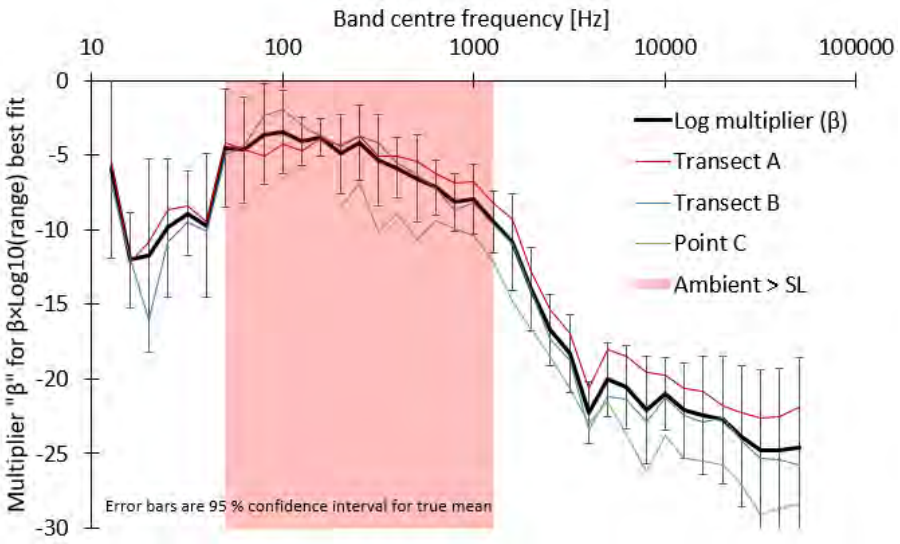


Figure 28. Transmission losses per band shown as the best fit multiplier "β" for a simple logarithmic transmission loss. Error bars are 95 % confidence interval for the true mean. While Transects A & B have some difference, this was not significant at a 10 % level in a t-test. Bands 50 – 1250 Hz have been corrected for contributing ambient noise as ambient noise was near or above recorded levels (red band).



APPENDIX E – RESULTS

Maps are presented with impact for different hearing groups as summarised here

Note that some maps have areas marked as “model artefacts”, these are areas where the levels are assumed to not be realistic, but rather an example of a digitisation problem with the bathymetry.

Group	Description	Example species
LF	Low frequency, baleen whales	Mike whale, Fin whale, Blue whale
HF	High frequency, most dolphins	Common dolphin, Risso’s dolphin, beaked whales, Bottlenose dolphin, Sperm whale, Killer whale
VHF	Very high frequency, few dolphins and porpoises	Harbour porpoise, Hourglass dolphin
PW	Phocid water, True seals	Harbour seal, Grey seal
OW	Otariid + other water, Fur seals, walruses and aquatic mammals	Walrus, Otter, Polar bear
P-	Fish with swim bladder, not coupled to inner ear	Salmon, Trout, Cod, Herring
P*	Fish with no swim bladder	Sharks and rays

Dredging L_E

Maps are provided for 90th percentile source levels for 1 hours and 8 hours.

Figure 29. Dredging, L_E, 1hr, LF group

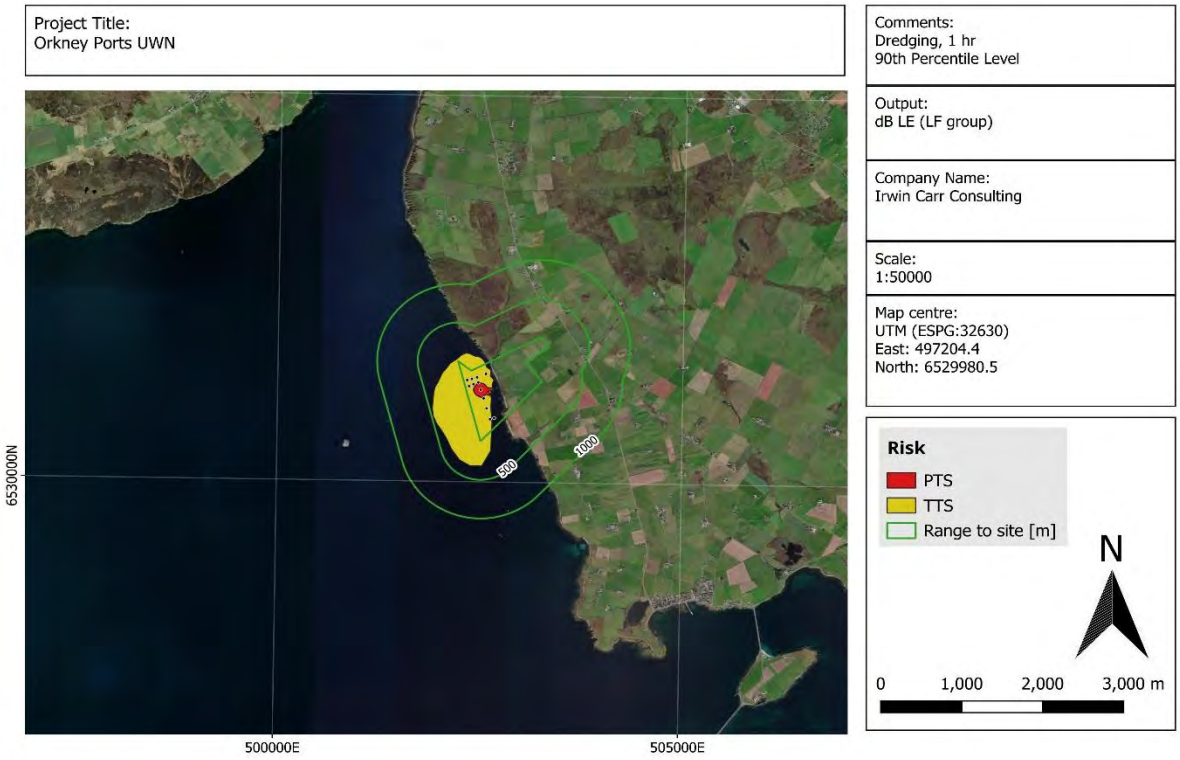


Figure 30. Dredging, L_E, 8hr, LF group

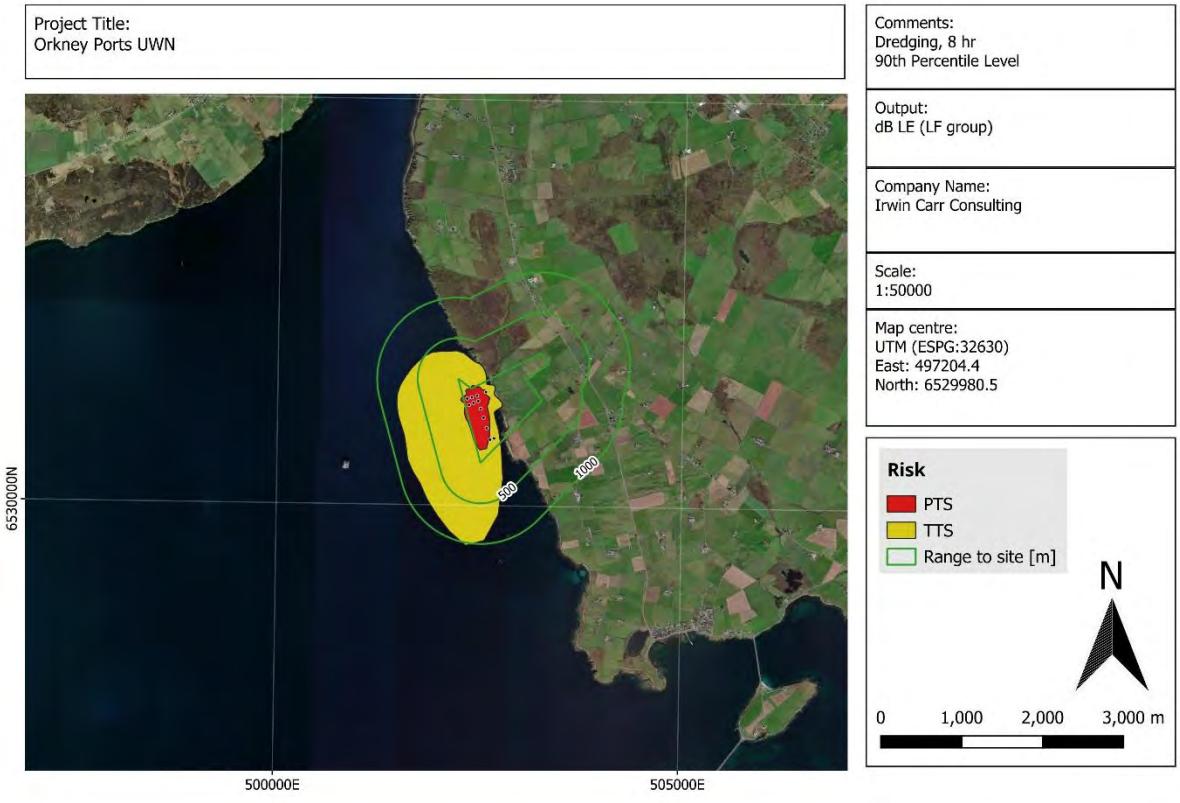


Figure 31. Dredging, L_E, 1hr, HF group

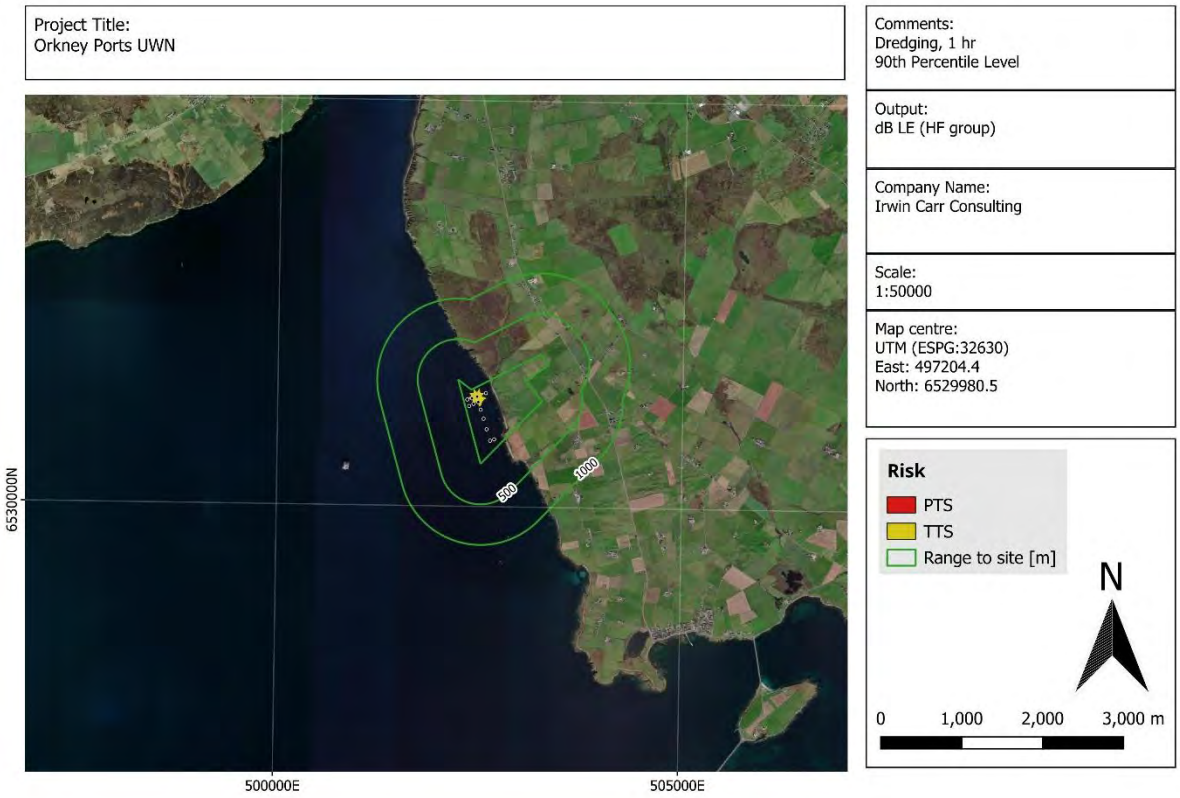


Figure 32. Dredging, L_E, 8hrs, HF group

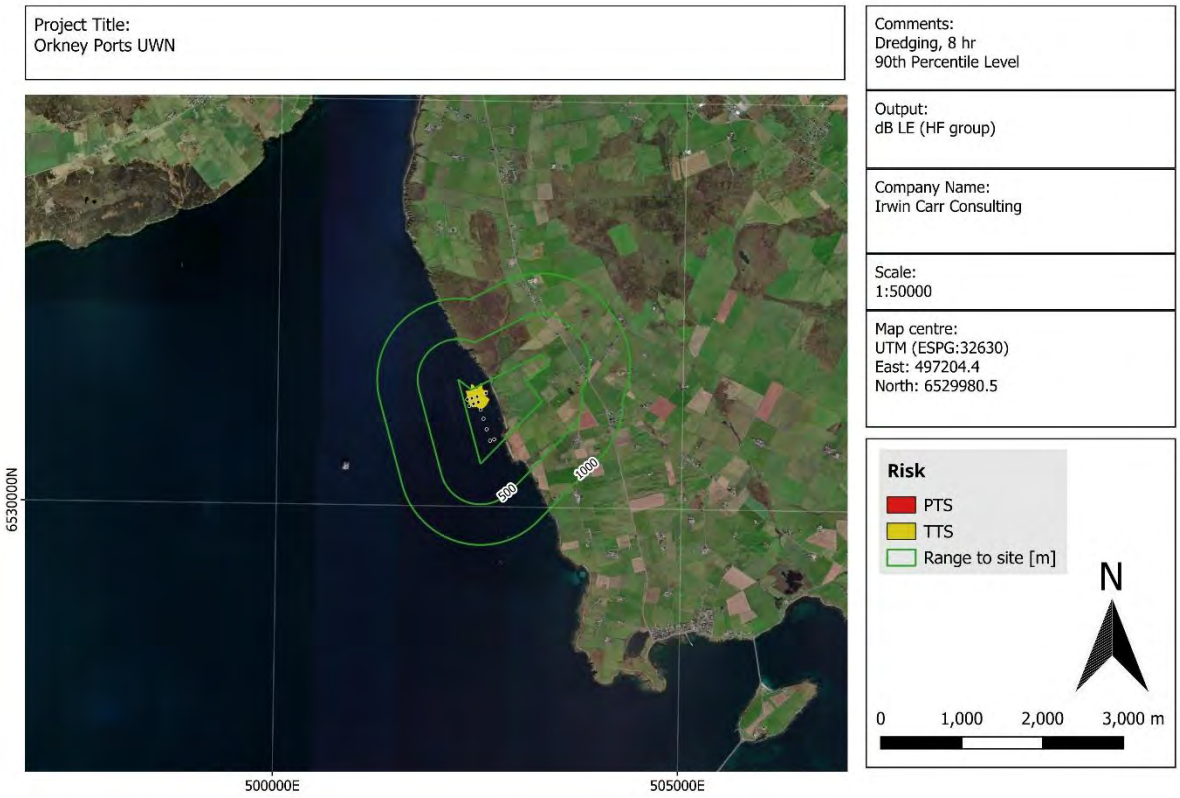


Figure 33. Dredging, L_E, 1hr, VHF group

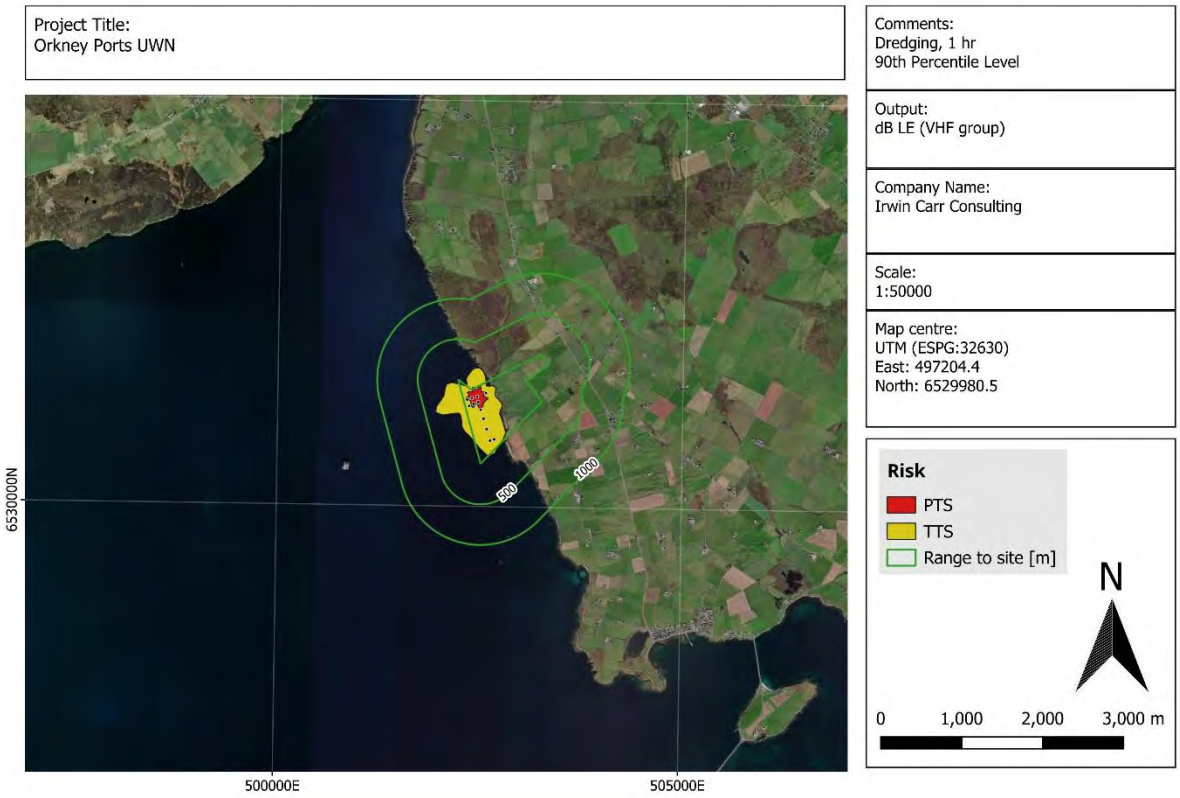


Figure 34. Dredging, L_E, 8hrs, VHF group

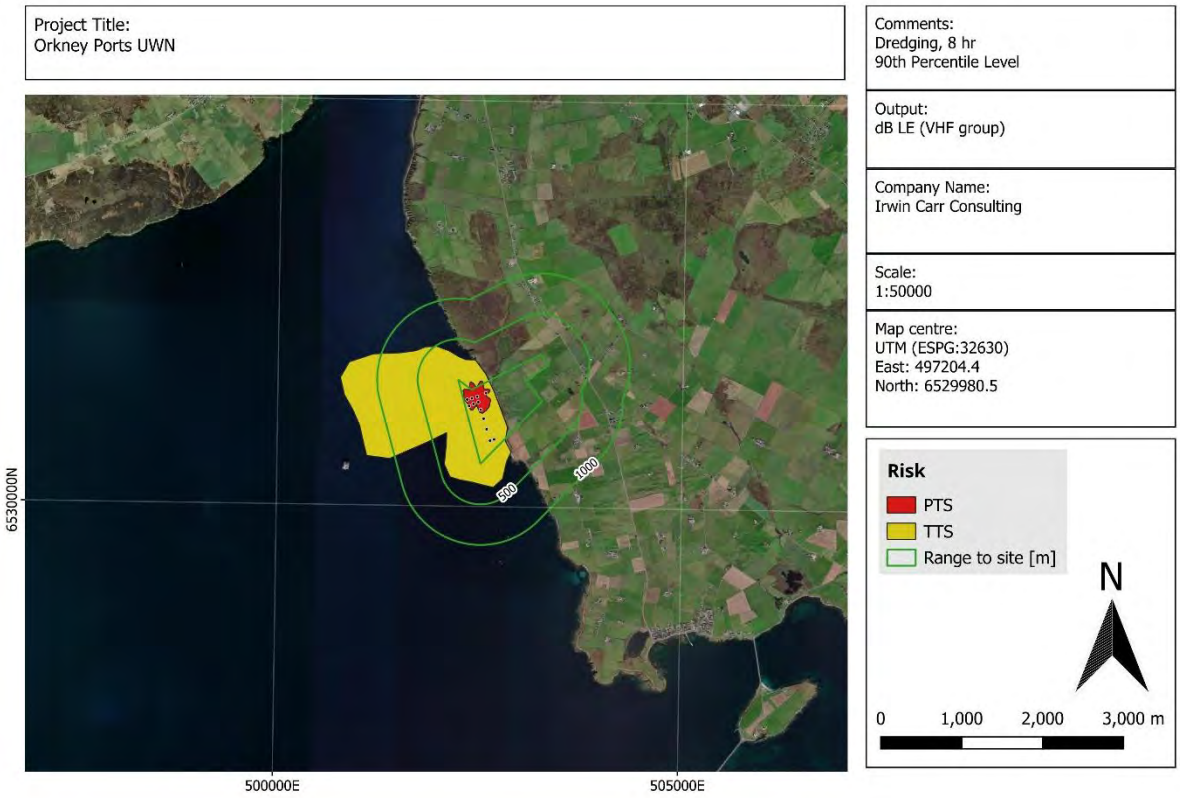


Figure 35. Dredging, L_E, 1hr, PW group

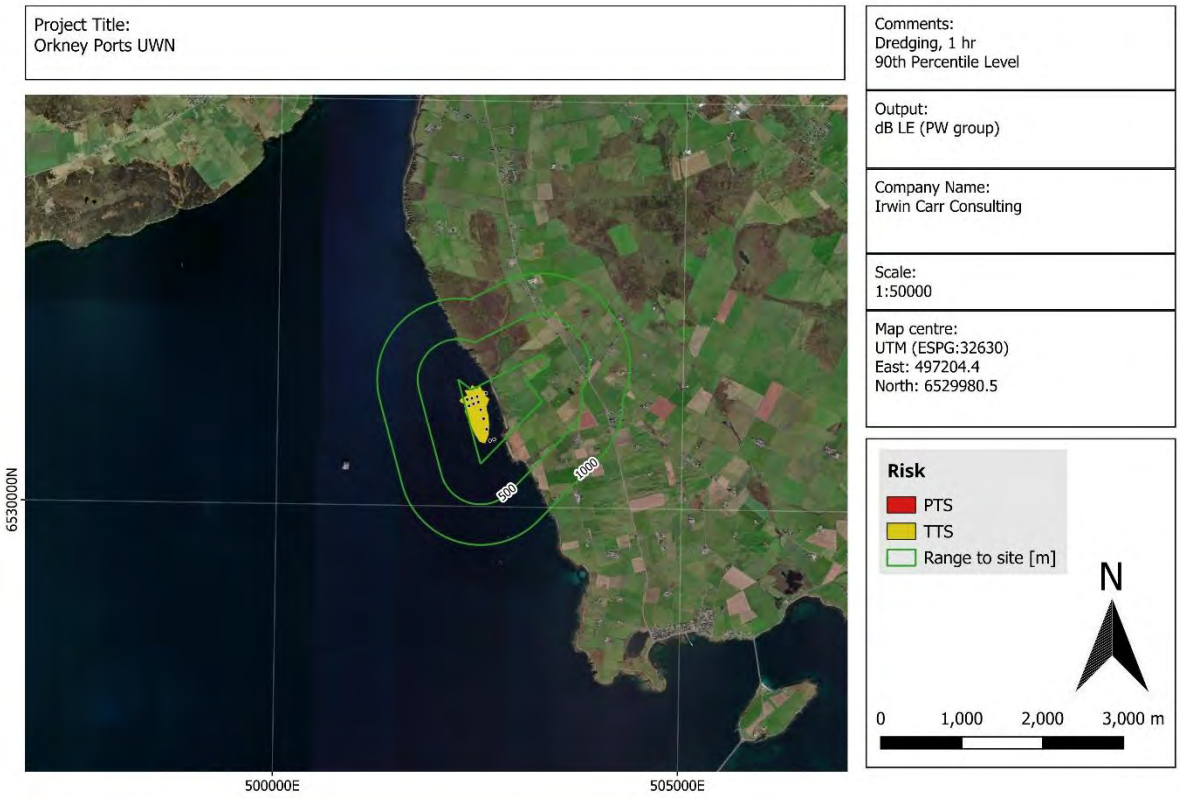


Figure 36. Dredging, L_E, 8hrs, PW group

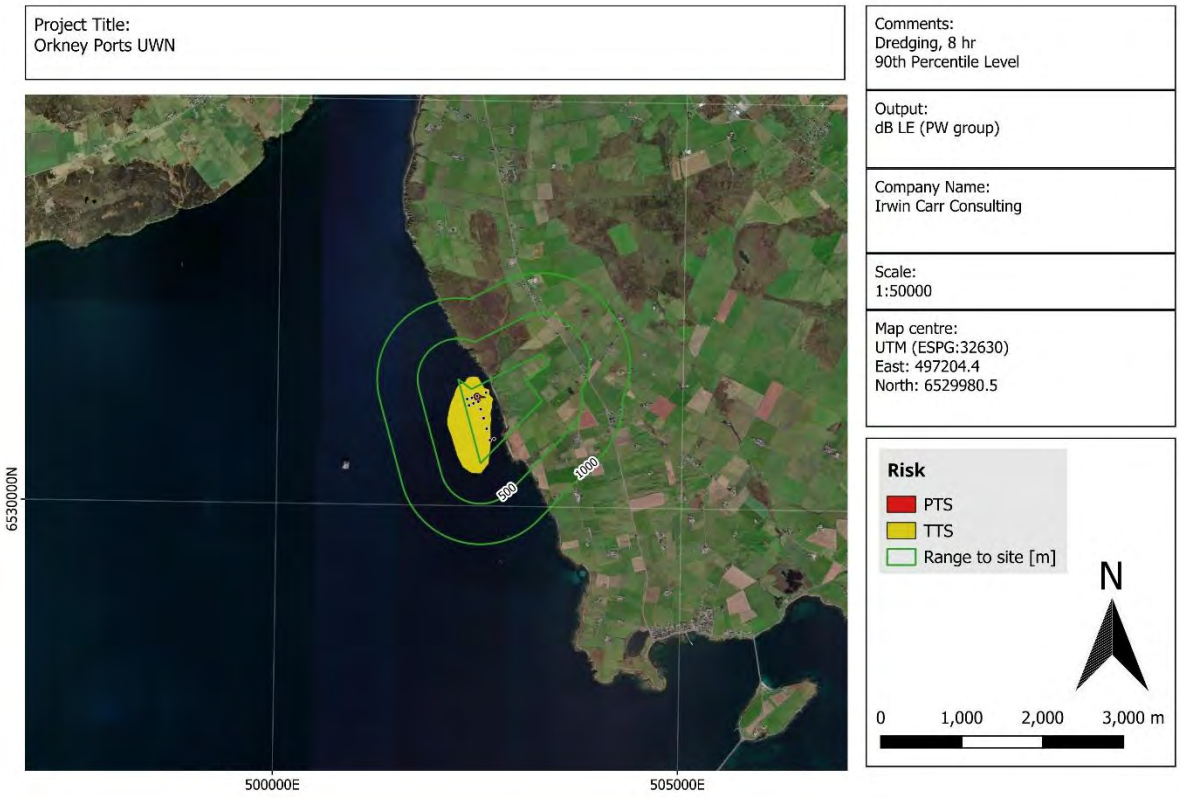


Figure 37. Dredging, L_E, 1hr, OW group

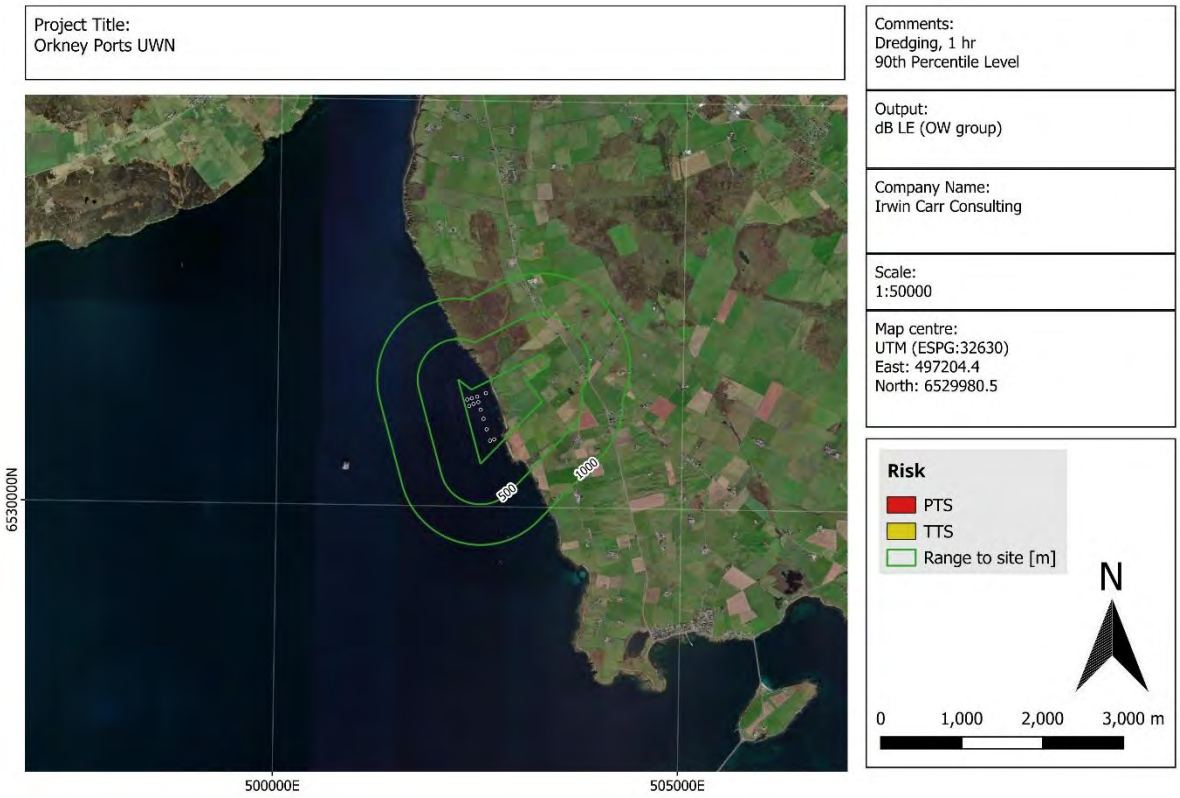


Figure 38. Dredging, L_E, 8hrs, OW group

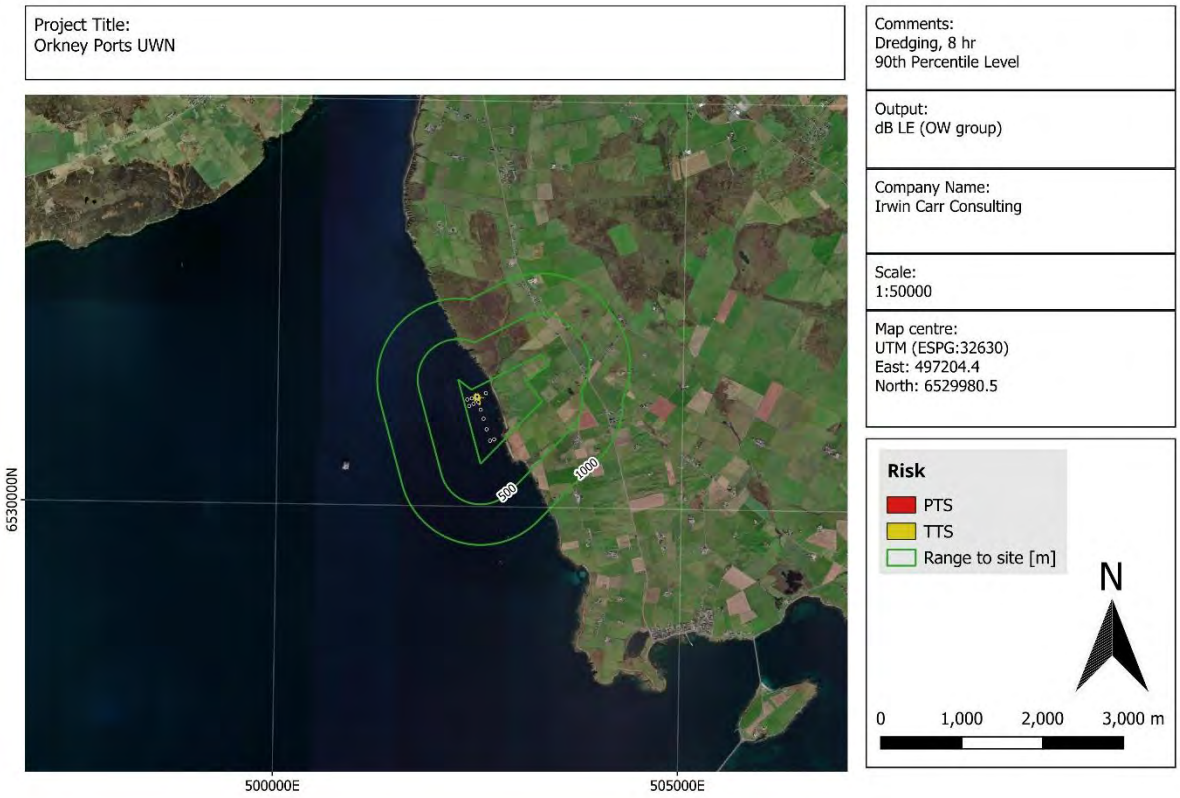


Figure 39. Dredging, L_E, 1hr, P- group

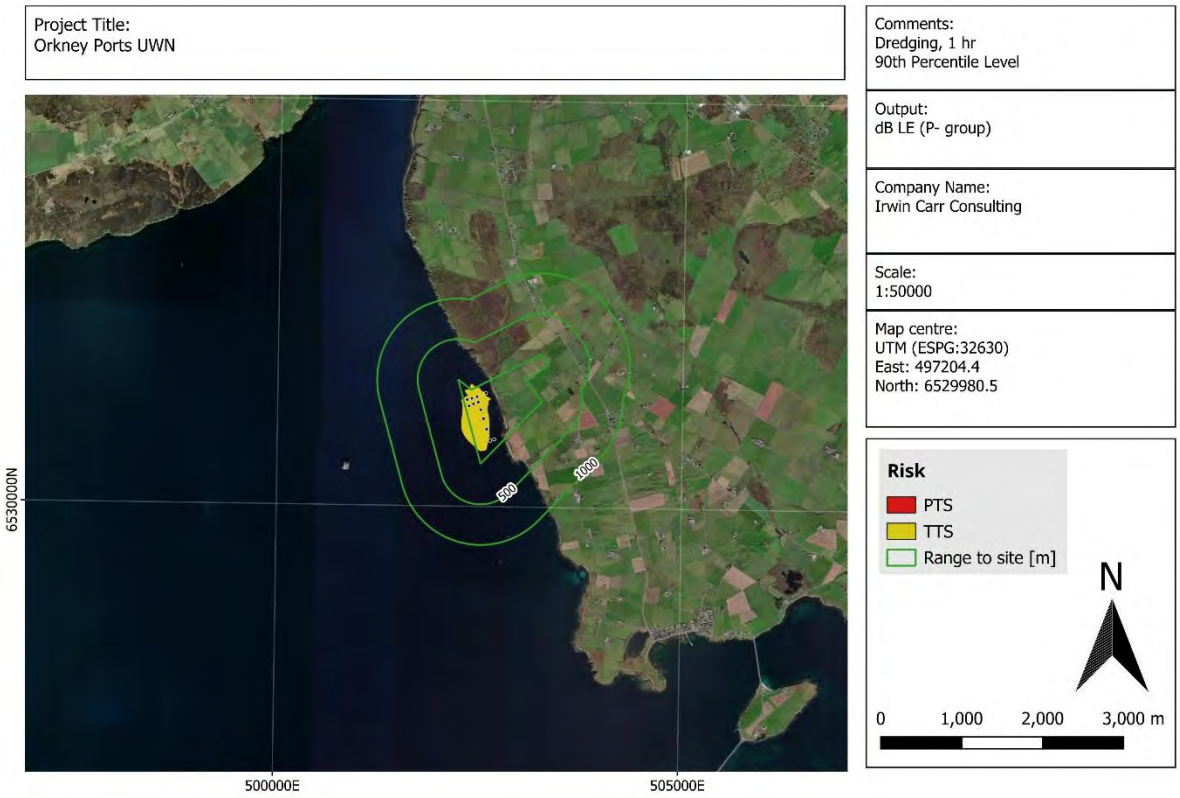


Figure 40. Dredging, L_E, 8hrs, P- group

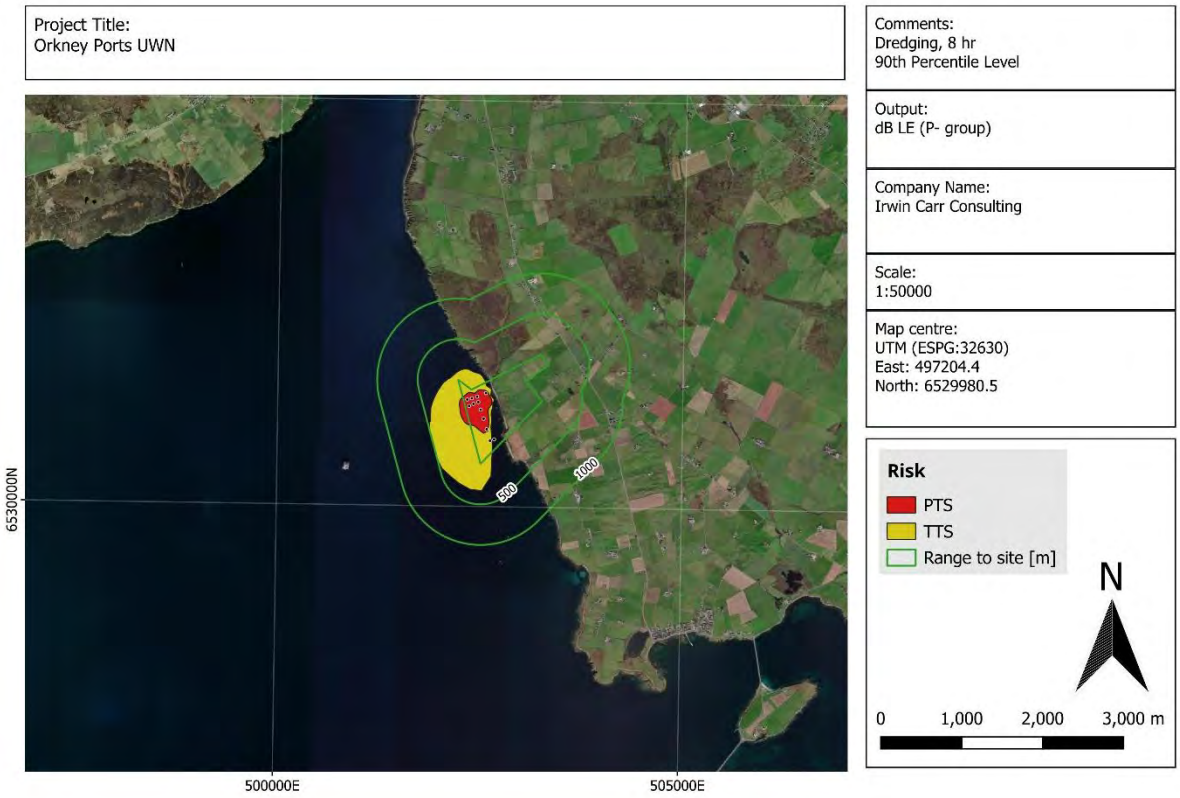


Figure 41. Dredging, L_E, 1hr, P* group

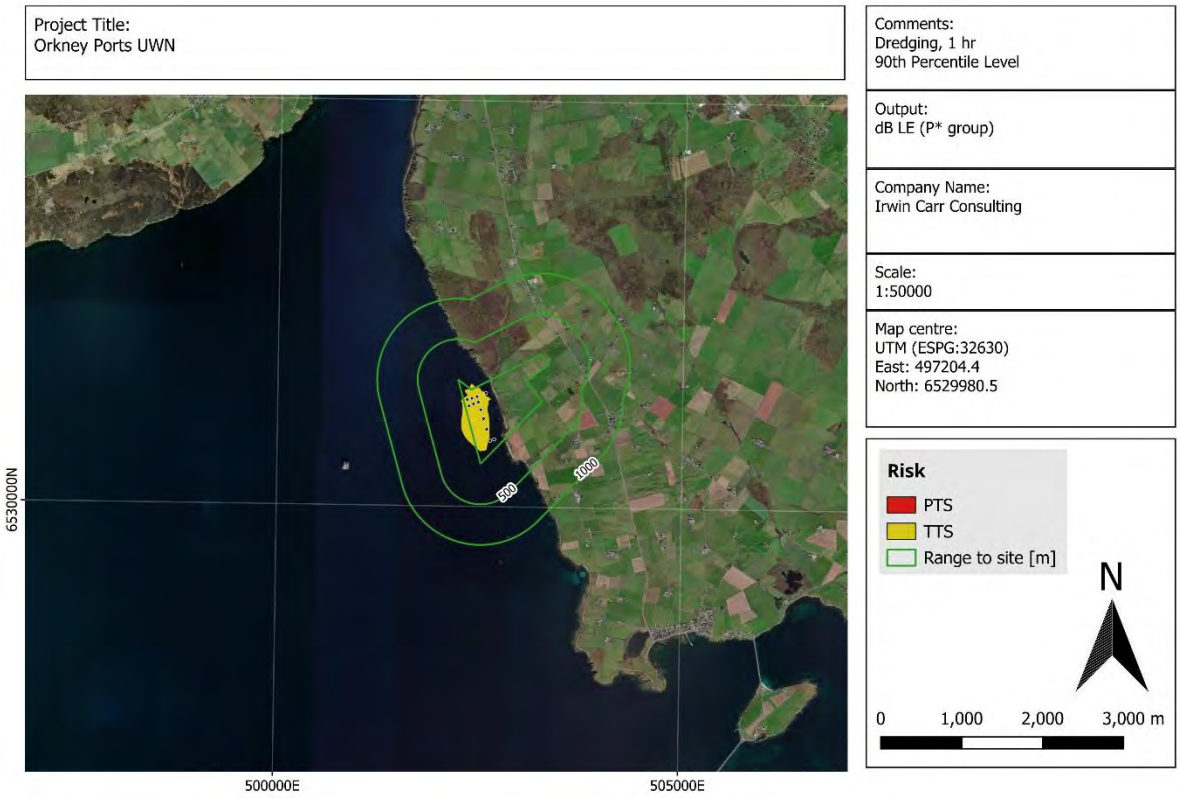
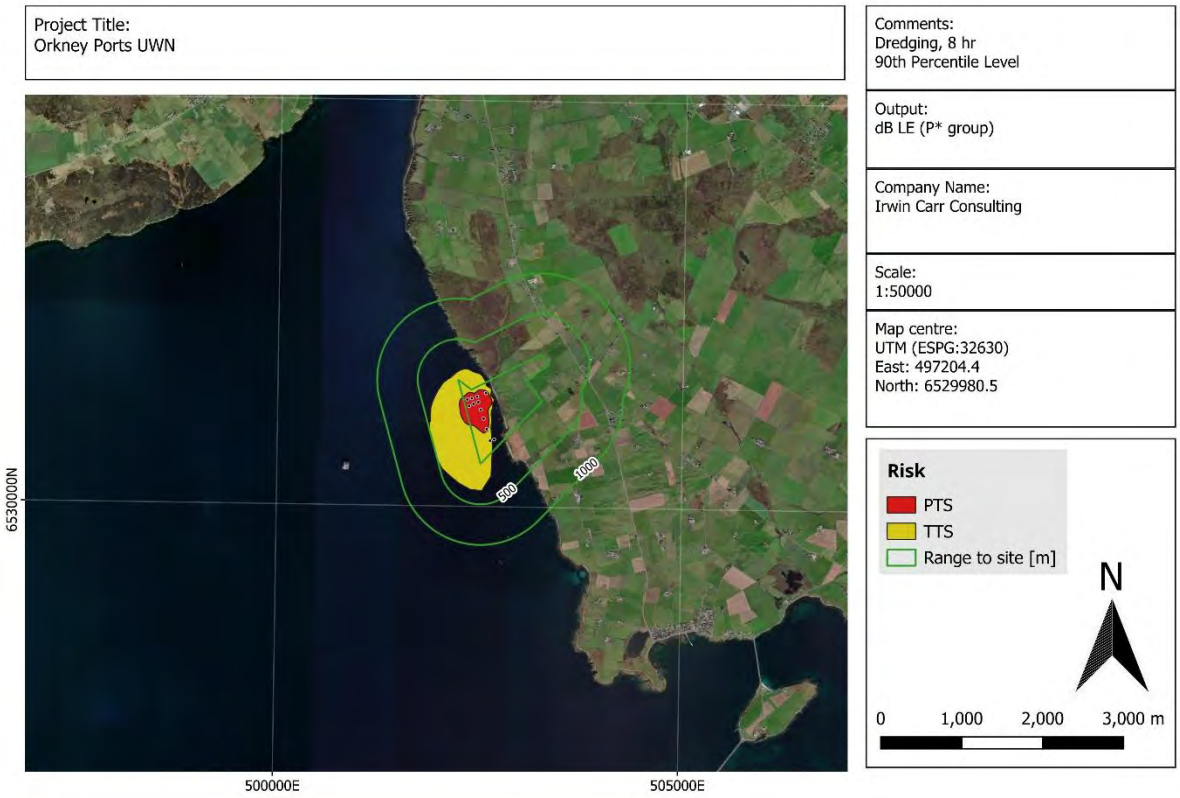


Figure 42. Dredging, L_E, 8hrs, P* group



Vibro Piling L_E

Figure 43. Vibro piling, L_E, 1 hour, LF group

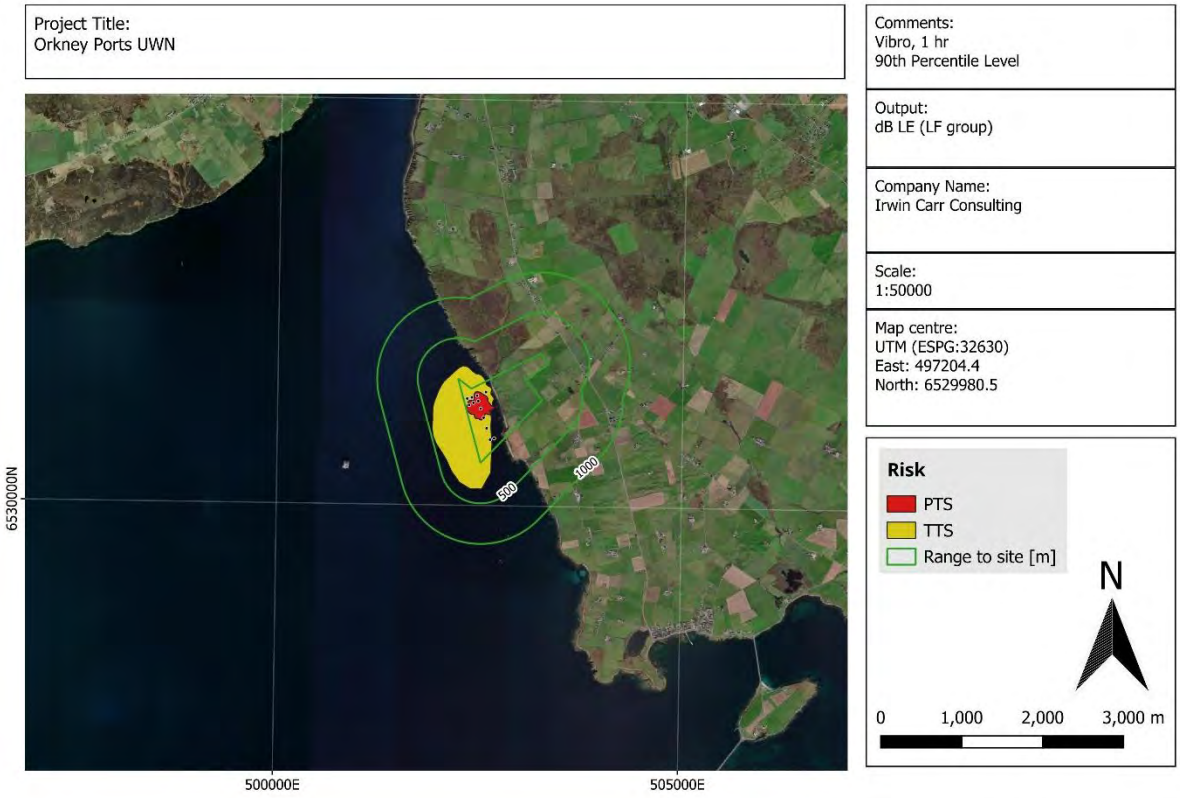


Figure 44. Vibro piling, L_E, 1 hour, HF group

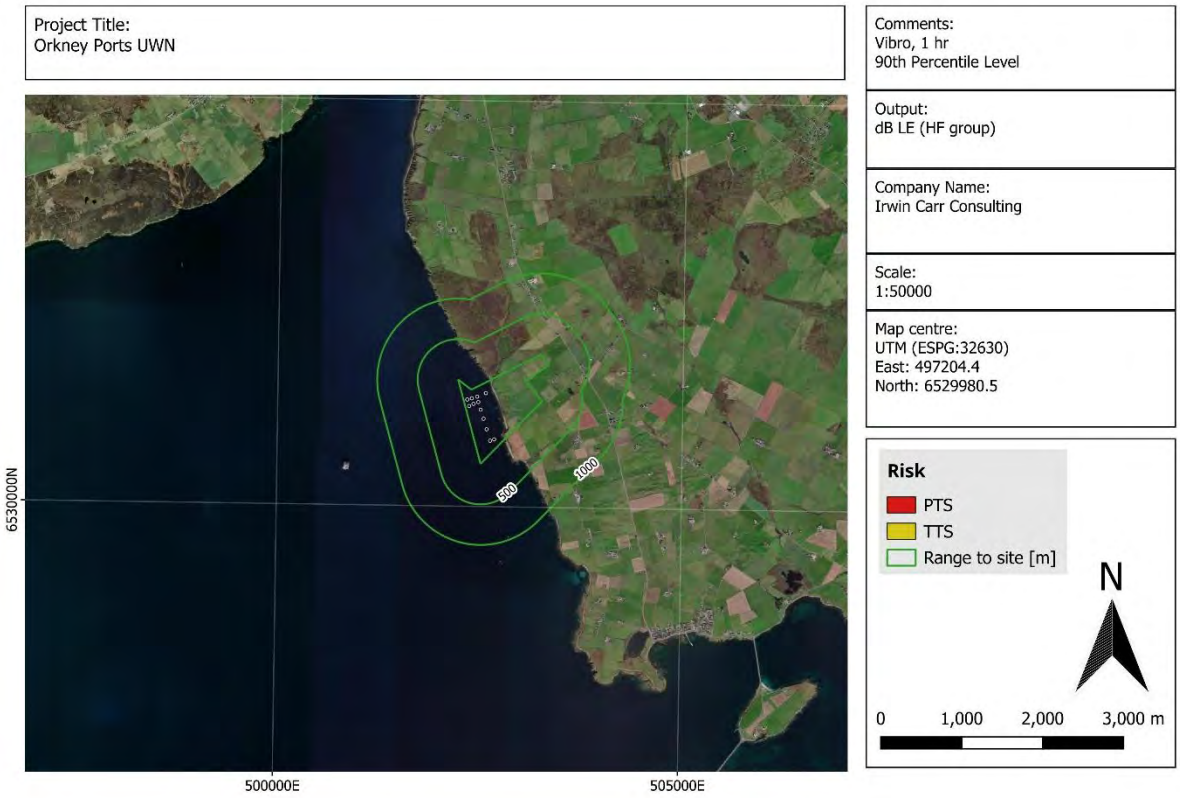


Figure 45. Vibro piling, L_E, 1 hour, VHF group

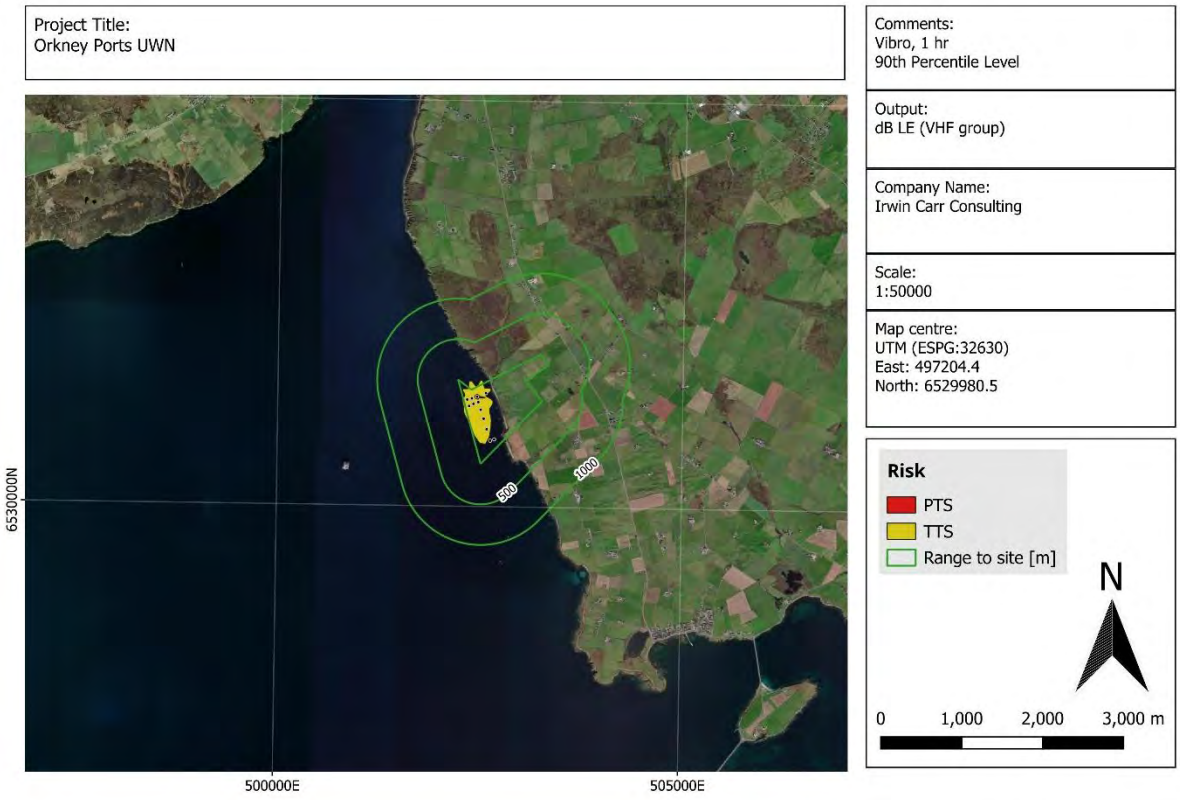


Figure 46. Vibro piling, L_E, 1 hour, PW group

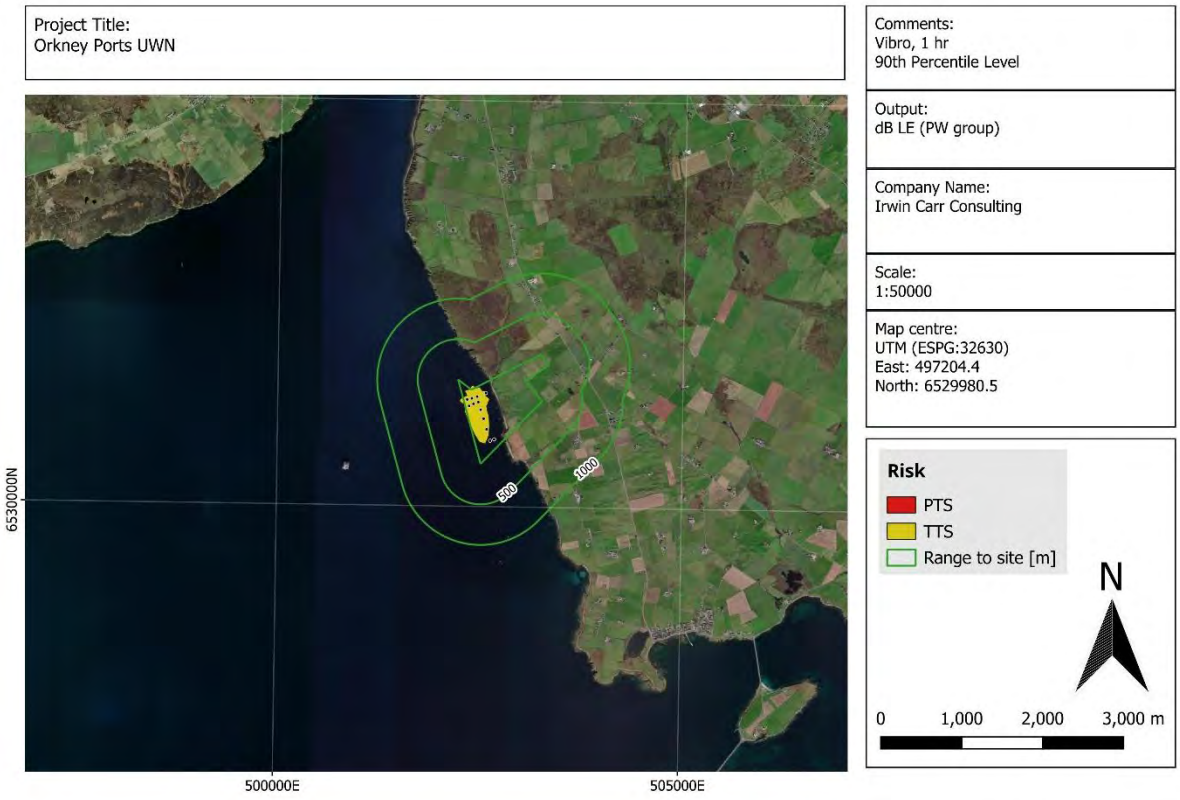


Figure 47. Vibro piling, L_E, 1 hour, OW group

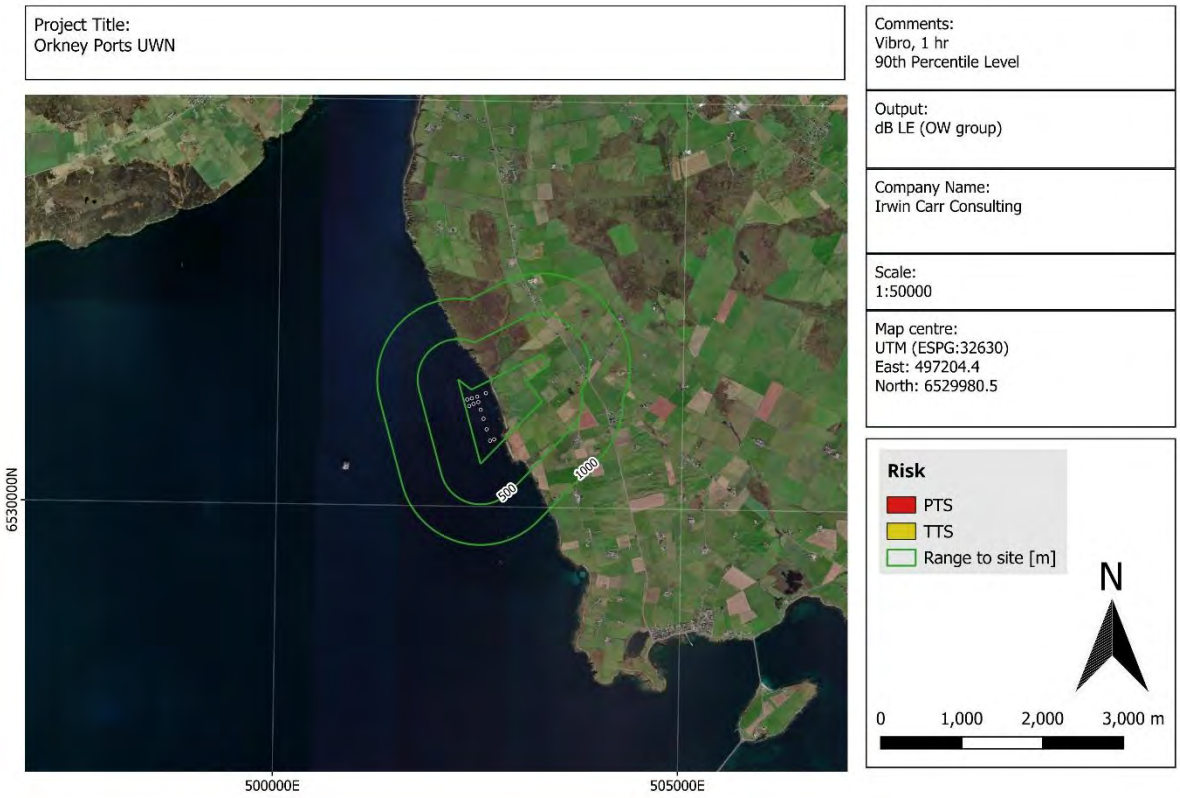


Figure 48. Vibro piling, L_E, 1 hour, P- group

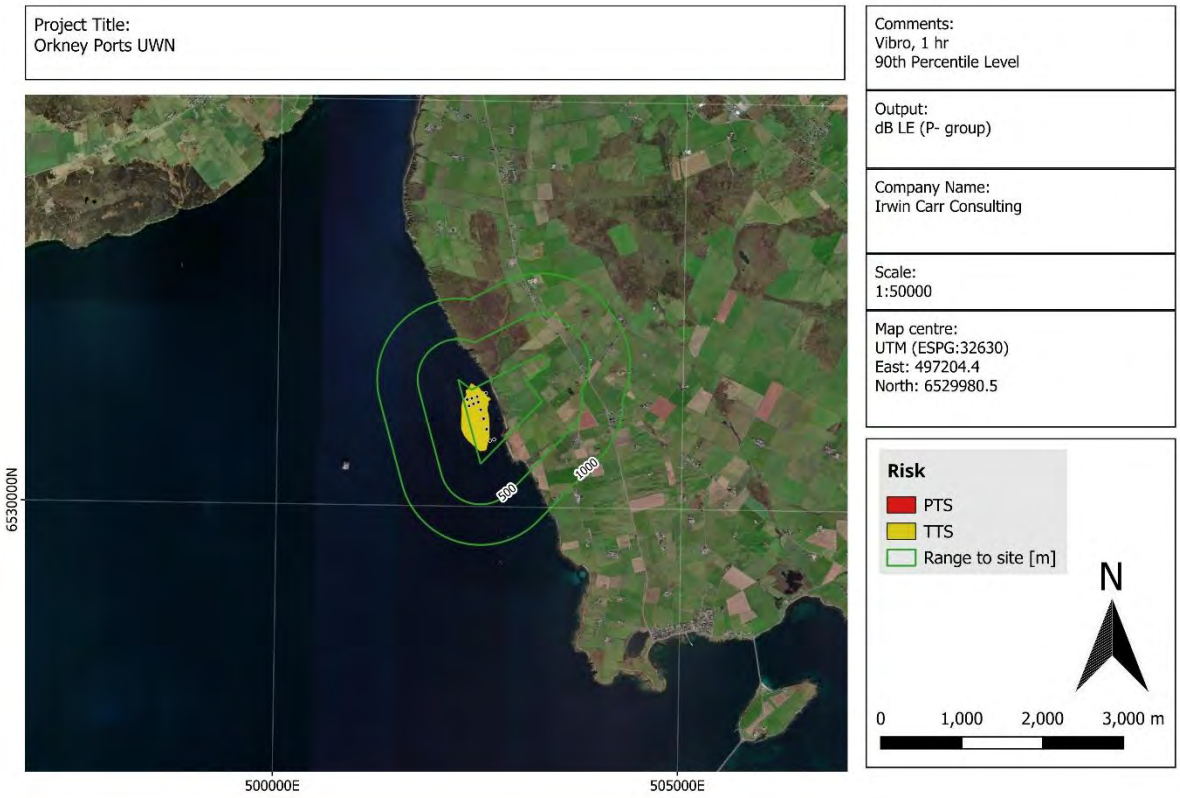
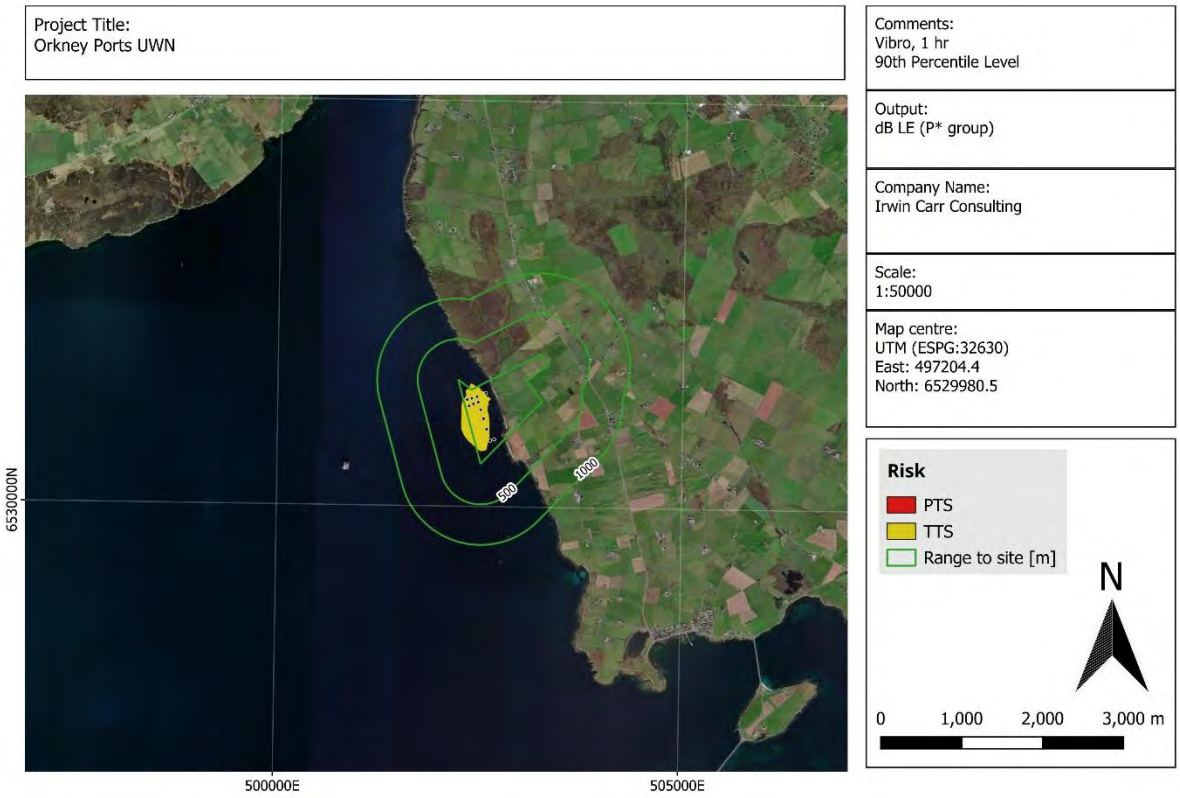


Figure 49. Vibro piling, L_E, 1 hour, P* group



Vibro piling L_P

Figure 50. Vibro piling, L_P, LF group

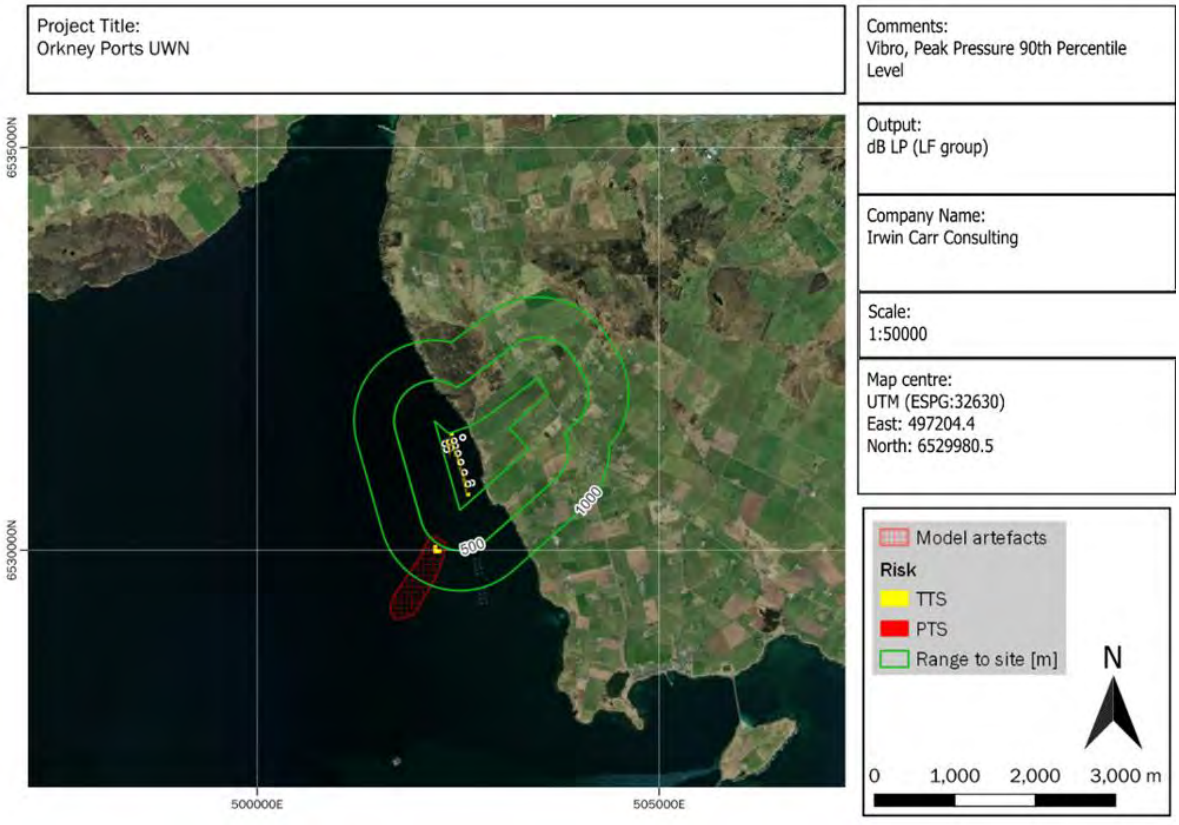


Figure 51. Vibro piling, L_P, HF group

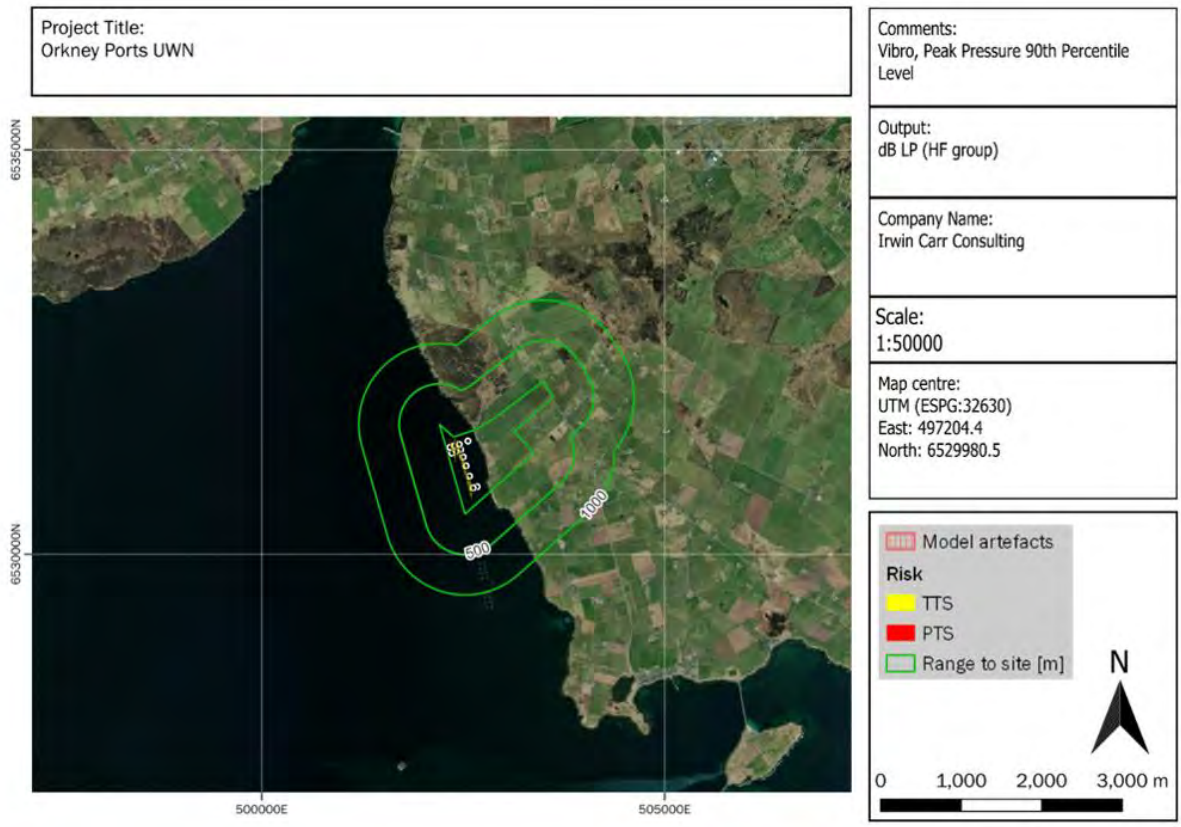


Figure 52. Vibro piling, L_P, VHF group

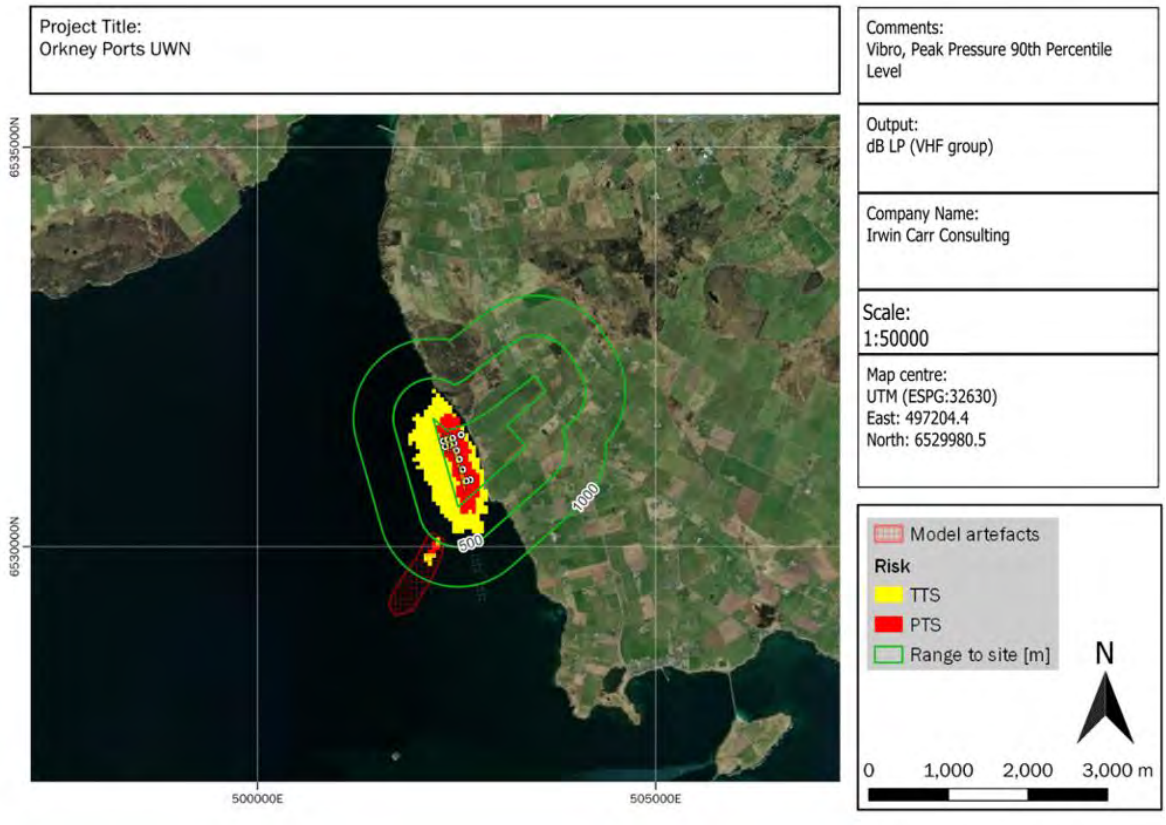


Figure 53. Vibro piling, L_P, PW group

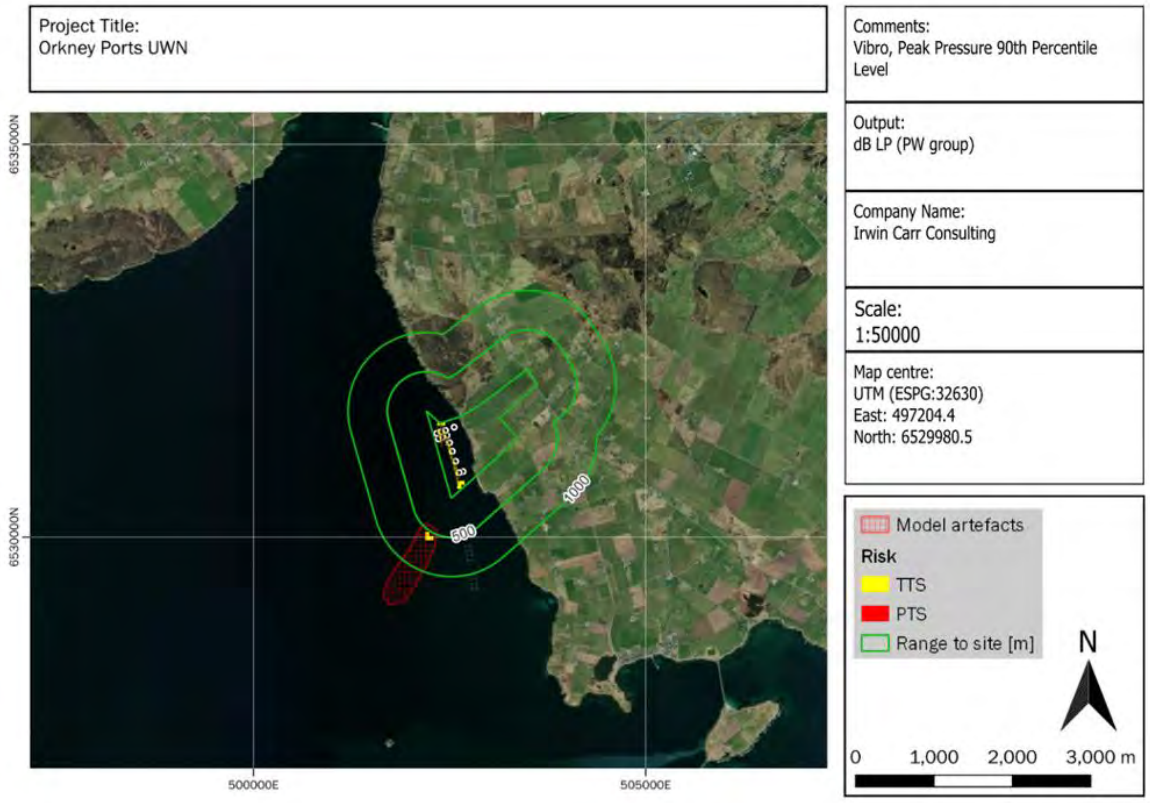


Figure 54. Vibro piling, L_P, OW group

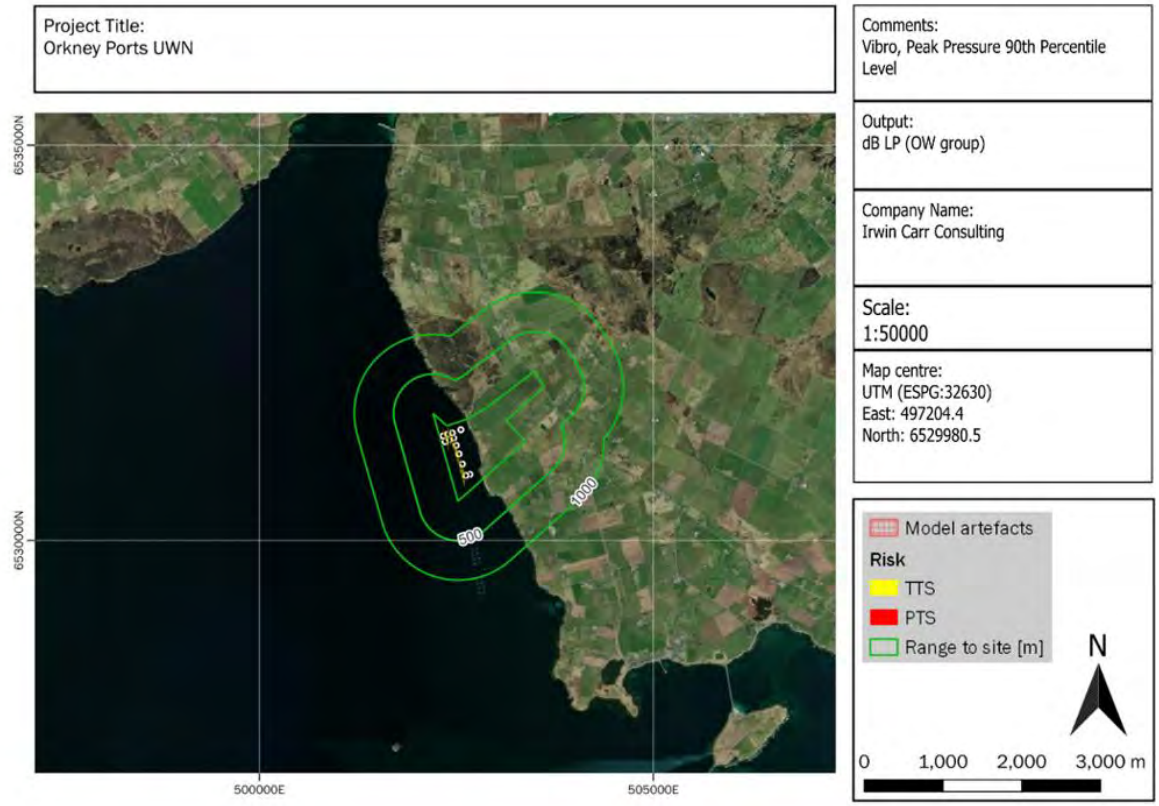


Figure 55. Vibro piling, L_P, P- group

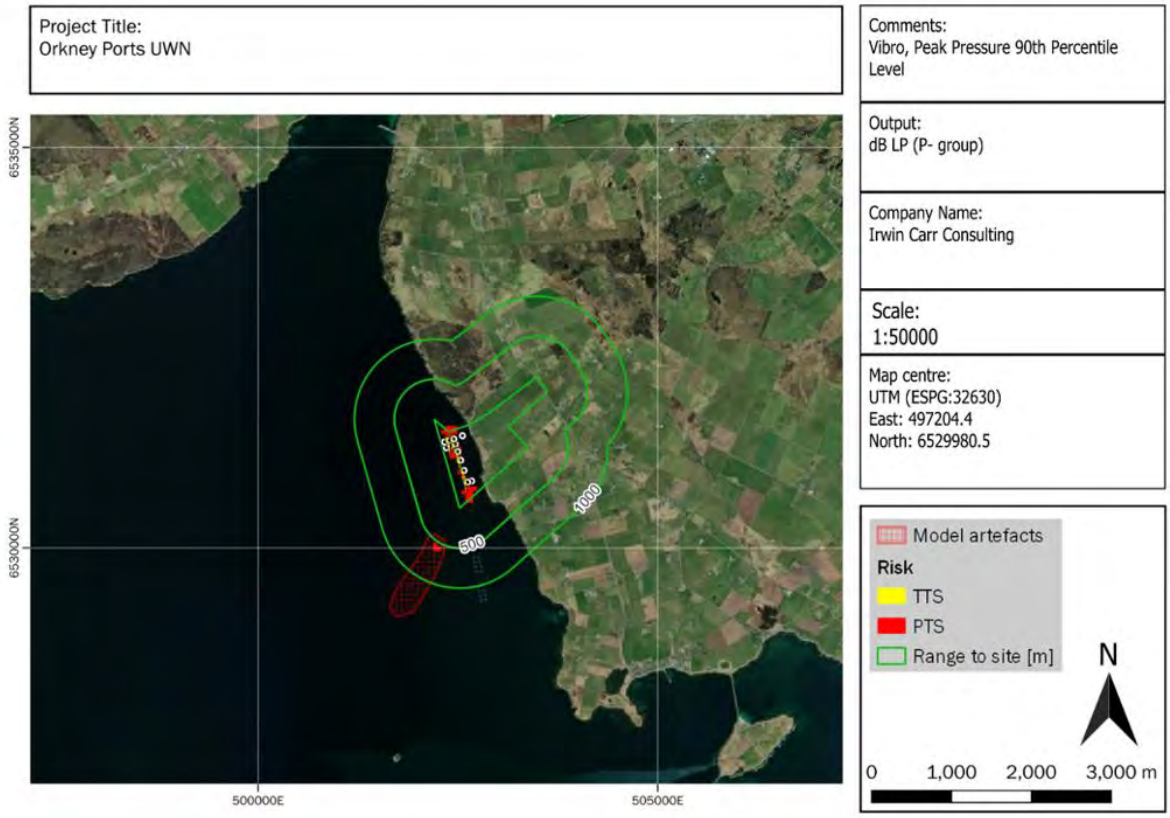
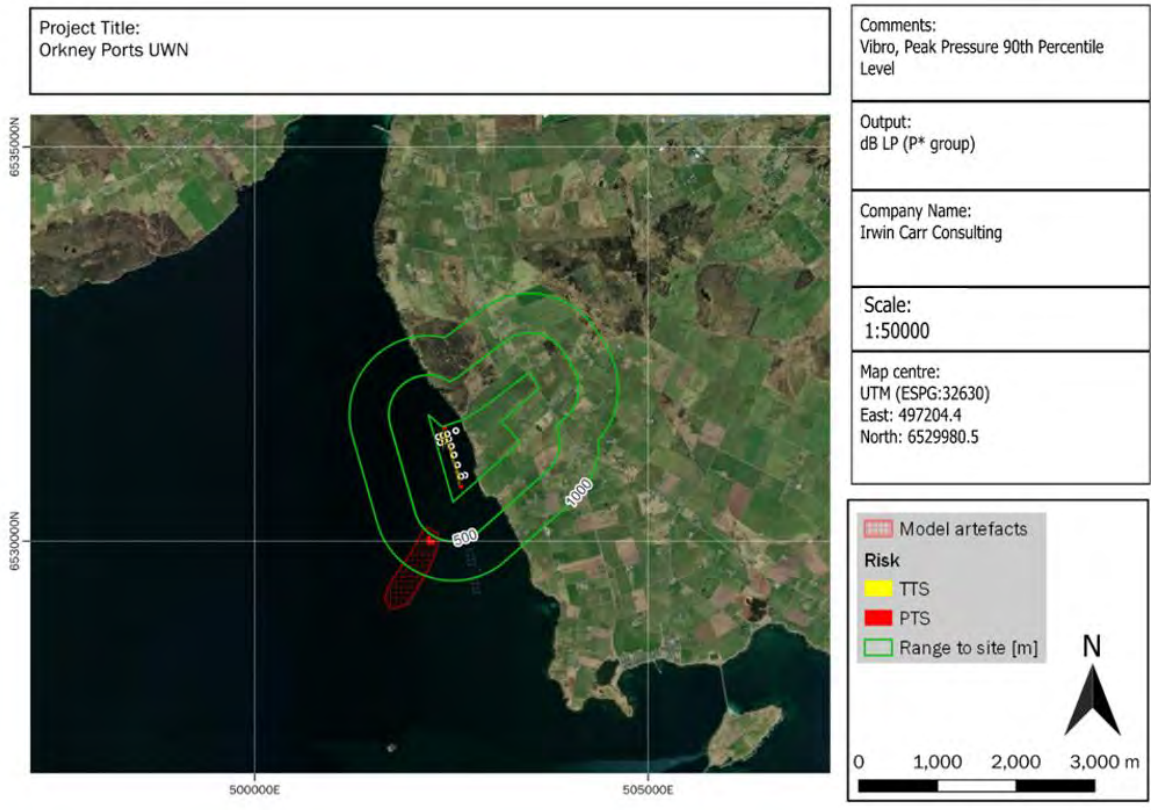


Figure 56. Vibro piling, L_P, P* group



C SEAL HAUL OUT SITES

Seal Haul Out Name	Distance* and Orientation	Species	No. seals (based on August counts)		NMPi Breeding Colony (Grey seal)
			Harbour seal	Grey seal	
Ve Ness	7km west	Harbour and Grey seal	0	8	No
North West Water Sound	7km south	Harbour seal	63	32	-
Calf of Flotta	9km south west	Grey seals	1	13	Yes
Barrel of Butter	10km west	Harbour seal	18	11	-
North Flotta	10km south east	Grey seal	0	228	Yes
Cava	12km west	Harbour seal	17	20	-
Flotta Oil Terminal	12km south west	Harbour seal	9	0	-
Holm of Houton	13km west	Harbour and Grey seal	21	24	No
North and East Fara	14km south west	Harbour and Grey seal	8	179	No
Switha	15km south west	Harbour and Grey seals	19	27	No
North east Hoy	16km west	Grey seals	0	3	Yes
Copinsay	18km east	Grey seals	0	311	No
South Ronaldsay East	19km south	Grey seals	0	0	Yes
Swona	19km south	Grey seals	0	238	Yes
South Ronaldsay West	20km south	Grey seals	0	0	Yes
Bay of Ireland	22km north west	Harbour seals	44	23	No
Selwick	22km west	Harbour and grey seals	17	117	No
Stroma	25km south	Harbour and Grey seals	0	570	No
Pentland Skerries	28km south	Grey seals	0	343	No
Deer Sound	31km east	Harbour and Grey seals	39	79	No
Gills Bay	31km south	Harbour and Grey seals	41	29	No
Duncansby Head	31km south	Grey seals	0	0	Yes
Auskerry	34km north east	Grey seals	0	77	Yes
Greenli Ness	37km north east	Grey seals	0	309	No
Bay of Holland East and Tor Ness	38km north east	Harbour and grey seals	11	607	No
Bay of Houseby	40km north east	Harbour and Grey seals	6	213	No

Seal Haul Out Name	Distance* and Orientation	Species	No. seals (based on August counts)		NMPi Breeding Colony (Grey seal)
			Harbour seal	Grey seal	
Helliar Holm North and Elwick	40km north	Harbour seal	21	13	No
Linga Holm	43km north east	Grey seals	1	347	Yes
Little Green Holm	43km north east	Grey seals	8	20	Yes
Muckle Green Holm	44km north east	Grey seals	0	5	Yes
Taing Skerry and Grass Holm	44.8km north	Harbour and grey seals	6	87	No
Odness	46km north east	Harbour and Grey seals	25	95	No
Little Linga	46km north east	Grey seals	3	27	Yes
Sty Taing	46km north east	Grey seals	0	0	Yes
Gairsay	46km north	Grey seals	0	0	Yes
Holm of Rendall	47km north	Harbour and Grey seals	28	6	No
Damsay and Holm of Grimbister	47km north west	Harbour and Grey seals	63	28	No
Sweyn Holm	48km north	Harbour and Grey seals	4	0	No
Holms of Spurness	48km north east	Grey seals	0	100	Yes
Holm of Huip	48km north east	Grey seals	0	214	Yes
Seal Skerry (Eday)	48km north east	Harbour and Grey seal	0	612	No
North end Mill Bay	49km north east	Harbour and Grey seal	10	44	No
South East Egilsay	51km north	Harbour and Grey seal	2	19	No
Rusk Holm	53km north east	Grey seal	0	0	Yes
Calf of Eday	54km north east	Grey seal	0	55	Yes
Egilsay North	56km north	Harbour and Grey seal	4	61	No
Holm of Scockness	56km north	Harbour Seal	20	22	-
Costa and Burgar	57km north west	Harbour and Grey seal	20	3	No
Eynhallow and Westside	58km north west	Harbour and Grey seal	77	88	No
South Westray	58km north east	Grey seal	0	0	Yes
Skerry of Wastbist	60km north east	Harbour and Grey seal	52	47	No
Spo Ness to Ness of Brough	67km north	Harbour and Grey seal	6	3	No

Seal Haul Out Name	Distance* and Orientation	Species	No. seals (based on August counts)		NMPi Breeding Colony (Grey seal)
			Harbour seal	Grey seal	
Holm of Papa Westray and North Wick	70km north	Harbour and Grey seal	22	206	No
Dunbeath-Wick	75km south	Grey seal	0	0	Yes
South North Ronaldsay	73km north east	Harbour and Grey seal	121	202	No
Narr Ness	77km north	Harbour and Grey seal	14	0	No
Seal Skerry (North Ronaldsay)	79km north east	Grey seal	0	612	No
Dunbeath-Helmsdale	90km south	Grey seal	-	-	Yes
Eilean nan Ron (Tongue)	93km south west	Grey seal	-	-	Yes
Kyle of Tongue Sandbanks	100km south west	Harbour and Grey seal	-	-	No

*Data not provided for those sites with ‘No. seals’ equating to ‘–‘

C BASKING SHARK RISK ASSESSMENT

envirocentre

part of CuraTerrae

Scapa Deep Water Quay
Basking Shark Risk Assessment



July 2026

CONTROL SHEET

Client: Orkney Island Council Harbour Authority
Project Title: Scapa Deep Water Quay
Report Title: Basking Shark Risk Assessment
Document number: 13340
Project number: 674795

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2	Final V2	JEP	IB	EC	16/11/2023
3	Final V3	JEP	MM	MM	21/06/2024
4	Final V4	JEP	GN	MS	19/07/2024
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6	Final V6	JEP	GN	IB	21/01/2026
7	Final V7	JEP	GN	IB	16/06/2026

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EXECUTIVE SUMMARY

EnviroCentre Limited was commissioned by Orkney Islands Council Harbour Authority to undertake a Basking Shark Risk Assessment to inform a basking shark license application in relation to the construction phase of the development of Scapa Deep Water Quay (SDWQ).

Basking sharks are protected under the Wildlife and Countryside Act 1981 (as amended). They are also listed as endangered on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List. Various records of basking shark have been reported in Orkney waters over the years.

Underwater noise is considered to be the main activity which could negatively impact basking sharks, with injury, death and disturbance of individuals being a possibility. Underwater noise modelling was commissioned as part of this assessment based on the construction method considered the most significant for generating underwater noise; dredging. The construction methods of the proposed development does not require underwater blasting, piling or drilling

Dredging has short risk ranges for Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) for basking sharks, being <50m at 1 hour (hr). TTS may be experienced up to 120m for 1hr exposure .There is no acute risk of noise related injury related to the dredging, and animals have time to swim away.

The development will result in increases in vessel movement in and out of the SDWQ area during construction and operation. This vessel increase, would increase the risk of collision with basking sharks, potentially resulting in death or injury to individuals. Basking sharks can often be observed with injuries to their dorsal fins, after colliding with vessels. Studies summarised by NatureScot suggest that basking sharks show very little avoidance measures to approaching vessels. This means the risk of collision is greater rather than disturbance. Therefore, speed limits within the harbour and on vessel approach are considered to be the most appropriate approach.

Mitigation in the form of a Basking Shark Protection Plan (BSPP) will be implemented and will reduce the risk of injury as well as limit the potential disturbance. The BSPP includes a Marine Mammal (and basking shark) Observer (MMO) protocol with an exclusion zone of 800m.

Mitigation will reduce the likelihood of impacts from underwater noise, and lessen the severity of the predicted effects, and although it won't be possible to completely avoid some level of disturbance to basking shark which may be present in the area, considering the low density estimates of basking sharks expected in Scapa Flow, the seasonal distribution of the species and the impact range of dredging activities a derogation licence would not be required.

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Limited was commissioned by Orkney Islands Council Harbour Authority to undertake a Basking Shark Risk Assessment to inform a basking shark license application in relation to the construction phase of the development of Scapa Deep Water Quay (SDWQ), approximately 8km south of Kirkwall at Bay of Deepdale, Scapa Flow. Please see Appendix A: Proposed Site Location and Layout.

1.2 Scope of Report

The aim of this report is to provide information required by Marine Directorate to determine whether a basking shark derogation licence can be issued. The objectives were as follows:

- Collate existing data in relation to basking shark to establish which species are likely to be present within the development site and the wider zone of influence.
- Identify potential impacts to basking shark which could occur as a result of the construction phase of the proposed development; and
- Detail mitigation which will be employed to reduce the risk of negative impacts.

1.3 Project Overview

1.3.1 Background to the Project

SDWQ is a major strategic port infrastructure project proposed by Orkney Islands Council Harbour Authority (OICHA, 'the Applicant') for Scapa Flow, Orkney. It is designed to provide a deep-water berth capable of accommodating floating offshore wind (FOW) assembly, integration, operations and maintenance, alongside heavy-lift capacity for large-scale turbines and foundations. The quay will also support wider marine industries and future energy transition activities. Its location offers naturally deep, sheltered water adjacent to sufficient land for laydown, with safe navigation and minimal dredging - attributes that make Scapa Flow one of the few sites in the UK capable of hosting operations at this scale. The location of SDWQ is shown in Appendix A.

A marine licence application under the Marine (Scotland) Act 2010 and a planning permission application under the Town and Country Planning (Scotland) Act 1997 were submitted in September 2023 for determination by the marine regulators, Scottish Government's Marine Directorate – Licensing Operations Team (MD-LOT) and OIC Planning Department ('the Competent Authorities'). These applications were supported by an Environmental Impact Assessment (EIA) undertaken under both the Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 ('the Terrestrial EIA Regulations') and the Marine Works (Environmental Impact Assessment (Scotland) Regulations 2017 ('the Marine EIA Regulations'). The requirement for Additional Information under the Marine and Terrestrial EIA Regulations has since been triggered four times, with this document supporting the latest Additional Information submission.

1.3.2 Site Location

The site is located adjacent to the Bay of Deepdale, approximately 8 km south of Kirkwall. It is located on the eastern coastline within Scapa Flow, approximately 4 km south of the existing Scapa Pier. A Location Plan is provided in Appendix A.

1.3.3 Main Purpose and Associated Activities

SDWQ shall provide deep-water berthing facilities for a wide range of industrial activities with the main purpose upon completion, and in the medium to long term, being the storage of components, and assembly of wind turbines serving the floating offshore wind industry. SDWQ shall be complete with additional emergency berthing facilities for small vessels. SDWQ is also identified as a potential site for the storage and supply of future fuels for the marine industry.

SDWQ is a permanent addition to the Orcadian infrastructure, and therefore decommissioning is not a planned phase of the Project and has not been considered within the assessment presented in this report.

1.3.4 Construction Programme

The key construction stages, their indicative durations and projected periods for works to be carried out therein are outlines in Table 1-1 below.

Table 1-1: Outline construction programme

Works Description	Est. Duration	Est. Works Period
Access road construction, haul road, earthworks and A961 re-alignment	60 weeks	December 2027 – February 2029
Caisson fabrication (off-site)	24 weeks	December 2027 – June 2028
Caisson transport (off-site fabrication to Orkney)	8 weeks	June 2028 – August 2028
Dredging bund construction	32 weeks	December 2027 – July 2028
Dredging	12 weeks	June 2028 – August 2028
Caisson installation (placement only)*	8 weeks	August 2028 – September 2028
Landside earthworks – Overburden removal, rock blasting and excavation	100 weeks	October 2027 – September 2029
Quay finishings	52 weeks	January 2029 – January 2030
Demobilisation	12 weeks	January 2030 – February 2030
Completion	N/A	February 2030

*Completion of the quay wall, including infilling of caisson cells and backfill to the rear of the units shall continue on to February 2029. This may or may not involve the vessel movements detailed in Table 1-2 depending on availability of suitable material on island. Vessel movements shown in Table 1-2 which refer to caisson infilling are worst case.

Terrestrial blasting is anticipated to be completed within the first 59 weeks of the landside earthworks programme. However, ground conditions may dictate a change in the blasting pattern, which may extend the blasting programme to up to 100 weeks. No more than two blasts would be carried out in any one week.

1.3.5 Outline Design Criteria

The below criteria will ensure the design provides a robust, long-lasting marine structure, ensuring safety, stability, and durability under challenging environmental conditions.

- **Dredging Requirements:** The operational depths of -15.0m Chart Datum (CD) and -20.0m CD
- **Environmental conditions:** Consideration of climate change and sea-level rise scenarios (A projected sea level rise of 0.9 m by 2100 is considered, based on national climate projections), with tidal lag (normal conditions) and wave conditions (1 in 50-year, 1 in 200-year, 1 in 570-year return periods) integrated into the design.
- **Materials:** Concrete and reinforcement materials must comply with Eurocodes and British Standards, with specifications for exposure classes, cement types, and aggregate properties.

- **Caisson design:** The caissons are designed with a focus on durability, using concrete that is resistant to degradation in marine environments. Concrete properties, cement types, and aggregate characteristics have been carefully specified to ensure a long lifespan.
- **Caisson foundations and fill:** Crushed imported rock is used as the foundation layer, with strict controls on durability and strength. Fill materials inside and behind caissons are selected for high density and internal friction to ensure stability.
- **Scour protection:** Concrete scour protection mattresses and rock armour is installed to mitigate seabed erosion caused by vessel thrusters and propellers near the quay wall.

1.3.6 Site Establishment and Access

Site establishment and access will include:

- **Access road:** 8 m asphalt carriageway with 1.8 m hard verge/service strip, 1.8 m south-side path, 1.5 m north-side soft verge, and drainage swales on both sides.
- **Access point:** formed from the realigned A961 (under separate planning permission), with reflective signage and two-way lights as required.
- **Programme role:** critical early works item enabling site access, laydown, cut-and-fill operations, and construction of the dredge containment bund.
- **Early services:** temporary service connections required early to support blasting, quarrying and earthworks.
- **Construction works:** topsoil stripping, overburden removal, rock cut, and placement of subbase and surcharge to form a haul road.
- **Environmental control:** works to account for SEPA requirements to protect groundwater dependent terrestrial ecosystems.
- **Progressive installation:** service trenching, drainage and ducting installed as works progress.
- **Completion:** surcharge trimmed and final surfacing applied at the end of the project.

1.3.7 Dredging

The dredging and reclamation areas can be seen in Figure 1-1. All suitable dredged material will be placed in a reclamation area behind a pre-constructed bund (see Section 1.3.8), with any unsuitable material disposed at the licenced sea disposal site. The volumes of material to be dredged are presented in Table 1-2.

The dredging works extend along the entire quay alignment, including the main quay as well as the small vessel berths to the northern end, and are essential for preparing the seabed for subsequent caisson installation. The structures will be founded on hard bearing strata, requiring the removal of superficial soils and hard strata from approx. -15m CD down to a maximum depth of -20.5m CD. The dredged area edge slopes depend on the material type, ranging from 1:3 in superficial soils to 1:1 in engineering rock, whilst the dredging berth pockets are required to be operative for elevations of -15m CD and -20m CD.

Dredging works will be executed in a single campaign using a cutter suction dredger (CSD) specifically selected for its capacity to operate efficiently under the anticipated soil, sea and weather conditions at Scapa Flow.



Figure 1-1: Dredging and reclamation areas

The discharging process to the reclamation area shall be carried out through the integration of the dredger pumps with the designated discharge pipeline system where the dredged material will be transported into the reclamation area. This operation will be carried out in parallel with the dredging activities, beginning at the northwest portion of the reclamation.

Turbidity meters will be installed to detect any increase in turbidity outside the reclamation area, the details of which will be included within the supporting Construction Environmental Management Document (CEMD) (see Table 7-1 in the HRA for further details).

Through the early contractor involvement design stage, it has been identified that a significant reduction in material disposed at sea could be achieved from that which was originally defined in the exemplar design. There is, however, potential for up to 82,000m^3 of glacial till which may be unsuitable for re-use, to be disposed at sea (see Table 1-2).

A 4,000m^3 capacity barge(s) will be used to transport material to the licensed offshore deposit site **FI040**. If the maximum volume (82,000m^3) is deposited, there will be 21 round trips to the sea deposit site (42 vessel movements) over 12 a week period, typically this activity will be carried out between the beginning of June to the end of August (currently 2027).

Table 1-2: Proposed dredge volumes

Description	Total volume dredged (m^3)	Volume reused on site (m$^{3)}$	Volume disposed offshore (m^3)
Hard Dredge	72,653	72,653	0
Soft Dredge	306,754	306,754	0
Total	**379,407**	**379,407**	**0**
Disposal Contingency	379,407	297,407	82,000

1.3.8 Quay Wall Construction

The quay wall will be formed from reinforced concrete caissons installed on a rock bed foundation. The main quay is composed of nine large reinforced concrete caissons, with a smaller caisson at the south end that ties into the south revetment. At the north end, the small vessel berths are formed by four caissons.

Caissons Design Criteria

- **Main quay structure:** nine large reinforced concrete caissons, plus a smaller caisson at the southern return tied into the rock armour revetment.
- **Caisson design:** varied cross-sections along the quay to suit dredge depths and ground conditions.
- **Cope level:** fixed at **+7.00 m CD**.
- **General dredge depth:** to **–15.0 m CD**, including **1 m over-dredge** allowance.
- **Southern dredge pocket:** 140 m section dredged to **–20.5 m CD**, including **1 m over-dredge** allowance.
- **Northern berths:** small vessel berths formed by a series of smaller caissons.
- **Foundation design:** dredge slopes vary by soil type to achieve founding level in engineering rock.
- **Geotechnical checks:** caissons assessed for sliding, overturning, bearing capacity and overall stability.
- **Ballasting:** each caisson will be ballasted in accordance with the design to ensure stability during transport and installation.
- **Delivery programme:** the 14 caissons will be transported to site in four shipments.
- **Direct installation:** the first caissons in each delivery batch will be installed directly from the semi-submersible delivery vessel to their final quay positions.
- **Temporary wet storage:** remaining caissons from subsequent deliveries will be towed to a temporary wet storage area within the project boundary until final installation.
- **Transport:** caissons will be dry stored during transport from Spain, reducing the risk of introducing non-native species.
- **Biosecurity:** a Biosecurity Plan will be prepared as part of the CEMD (see Table 7-1 in the HRA).
- **Mitigation measures:** the plan will set out measures to prevent the introduction of invasive non-native species in line with relevant legislation and best practice.

Caisson Unloading at Scapa Flow

Unloading operation: caisson deliveries unloaded using 3 tugboats of at least 4,000 Horsepower (3,000kW) hired locally, with operation carried out in one to two good weather days per shipment. Caissons unloaded from semisubmersible vessel directly to the quay line or to a nearby storage area.

- **Auxillary equipment installation:** caissons fitted with auxiliary equipment (e.g. winches, mooring ropes and anchors, etc.).
- **Temporary securing:** After unloading, they will be temporarily secured either by tying them together alongside the partially constructed quay or by anchoring them to the seabed close to the project site. No piling or drilling is required for this operation, and underwater noise will be negligible.
- **Final Installation:** When weather conditions permit, the caissons will be sunk into their final positions.

Caisson Installation

- **Installation Duration and Conditions:** installation typically completed during daylight hours within 6–8 hours. Operations require suitable metocean conditions:
    - Mean wave height (Hm) < 0.5 m, peak wave period (Tp) < 7 s and wind speed at 10 m above sea level (U10) < 15 m/s
- **Towing to Installation Location**: caissons are towed individually from the semisubmersible vessel or temporary storage area to the quay line. Typically, one to three tugboats are used for towing and installation support.

- **Positioning and Controlled Sinking**: during sinking using tugs and winches. Installation continues until controlled touchdown on the prepared foundation.
- **Ballasting Operations:** caissons contain independent watertight cell groups, filled simultaneously with seawater using pumps or valves.
- **Tolerance Verification and Completion**: ballast water is sourced from Scapa Flow after placement. If the caisson is within tolerance, ballasting continues until full. If tolerances are not met, the caisson is de-ballasted, repositioned, and reinstalled, typically requiring only one attempt.

1.3.9 Landside Excavation Platform

- **Earthworks and Excavation:** Soft soils excavated using mechanical methods, with rock removal undertaken through drilling and terrestrial blasting. No marine blasting is planned.
- **Programme and Blasting Frequency:** scheduled over approximately 100 weeks (provisionally October 2027 to September 2029). Blasting will occur intermittently throughout the programme. Approximately 35 blasts are anticipated. No more than two blasts will take place per week. Blast timing will depend on construction progress and cannot be restricted to specific seasons.
- **Drainage and Site Preparation:** Pre-earthworks drainage installed to manage surface water runoff.
- **Noise and Sediment Control Bund:** 6 m high bund will be constructed at least 5 m from the cliff edge before blasting commences near the coast. The bund will act as a noise barrier for marine receptors and a retention wall for sediment runoff. The bund will be removed once final site levels are achieved.
- **Blasting Methodology:** blasting will progress in 70 m-wide strips from west to east across the site. Each strip will be divided into sections sized to accommodate up to two weekly blasts. Blasting activities will be undertaken simultaneously from both ends of each strip.
- **Material Processing and Fill Operations:** processing areas established at both ends of the site. Dual processing locations reduce haulage distances for blasted material. Fill operations will be supplied from both directions, improving material distribution efficiency.

1.3.10 Reclaimed Land (Sea Filling)

- **Initial Land Reclamation:** dredge bund and enclosed reclaimed area will be completed during the dredging campaign, forming the initial phase of land reclamation. General infilling will commence once the caissons have been installed, filled, and backfilled.
- **Perimeter Closure:** rock armour revetments constructed at the north and south ends of the quay wall after caisson installation. These revetments will close the reclamation perimeter and protect the site from wave action.
- **Rock Armour Revetments:** designed for a 60-year service life and 1-in-200-year wave conditions. Revetments will include appropriately sized underlayers and geotextiles.
- **Land Reclamation Fill Materials:** Reclamation will primarily use dredged material and suitable excavated material from landside works (screened on site to remove fines before placement). Imported quarry material placed behind the caissons to meet grading and compaction requirements for caisson stability.
- **Sediment Control:** marine containment substantially established before reclamation filling progresses. Containment bund will minimise sediment discharge beyond the construction area.

1.3.11 Pollution Control

Strict pollution prevention controls implemented during land reclamation works to minimise risk via drainage systems designed in accordance with best practice and regulatory requirements, no untreated surface water to be discharged directly to surrounding coastal waters and an outline Construction Environmental Management Document (CEMD) has been prepared for the project (see Table 7-1 in the HRA).

1.3.12 Vessel Movements During Construction

The construction phase will see the following vessel movements as outlined in Table 1-3 below. In total during the entire construction phase (26 months), there will be 112 vessel movements taking place over an eight-month period between June 2028 and February 2029, inclusive.

Table 1-3: Construction phase vessel movements

Vessel	Predicted Number of Movements	Timescales (provisional)
Caisson delivery, offloading and installation	20 movements (4 deliveries) using a semi-submersible vessel (3 tugs for offloading, 1 tug for installation) Tugs deployed from nearby Scapa Pier	July 2028 – September 2028
Scour protection	10 trips (20 movements)	August 2028 – September 2028
Caisson infilling	15 trips (30 movements)	August 2028 – February 2029
Dredging	21 trips (42 movements)	June 2028– August 2028
Total	**112**	

Baseline vessel movements (as informed by the Navigational Risk Assessment (NRA); see Technical Appendix 2.3 of EnviroCentre 2024) in Scapa Flow is characterised by a high level of diverse maritime traffic year-round, with Automatic Identification System (AIS) data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow—closest to the SDWQ site—current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents only ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

The construction phase vessel movements will therefore result in an additional 21.5 vessel movements per month on average (+0.16% from baseline) during winter months (October-March) and an additional 90.4 vessel movements per month on average (+0.5% from baseline) during summer months (April-September).

1.4 Operation

The Project is likely to operate as a marine facility 24 hours per day and 7 days per week, so there is the potential for activity at any time of the day or night. This will include:

- Flatbed lorries: delivering and uplifting from site.
- HGVs: delivering and uplifting from site.
- Light vans: delivering cargo or providing maintenance and servicing to site.
- Road Tankers: delivering bulk goods and liquids to site or removing liquids and waste from site; and
- Forklift trucks: loading and unloading vehicles servicing the site. In addition to the general cargo operations, there will be:
- Minibuses/ cars collecting/ returning people working on site - vehicles not allowed in working area.
- Security staff based within the site and undertaking patrols when appropriate.
- Staff looking after the facility maintenance and assisting with vessel moorings.
- Third Party Stevedore Companies loading and unloading vessels; and
- Coaches and taxis facilitating crew changes on vessels.

The internal roadways and footpaths will be demarcated with designated routes, and barriers will be installed where necessary. There will be a security fence around the working area perimeter to protect it as well as the

public, in addition to preventing access to breakwaters, rock armour revetments etc. (access gates will be provided for maintenance). The fence will be constructed in accordance with the requirements of the International Ship and Port Facility Security Code (ISPS).

Table 1-4 provides a summary of the indicative infrastructure likely to be present upon completion of the Project. The indicative locations of quayside infrastructure services are shown on Figure 1-2.

Table 1-4: Indicative operational infrastructure

Infrastructure Type	Qty	Description
Future Marine Fuels	TBC	Possible storage and supply to vessels of very low or zero carbon fuels. Note this will be subject to further assessments and approval.
Water Tanks	4	Four water storage tanks with built-in treatment systems (as required) will be installed as indicated on Figure 1-2 outside of the main working area to supply potable water to the whole site and vessels.
Sub-station	1	Located near to the water tanks will be a 33kV /11kV/415V substation for whole site supply, including shore power for vessels, as indicated on Figure 1-2 not in main working area.
Main gatehouse / Access building	1	As indicated on Figure 1-2 outside of main working area, may contain admin offices and is the security control for site.
Car park, cycle storage and bus stop	-	Vehicle parking spaces and bicycle racks. Bus stop for use by internal bus services (drop off and pick up only).



Figure 1-2: Proposed SDWQ operational layout

1.4.1 Vessel Movements During Operation

The project is designed to be flexible so that many types of vessels can berth, subject to draught and length. While the quay is a major strategic facility, its operational profile is characterised by the infrequent arrival of large vessels, likely to be aligned with the integration and deployment schedules of major offshore wind developments. Approximately 80% of vessel activity will take place in the summer months

There is significant existing vessel activity in the wider area around the proposed SDWQ site. There will be increased vessel activity introduced by the SDWQ project in the area from the existing shipping route to the site (EnviroCentre SEIR May 2025); however, there are some existing vessel movements in this area, as shown by the vessel tracks in EnviroCentre SEIR (May 2025), and in more detail in the NRA submitted with the EnviroCentre EIAR (2023). Table 1-5 outlines the annual and seasonal operational vessel activity expected for the Project.

As per Section 1.3.12. there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; EnviroCentre SEIR May 2025) and summarised above in section 1.3.12, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

Table 1-5: Annual and seasonal operational vessel activity

	Per year		**Per winter season (October-March)**		**Per summer season (April-September)**	
	Vessel number	**Vessel movements (return trips)**	**Vessel number**	**Vessel movements (return trips)**	**Vessel number**	**Vessel movements (return trips)**
Large vessels	28	56	6	12	22	44
Smaller vessels	12	24	2	4	10	20
Pilot boats for large vessels	56	112	11	22	45	90
Total	**96**	**192**	**19**	**38**	**77**	**154**

1.4.2 Wet Storage

There is no planned wet storage of fully constructed turbines at the Project site. Any future proposals for wet storage will be conducted in accordance with the relevant regulations/consents.

1.4.3 Quayside Cranes

- **Crane Strategy:** no fixed or permanent cranes will be installed on site. Crane activity will generally coincide with vessel arrivals and departures.
- **Weather Constraints:** lifting operations are highly dependent on weather conditions, particularly wind. Less than 20% of lifting operations are anticipated to occur during winter.

- **Vessel Movements and Crane Activity:** approximately 30 vessel trips per year (60 vessel movements) will require crane operations. Expected seasonal distribution of 24 vessel trips (approximately one per week) in summer and 6 vessel trips (approximately one per month) in winter. Vessels will typically remain berthed for 2–5 days. Estimated crane operating days of 8–20 days per month in summer and 2–5 days per month in winter.
- **Number of Cranes on Site**: in summer up to four cranes operating simultaneously (typically one vessel crane and three mobile cranes) and in winter up to two smaller mobile cranes.
- **Storage and Visual Presence:** mobile cranes will generally be stored on site during summer. In winter, cranes may remain on site or be removed for use elsewhere. When not in use, crane booms will be retracted and lowered horizontally. Stored cranes will have a height of approximately 5 m.
- **Noise and Lighting:** mobile cranes move slowly and generate limited engine noise. Mobile cranes do not normally provide their own lighting. Winter lifting operations will typically be restricted to daylight hours.

1.5 Alternative Consideration

The project was identified as part of the Orkney Harbours Masterplan. At the start of the Masterplan development, optioneering was undertaken through stakeholder discussions / workshops, OICHA internal discussions with staff, market assessments in conjunction with desk-based research. A Strategic Environmental Assessment was used to inform a draft Orkney Harbours Masterplan Phase 1 with details of the process including alternatives considered, reasons for discounting or taking forward options and potential environmental impacts as reported in the Strategic Environmental Assessment – Environmental Report.

1.5.1 Do Nothing

SDWQ is proposed to be a nationally significant deepwater quay for offshore wind. Doing nothing will not allow the long-term future of Orkney, in particular looking at facilities that ensure the decarbonisation of the industry. By doing nothing, what is considered the UK's most significant marine energy infrastructure programme ever undertaken will not be possible and as a result the UK's position for marine-based renewables in Europe and internationally will be weakened.

1.5.2 Relocation

The siting of the proposed development was originally positioned in an area to the north of the Burn of Deepdale. However, following initial site investigations and preliminary ecological surveys it was decided to move the development to its current location. The move was a result of the engineering and environmental considerations as listed below:

- The quantity of overburden and unsuitable material (for development purposes) was determined to be greatly reduced by positioning the development on the land to the south of the burn;
- The current site selected avoided crossing the Burn of Deepdale; and
- Moving the development footprint to the south avoided encroachment into the Gaitnip Local Nature Reserve (LNR) which would have been the case if it was situated to the north of the Burn of Deepdale.

1.6 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre Limited.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre Limited for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

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2 METHODS

2.1 Baseline

In order to gather data pertaining to basking shark use of the site, a desk study was conducted. The following sources were checked:

- Orkney Marine Mammal Research Initiative (OMMRI)[1];
- The Shark Trust basking shark sightings[2];
- NatureScot Basking shark satellite tagging project, Commissioned Report[3];
- Sea Watch Foundation (SWF) website for recent sightings[4 & 5];
- The Hebridean Whale and Dolphin Trust (HWDT) Whale Track[6];
- Orcadian Wildlife (OW) website for recent sightings [7]; and
- Scottish Marine Animal Stranding Scheme (SMASS)[8] for stranding records;
- ORCA website for recent records[9]; and
- OMMRI Trustees' Annual Report April 2022-2023[10].

2.2 Underwater Noise Modelling

Underwater noise modelling was commissioned as part of this assessment assess noise levels generated by common construction methods. Note, piling and associated drilling are no longer required for the caisson design.

Please refer to Irwin Carr Consulting report: 'SDWQ, UW Noise Modelling', Appendix B which details the methods and findings of the underwater noise modelling.

2.3 Disclaimer

It should be noted that the baseline is limited by the reliability of third party information and the geographical availability of biological and/or ecological records and data. The absence of species from biological records cannot be taken to represent actual absence. Species distribution patterns should be interpreted with caution as they may reflect survey/reporting effort rather than actual distribution.

[1] Orkney Marine Mammal Research Initiative data request, available at: https://ommri.org/ (Accessed 07/06/2024)
[2] The Shark Trust basking shark sightings available at: https://www.sharktrust.org/basking-shark-project (Accessed 07/06/2024)
[3] Witt, M.J., Doherty, P.D., Godley, B.J. Graham, R.T. Hawkes, L.A. & Henderson, S.M. 2016. Basking shark satellite tagging project: insights into basking shark (Cetorhinus maximus) movement, distribution and behaviour using satellite telemetry. Final Report. Scottish Natural Heritage Commissioned Report No. 908. (Accessed 07/06/2024)
[4] Sea Watch Foundation Cetaceans of Orkney available at: https://seawatchfoundation.org.uk/wp-content/uploads/2012/07/Orkney2.pdf (Accessed 07/06/2024)
[5] Sea Watch Foundation Recent Sightings Orkney available at: https://www.seawatchfoundation.org.uk/recentsightings/ (Accessed 12/12/2023)
[6] HWDT sightings data available at: https://whaletrack.hwdt.org/sightings-map/ (Accessed 07/06/2024)
[7] Orcadian Wildlife information available at: http://orcadianwildlife.co.uk/wPress/cetaceans-in-orkney/ last accessed 12/12/2022
[8] Scottish Marine Animal Stranding Scheme (SMASS) available at: https://strandings.org/map/ last accessed 10/04/2023
[9] ORCA Whale and Dolphin Sightings interactive map, available at: https://orca.org.uk/whale-dolphin-sightings (Accessed 27/05/2024)
[10] OMMRI Trustees' Annual Report 6th April 2022 to 5th April 2023, available at: https://ommri.org/wp-content/uploads/2024/03/22-23-TAR_FINAL.pdf (Accessed 28/05/2024)

3 BASELINE

3.1 Desk Study

Basking sharks are listed as endangered on the International Union for Conservation of Nature and Natural Resources (IUCN) Redlist[11]. They are a PMF and are afforded domestic protection under the Wildlife and Countryside Act. The nearest known basking shark hotspot[12] during the summer months, between May and October is along the coast of the Isle of Skye, approximately 240km south west of Orkney.

No sightings of basking sharks have been recorded within the development area, however records of basking shark have been reported within the waters surrounding Orkney. Table 3-1 lists records of basking shark applicable to the development site:

Table 3-1: Records of basking shark

Resource	Date records available	Records/ Information
SWF	N/A	No information available
HWDT	2014-2024	Seven sightings of seven individuals reported to HWDT with the nearest located 41km west of the proposed development site.
OW	N/A	No information available
OMMRI	1936-2020	58 records of basking shark sightings within 10km of SDWQ have been submitted to OMMRI between 1936-2020.
ORCA	N/A	No information available
OMMRI 2022 Sightings Report	N/A	No information available
JNCC	N/A	No information available
SMASS	N/A	No information available

Basking shark are considered likely to be impacted by the SDWQ development, due to number of sightings and record locations.

[11] IUCN Redlist available at: http://www.iucnredlist.org/ (Accessed 07/06/2024)
[12] The Shark Trust basking shark sightings available at: https://www.sharktrust.org/basking-shark-project (Accessed 12/12/2023)

4 BASKING SHARK RISK ASSESSMENT

4.1 Activities Affecting Basking Shark

4.1.1 Underwater Noise Producing Activities

The Marine Scotland '*Guidance for Scottish Inshore Waters: The Protection of Marine European Protected Species from Injury and Disturbance'*[13] defines what disturbance means to marine mammals as: 'Changes in behaviour which may not appear detrimental in the short-term, but may have significant long-term consequences. Additionally the effects may be minor in isolation, but may become more significant in accumulation'. This is also considered applicable to basking sharks. Therefore, those disturbances which may be identified that are applicable to basking sharks includes the following behaviour:

- Changes in (direction or speed of) swimming or diving behaviour;
- Certain surface behaviours such as tail splashes or breaching (jumping out of the water); and
- Moving out of a previously occupied area.

The following negative effects are linked to disturbance:

- Displacement from important feeding areas;
- Disruption of feeding;
- Disruption of social behaviours such as communication, pupping, breeding, nursing, resting and feeding;
- Increased risk of injury or mortality;
- Increased vulnerability of an individual or population to predators or physical stress; and
- Changes to regular migration pathways to avoid human interaction.

At the time of underwater noise modelling being undertaken only exemplar tender designs were completed, with works originally involving dredging, piling and drilling, thus the exact details of the construction methodologies were unknown. However, to caveat for this the data used to inform the noise models was interpolated from equipment used on similar projects. Since the underwater noise modelling was undertaken, piling and associated drilling works have been removed from the design. Therefore, the construction method below is considered the most significant:

Dredging Method and Duration

Dredging for the project will involve a total of 379,407 m³ of material, comprising 72,653 m³ of hard dredge and 306,754 m³ of soft dredge, with up to 82,000 m³ of unsuitable glacial till potentially requiring sea disposal. A single dredge campaign is planned using a cutter suction dredger over an estimated twelve-week period from June to August 2028, covering the full quay alignment to depths of –15 m CD in most areas and –20 m CD in the deep pocket.

Dredged sediments will be pumped through a pipeline into a reclamation bund constructed to +4.0 m CD using screened site-won material, with an integrated weir box to manage overflow. Turbidity will be monitored outside the bund and silt booms deployed during infilling.

[13] https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2020/07/marine-european-protected-species-protection-from-injury-and-disturbance/documents/marine-european-protected-species-guidance-july-2020/marine-european-protected-species-guidance-july-2020/govscot%3Adocument/EPS%2Bguidance%2BJuly%2B2020.pdf

Ballast Water and Caisson Transport

Caissons will be transported to site on a semi-submersible vessel and kept dry during transit, which significantly reduces the risk of biofouling. After placement at Scapa Flow, ballasting operations will use local seawater, and some caissons may undergo temporary in-water wet storage before installation.

4.2 Increased Vessel Movement

Baseline Vessel Movements

The Project have provided information on the current typical monthly vessel movements experienced within the eastern area of Scapa Flow. This baseline is derived from the Project NRA (see Appendix 2.3 of EnviroCentre, 2025a). Baseline vessel activity in Scapa Flow is characterised by a high level of diverse maritime traffic year-round, with AIS data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow—closest to the Project site—current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents only ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

Vessel Movements During Construction

As per Table 1-3 the construction phase will see a total of 112 vessel movements over the 26-month period. This includes: Caisson deliveries and tug operations; Scour protection trips; Caisson infill trips; and dredging disposal trips (barge to FI040).

Vessel movements during operation

As per Section 1.4.1. there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; see Technical Appendix 2.3 of EnviroCentre, 2024) and summarised in Section 1.4.1, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

4.3 Cumulative Impacts

Other developments within Orkney are considered to have the potential to result in an in-combination effect for marine mammals. The developments that have been considered for the in-combination assessment are listed in Section 9.2.2 and 9.3.3 of the HRA [July 2026]. Please refer to these documents where this is discussed further.

4.4 Effects of Acoustic Impacts on Basking Sharks

The effects of underwater noise to fish are less well understood as they are in marine mammals, however there is potential for permanent or temporary injury or in extreme circumstances, death in basking shark. Within the modelling report, the terminology for fish has a slightly different meaning with Permanent Threshold Shift (PTS) thresholds meaning thresholds above which mortality and potential mortal injury or recoverable injury. The meaning of Temporary Threshold Shift (TTS) (temporary hearing shift) is the same as marine mammals; effects which an animal can recover from but may experience 'masking' which reduces its ability to communicate with other animals and locate prey, resulting in fatigue. Sound levels below TTS may still have an effect on behaviour such as dispersal away from the area of noise generation.

Basking sharks do not rely heavily on hearing for foraging, instead they rely on their olfactory senses (smell) and their lateral line which senses pressure changes in water and their electrosensory pores detect signals from prey[14]. However, basking shark are sensitive to noise related activities.

Two noise sources were considered for this assessment, but drilling was screened out as it was not considered loud enough to be meaningfully assessed in an environment with many vessels and general human activity. The underwater noise modelling provide a comparison of drilling noise with the other noise producing works and vessel noise which is depicted in, below.

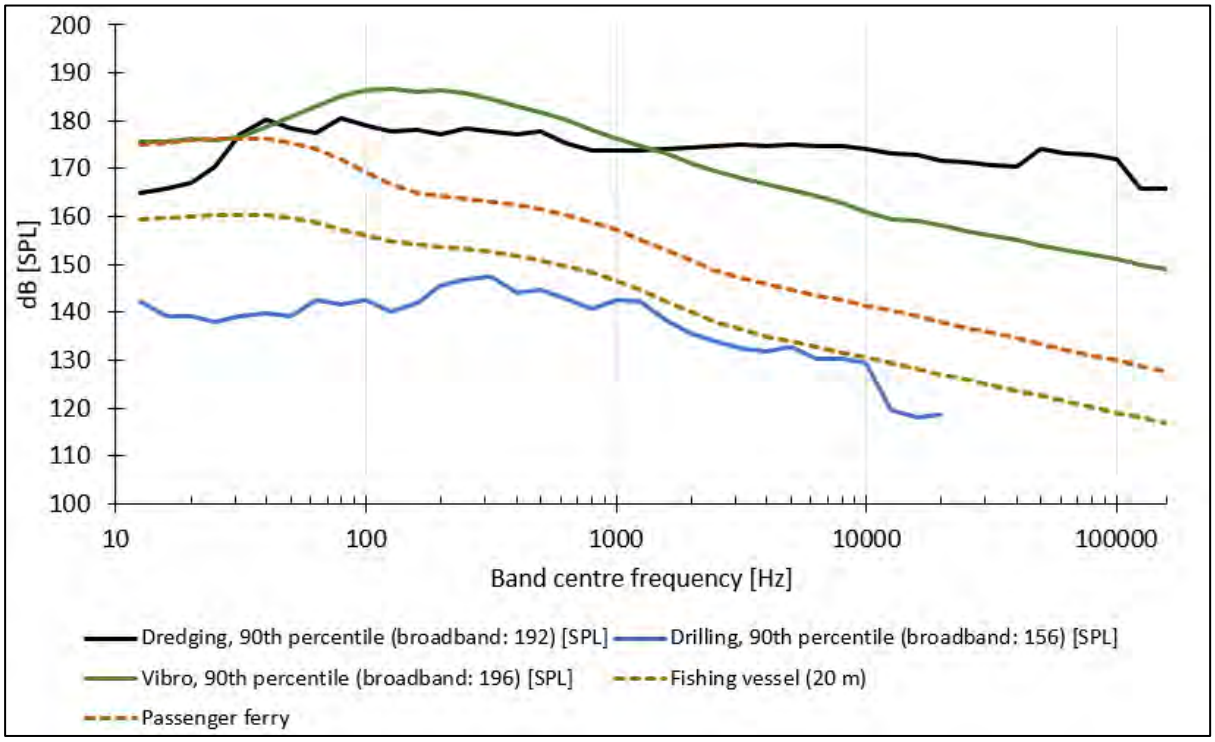


Figure 4-1: Underwater noise modelling figure 7.1 showing the three sound sources considered in the report, alongside a fishing boat and a small ferry for context.

Dredging

The noise from dredging, also presents a short risk range for PTS <50m for basking sharks at 1hr and 8hrs, with TTS a risk out to 120m for 1hr. It is considered that any animals would move away from the noise source and so prolonged exposure is considered unlikely. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away.

[14] https://www.marlin.ac.uk/assets/pdf/species/marlin_species_1438_2021-04-07.pdf

Deposition of Dredge Disposal Materials

Following identification and screening of available disposal options by EnviroCentre[15], a combination of on land and at sea disposal were considered the most appropriate options. At sea disposal (within the disposal site) would only consist of material considered unsuitable for construction works i.e. material with high silt content. At sea disposal was considered as it would require minimal transportation requirements and low environmental risk. The selected licensed marine waste disposal site which has been 'open' since 2020, is located 24km from the proposed SDWQ development site. It has been agreed that disposal of any dredge arising, to sea, will take place out with the SPA (disposal site FI040).

Comparisons of dredging sound for all activities associated with dredging (dredging itself, transit, placement, pumping and rainbowing – aerial discharge of dredged material in a fountain) for a 2,000ha harbour extension of the Port of Rotterdam using modelling revealed that rainbowing had the second lowest sound levels recorded out of all elements of the dredging activities (sediment consisted of sand)[16]. As such, with dredge noise levels for the SDWQ project having short risk ranges of PTS (<50m) and TTS (120m), based on the modelling example, it could be assumed that disposal would have reduced risk ranges of noise output on basking sharks.

General Disturbance

Disturbance to basking sharks may occur as a result of the works occurring as basking sharks are sensitive to disturbance. The most likely disturbance to basking sharks as a result of the noise related activities include both physiological (increased stress and cortisol levels, rapid heartbeat and increased breathing rate) and behavioural disturbance (trashing tails, breaching and diving)[17].

It is expected that basking sharks would be likely to exhibit a behavioural change as a result of the noise, predominantly changing direction away from the noise source, with tail splashing occurring. In addition, physiological stress is likely to also occur. This could impact basking sharks energy and fitness levels through disturbing foraging, breeding or causing avoidance of feeding areas for periods of time.

4.5 Effects of Water quality in relation to dredging

Increases in suspended sediment concentration (SSC) arising from project dredging activities during construction have the potential to affect basking sharks indirectly by altering the availability or behaviour of their prey.

As outlined in section Technical Appendix 4.1, Volume 3 of the EIAR (EnviroCentre, 2023), the marine deposits within the dredge area comprise an approximate stratigraphic order of superficial marine deposits (loose to medium dense gravelly silty sands with shell fragments and occasional cobbles) overlying glacial till. A Dredging Best Practicable Environmental Option Report (BPEO) has been produced for the proposed development which identifies the dredge budget to consist of approximately 17% gravel, 60% sand, and 23% silt and clay.

Hydrodynamic modelling summarised in Technical Appendix 4.1, Volume 3 of the EIAR (EnviroCentre 2023) show little impact on the surrounding water column and seabed due to the low energy environment in this part of Scapa Flow. Therefore Section 8.4.1 of the EIAR (EnviroCentre, 2023) concluded that impacts on prey species for basking shark are expected to be negligible such that their abundance and general distribution remains unchanged from the baseline. In addition, the magnitude

[15] SDWQ BPEO Report Final - Rev1
[16] https://dredging.org/documents/ceda/html_page/2013-06-woda-technicalguidance-underwatersound_lr.pdf
[17] https://foweyharbour.co.uk/wp-content/uploads/2021/04/basking_shark_code_of_conduct.pdf

or the sediment discharge and dispersion from dredging works will be low within the dredge area and its immediate vicinity, and negligible out with this area. Thus, the supporting habitats for basking sharks beyond the development footprint will be maintained.

Proposed reclamation fill activities could also result in plumes and increased SSC, with a resultant impact on prey species. The fill material will be a mixture of sediment locally generated by quarries and dredging, the coarse nature of which, in combination with locally weak tidal currents, will limit the duration and spread of any plume generated.

Chapter 5 of the EIAR (EnviroCentre, 2023) states that impact on prey species will be temporary and spatially restricted (Section 5.6.3.1 of EnviroCentre, 2023) and confirmed that there is sufficient alternative habitat for foraging and commuting for basking sharks.

Overall, due to the limited spatial extent (i.e. restricted to discrete areas near the dredging and reclamation areas), the relatively short-term duration (as it is limited to the duration of the dredging activities) and intermittent nature and high reversibility, the risk of degradation of water quality directly associated with the project is considered to be low to basking shark i.e. unlikely to cause a change in status of the waterbodies in question at both the dredge and disposal sites.

As a precautionary measure during construction, the Project proposes to undertake turbidity monitoring to protect water quality and ensure minimal environmental impact. The project proposes to monitor sediment re-suspension levels to prevent damage to the local ecosystem and aquaculture as high sediment concentrations can contribute to suboptimal conditions and may harm aquaculture fish since it affects the overall ecological balance and the fish have restricted movement. By monitoring turbidity, the project can determine potential impacts on the environment and implement corrective actions. Furthermore, silt booms will be utilised to contain fine sediments while reclamation works are undertaken, to minimise the spread of sediments and thus disturbance to prey species in the marine environment.

Measures such as silt booms and careful dredging protocols will act to limit sediment disturbance and prevent the release and dispersal of sediments.

Any SSC increases will be confined to a very small spatial area and short-term duration and will not extend into wider foraging grounds used by basing sharks. The supporting habitats for prey species beyond the project site will therefore remain unaffected.

Overall, the associated risk of degradation of water quality directly associated with the proposed disposal and thus impacts to basking sharks is considered to be low i.e. unlikely to cause a change in status of the waterbodies in question at both the dredge and disposal sites.

4.6 Effects of Terrestrial Noise from Blasting

Disturbance of basking sharks whilst at the surface of the water could be caused by noise associated from terrestrial blasting, which could have a negative impact on basking sharks.

Although the majority of energy generated within the atmosphere from any surface mineral blasting will be of a sub-audible nature, there will also be a component that is audible, i.e. at frequencies greater than 20 Hz, and as such can be heard as noise and measured in terms of dB(A).

Routine blasting operations regularly generate air overpressure levels at the closest point to blast area of around 120 dB and the National Marine Fisheries Service (NMFS) predicts that marine species

exposed to ≥100 dB (in-air) will be behaviourally harassed[18]. However, the intensity of these noise levels experienced at a distance from the blast site are affected by a range of meteorological conditions (wind speed and direction, temperature, cloud cover and humidity). For example, if a blast is detonated in a motionless atmosphere in which the air temperature is constant, then the air overpressure intensity will decrease purely as a function of distance and will, once outside of the immediate vicinity of the blast, reduce by 6 dB as the distance from source doubles. Although such conditions are very rare, the overall result is that the nominal 6 dB reduction may be greater in some directions from the source and less in others.

A 6m high bund will be formed at the seaward boundary of the site by retaining the existing land and excavating behind, creating a natural noise screen from terrestrial blasting (and other works) and will only be removed once the site is excavated to the final profile. This would reduce the effects of noise on basking sharks at the waters surface. Furthermore, a 10-minute pre-work search is to be implemented to ensure that no basking sharks (or other marine mammals) in the marine environment are in the vicinity of the works that could be impacted.

In addition to bunding, a range of controls and mitigation measures can and should be implemented when undertaking terrestrial blasting, including screens to further dampen sound, which would also reduce the effects of noise on basking sharks at the water's surface.

Due to the reduction in noise doubling from the source of blast site, doubling incrementally, it will be unlikely that basking shark would be negatively impacted to a population level from terrestrial noise associated with blasting.

4.7 Effects of Increased Vessel Movement on Basking Sharks

Vessel movements of approximately 42 vessel movements over a 12-week period (between June – August 2028) are expected for the dredge disposal for the Project. 70 vessel movements are expected for works associated with caisson delivery, scour protection and caisson installation. This equates to 112 vessel movements in total during construction, which is considered a relatively low number of vessel movements over the length of the period of works (26 months in total).

During the operational phase, the estimated number of vessels calling at the Project Quay in the operational phase is 96 per year (192 vessel movements), comprising 28 large vessels and 12 smaller vessels per year. Each of the 28 large vessels will have two associated pilot boat (2 vessel movements). In total, the estimated vessel movements per year is 192. The majority of these vessels (approximately 80 %) are expected to occur during the summer months (April – September), so there will be an increase of 26 vessel movements per month in summer and 6 per month in winter.

All vessels will follow designated shipping lanes, with the only area of increased vessel being the route of 2.9km (1.6 nautical miles) leading from the main shipping lane into the SDWQ.

Overall, there will be a low increase in the number of vessels in the SDWQ area, associated with the construction and operational phases of the project, with vessels mainly using existing shipping routes and the works are considered to be temporary in nature, however, more vessels increase the risk of collision with basking sharks, potentially resulting in death or injury to individuals.

The construction phase will require a variety of vessels that differ in size, speed and operating procedure. This can result in a wide range of basking shark collision risk levels for different vessels and SDWQ development activities. Although larger vessels have a greater footprint and therefore may

be considered more likely to make encounters with basking sharks, the speed at which smaller vessels travel can be more detrimental to basking sharks.

Basking sharks can often be observed with injuries to their dorsal fins, after colliding with vessels. Studies summarised by NS[19] suggest that basking sharks show very little avoidance measures to approaching vessels, this is likely more apparent during the summer months when they are 'in a trance like state' feeding at the surface. It is unknown how sensitive they are to disturbance from vessel movements.

The increase in the number of vessels travelling through to SDWQ, during construction including dredge disposal and during operation, would increase the risk of collision with basking sharks, potentially resulting in death or injury to individuals. However, the likelihood of vessel collisions is dependent upon vessel speed, animal behaviour and vessel manoeuvrability[20]. Vessels travelling at slower speeds in general can allow time for basking sharks and vessel operators to react to avoid collisions.

Therefore, the effects of these impacts from vessels will be highly localised around the established shipping routes. As the majority of the vessel routes will be using existing routes, basking sharks will likely already be habituated to vessels in those areas and/ or avoid the area already. In the area of increased vessel activity close to the project site, there is a greater likelihood of vessel collision with basking sharks, however, the vessel numbers in this area are very low, as stated above, and over time, basking sharks would likely become habituated to vessels using this route. The BSMP will be adhered to during operation. This includes limits on vessel speed.

Vessel movement protocols secured via adherence to the Vessel Management Plan would further mitigate risk of vessel collision to basking sharks.

Overall, the risk of injury or disturbance from vessels is considered minimal, and any effects are expected to be highly localised. The introduction of project vessels during construction and operation is not considered to be a substantive increase to baseline vessel movements. As such, when considering the proposed mitigation measures, it can be concluded that the predicted impacts on basking sharks would be limited.

4.8 Conclusion

Some of the activities associated with the SDWQ development (dredging and vessel movement) have the potential to cause disturbance, injury or in extreme circumstances, death to individual basking shark but the risk is considered to be low. For the most part the activities associated with the proposed development may result in temporary avoidance of a small area of habitat available to individuals. It is considered that with mitigation described in the following Basking Shark Mitigation Plan (BSMP) the risk of death and injury will be negligible. It is not possible to rule out some level of disturbance to individuals which might be present within the area.

Overall, the increase in the number of vessels travelling through to SDWQ, during construction, dredge disposal and operation, would increase the risk of collision with basking sharks, potentially resulting in death or injury to individuals.

[19] NatureScot (2009) Commissioned Report 339: Basking Shark Hotspots on the West Coast of Scotland available at: https://www.nature.scot/doc/naturescot-commissioned-report-339-basking-shark-hotspots-west-coast-scotland (Accessed 07/06/2024)
[20] SEER U.S. Offshore Wind Synthesis pf Environmental Effects Research: Presence of Vessels: Effects of Vessl Collision on Marine Life (2022): https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Effects-of-Vessel-Collision-on-Marine-Life.pdf

Although there are some uncertainties regarding the overall population status and trends of basking shark in UK waters, it is considered that due to the relatively small area over which individuals are likely to be affected, the low density estimates of basking sharks expected in Scapa Flow, the seasonal distribution of this species, the impact range of dredging activities and the mitigation measures such as following the Scottish Marine Wildlife Watching Code and the Basking Shark Code of Conduct, there will not be an overall negative effect on the favourable conservation of the local basking shark population.

5 BASKING SHARK MITIGATION PLAN

The basking shark mitigation will comprise a standard Marine Mammal Observation Protocol (MMOP) as per JNCC guidance will be implemented during dredging operations in sea states less than 4 and during times of optimal visibility

5.1 Basking Shark Observation Protocol

The Basking Shark Observation Protocol (BSOP) will be implemented so that the construction and dredging works do not cause injury or unnecessary disturbance to basking sharks. This section has been designed with reference to current JNCC guidance 'Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise' (August 2010) [21].

5.1.1 Marine Mammal Observer

A suitably qualified Marine Mammal Observer (MMO), competent in the identification of basking shark at sea, will be present during the dredging. The MMO will undertake observation for basking shark within the mitigation zone before dredging commences and will be dedicated to that one task for the duration of any watch. The MMO will advise the contractors and crews on the implementation of the procedures set out in the agreed protocol, to ensure compliance with those procedures.

The JNCC guidance provides the following definitions of an MMO:

MMO: Individual responsible for conducting visual watches for basking sharks. It may be requested that observers are trained, dedicated and/or experienced.

Trained MMO: Has been on a JNCC recognised course.

Dedicated MMO: Trained observer whose role on board a vessel is to conduct visual watches for basking sharks.

Experienced MMO: Trained observer with three years of field experience observing for basking sharks, and practical experience of implementing the JNCC guidelines.

The MMO will be positioned appropriately to cover the full mitigation zone and will be trained. The identity and credentials of the MMO will be agreed with Marine Directoraite.

5.1.2 MMO Equipment

The MMO will be equipped with binoculars (10X42 or similar) and/or a spotting scope (20-60 zoom or equivalent), a copy of the agreed protocol and the Marine Mammal Recording Form (MMRF), which is a Microsoft Excel spreadsheet containing embedded worksheets named Cover Page, Operations, Effort and Sightings. A Microsoft Word document named Deck forms is also available, and the MMO may prefer to use this when observing before transferring the details to the Excel spreadsheets. Although these forms were developed for seismic surveys, they can be used for dredging operations, although many columns will not be applicable. The ability to determine the range of basking sharks is a key skill for MMOs, therefore a hand-held rangefinder will be used to verify the range.

[21] https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf

All MMO forms, including a guide to completing the forms; and instructions on how to make a rangefinder are available on the JNCC website: http://jncc.defra.gov.uk/marine/seismic_survey

5.1.3 Communication

The contractor will be responsible for the communication channels between those providing the mitigation service and the crews working on the dredging. A formal chain of communication from the MMO to the contractor, who will start/stop dredging, will be established. In order to confirm the chain of communication and command the MMO will attend any relevant pre-mobilisation meetings.

5.1.4 Mitigation Zone

Following appointment of contractor / Ecological Clerk of Works (ECoW), logistical information will be available/ updated to provide more detailed mitigation zones for the MMO. This may change throughout the construction period due to ground levels changing and depending on the area of works which need to be viewed.

The JNCC guidance defines the mitigation zone as a pre-agreed radius around dredging site (prior to any works. This is the area where a MMO keeps watch for basking sharks (and delays the start of activity should any basking sharks be detected). The extent of this zone represents the area in which a basking shark could be exposed to sound that could cause injury. The MMO should be located on the most appropriate viewing platform to ensure effective coverage of the mitigation zone. The radius of the mitigation zone should be 800m for dredging to cover the PTS and TTS ranges of the activities and to account for all marine mammals (including cetaceans and seals).

5.1.5 Dredging Protocol

The standard JNCC protocol is outlined below:

1. The MMO should be situated in location that provides the best viewing platform and is likely to be closest to the dredging activities. For example, an elevation area of the coast or a vessels bridge that allows 360 degree cover (depending upon the size of the mitigation zone more than one MMO viewing platform (and therefore more than one vessel) may be required to ensure that the entire mitigation zone can be observed).

2. At least 30 minutes before any type of dredging works, a visual watch known as the ‘pre-works search’, should be carried out in the mitigation zone. The pre-works search should continue until the MMO advises that the mitigation zone is clear of basking sharks, and the works can start.

3. The MMO will scan the waters using binoculars or a spotting scope and by making visual observations. Sightings of basking sharks will be appropriately recorded in terms of date, time, position, weather conditions, sea state, species, number, adult/juvenile, behavior, range etc. on the JNCC standard forms. Communication between the MMO and the contractor and the start/end times of the activities will also be recorded on the forms.

4. Dredging works should not be undertaken within 20 minutes of a basking shark being detected within the mitigation zone.

5. If a basking shark is observed within the mitigation zone, it should be monitored and tracked until it moves out of range. The MMO should notify the relevant chain of command of the detection and advise that the operation should be delayed. If the basking shark is not detected again within 20 minutes, it can be assumed that it has left the area and the works may commence.

6. A soft-start will be employed, with the gradual ramping up of dredging (where possible) power incrementally over a set time period until full operational power is achieved. This will allow for any basking shark to move away from the noise source.

7. If a basking shark enters the mitigation zone during the soft-start then, whenever possible, the dredging operation will cease, or at least the power will not be further increased until the basking shark exits the mitigation zone and there is no further detection for 20 minutes.

8. If a basking shark enters the mitigation zone during the soft-start then, whenever possible, dredging operation will cease until the basking shark exits the mitigation zone and there is no further detection for 20 minutes.

5.1.6 Reporting

As per the JNCC guidance, reports detailing the dredging activity and basking shark mitigation (the MMO reports) will be sent to Marine Directorate at the conclusion of the activities. Reports will include:

- Completed MMRFs;
- Date and location of the activities;
- A record of all occasions when activities occurred, including details of the duration of the pre-search and soft-start procedures, and any occasions when activities were delayed or stopped due to presence of basking shark;
- Details of watches made for basking shark, including details of any sightings, and details of the activity during the watches;
- Details of any problems encountered during the activities including instances of non-compliance with the agreed protocols; and
- Any recommendations for amendment of the protocols.

5.1.7 Terrestrial Noise Considerations - Blasting

Following appointment of contractor logistical information will be available/ updated to provide more detail regarding terrestrial blasting protocols and blasting methods will be determined by the contractor once commissioned.

The MMO protocol implemented for dredging will also be undertaken for terrestrial blasting. However, a 10-minute pre-work search would be required rather than a 30-minute pre-works search.

In addition, the following mitigation methods should be considered to be implemented for terrestrial blasting:

During terrestrial blasting, minimising air overpressure at the source, such that, even under unfavourable weather conditions, all such energy is within acceptable criteria at distance, remains the best practicable approach. It is an approach that all surface mineral sites are obliged to follow under the provisions of The Quarries Regulations 1999.

Detonating cord should be used as sparingly as possible, and any exposed lengths covered with as much material as possible. Just a few feet of exposed cord can lead to significant amounts of audible energy and, hence, high air overpressure levels. Stemming release can be controlled by detonation technique, together with an adequate amount of good stemming material. It should be noted however that detonation cord and stemming release have been virtually eliminated with the use of in hole initiation techniques.

If the use of exposed detonating cord is avoided the characteristic noise of a blast is no longer a sharp crack but rather a dull thump. This is partly due to the detonating sequence and partly due to natural energy dissipation and reduction. Whilst some of the noise perceived by a neighbouring resident would be directly from the blast itself, the lower frequency components of the air overpressure might well induce secondary rattling of windows and ornaments within a property which could augment the overall effect.

Thus, in terms of noise control or reduction in the care and attention to blast design and subsequent implementation, including initiation, necessary for the control of air overpressure is equally applicable to noise.

BS 6472-2:2008 states that "The highest [air overpressure] levels normally measured in the United Kingdom are generally less than 1% of the levels known to cause structural damage." Therefore, by implementation of the best practice measures, effects due to air overpressure generation by the proposed development are anticipated to have a negligible effect on basking sharks when at the water's surface**.**

5.2 Vessel Movement Mitigation Protocol

The Harbour Authority implement speed restrictions on vessels within Orkney waters, additionally, leaflets can be created to provide additional advice to port users to avoid disturbance to and/or collision with basking sharks during construction which should include, but is not limited to the following:

- A strict speed limit for marine traffic, including dredge disposal works, will be implemented to reduce risk of collision with basking sharks (4 knots within the water).
- Implementation of a Vessel Management Plan including agreed routes, speed limits and incorporation of the Scottish Marine Wildlife Watching Code[22].
- Safe vessel operation to minimise risk of collision with basking sharks to be promoted to users. Training courses such as those provided by the WiSe scheme[23] could be offered at regular intervals.

Additionally (where possible) leaflets can be created to provide additional advice to quay users to avoid disturbance to and/or collision with basking sharks which should include, but is not limited to the following:

- Keep a safe distance from basking sharks. Never get closer than 100m (200m if another boat is present), but if within 100m, switch the engine to neutral;
- Never drive head on to, or move between, scatter or separate basking sharks. If unsure of their movements, simply stop and put the engine into neutral;
- Spend no longer than 15 minutes near the animals;
- Special care must be taken with mothers and young;
- Maintain a steady direction and a slow 'no wake' speed; and
- Avoid sudden changes in speed.

Wildlife code of conduct methods have been created by NatureScot and are available on their website[24].

[22] https://www.nature.scot/doc/scottish-marine-wildlife-watching-code-smwwc
[23] Information available at: https://www.wisescheme.org/ (accessed 02/06/2023)
[24] https://www.nature.scot/sites/default/files/2017-06/Publication%202017%20-%20The%20Scottish%20Marine%20Wildlife%20Watching%20Code%20SMWWC%20-%20Part%201%20-%20April%202017%20%28A2263518%29.pdf

5.3 Additional Good Practice Recommendations

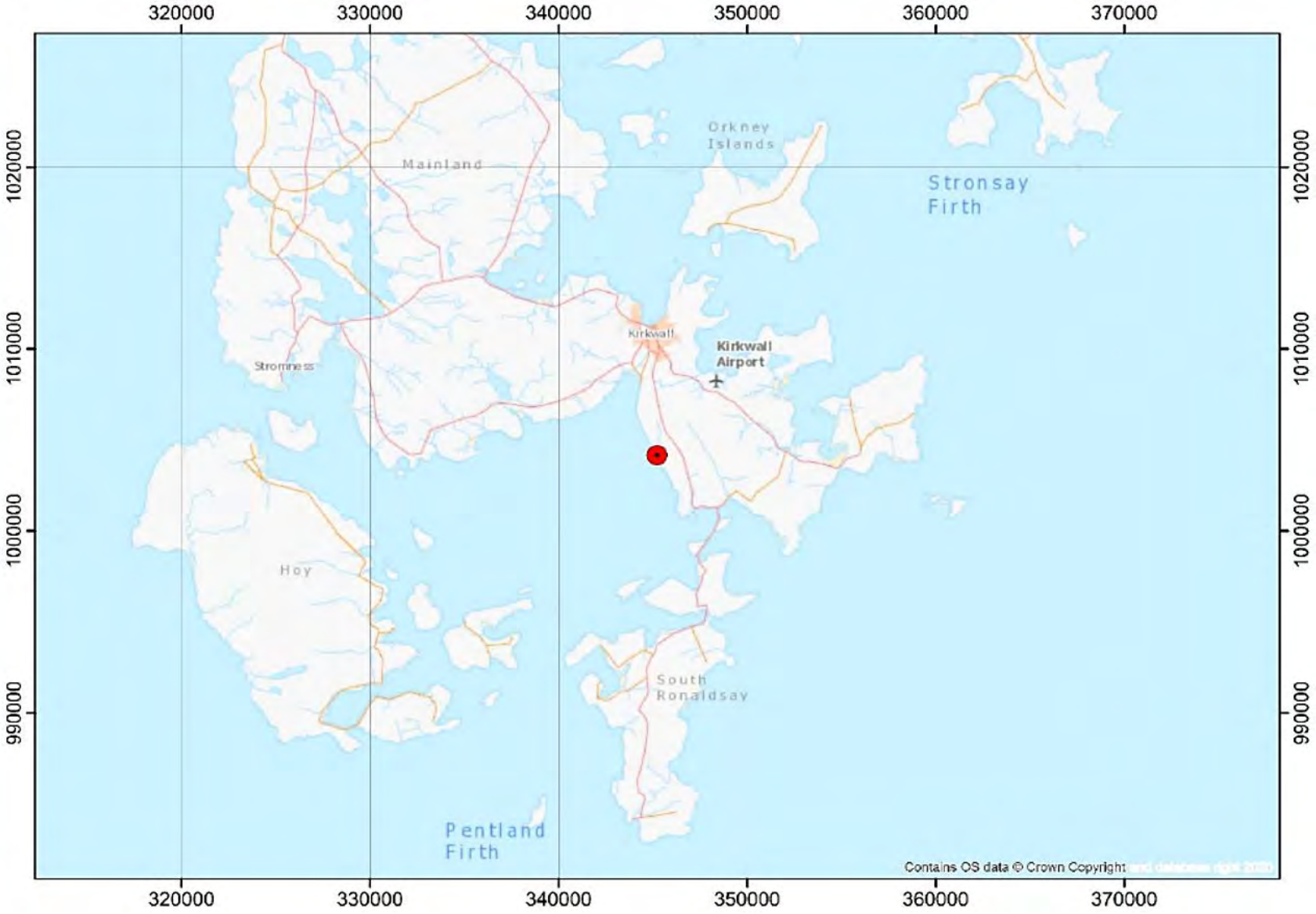
If any dead basking shark is anecdotally observed during construction or operation, it should be reported to the Scottish Marine Animal Stranding Scheme (SMASS) (www.strandings.org) and live basking shark strandings will be reported to British Divers Marine Live Rescue (www.bdmlr.org.uk). All dead or stranded basking shark should also be reported to the local NatureScot office.

The MMO should keep a record of all basking shark sightings, whether in the mitigation zone or not, to be issued to NatureScot. An understanding of the location of species is essential to appropriately assess the impacts of a proposed development and plan and target effective mitigation, therefore this data could be used to inform future projects. Biodiversity data are extremely important as, aside from use in planning and decision making, they are key to delivering state of environment reporting, education, modelling trends in species and habitat distribution, and research and policy making.

APPENDICES

A PROPOSED SDWQ LOCATION AND DISPOSAL SITE FI040

Site Location



Location of Disposal Site FI040

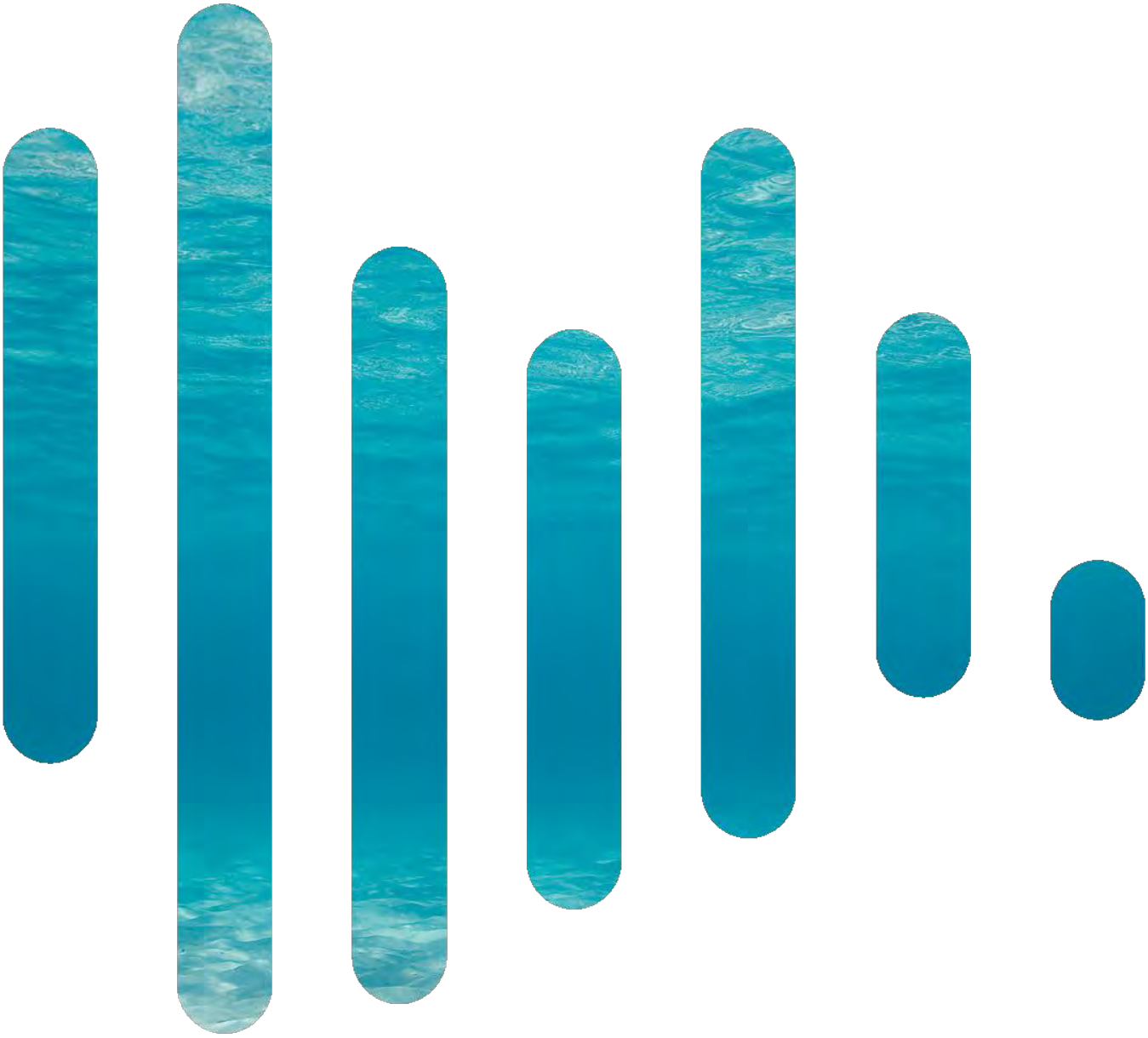


Source: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=712

B UNDERWATER NOISE MODELLING REPORT

(Note – Piling and Associated Drilling No Longer Required for the Caisson Design)

IRWIN CARR
CONSULTING



Scapa Deep Water Quay, UW Noise Modelling

Kirkwall, Orkney

RP001 Rv4 2022248 (Scapa DWQ, UW Modelling)

19 May 2025

PROJECT: SCAPA DEEP WATER QUAY, UW NOISE MODELLING

PREPARED FOR: ENVIROCENTRE

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SCOTLAND

ATTENTION: EMMA CORMACK

REPORT NO.: RP001 2022248 (Scapa DWQ, UW Modelling)

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Status:	Rev:	Comments	Date:	Author:	Reviewer:
Draft	1.0		19 May 2025	Rasmus Sloth Pedersen [Redacted]	Shane Carr

EXECUTIVE SUMMARY

BRIEF DESCRIPTION OF WORK

In relation to the construction of a deep-water port in Scapa Flow, both dredging, drilling and piling is planned. The noise from these activities can adversely affect local fauna either through direct injury of sensory systems or indirect harm from noise pollution drowning out communication and foraging sounds. Noise modelling has been carried out in respect to the various noise sources and local animals to estimate impact from noise and what mitigation can/needs to be employed to keep impacts below levels of significant harm to the local wildlife.

Source sources (dredging, piling and blasting) are modelled from a combination of empirical models (based on recorded data) and numerical models (calculated source levels from inputs).

CONCLUSION & RESULTS SUMMARY

Dredging

The noise from dredging, while presenting a significant Permanent Threshold Shift (PTS (hearing injury) risk to ranges <210 m for the Very High Frequency (VHF) group (e.g., porpoise), this is only for animals staying close to the activity for extended periods (> 1 hour) and assumes continuous dredging with the dredger level as given by the 90th percentile. For the best estimate (model mean) the PTS risk range is 210m after 8 hours exposure. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away. Further the area ensonified does not “block” access through a channel or strait.

Vibro piling

Prolonged exposure to vibro piling at close range (<50 m) carries some auditory risk for the animals assessed, specifically groups LF, VHF and P- (baleen whales, porpoises and salmon/trout), where the peak pressures in the noise have risk ranges up to 300 m for the VHF group. We therefore suggest surveillance takes place prior to piling to minimise the risk of impact on porpoises. While this is a significant risk for animals close to the activity, we stress that we have used a very conservative approach to estimating the source levels, and the realised emission will likely be significantly lower.

Further, animals will tend to move around, or away from noise, which will limit exposure. In Figure 16, p. 23 and Figure 18, p. 24 we show an example of the effect of using moving receivers (animats, modelled animals) to estimate what might be the effect of movement.

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Abbreviations and Definitions:

PTS	Permanent Threshold Shift
VHF	Very High Frequency
SOFAR	Sound Fixing And Ranging
SSP	Sound Speed Profile
SPL	Sound Pressure Level
Hearing group	Refers to the Southall 2019 hearing groups (Southall, et al., 2019).
"," and "."	Comma "," is used as thousands separator, while dot "." Is used as decimal separator.
TL, PL	Transmission Loss, Propagation Loss. Used interchangeably in this document.
Psu	Practical salinity unit, equivalent to parts per thousand as g/kg, mass of salts per mass of water.
Noise	Sound that causes, or is assumed to cause, annoyance or disadvantage. No automatic significance of impact is associated with this term.
Solver	Mathematical algorithm for calculating sound transmission losses in water.
[]	Square brackets are used throughout to denote units, e.g.: "Pressure [Pa]" means pressure in Pascals.
Degrees	Either angular degrees (0-360) or degrees Celsius
3rd octave, decidecade	Refers to the subdivision of octaves (doublings of frequency) and decades (10x frequency). Using the appropriate base frequency, the two are identical for practical purposes.
Worst case	Used as "reasonable worst case". E.g. use of MHWS instead of historical maximum for max water level. Or 90th percentile as representative of worst-case.
Mean case	The expected case, both median and mean values will inform this.
Signature, Impulse	When in relation to a sound, this refers to the time-pressure signal associated with that sound, normally as a time-series of pressures relative to ambient pressure, in pascals.
Vibro	Vibration pile driving
MSL	Mean Sea Level
β, Log multiplier	Symbol used to denote the factor multiplied by the base ten Log in equations like: "$TL = \beta \times Log_{10}(range)$"
SL, Source level	Apparent monopoint source level as viewed from the acoustic far field

1 INTRODUCTION

In relation to the construction of a deep-water port in Scapa Flow, both dredging, drilling and piling is planned. The noise from these activities can adversely affect local fauna either through direct injury of sensory systems or indirect harm from noise pollution drowning out communication and foraging sounds. Noise modelling has been carried out in respect to the various noise sources and local animals to estimate impact from noise and what mitigation can/needs to be employed to keep impacts below levels of significant harm to the local wildlife.

Source sources (dredging, piling and blasting) are modelled from a combination of empirical models (based on recorded data) and numerical models (calculated source levels from inputs).

1.1 Underwater Acoustics Basics

Underwater acoustics modelling is the application of physical models to characterise the behaviour of sound in environments under the surface of the sea and in the top layers of the seabed. As some familiarity with in-air acoustics is assumed the focus here is on key differences between in-air acoustics and underwater acoustics, making waterborne propagation more efficient than airborne propagation.

This chapter only gives reader a quick overview, please see APPENDIX B – Underwater Acoustics Basics APPENDIX *for more detail.*

1.1.1 SOUND SPEED

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[1] much as 340 m/s is in air.

The soundspeed changes with depth, “sound speed profile”, this is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR (Sound Fixing And Ranging) channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

1.1.2 SPREADING LOSS

Most of the propagation loss (loss in dB from source to receiver, “PL”) that occurs initially is governed by “spreading loss”. It is the simple “thinning out” of acoustic energy as it spreads away from the source, usually in all directions – spherically. This means a reduction in received level of 6 dB per doubling of distance

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Here we expect spreading loss to be ~3 dB per doubling of distance.

1.1.3 ABSORPTION

Besides the “thinning out” of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is salinity dependant. Frequencies under 1 kHz experiences almost no absorption, while high frequencies, over 10 kHz, can be attenuated by over 10 dB / km.

Small bubbles, wind or wave induced, will further attenuate especially the high frequencies.

1.1.4 SEDIMENT

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

[1] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies.

1.1.5 SOUND LEVEL UNITS

All references to sound pressure levels (SPL), peak pressure levels (L_p) and sound exposure levels (L_e) refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 1: Definitions.

Unit	Definition	Comments
SPL (dB_{RMS}) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p ($dB_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}}^2$
$L_{p\text{-}p}$ ($dB_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[2] equivalent to $L_P + 6.02\ dB$
L_E (dB_{SEL}) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-}"time"}$ or $L_{E\text{-single blow}}$.

If the averaging period for SPL is equal to the total even duration then SPL is equal to "Leq" the "equivalent constant level".

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

[2] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

2 SITE AND LOCAL ENVIRONMENT

The site is located in Orkney, Scotland:

- Scapa DWQ at Lat: 58.920345, Lon: -2.965084. Mean water depths 5-30 m.

The site is sheltered from oceanic swell, with little current and with no major outflows from rivers, meaning that the conditions important for sound propagation are quite stable. The sediment is generally a soft upper layer of mud/silt and gravel overlaid a layer of weathered sedimentary rock, before a stronger layer of sedimentary rock (silt-/mud-/sand-/lime-stone).

Figure 1. General location of Scapa DWQ development (in red circle) on Main Island of the Orkney Islands. Hatston site (just north west of Kirkwall, shown for completeness).

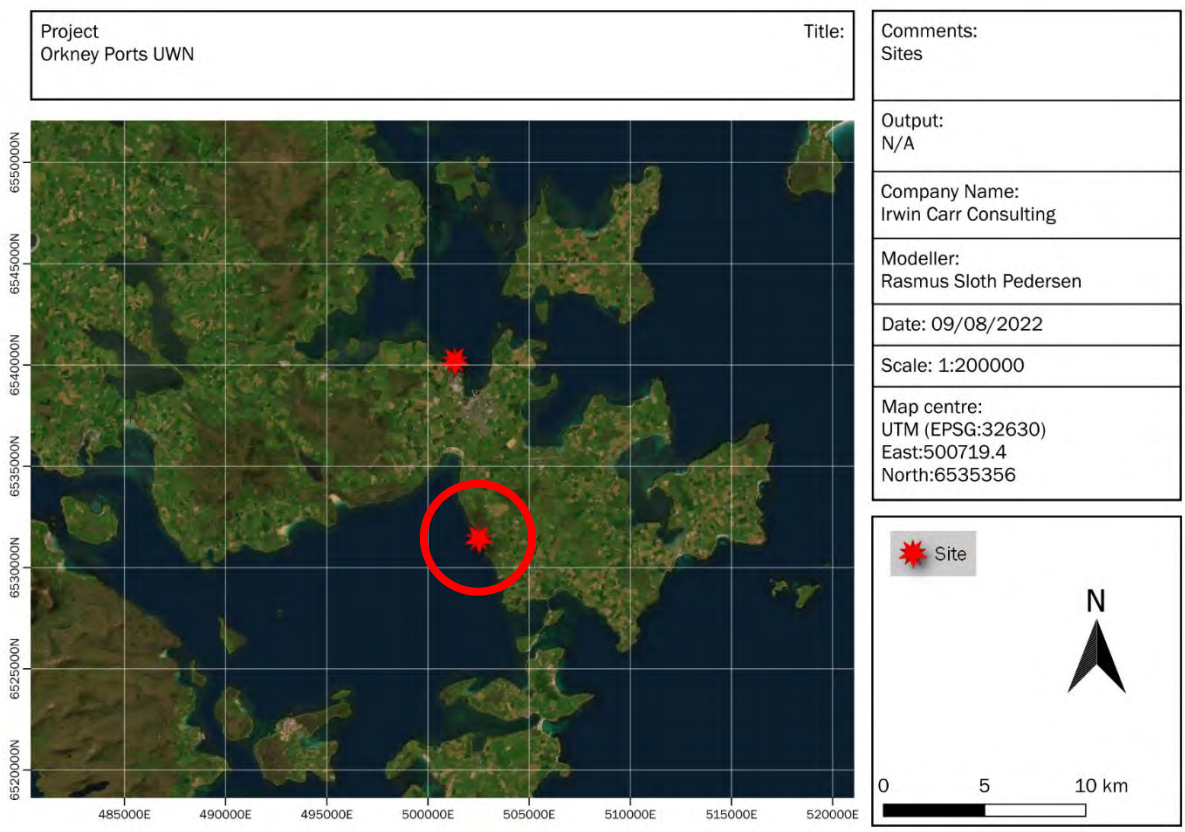
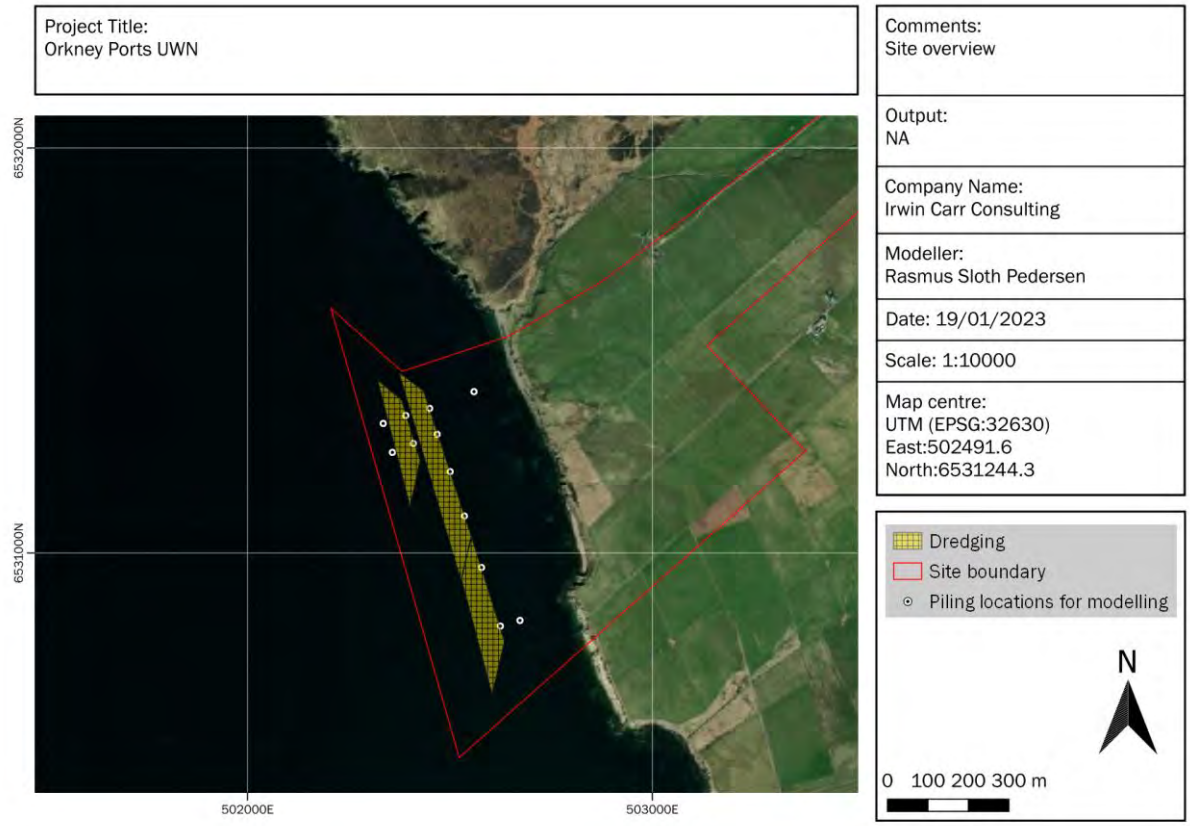


Figure 2. Overview of piling locations for modelling and approximate areas to be dredged.



2.1 Depth, Bathymetry

Depth data for the sites were collected from 3 sources:

- The proponent, detailed data near the site, 4 m resolution.
- EMODNet (European Marine Observation and Data Network, 2019), long range data, ~90 m resolution.
- Nautical charts such as http://fishing-app.gpsnauticalcharts.com, medium range data, variable resolution.

These were corrected to MSL and combined (using a mosaic method) to give the best possible total cover of the area.

For the "worst case" scenario the MHWS (Mean High Water Spring) level is used (deeper water decreases sound transmission loss).

2.2 Water properties

The water properties are important for the sound propagation. Generally the two sites have no major outflows of fresh water so salinity is expected to be near 35 psu (confirmed by (Marine Scotland, 2022)).

2.2.1 TEMPERATURE

The temperature was measured with the inbuilt thermometer of the Soundtrap hydrophone (used for on-site measurements).

Average water temperature at Scapa site during monitoring: 8.9 °C

The water columns are assumed to be well-mixed, given lack of nearby freshwater outflows, windy location, evaporation and generally shallow depths (<30 m).

2.2.2 SOUNDSPEED PROFILE

Given the water properties presented above, we assume the water soundspeed to be constant at all depths, with no significant deviations from the expected values.

The sound speed calculation is based on a widely used model for sound speed in water (Leroy, Robinson, & Goldsmith, 2008), with input of temperature, depth and salinity.

Sound speed in the water is calculated as 1486 m/s

2.3 Sediment properties

Given the project is a construction project there are sediment cores available for sediment characterisation provided by "Causeway Geotech". These give good coverage in the areas close to the Scapa DWQ. For general sediment outside the development area, we have used data from British geological survey (British Geological Survey, 2022).

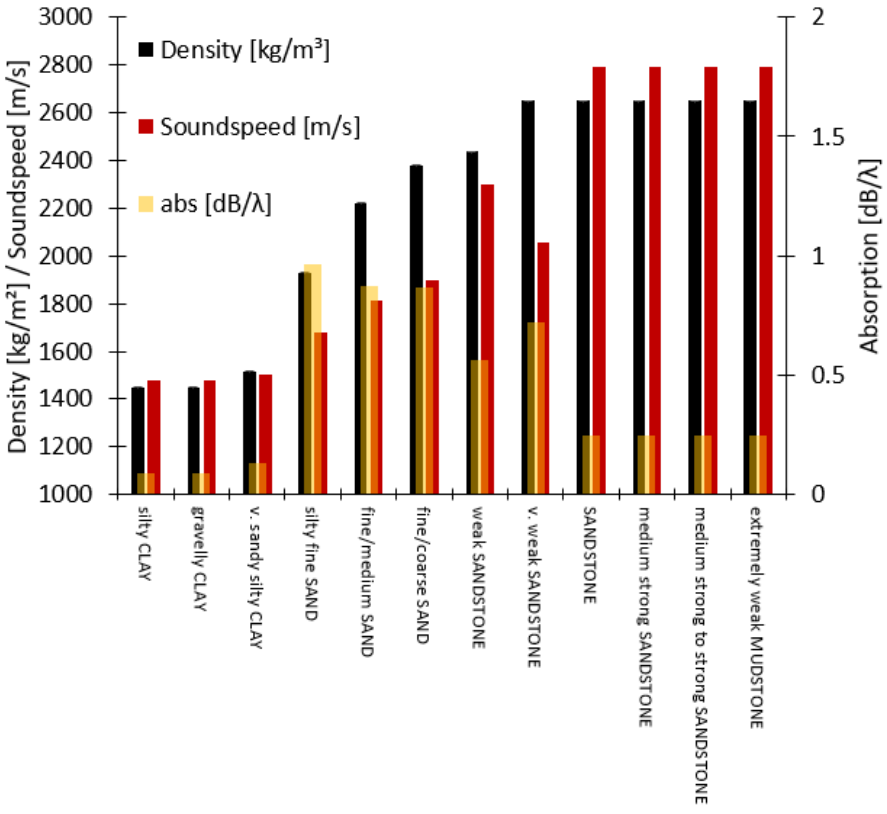
Where samples were taken we mapped the descriptions in the sediment core reports in relation to their Udden-Wentworth or Folk sediment description where these matched the nomenclature well. For other sediment types, e.g. sandstone/mudstone/limestone we have used given values for nominal "sandstone" (Jensen, Kuperman, Porter, & Schmidt, 2011; Boyce, 1981). The cores also contain classifications such as "weak sandstone" this was interpreted as loose, sandy sandstone, and we characterised this with density and soundspeed between that of sandstone and sand. This interpolation was based on an assumption that the scale "very weak-, weak-, medium weak-, sandstone" corresponds to linear interpolation between sand and sandstone (see Table 2 below). We have not changed the properties for categories indicating harder than usual sediments, such as "medium strong", "very strong".

Table 2. Example of interpolation scheme for Sand-sandstone.

Material	Interpolation value	Density [kg/m³]
Sand	0	1931
Very weak sandstone	0.25	2111
Weak sandstone	0.5	2291
Medium weak sandstone	0.75	2470
Sandstone	1	2650

Where we had no direct properties (density, sound speed, absorption) for the sediment we have used a modelling approach to estimate them, following (Ainslie, 2010).

Figure 3. Sediment types. Note that absorption is read on the right vertical axis.



2.4 Background/Ambient Noise

Baseline noise monitoring was carried out on 29-30 November 2022. On both days the weather was very calm (< sea state 1) with no detectable current. The Scapa site was unexpectedly noisy with ~130 dB SPL for all measurements (unaffected by range to our vessel). There were multiple other vessels in the bay, but all far away (> 1km). The most likely source was the small oil platform stationed a few km to the south. This could have some active machinery causing the noise, indicated by the tonal components (seen as horizontal bands in spectrogram in Figure 4).

Note that ambient noise here excludes noise from nearby vessel passes, it is meant as the ambient noise with no identifiable noise sources.

Table 3. Typical background noise levels.

Site	SPL [dB]
Scapa	129.9
Hatston	107.2

Figure 4. Spectrogram of ambient noise at Scapa.

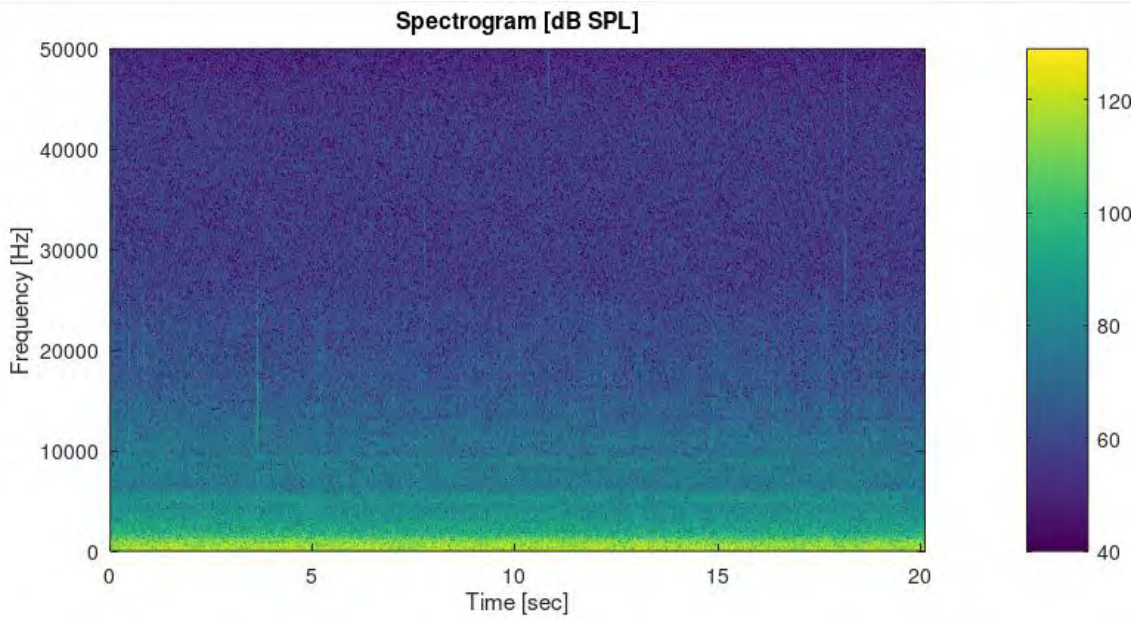


Figure 5. Spectrogram of ambient noise at Hatston.

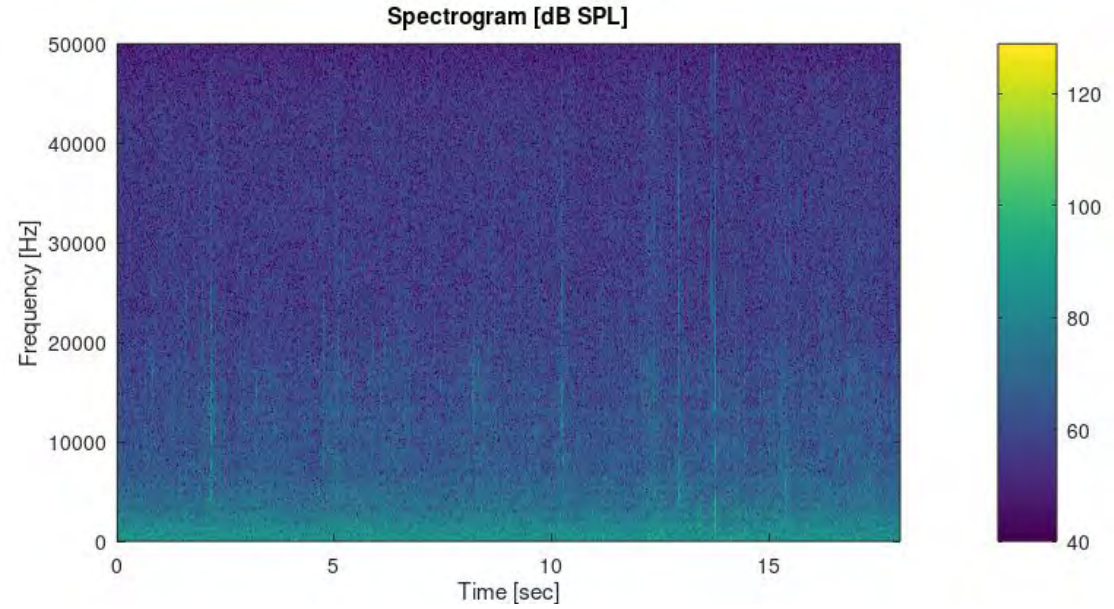
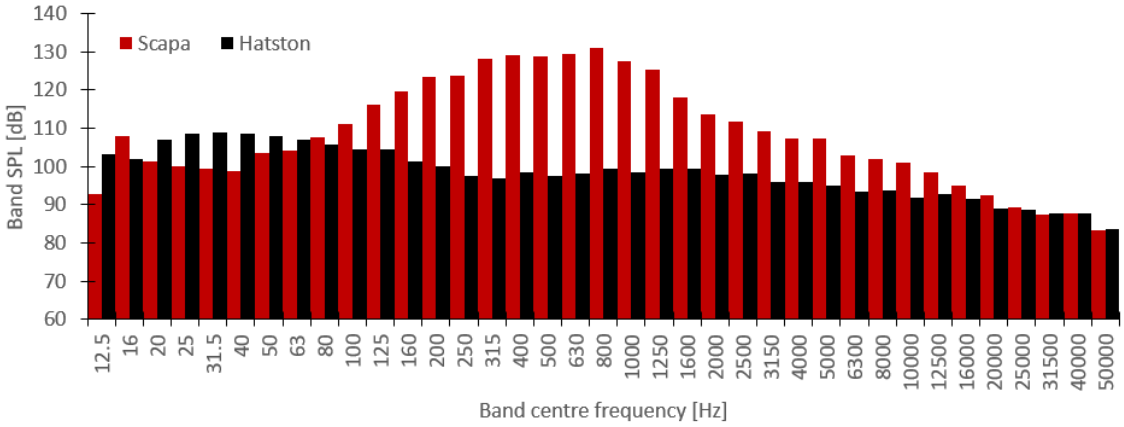


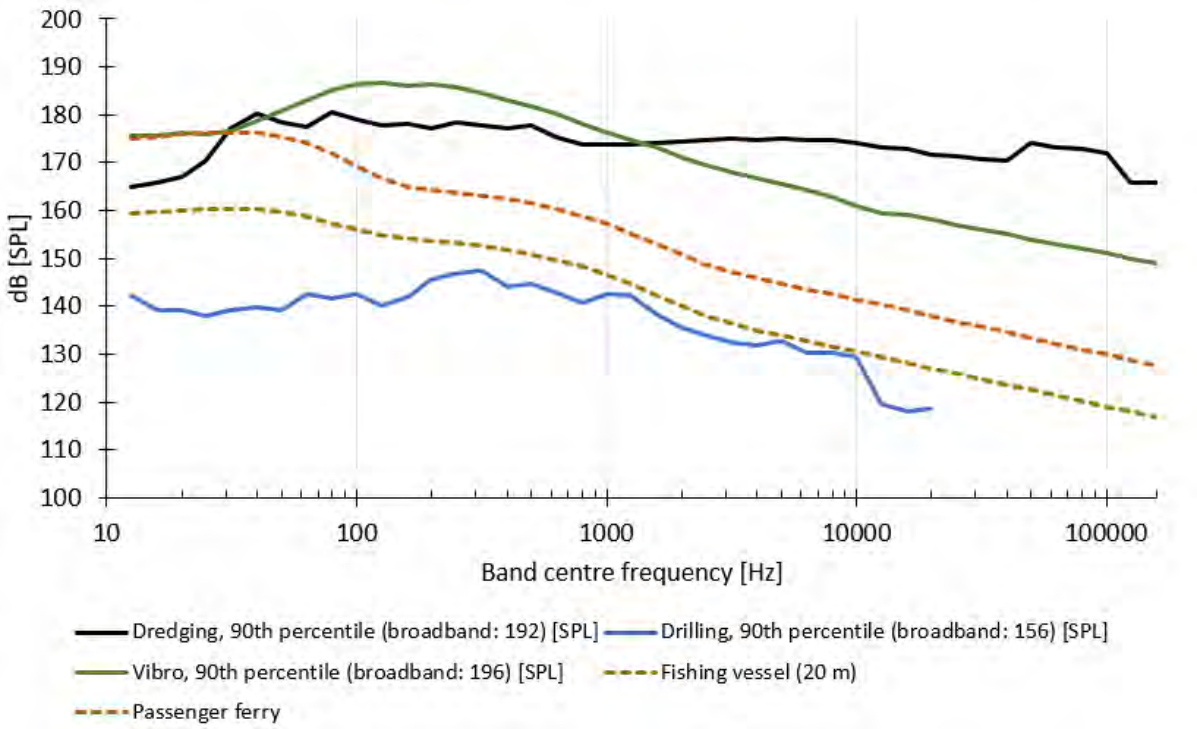
Figure 6. Typical band levels of ambient noise at Scapa and Hatston.



3 SOUND SOURCE MODELLING

We have considered three noise sources for this assessment, but have screened out the drilling as it is not loud enough to meaningfully assess in an environment with many vessels and general human activity (compare with vessel noise in Figure 7, below).

Figure 7. The three sound sources considered in this report. A fishing boat and a small ferry has been added for context.

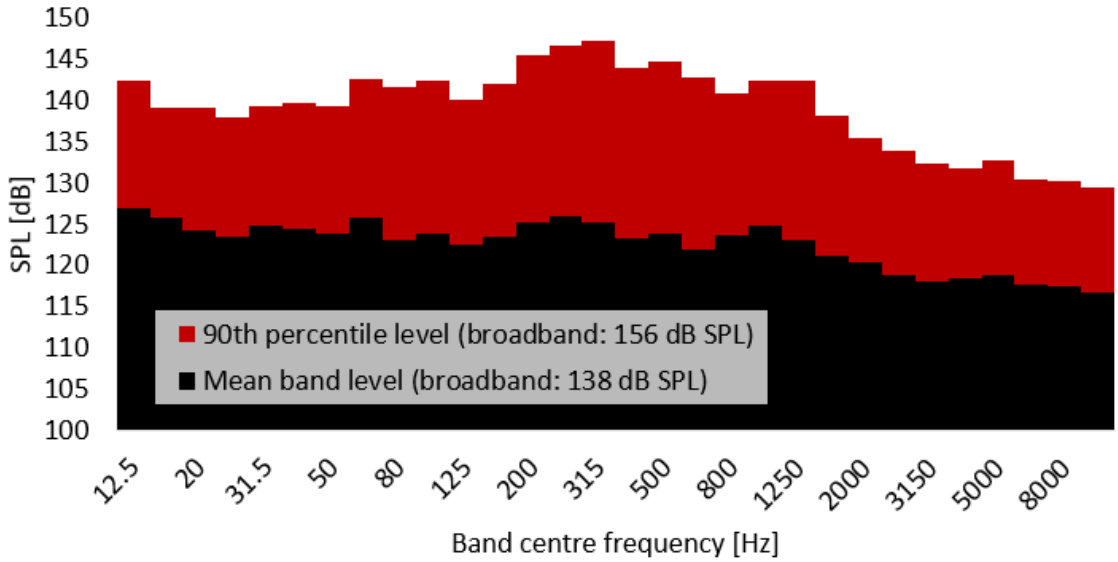


3.1 Drilling

As some hard sediment is expected round piles might be placed in pre-drilled holes, based on the range of noise levels presented in Figure 8, the drilling noise is assumed to be insignificant to the marine life.

The measured levels presented are a summary of 13 different recorded drilling episodes shows noise levels to vary considerably between sites and equipment, and there is no clear connection between drill size, power or sediment type to the emitted noise level. However, given the modest broadband level of even the 90th percentile level (156 dB SPL) this noise source can be ignored.

Figure 8. Example of drilling noise band levels. Data from various drills, diameter 0.1-1.2 m and various rock types.



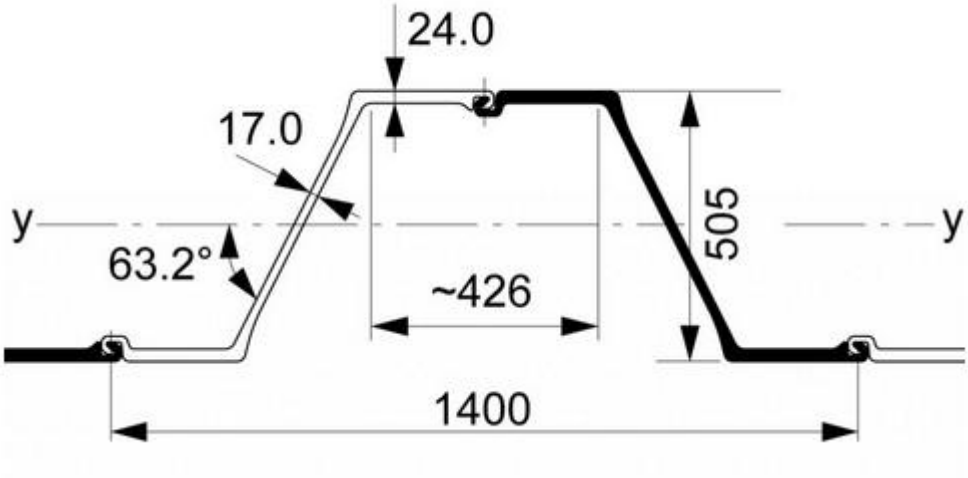
3.2 Vibration Piling Model

Two types of piles are expected to be used:

1. Tubular piles, expected to have a diameter of 2.1 m
2. Sheet piles (Arcelor Mittal AZ52-700[3]).

Both will be vibrated into the sediment or into holes left by the drilling campaign.

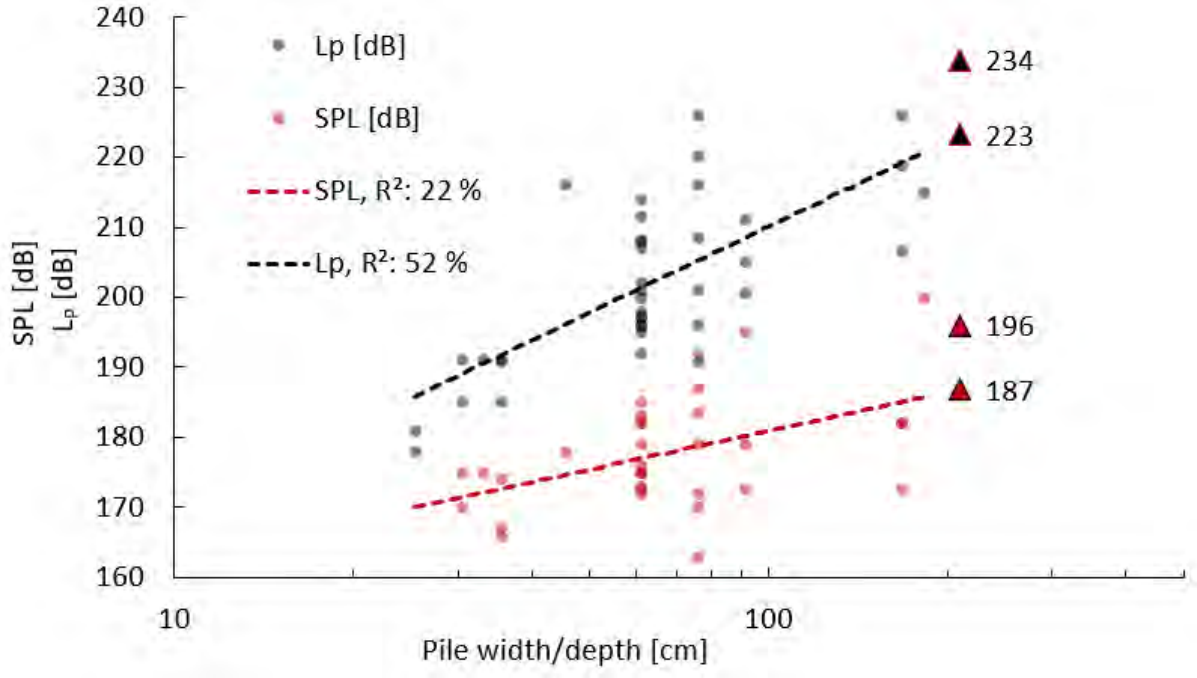
Figure 9. Schematic of the sheet piles.



The diameter of the tubular pile (210 cm) is used a basis for an empirical model based on 50 recorded levels as from CalTrans (CalTrans, 2015).

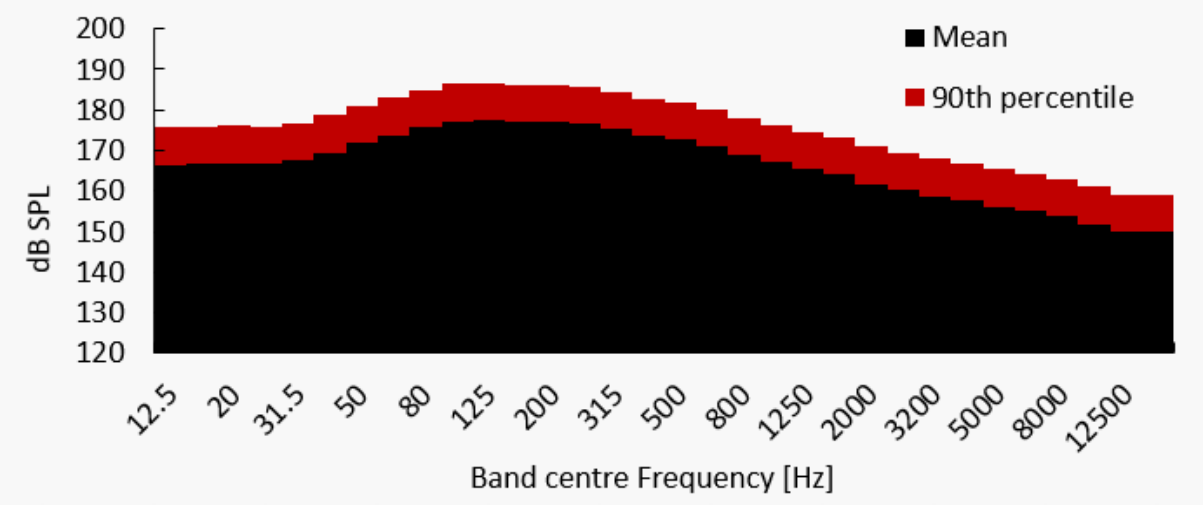
[3] https://sheetpiling.arcelormittal.com/products/az-52-700/

Figure 10. Basis of vibro piling broad band source level as a function of pile size (210 cm diameter).



Given the low confidence we have in this approach (low R^2 values) we use the 90th percentile level as the broadband source level. L_P is estimated to be 234 dB and SPL 196 dB. The frequency content is assumed to be identical to that of the impact piling.

Figure 11. Band levels for vibro-piling.



3.3 Dredging

Dredging is done to chart Datum -15 metres, meaning this will likely be done with a cutter suction dredger (Max reach 15 m) and possible assistance from a backhoe dredger. For the cutter suction dredger a cutter power of 540 kW is assumed, equivalent to the Boskalis "Seine"[4] cutter suction dredger. For cumulative modelling it's assumed that the dredging is potentially active 24 hours per day. The Backhoe dredging is quieter and has been ignored in favour of using the louder method for the assessment.

[4] https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwibnqWF-sH8AhUQg1wKHfYmBVoQFnoECB8QAQ&url=https%3A%2F%2Fboskalis.com%2Fmedia%2Fqbjnfdlv%2Fseine_cutter_suction_dredger.pdf&usg=AOvVaw1bBD75xRPcFc3H0TUXTFkD

Figure 12. Approximate extent of dredging campaign (yellow hatched area).

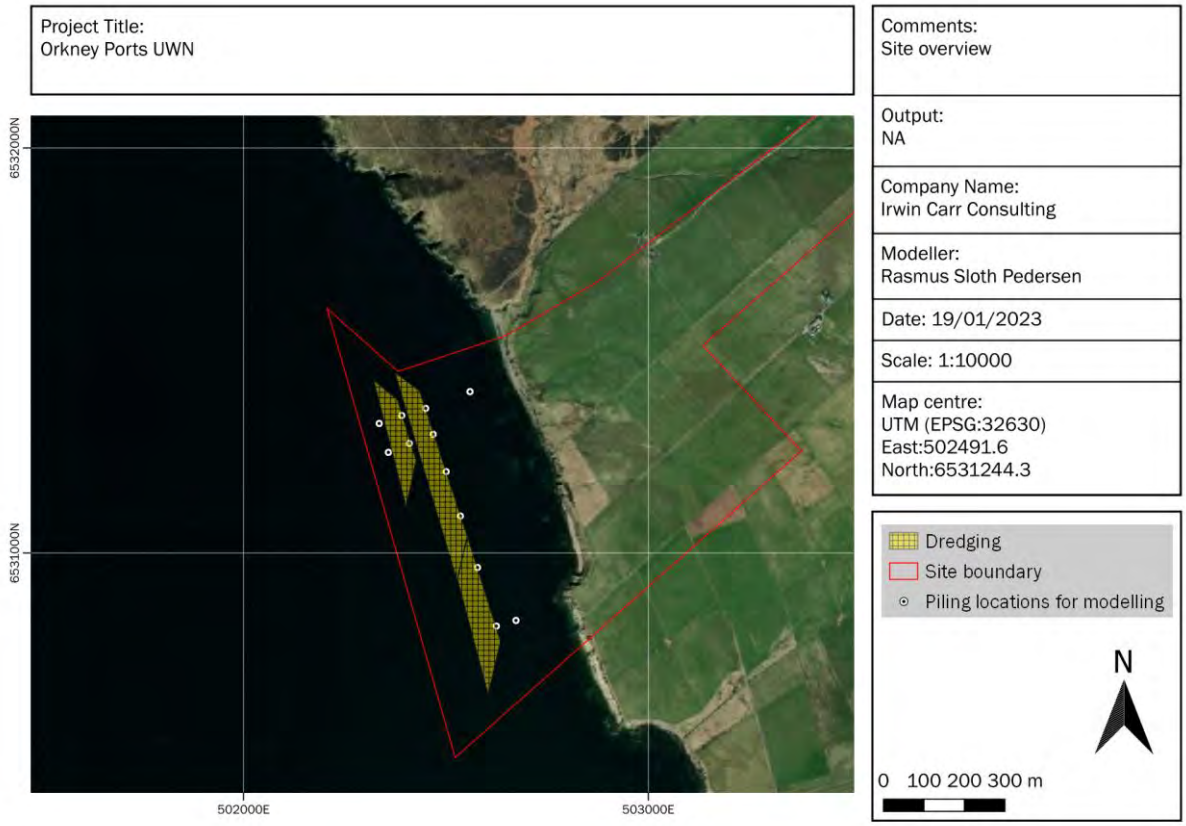
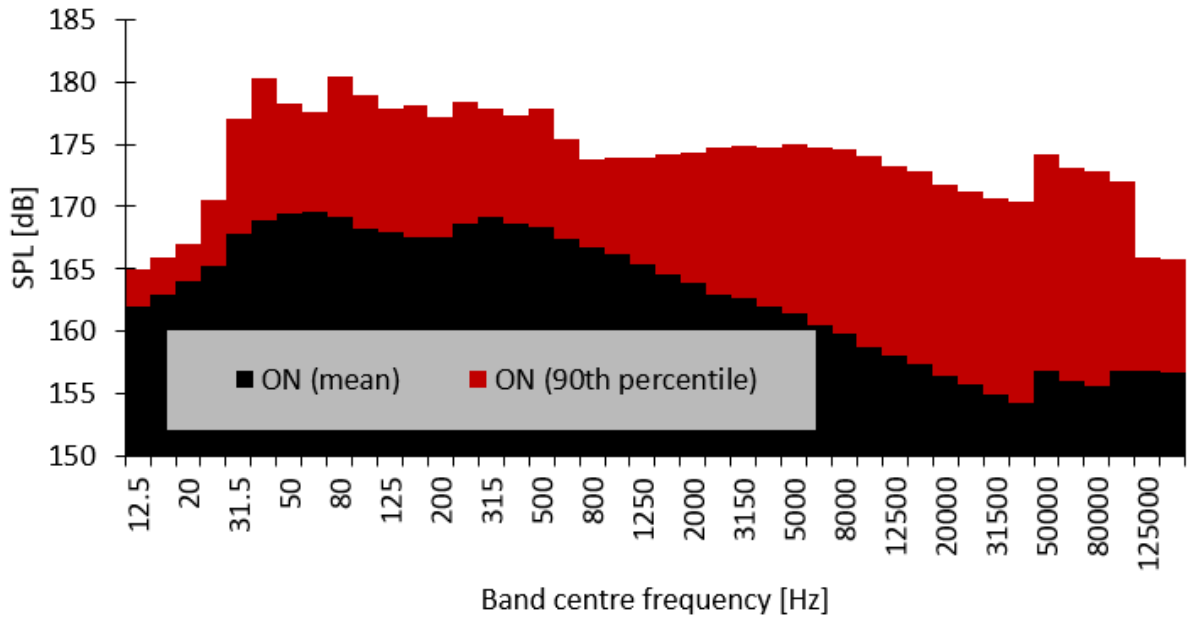


Figure 13. Band levels as modelled for a 540 kW cutter suction dredger with coarse sediment. "ON" refers to active dredging.



4 TRANSMISSION LOSS MODELLING

Transmission loss modelling is done using dBSea underwater noise modelling software.

This software is partially developed by us and can model frequencies from 10 Hz to 168 kHz, normally as 3rd octave bands, but any logarithmic band-spacing can be used. All solvers are range dependent (meaning all conditions can change with range not just depth).

Further details of this modelling software package can be found in APPENDIX A - dBSea.

The sound sources from section 3, Sound Source Modelling, p. 14, was used sources for the model, both as band levels when modelling energy transmission losses (L_E, SPL) and as timeseries/impulse for modelling peak pressure (L_P).

Previous to this assessment measurements of the actual transmission loss for the two sites were measured along two transects for each site. The modelling has been calibrated to match the measurements of these recordings (details in APPENDIX D – MODEL CALIBRATION).

The measurements show a broadband transmission loss consistent with ~12 × Log_{10}(range) at Scapa. However, these are frequency specific, and these losses are not consistent across all frequencies. We have matched the frequency-wise transmission losses to the extend that they are less than 20 × Log_{10}(range) as we find it unlikely that a transmission loss, even for higher frequencies, of > 20 × Log_{10}(range) is sufficiently representative for the site as a whole.

5 ASSESSMENT CRITERIA

5.1 Reporting units

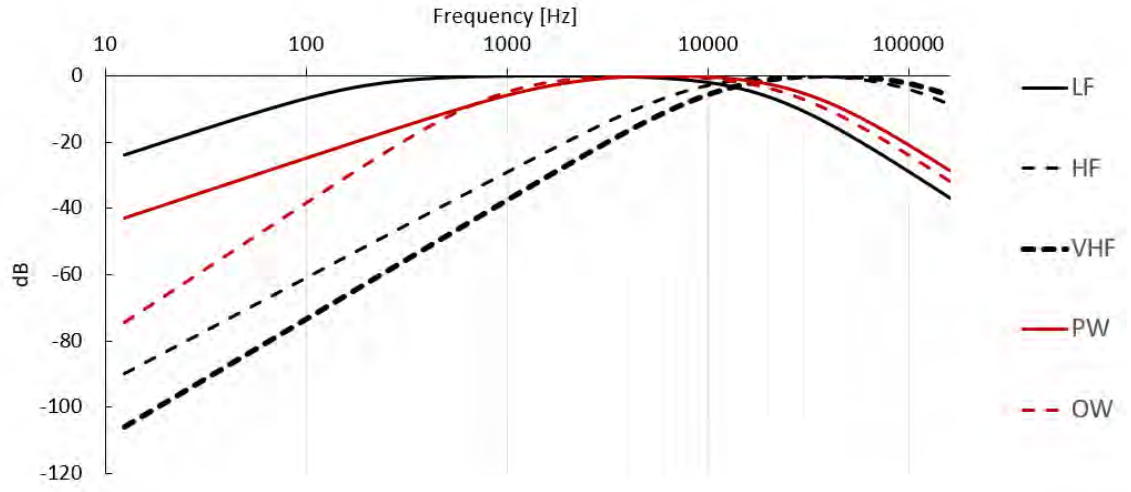
See 1.1.5, p. 8 for definitions.

5.2 Weighting of Noise Levels

When not reporting L_p or $L_{p\text{-}p}$ levels, the noise levels are often weighted according to a generalised hearing sensitivity profile for up to ten different hearing groups. This is done to better reflect the actual impact on the species in question, much like dB(C) level unit for humans.

See Table 4, for full group names and limits.

Figure 14. Weightings for various hearing groups. For L_E levels, the weightings are applied to the noise level to give the weighted noise level (similar to dB(A) or dB(C)-weighted noise for humans).



5.2.1 MARINE MAMMAL WEIGHTINGS

For the marine/aquatic mammals present we will adhere to the thresholds described in “Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing” (National Marine Fisheries Service, 2018), which determines impact from an assessment of area wherein the noise will induce either

"Temporary Threshold Shift" (TTS) or "Permanent Threshold Shift" (PTS)[5] as judged by the weighted SEL level (L_{E-24}) over a typical 24-hour period or by L_P levels, for the different hearing groups.

Please note that the Southall 2019 thresholds and weightings are identical to the NMFS 2018 criteria, only the nomenclature has changed (Southall, et al., 2019; National Marine Fisheries Service, 2018).

Thresholds for behavioural disruption are set by NOAA fisheries[6]. These are 120 dB RMS[7] for continuous noise and 160 dB SPL[8] for impulsive noise.

The hearing groups from the Southall 2019 and the NMFS 2018 guidance were specified by collating available information on marine mammal hearing and generalising their hearing sensitivity into representative groups. This grouping represents a significant research effort and are reviewed by the leading experts (academic, industrial and conservation) on the topic. Because of the large amount of work this represents and the widespread acceptance of the method, the thresholds and the methodology associated, have become de-facto standards for assessing noise impact on marine mammals and represents best available knowledge and practise.

Along with weighting curves, similar in function to the human dB(C) curves, a set of thresholds for hearing impact and injury is associated with the framework and allows for conversion of threshold exceedance into ranges with risk of impact. E.g. we might see that the PW group (true seals) has a risk of PTS at ranges shorter than 50 meters, and a risk of TTS at ranges shorter than 200 meters.

All marine mammal species are covered by the hearing groups and a full list of species in the different groups can be found in the "Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects" (Southall, et al., 2019), but in general the groups cover the following species:

Table 4. Summary of Southall 2019 thresholds and groups with species examples. For full species list see source (National Marine Fisheries Service, 2018; Southall, et al., 2019)

Hearing group	Species examples	Non-impulsive TTS/PTS threshold [$L_{E-24\ hours}$]	Impulsive TTS/PTS threshold [$L_{E-24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
PW	Harbour seal, Grey seal	181/201	170/185	212/218
OW	Otters	199/219	188/203	226/232
LF	Minke whale, Humpback whale	179/199	168/183	213/219
HF	Sperm whale, Common dolphin, Bottlenose dolphin, Killer whale, Risso's dolphin, Pilot whales	178/198	170/185	224/230
VHF	Porpoise	153/173	140/155	196/202

It's important to note that the assessment is thus based on the received level of receptors with the above-described auditory sensitivity and not based on the sensitivity of the individual species.

[5] TTS/PTS. A temporary/permanent change in hearing sensitivity caused by acoustic stimuli.

[6] Available from: https://archive.fisheries.noaa.gov/wcr/protected_species/marine_mammals/threshold_guidance.html

[7] Here taken as meaning "SPL"

[8] Assumed to be SPL of 90 % of energy in one impulse or SPL of total duration (L_{EQ}).

5.3 Fishes etc.

Impacts of noise on fishes is less well established than for marine mammals, but a review from 2014 (Popper, et al., 2014) provides guidelines on exposure limits for fish and turtles. The report does not directly use the PTS nomenclature (as above for mammals) as many fish have the capacity to repair structural damage to their ear, and even structural damage then cannot be said to be "permanent".

We use "PTS" here to cover the categories "Mortality and potential mortal injury" and "Recoverable injury".

Note that we use the impulsive limits from piling for all impulsive sources as the information for explosions is rather less well documented (and limits are significantly higher).

TTS is directly used in the report, and we use it in the same way here.

As there are no TTS/PTS limits for non-impulsive noise, we apply the limits for cumulative impulsive noise.

Table 5. Overview of Impact piling thresholds from (Popper, et al., 2014) (Table 7.3). We use these for all impulsive noise, even though explosions have separate thresholds (Table 7.2 in report)).

Hearing group	Species examples	Impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
P* (Fish with no swim bladder)	Sharks, Rays	186/216	TTS not specified/213
P- (Fish with swim-bladder, but not involved in hearing)	Salmon, Trout, Cod, Herring	186/203	TTS not specified/207
P+ (swim-bladder used in hearing)	Carp, Catfish	186/203	TTS not specified/207

5.4 Threshold Interpretation

5.4.1 THRESHOLD TYPES

The three threshold types refer to different ways that sound can affect the hearing of an animal and are ***important to keep in mind*** when evaluating the results of this report:

5.4.1.1 Non-impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***continuous***[9] sound received by the animal over a typical 24-hour period as sound exposure, L_E.

When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within the zone. Alternatively this can be thought of as the total sound-dose limit over 24 hours.

Weightings are applied for non-impulsive L_E (for mammals only[10]).

5.4.1.2 Impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal over a typical 24-hour period as sound exposure, L_E.

[9] Please see (National Marine Fisheries Service, 2018) for definitions of "non-impulsive" and "impulsive". For quick reference, if a sound is shorter than 1 second and is clearly intermittent in nature, it is impulsive – otherwise, it's continuous.

[10] When assessing for fish groups levels are not weighted.

When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within this zone.
Alternatively this can be thought of as the total sound-dose limit over 24 hours.

5.4.1.2.1 Impulsive $L_{E\ single\ impulse}$ / $L_{E\ \#\ impulses}$

It is sometimes useful to assess the impact of a single/a number of impulse(s). When we do this, we will refer to it as "LE single impulse / LE # impulses".
Like for the Lp, when single-impulse LE is presented as an impact zone, this refers to the area, within which, an animal would suffer the effect acutely/instantly.

Weightings are applied for Impulsive L_E (for mammals only).

5.4.1.3 Impulsive, L_p

The threshold over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal at any instant as maximal peak pressure.
When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect acutely/instantly and from just one exposure.
Weightings are ***not*** applied for Impulsive L_P.

5.4.2 MASKING

Levels that are not over threshold can still cause significant impact, if that noise makes foraging, navigation or communication harder due to masking or where biologically relevant sounds are "drowned out" by the anthropogenic noise. Continuous noise is more likely than impulsive noise to cause this form of impact.

5.4.3 DISPERSAL

Many animals can recognise sounds and might be dispersed from an area at noise levels well below TTS limits. Quantifying a level of dispersal from desk-spaced studies is very challenging and not done here.

6 CONCLUSION & RESULTS SUMMARY

Dredging

The noise from dredging, while presenting a significant PTS risk to ranges >500 m for the VHF group, this is only for animals staying close to the activity for extended periods (> 1 hour) and assumes continuous dredging with the dredger level as given by the 90th percentile. For the best estimate (model mean) the PTS risk range is 450 m after 8 hours exposure. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away. Further the area ensonified does not "block" access through a channel or strait.

There is no issue identified for species outside the VHF range.

Vibro piling

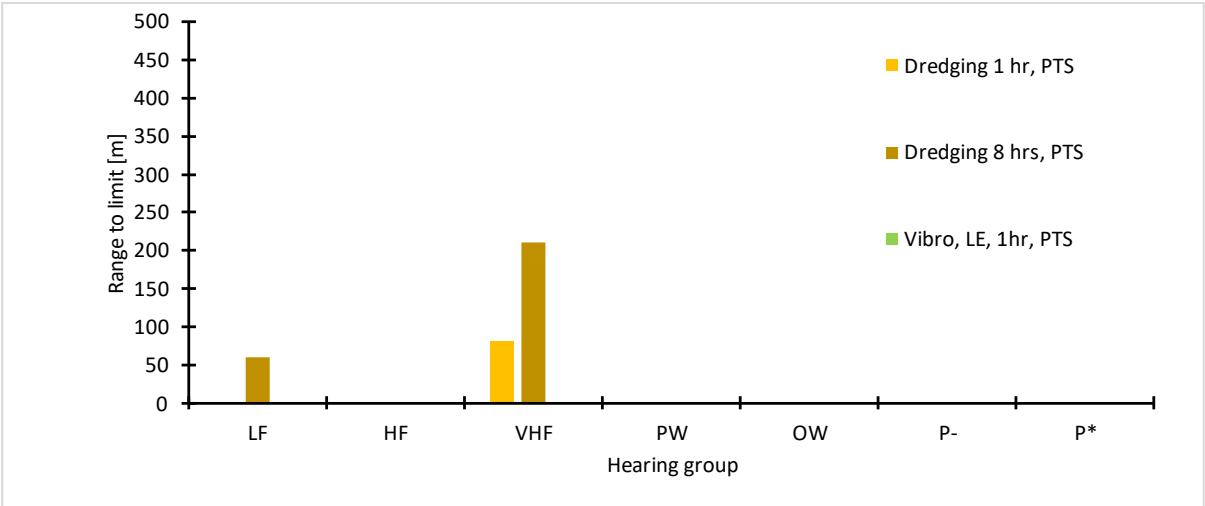
Prolonged exposure to vibro piling at close range (<100 m) carries some auditory risk for the animals assessed, specifically groups LF, VHF and P- (baleen whales, porpoises and salmon/trout), where the peak pressures in the noise have risk ranges up to 300 m for the VHF group. We therefore suggest surveillance takes place prior to piling to minimise the risk of impact on porpoises. While this is a significant risk for animals close to the activity, we stress that we have used a very conservative approach to estimating the source levels, and the realised emission will likely be significantly lower.

Further, animals will tend to move around, or away from noise, which will limit exposure. In Figure 16 and Figure 18 we show an example of the effect of using moving receivers (animats, modelled animals) to estimate what might be the effect of movement.

Table 6. Overview of maximal ranges to limits [m].

Activity	Dredging				Vibro piling			
Dose	1 hr L_E		8 hrs L_E		1 hr L_E		Peak pressure L_P	
Hearing group	TTS	PTS	TTS	PTS	TTS	PTS	TTS	PTS
LF	230	<50	1250	60	760	<50	<50	<50
HF	60	<50	160	<50	<50	<50	<50	<50
VHF	620	80	1350	210	180	<50	550	300
PW	70	<50	250	<50	100	<50	100	<50
OW	<50	<50	<50	<50	<50	<50	<50	<50
P-	120	<50	600	<50	390	<50	<50	125
P*	120	<50	600	<50	390	<50	<50	<50

Figure 15. Overview of PTS risk ranges



7 RESULTS

The noise maps for each activity and hearing group are presented in APPENDIX E – Results.

7.1 Dredging

While exposure to 8 hours of dredging has significant PTS risk ranges (< 210 m) for 2 hearing groups: LF (baleen whales) and VHF (porpoises), but only after prolonged exposure (> 1 hour). The relatively low (compared to limits) source level of the dredging means that there is not acute risk from noise and animals have time to swim away.

Using a model approach to have moving receivers (animats, see Figure 18, p. 24) we can estimate the impact on moving animals. The animats in the model move 0.5-4 m/s depending on the received level and evade levels >120 dB.

Figure 16. Summary of total exposure (L_E) of 225 animats of the VHF group in the soundfield of the dredging. 44 exceeded TTS limit (20 %), none exceeded the PTS limit.

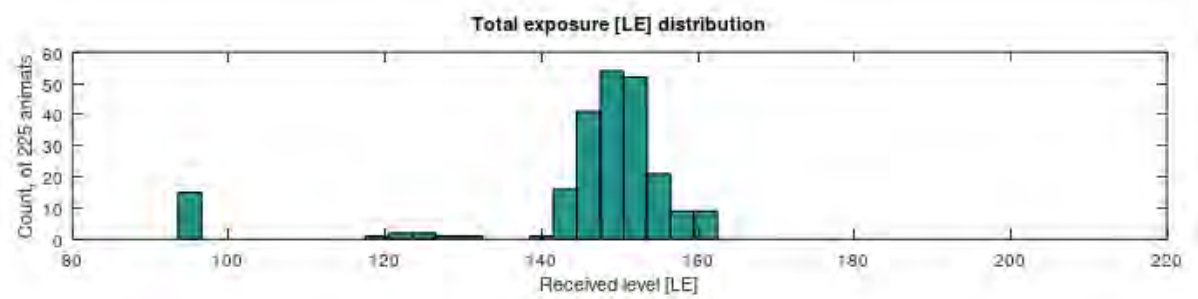


Figure 17. TTS and PTS risk ranges for all groups.

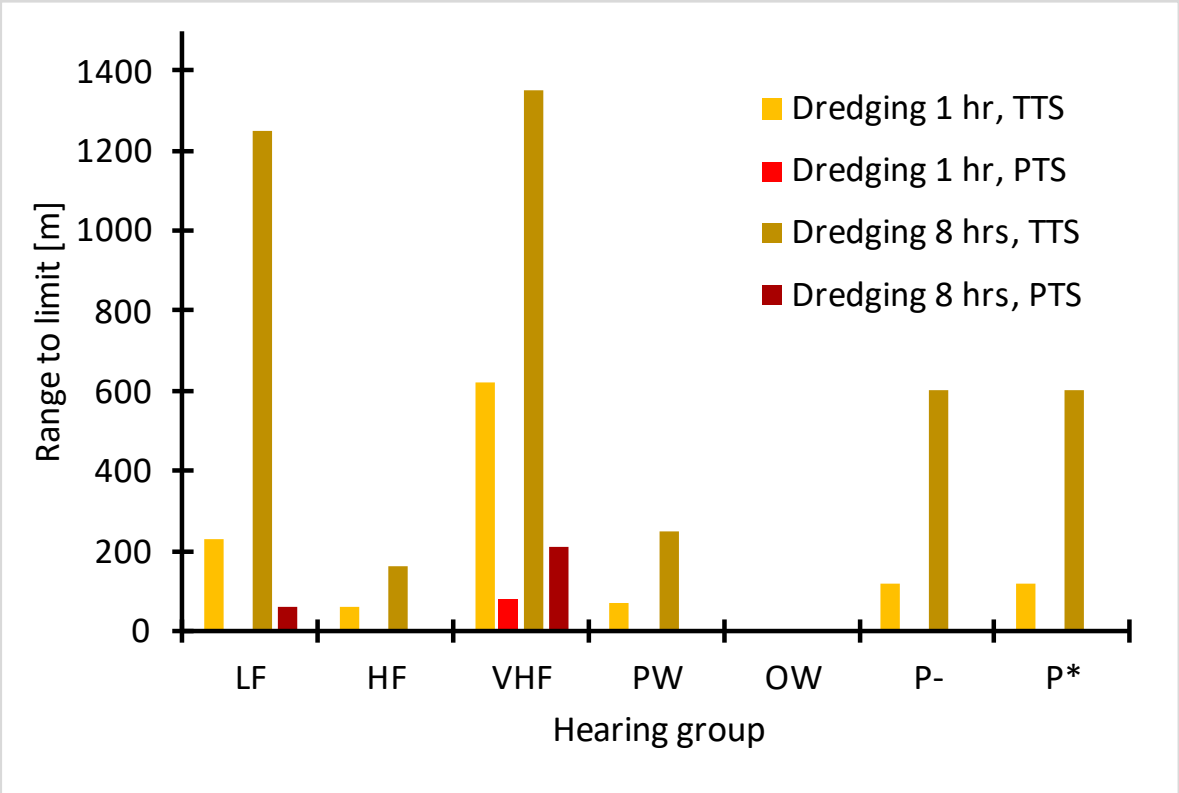
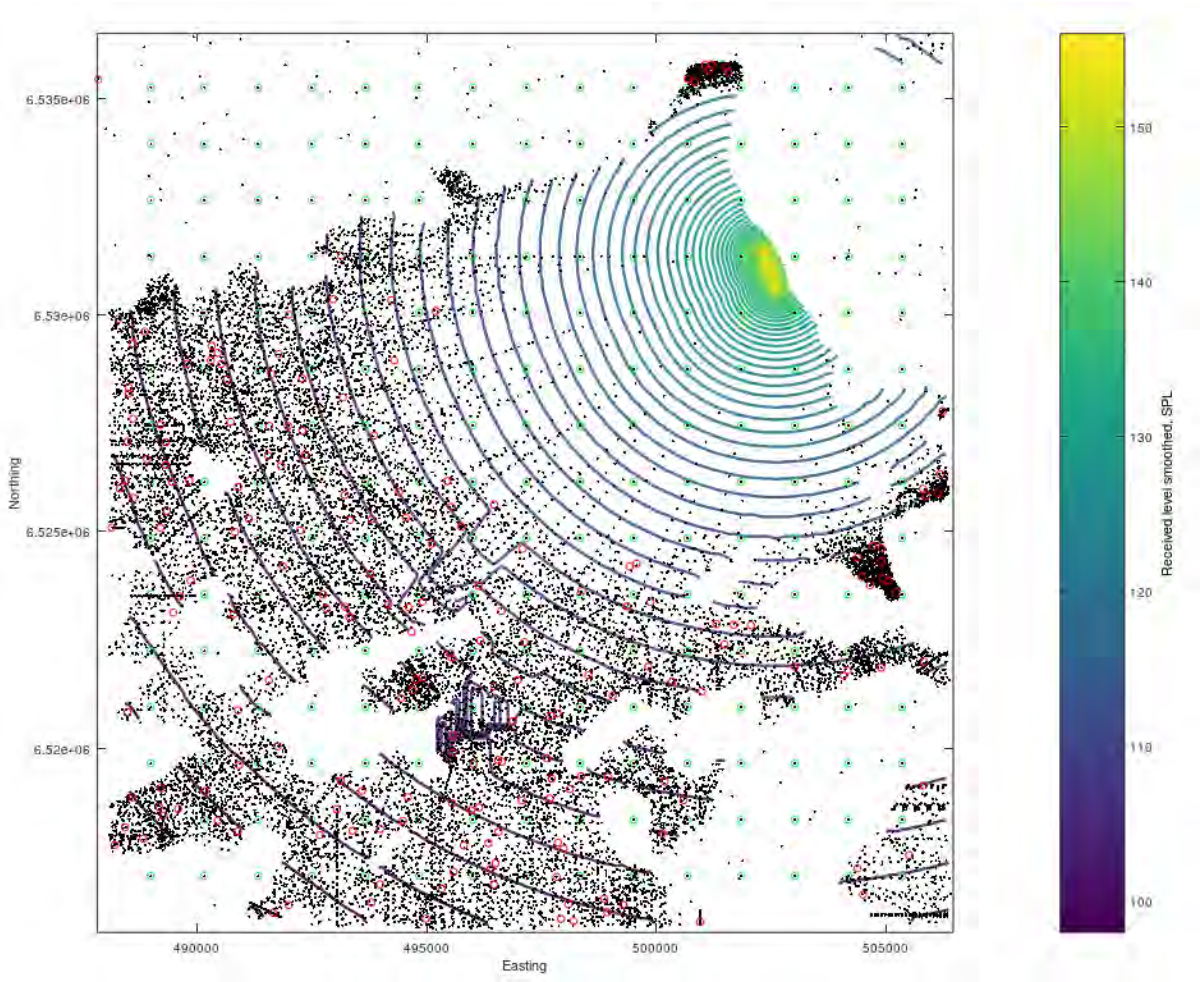


Figure 18. 225 “animats” in the dredger soundfield for 8 hours. Green spots are starting points, and red spots end points. Area covers Scapa Flow.a



7.2 Vibro piling

Longer exposures (> 1 hour) lead to significant PTS risk zones within 50 for all groups, but the proposed duration of vibro piling on this site is less than 1-hour per day.

The peak pressures in the vibro piling have a PTS risk zone max range of 50m. While the risk for the LF and P- groups is only for prolonged exposure, the risk to the VHF group is acute, i.e. the animal has no chance to swim away to avoid the risk.

Figure 19. TTS and PTS risk ranges for all groups.

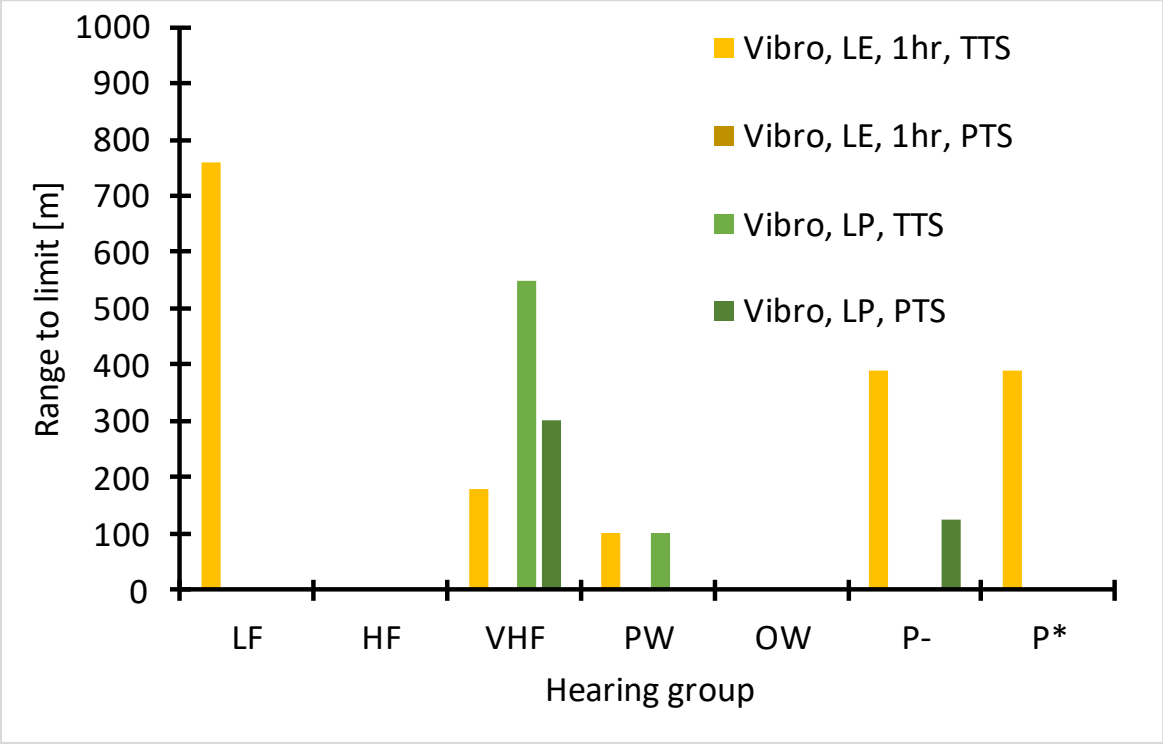
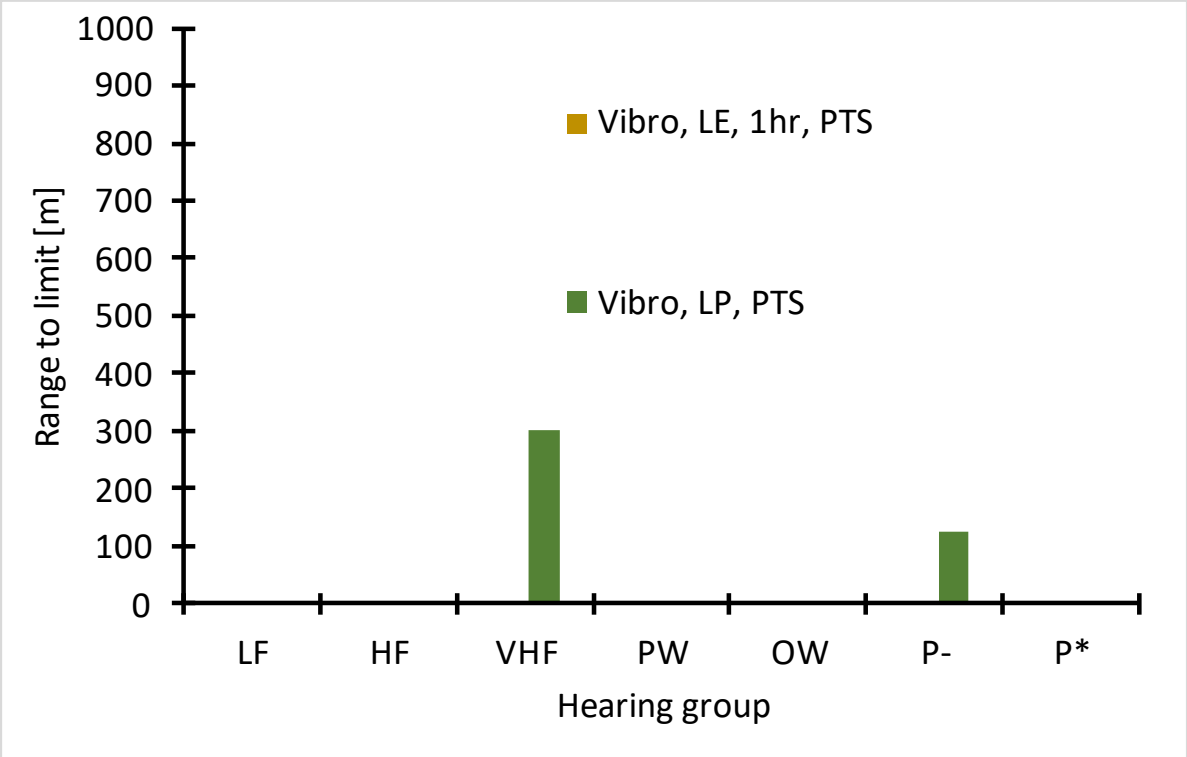


Figure 20. PTS risk ranges for all hearing groups.



8 BIBLIOGRAPHY

Ainslie, M. A. (2010). *Principles of Sonar Performance Modelling.* Heidelberg: Springer. doi:10.1007/978-3-540-87662-5

Audoly, V. M. (2020). Accounting for sea floor properties in the assessment of underwater noise radiated from ships in shallow water. *Proceedings of Meetings on Acoustics* .

Boyce, R. E. (1981). *LABORATORY-DETERMINED SOUND VELOCITY, POROSITY, WET-BULK DENSITY, ACOUSTIC IMPEDANCE, ACOUSTIC ANISOTROPY, AND REFLECTION COEFFICIENTS FOR CRETACEOUS-JURASSIC TURBIDITE SEQUENCES AT DEEP SEA DRILLING PROJECT SITES 370 AND 416 OFF THE COAST OF MOROCCO.* La Jolla: Scripps institution of Oceanography.

British Geological Survey. (2022, June 30). *Geology of Britain Viewer*. Retrieved from British Geological Survey: https://mapapps2.bgs.ac.uk/geoindex/home.html

CalTrans. (2015). *Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish, CALTRANS.* Sacramento: California Department of Transportation.

European Marine Observation and Data Network. (2019, May 01). *Bathymetry portal*. Retrieved from EMODnet: http://portal.emodnet-bathymetry.eu/

Jensen, F. B., Kuperman, W. A., Porter, M. B., & Schmidt, H. (2011). *Computational Ocean Acoustics, Second Edition.* Springer. doi:10.1007/978-1-4419-8678-8

Leroy, C. C., Robinson, S. P., & Goldsmith, M. J. (2008). A new equation for the accurate calculation of sound speed in all oceans. *The Journal of the Acoustical Society of America*, 2774-2782.

Marine Scotland. (2022, 12 12). *Salinity*. Retrieved from Marine Scotland: https://marine.gov.scot/sma/assessment/salinity

National Marine Fisheries Service. (2018). *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0).* Silver Spring: U.S. Department of Commerce.

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J., . . . Travolga, W. (2014). Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. *Springer Briefs in Oceanography, S3*.

Southall, B. L., Finneran, J. J., Reichmuth, C., E.Nachtigall, P., Ketten, D. R., Bowles, A. E., . . . Tyack, P. L. (2019). Marine Mammal Noise Exposure Criteria:Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals*, 125-232. doi:10.1578/AM.45.2.2019.125

APPENDIX A - DBSEA

A summary of dBSea's models in standard scenarios can be found in the document (online):
http://www.dbsea.co.uk/media/30782/dBSea-Benchmark-Testing.pdf
(also see Figure 23, p. 29 for one example).

All solvers in dBSea are based on Jensen et al. 2011 (Jensen, Kuperman, Porter, & Schmidt, 2011)

dBSea has four primary models of calculation:

- **Range dependent Parabolic Equation model - dBSeaPE**
  dBSeaPE uses a split-step, wide angle parabolic equation method. It uses either Greene's approximation or several Padé terms (as set by user) to get very wide propagation with low phase error.

  dBSeaPE is best suited to deeper scenarios (>50 m) or where sediment interaction is not dominant relative to sound speed profile. The model is very efficient for low frequencies and only suffers a small efficiency penalty for higher frequencies.

  dBSeaPE will generally be used for deeper/long range scenarios in the frequency interval 10-1000 Hz.
- **Range dependent Normal Modes model - dBSeaModes**
  dBSeaModes is especially suited to shallower and sediment dependent scenarios and will typically be used where water is shallower than 50 m and depth changes are a large proportion of the total depth, or where sediment effects are thought to play a significant role. dBSeaModes incurs a significant efficiency-penalty at high frequencies and will normally be used in the frequency range 10-1000 Hz.
- **Ray tracing**
  dBSea uses a Gaussian raytracing method, dBSeaRay, to calculate transmission losses for higher frequencies (scenario dependent, but normally from 500 Hz). dBSeaRay compares favourably with the opensource BELLHOP model, in that it is accurate to lower frequencies and agrees well with PE and NM models.
- **Full waveform propagation**
  dBSeaRay also supports full waveform propagation in the frequency range 10 Hz to 168 kHz (limited by the waveform sample rate). Used in this way dBSeaRay takes into account all scenario range dependence (as models above) as well as the arrival time, phase information and transmission loss of all significant paths to any number of receivers in the scenario (the results grid).

General notes:

- dBSea is an "Nx2D" solver, meaning it models transmission losses in "N" number of vertical radial slices from the source (Figure 22, p. 28). There is no backwards propagation towards the source, and no sideways reflection/refraction (We're testing dBSea with full 3D solvers currently).

- dBSea models the sediment propagation only for compressional waves, not for shear waves. This generally means that the transmission loss will be slightly underestimated as no energy is transferred into shear waves, and also means that dBSeaRay does not propagate into the sediment, but relies on a complex reflection coefficient (calculated from the sediment layers) to calculate the reflection/refraction properties of the sediment. Given that dBSeaRay is generally only used for higher frequencies, this has very little practical effect, as higher frequencies will only interact weakly with deeper layers of the sediment.

- The individual sources in a scenario are modelled radially (radial coordinates) from the source at several depths. In post-processing levels are transferred to a cartesian "results grid". This results grid stores levels from all sources so that the cumulative level at any point in the scenario can be investigated immediately.

- Levels can be, and are often post-processed to apply a conservative margin and smooth results (Figure 21, p. 28). Radial smoothing (triangular kernel of variable width) is carried out to mitigate modelling artefacts arising from low environment sampling density or chance occurrences. Levels are often made to decrease monotonically from the source to make general trends more visible and decrease the risk of misinterpreting impact ranges.

- When refereeing to a level at a certain range, this usually refers to the greatest level at any depth at that range (unless specifically mentioned otherwise).

Figure 21. Post-processing to eliminate artefacts and ease interpretation. Level are radially smoothed by default, and are made to be monotonically decreasing with increasing range from the source.

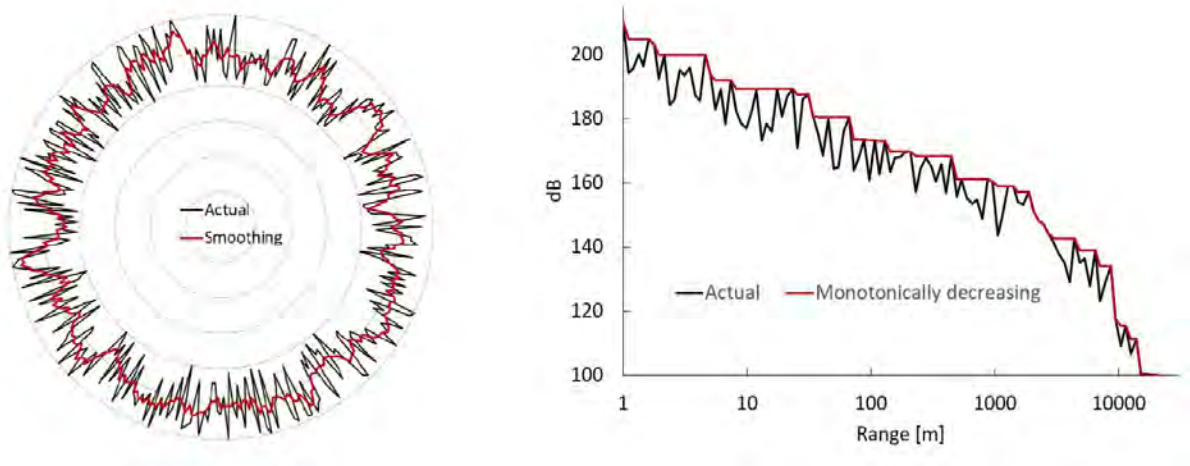


Figure 22. Low resolution schematic of the dBSea modelling space. Source transmission loss is modelled radially from the sources at a number of depths. Results are extracted from a "square" 3D grid that hold cumulative levels from all sources in the scenario.

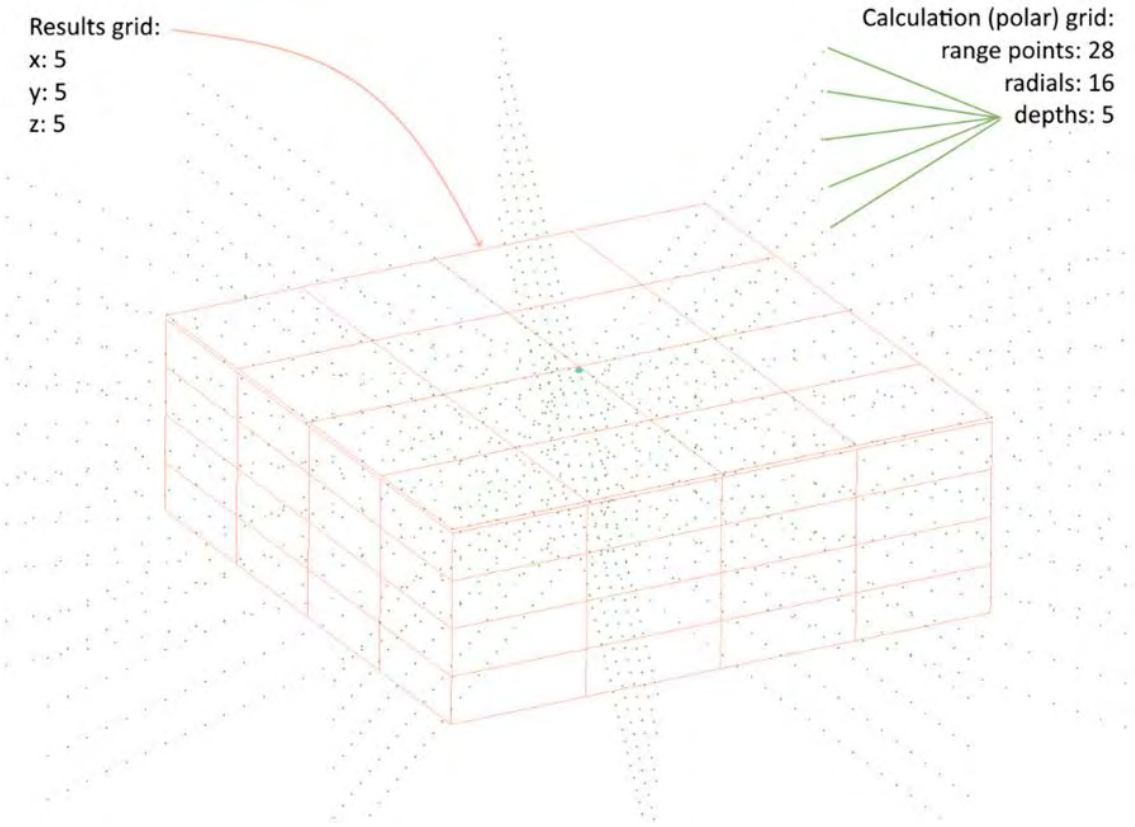
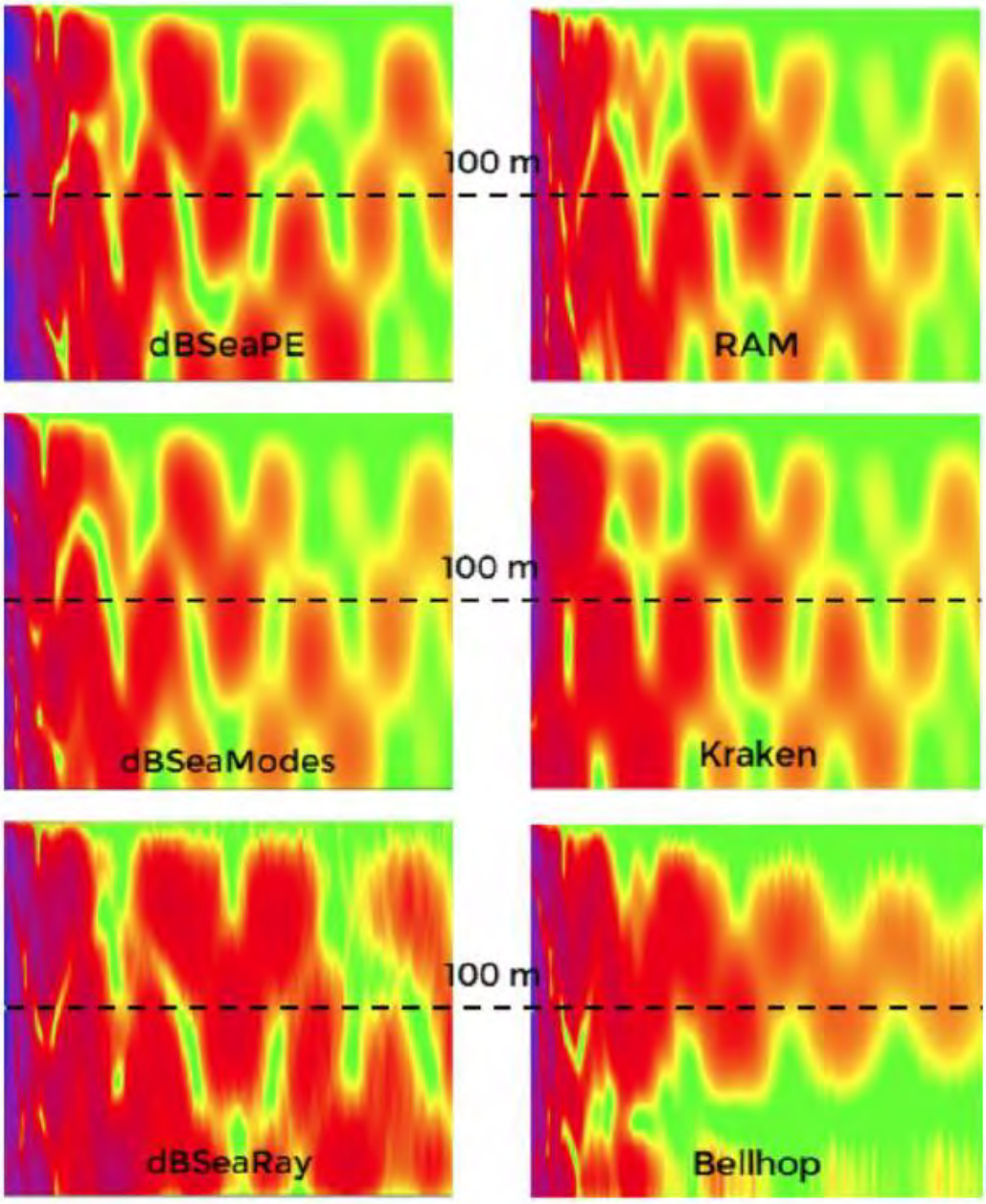


Figure 23. the "Pekeris" standard problem, a low frequency problem. Note that due to sediment effects, neither dBSeaRay nor Bellhop should be relied upon for low frequency problems, and are only include for completeness.



APPENDIX B – UNDERWATER ACOUSTICS BASICS

Sound Speed

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[11] much as 340 m/s is in air. Soundspeed is given by the following equation:

$$c = \frac{Z}{\rho}$$

$$Soundspeed\ [m/s] = \frac{Acoustic\ impedance\ \left[\frac{kg}{m^2 \cdot s}\right]}{Specific\ density\ [kg/m^3]}$$

Because changes to pressure, salinity and temperature occur with changes in depth, the specific density and acoustic impedance of water changes with depth, and thus the soundspeed changes as well.

The soundspeed profile is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. This change is quantified in "Snell's Law" and results in sound being "bent" towards the depth of minimal soundspeed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

Spreading loss

Most of the propagation loss (loss in dB from source to receiver, "PL") that occurs initially is governed by "spreading loss". It is the simple "thinning out" of acoustic energy as it spreads away from the source, usually in all directions – spherically.

For a sound source in an unbound medium the initial PL will be dominated by spherical PL:

$$Received\ level = Source\ level_{at\ reference\ range} - 20 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction in received level of 6 dB per doubling of distance and explains the rapid reduction in received levels often seen close to the source, e.g.: with a reference range of 1 m, at 16 meters range, there has been 4 doublings of distance, and thus 24 dB loss (4×6 dB).

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Also, at greater ranges a doubling of distance is no longer trivial as the PL from spherical spreading loss from 500 m to 1000 m is also just 6 dB.

Sound Channels and Wave guides

In bounded mediums where the sound energy is confined to cylindrical spreading, the PL (ignoring absorption) is often well-characterised by:

$$Received\ level = Source\ level_{at\ reference\ range} - 10 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction of received level of 3 dB per doubling of distance. Depending on the sediment this kind of "waveguide" can sustain efficient transmission of sound over long ranges, provided the sediment is acoustically hard and there is low absorption (such as is the case for low frequencies or in low salinity).

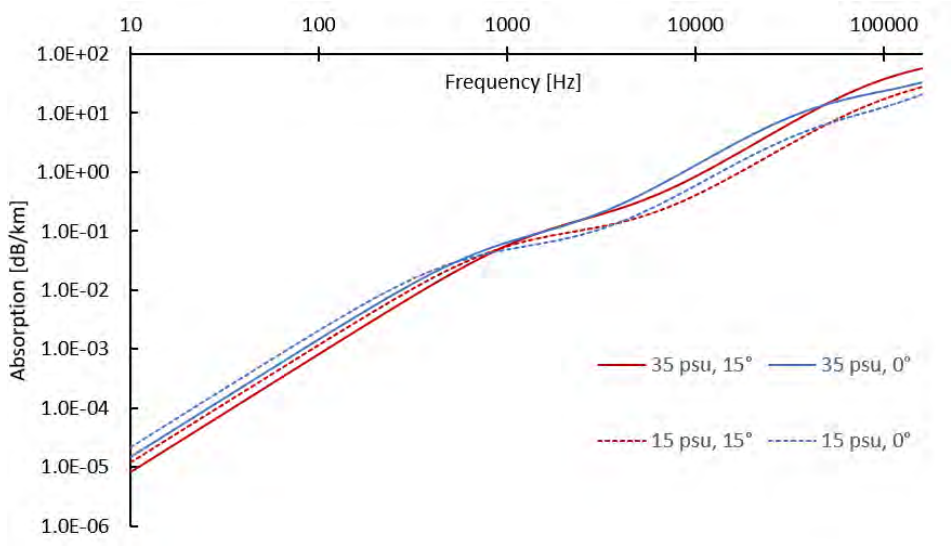
In absence of a bounding from the surface or the seabed, a soundspeed profile with a clear low-speed region, surrounded by higher soundspeeds can act a sound channel, by focusing the sound towards a single depth (with lower soundspeed), limiting the PL from spherical to cylindrical (a SOFAR channel is formed).

[11] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

Absorption

Besides the "thinning out" of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is mostly governed by the concentration of boric acid and magnesium sulphate and is very dependent on the frequency, with lower frequencies, <1 kHz, experiencing almost no absorption, while high frequencies, > 10 kHz, can be attenuated by over 10 dB / km.

Figure 24. Absorption comparison at salinities of 35 psu & 15 psu and temperatures of 0° and 15°. Both scales are logarithmic. Note how increased salinity increases high-frequency absorption (solid v dashed lines), while a decrease in temperature increases absorption at lower frequencies (red v blue lines).



Small bubbles, wind or wave induced, will further attenuate especially the high frequencies, but as modelling is often done to estimate a worst-reasonable case, or for weather sensitive activities, fair weather with little wind and waves are assumed, thus ignoring this attenuation effect.

Sediment

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies. This effect coupled with the high absorption at high frequencies often leads to the soundscape being dominated by frequencies from a few hundred hertz to a few thousand hertz. In deeper water, or with an upward refracting soundspeed profile, low frequencies will tend to dominate the soundscape away from sound sources, as there is no efficient mechanism for attenuating them.

A "cut-off[12]" frequency, below which, there will be high sediment-associated attenuation can be approximated by:

$$f_{cut-off} = \frac{c_{water}}{4 \cdot D \cdot \sqrt{1 - \left(\frac{c_{water}}{c_{sediment}}\right)^2}}$$

With "C_{water}" and "$C_{sediment}$" being the soundspeed in the water and the sediment respectively, and "D" the local depth (Jensen, Kuperman, Porter, & Schmidt, 2011).

[12] The cut-off is not an immediate loss of energy in frequencies under this frequency, but rather something like a high pass, 1st-order, Butterworth filter (Audoly, 2020).

In water with lower salinity and less absorption, the soundscape will tend to have a relatively higher content of high frequencies as these are absorbed much less efficiently when the salinity is lower.

Sound transmission Across Interfaces

Sound waves are reflected and refracted (Snell's law) as they travel through interfaces. Also, depending on acoustic impedance and interface angles only a proportion of the incident acoustic energy is transmitted through that interface (the rest is reflected).

In the following: W: Watt; Pa: Pascal; s: second; m: metre; N: Newton; J: Joule; θ: angle; v: soundspeed; Z: acoustic impedance; p: pressure from ambient;

Snell's law:

$$\frac{\sin\theta_{in}}{\sin\theta_{out}} = \frac{v_{in}}{v_{out}}$$

- rearranged to give transmission angle from incidence angle and soundspeeds:

$$\sin^{-1}\left(\frac{\sin\theta_{in}}{\frac{v_{in}}{v_{out}}}\right) = \theta_{out}$$

Transmission fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{2\cdot Z_{out}\cdot\cos\theta_{in}}{Z_{out}\cdot\cos\theta_{in} + Z_{in}\cdot\cos\theta_{out}}$$

Reflection fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{Z_{out}\cdot\cos\theta_{in} - Z_{in}\cdot\cos\theta_{out}}{Z_{out}\cdot\cos\theta_{in} + Z_{in}\cdot\cos\theta_{out}}$$

It follows from these relations that for transmission from an acoustically relatively slow medium like water to an acoustically faster medium here exists an incident angle above which there is total reflection, and thus no transmission of acoustic energy through the interface (real interfaces are rugged and lumpy, and perfect reflection is not realistic).

For the water/sediment interface presented here (sediment is sand with a soundspeed of 2000 m/s) this occurs at 0.84 radians (~48.5 degrees) from normal incidence.

The fraction of pressure transmission from water (soundspeed 1500 m/s) to sediment (2000 m/s) is around 146 % at normal incidence and drops as the incidence angle increases away from normal, much faster for water-to-sediment than for sediment-to-water.

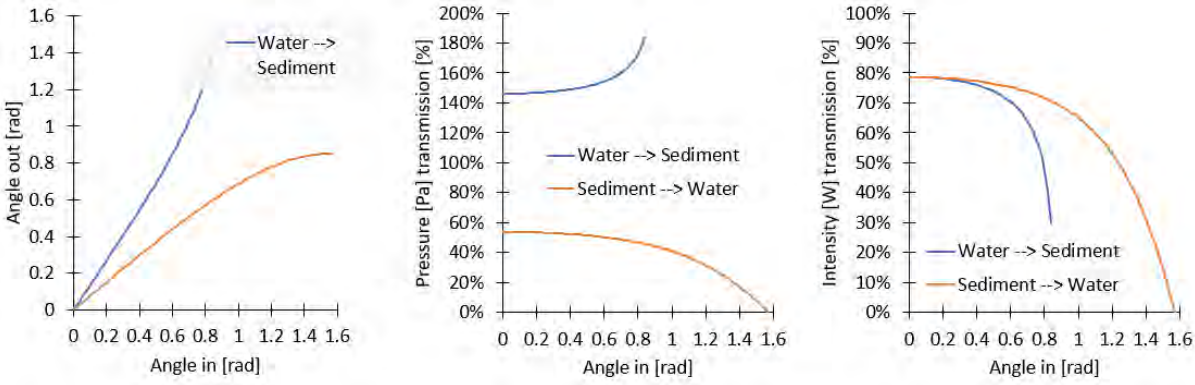
While it may seem counter-intuitive that pressure can increase after transmission over an interface, remember that the energy in the sound is a function of pressure *and* acoustic impedance:

$$I = \frac{p^2}{Z}$$

$$With\ units: [W] = \frac{[Pa]^2}{\left[\frac{Pa\cdot s}{m^3}\right]} = \frac{\frac{N^2}{m^4}}{\frac{N}{m^2}\cdot s} = \frac{N^2\cdot m^3}{m^4\cdot\frac{N}{m^2}\cdot s} = \frac{N}{m\cdot m^{-2}\cdot s} = \frac{J\cdot m}{m^{-1}\cdot s} = \frac{J}{s} = W$$

Thus, if the transmitted intensity fraction is 80 % then the reflected intensity is 20 %; there is energy conservation.

Figure 25. Transmission angles [radians] and fractions as function of incident angle between water and sediment (sand). Note that total reflection from water to sediment occurs around incident angle of 0.84 [rad] (48.5 degrees), meaning there is no transmission of sound at greater incidence angles.



Simplified Propagation Loss Model

Taking all the above into account we can construct a simplified model, that will give a good indication of the expected propagation loss (PL) in scenarios of constant depth:

$$PL = \begin{Bmatrix} r < D \ : & -20 \cdot \log_{10}\left(\frac{r}{r_0}\right) \\ r > D \ : & -20 \cdot \log_{10}\left(\frac{D}{r_0}\right) - 10 \cdot \log_{10}\left(\frac{D}{r_0}\right) \end{Bmatrix} - \alpha(f) \cdot r - l(f) \cdot r$$

Where:

- "r" is horizontal range from source.
- "D" depth at source.
- "r_0" the reference range of the source (often 1 m).
- "f" the frequency,
- "l" the frequency specific leakage loss to the sediment.
- "α" the frequency specific absorption.

Sound Level Units

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 7: Definitions.

Unit	Definition	Comments
SPL (dB_{RMS}) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p ($dB_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}{}^2}$
$L_{p\text{-}p}$ ($dB_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[13] equivalent to $L_P + 6.02\ dB$
L_E (dB_{SEL}) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-}"time"}$ or $L_{E\text{-}single\ blow}$.

If the averaging period for SPL is equal to the total even duration, then SPL is equal to "Leq" the "equivalent constant level".

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

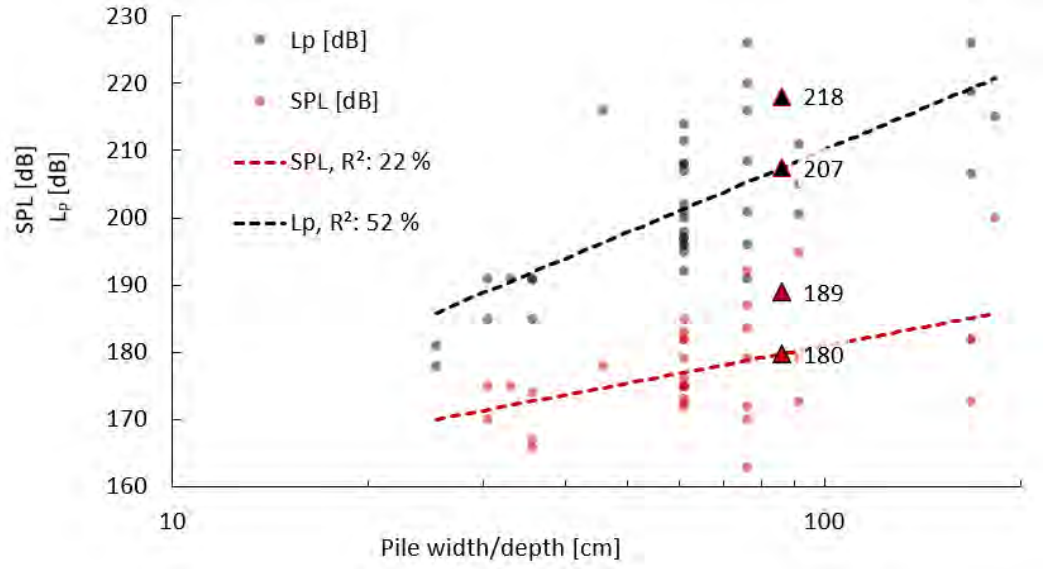
[13] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

APPENDIX C – SOURCE MODELS

Vibration piling model

We only have a few recordings (50) from vibration piling and have no dedicated source model for this type of piling. Instead, we rely on published recorded levels as from CalTrans (CalTrans, 2015).

Figure 26. Basis of vibro piling broad band source level as a function of pile size.



Given the low confidence we have in this approach (low R^2 values) we use the 90th percentile level as the broadband source level. L_P is estimated to be 218 dB and SPL 189 dB. The frequency content is assumed to be identical to that of the impact piling.

Table 8. Sources decidecade band levels.

Band centre frequency [Hz]	Dredging, Mean (broadband: 182) [SPL]	Dredging, 90th percentile (broadband: 192) [SPL]	Drilling, Mean (broadband: 138) [SPL]	Drilling, 90th percentile (broadband: 156) [SPL]	Vibro, Mean (broadband: 187) [SPL]	Vibro, 90th percentile (broadband: 196) [SPL]
12.5	162	165	127	142	166	176
16	163	166	126	139	167	176
20	164	167	124	139	167	176
25	165	170	123	138	167	176
31.5	168	177	125	139	168	177
40	169	180	124	140	169	179
50	169	178	124	139	172	181
63	170	178	126	143	174	183
80	169	180	123	142	176	185
100	168	179	124	142	177	186
125	168	178	123	140	178	187
160	168	178	123	142	177	186
200	168	177	125	146	177	186
250	169	178	126	147	177	186
315	169	178	125	147	175	184
400	169	177	123	144	174	183
500	168	178	124	145	173	182
630	167	175	122	143	171	180

800	167	174	124	141	169	178
1000	166	174	125	142	167	176
1250	165	174	123	142	165	175
1600	165	174	121	138	164	173
2000	164	174	120	135	162	171
2500	163	175	119	134	160	169
3150	163	175	118	132	159	168
4000	162	175	118	132	158	167
5000	162	175	119	133	156	165
6300	161	175	118	130	155	164
8000	160	175	117	130	154	163
10000	159	174	117	129	152	161
12500	158	173	110	120	150	159
16000	157	173	109	118	150	159
20000	156	172	109	119	149	158
25000	156	171			148	157
31500	155	171			147	156
40000	154	170			146	155
50000	157	174			145	154
63000	156	173			144	153
80000	156	173			143	152
100000	157	172			142	151
125000	157	166			141	150
160000	157	166			140	149

APPENDIX D – MODEL CALIBRATION

Recorded Transmission losses

Scapa

Broadband transmission losses for exposure levels (L_E) show good consistency between measurements and a transmission loss consistent with -14.7 × Log_{10}(range), suggesting a sediment with some ability to reflect sound back into the water column and form a waveguide.

Transmission loss for peak pressure levels (L_P) were near spherical spreading loss which is consistent with a poorly reflecting bottom resulting in little overlap in arrival times for the source impulse.

There was a clear pattern in the transmission losses versus frequency, with higher frequencies experiencing much higher losses, likely due to interaction with a rough sediment resulting in a lot of scattering.

*Note that for the bands 50 – 1250 Hz the ambient noise at Scapa was above the source level, while we have tried to compensate for this, those values are still subject to considerable uncertainty (*Figure 28*).*

Figure 27. Broadband transmission losses at Scapa. L_P losses follow a near spherical loss pattern while L_E shows a tendency to follow a waveguide with some absorption losses. Thick lines are best fit of logarithmic loss, while thin lines are for loss accounting for the depth at the source. Error bars are expected 95 % of measurements.

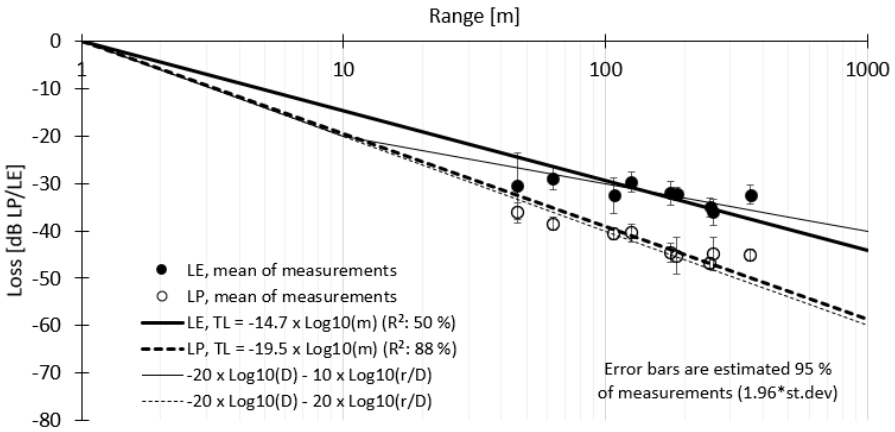
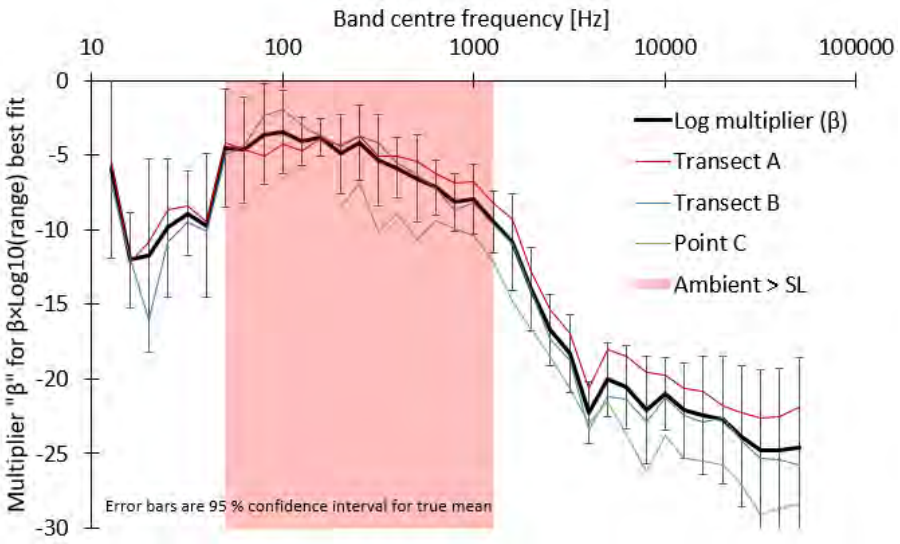


Figure 28. Transmission losses per band shown as the best fit multiplier "β" for a simple logarithmic transmission loss. Error bars are 95 % confidence interval for the true mean. While Transects A & B have some difference, this was not significant at a 10 % level in a t-test. Bands 50 – 1250 Hz have been corrected for contributing ambient noise as ambient noise was near or above recorded levels (red band).



APPENDIX E – RESULTS

Maps are presented with impact for different hearing groups as summarised here

Note that some maps have areas marked as “model artefacts”, these are areas where the levels are assumed to not be realistic, but rather an example of a digitisation problem with the bathymetry.

Group	Description	Example species
LF	Low frequency, baleen whales	Mike whale, Fin whale, Blue whale
HF	High frequency, most dolphins	Common dolphin, Risso’s dolphin, beaked whales, Bottlenose dolphin, Sperm whale, Killer whale
VHF	Very high frequency, few dolphins and porpoises	Harbour porpoise, Hourglass dolphin
PW	Phocid water, True seals	Harbour seal, Grey seal
OW	Otariid + other water, Fur seals, walruses and aquatic mammals	Walrus, Otter, Polar bear
P-	Fish with swim bladder, not coupled to inner ear	Salmon, Trout, Cod, Herring
P*	Fish with no swim bladder	Sharks and rays

Dredging L_E

Maps are provided for 90th percentile source levels for 1 hours and 8 hours.

Figure 29. Dredging, L_E, 1hr, LF group

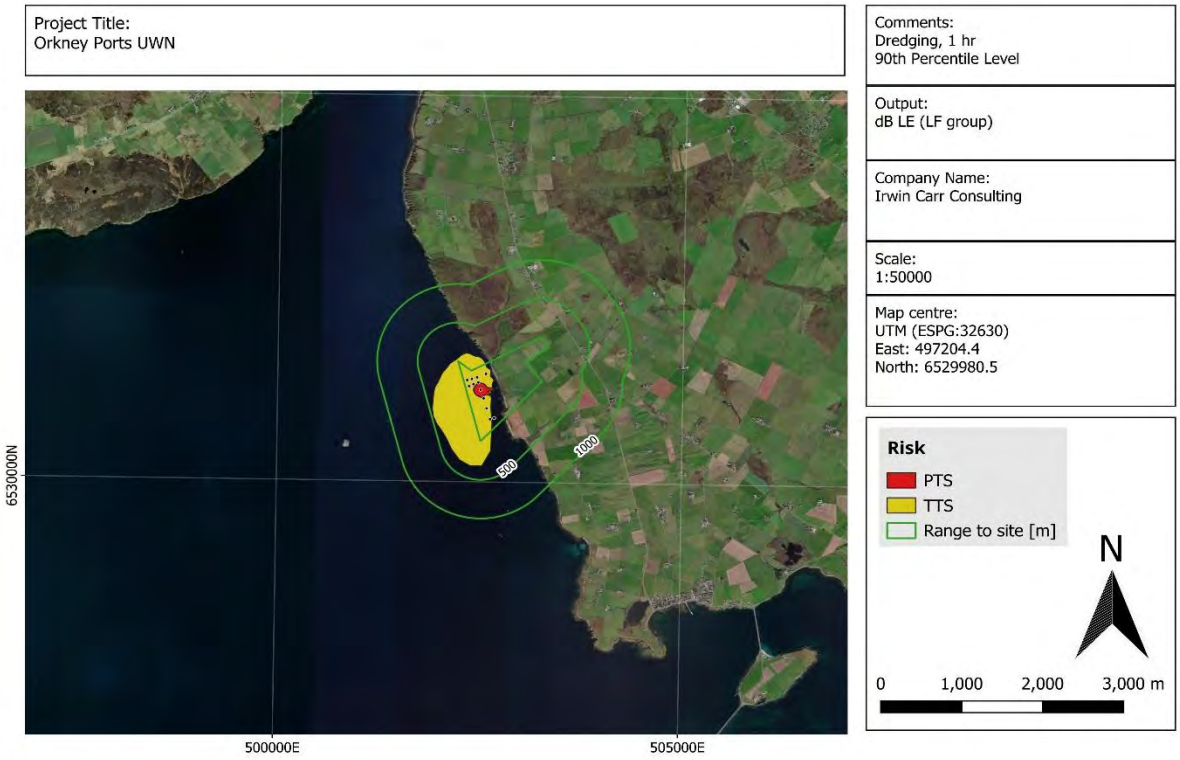


Figure 30. Dredging, L_E, 8hr, LF group

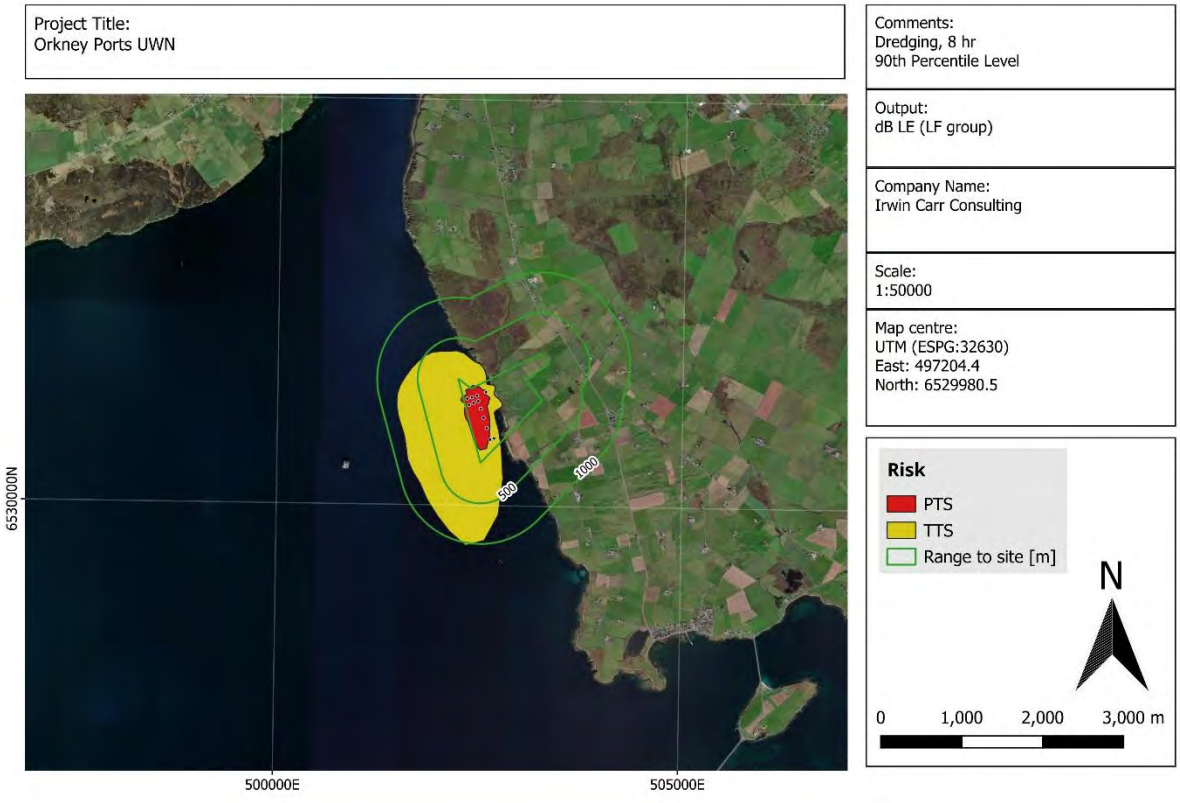


Figure 31. Dredging, L_E, 1hr, HF group

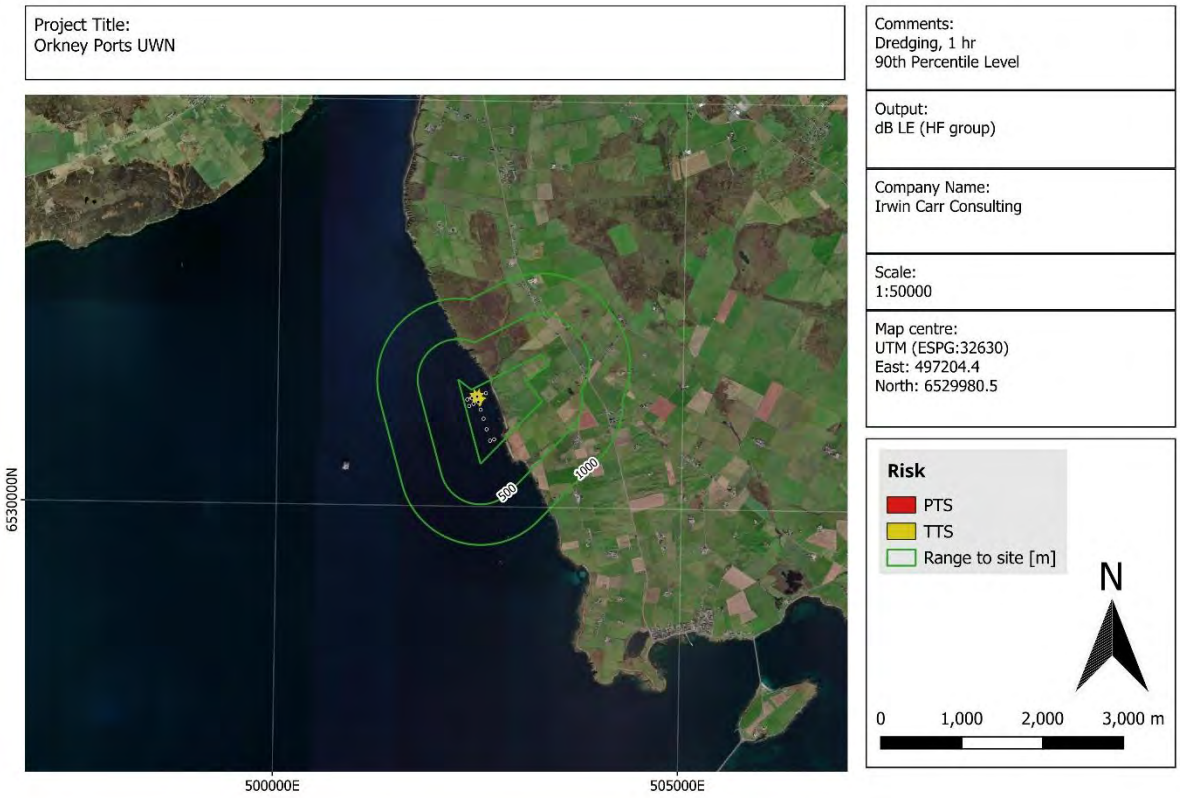


Figure 32. Dredging, L_E, 8hrs, HF group

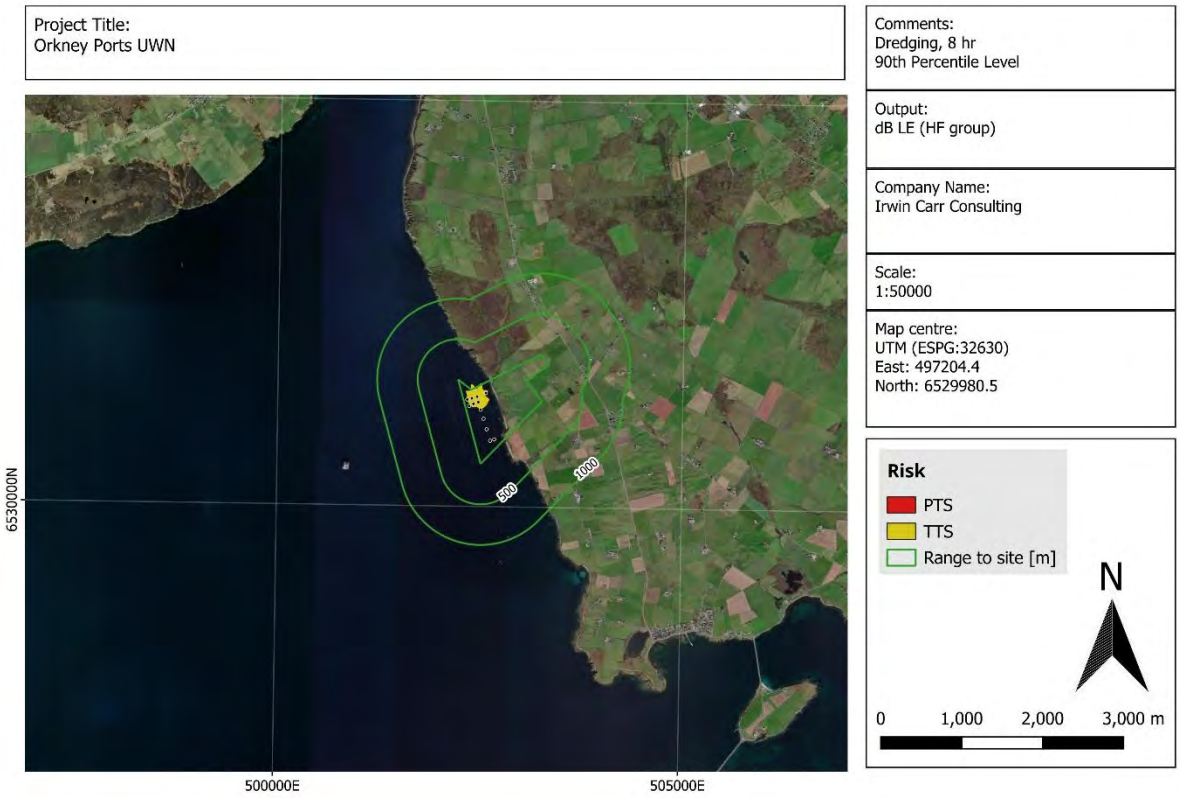


Figure 33. Dredging, L_E, 1hr, VHF group

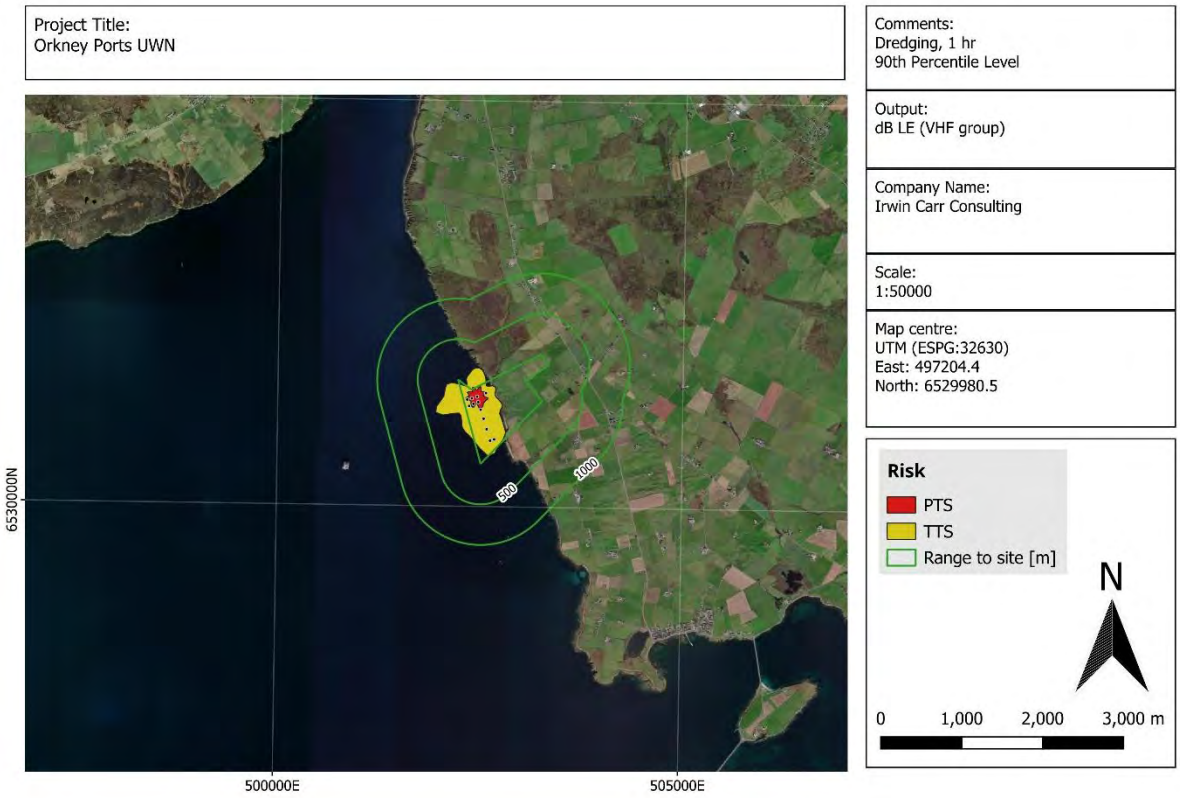


Figure 34. Dredging, L_E, 8hrs, VHF group

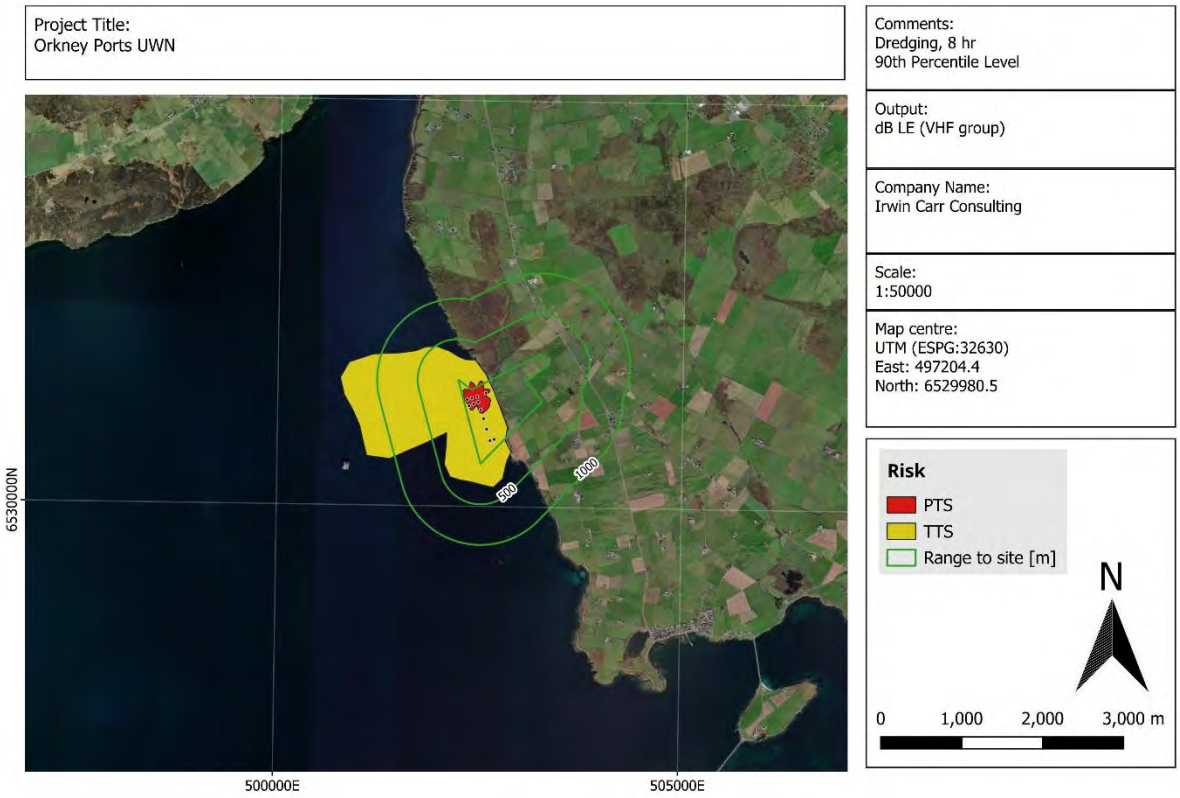


Figure 35. Dredging, L_E, 1hr, PW group

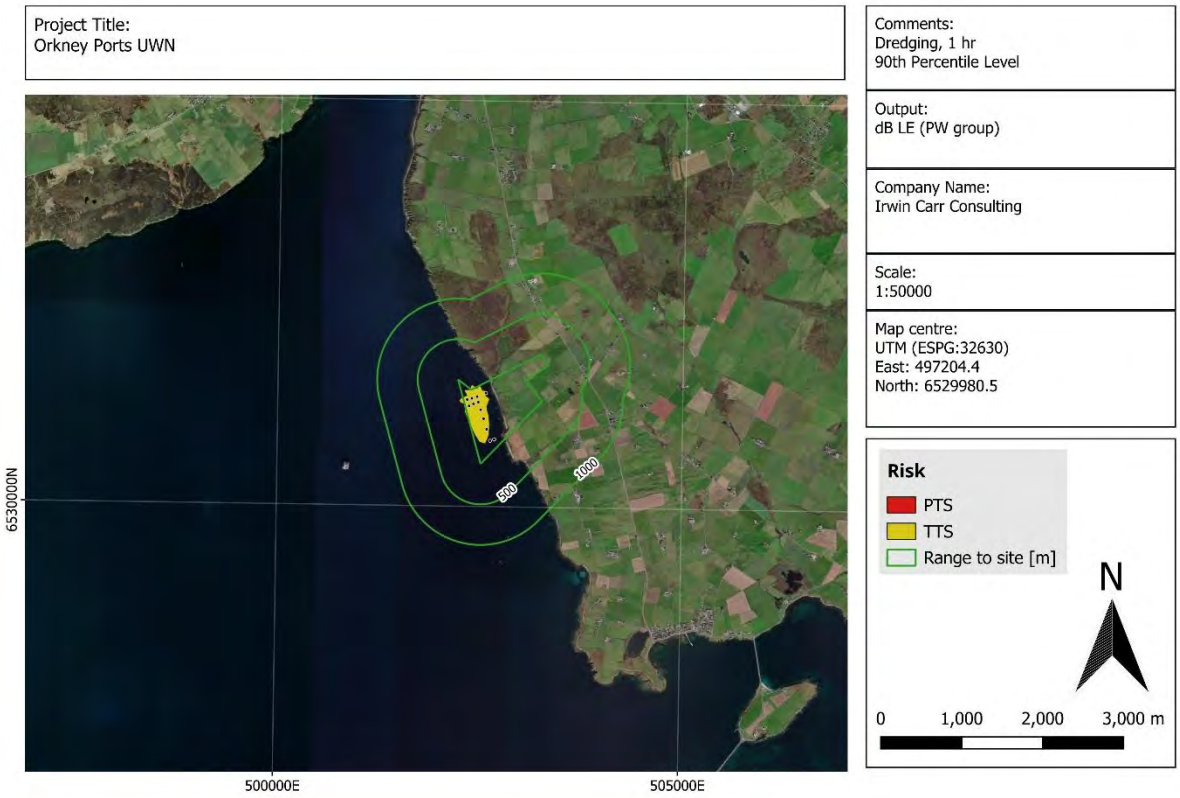


Figure 36. Dredging, L_E, 8hrs, PW group

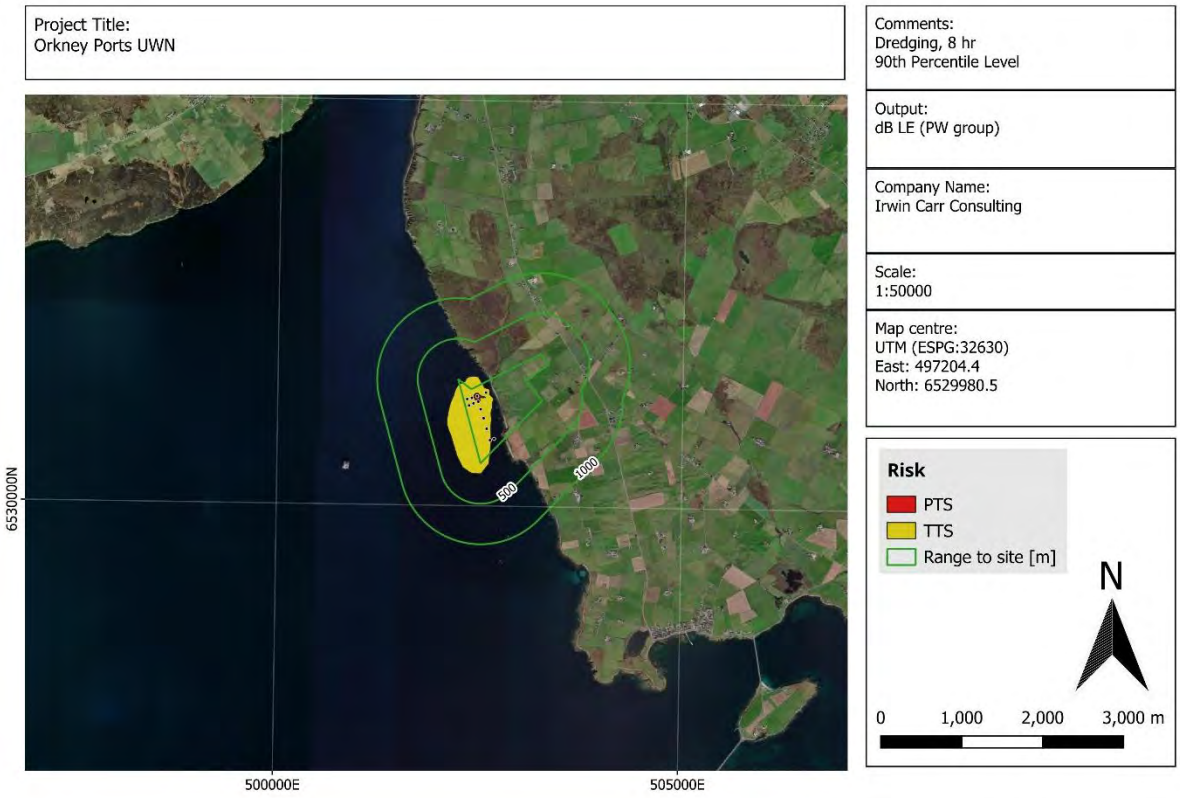


Figure 37. Dredging, L_E, 1hr, OW group

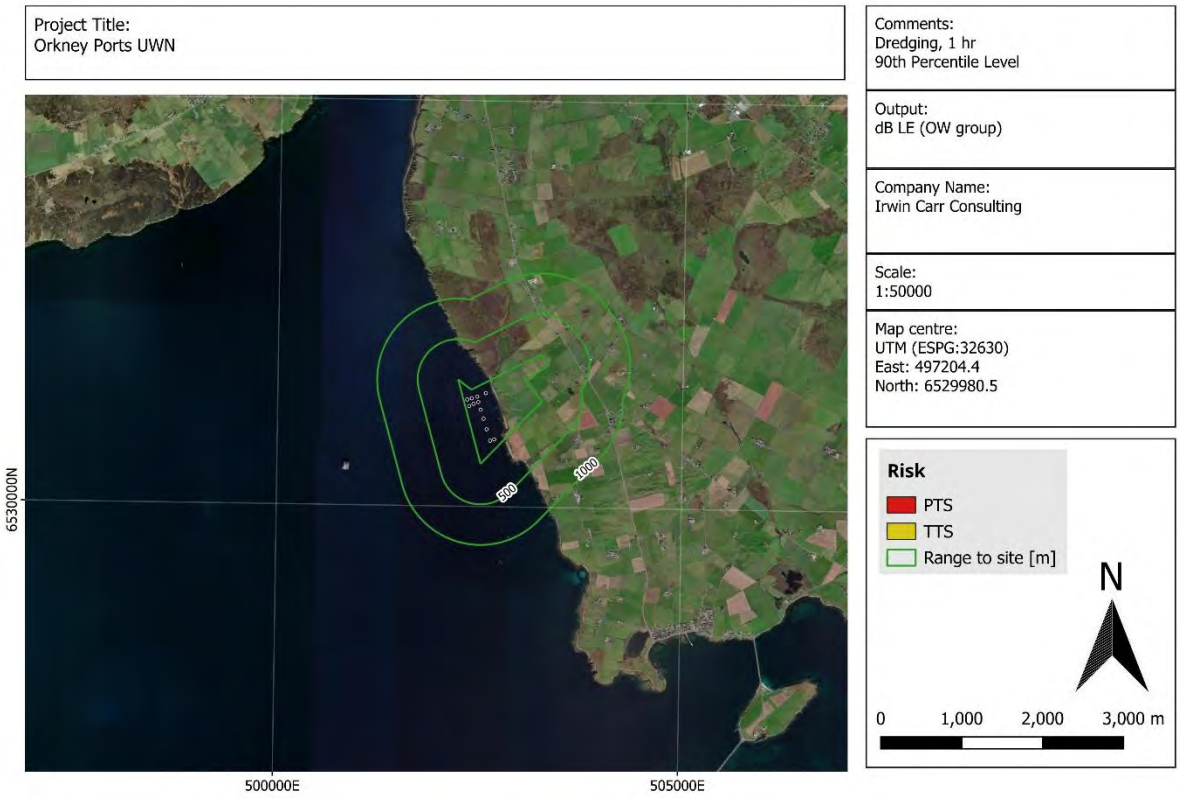


Figure 38. Dredging, L_E, 8hrs, OW group

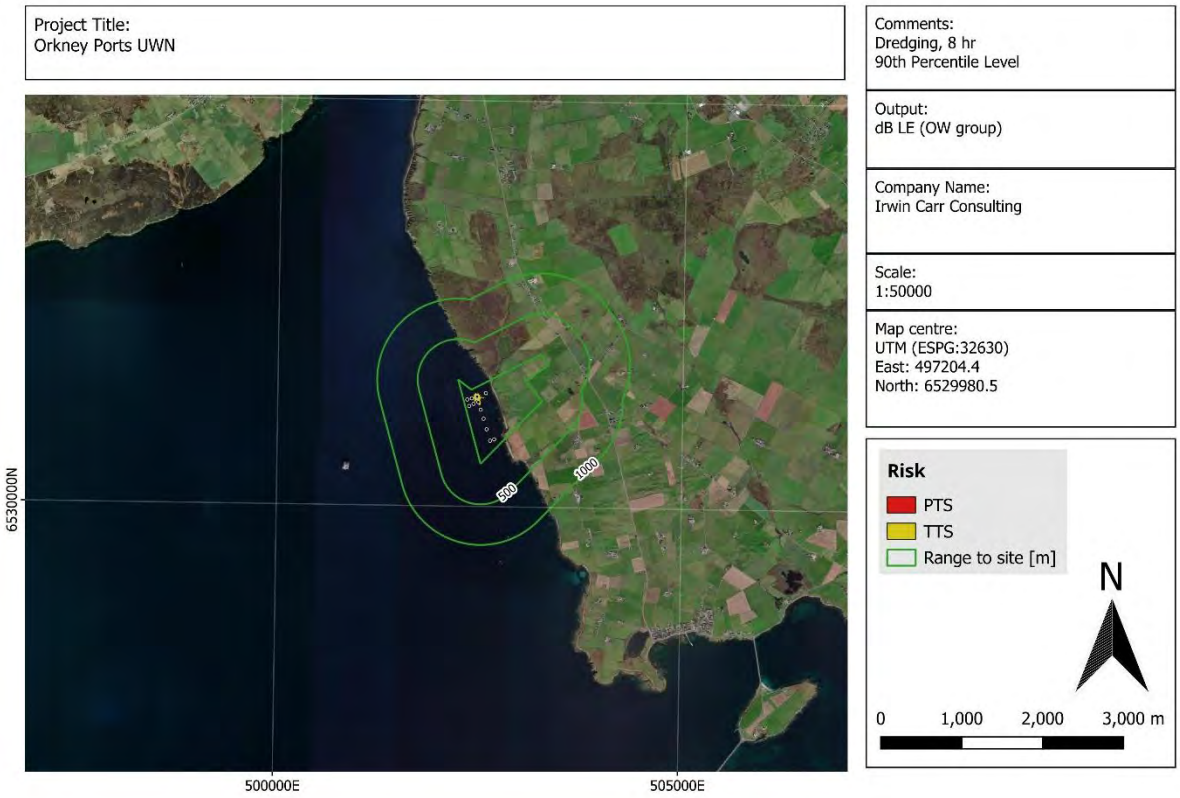


Figure 39. Dredging, L_E, 1hr, P- group

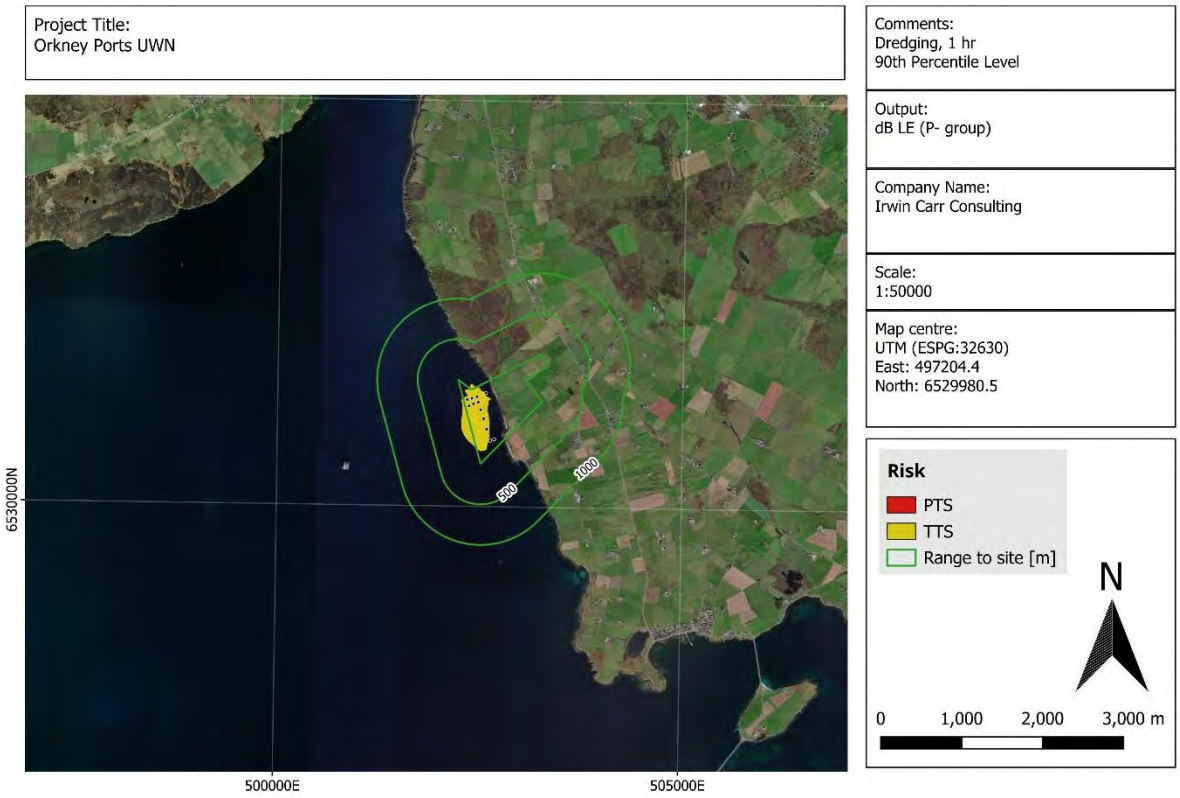


Figure 40. Dredging, L_E, 8hrs, P- group

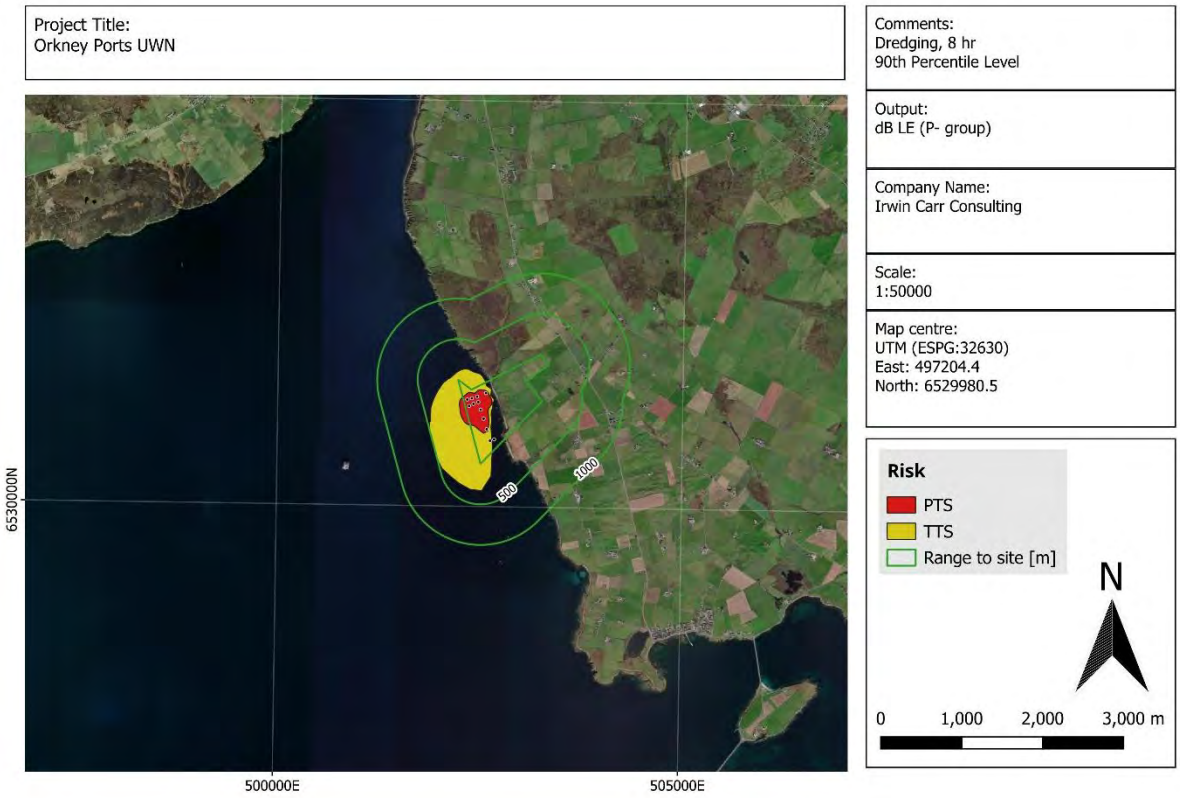


Figure 41. Dredging, L_E, 1hr, P* group

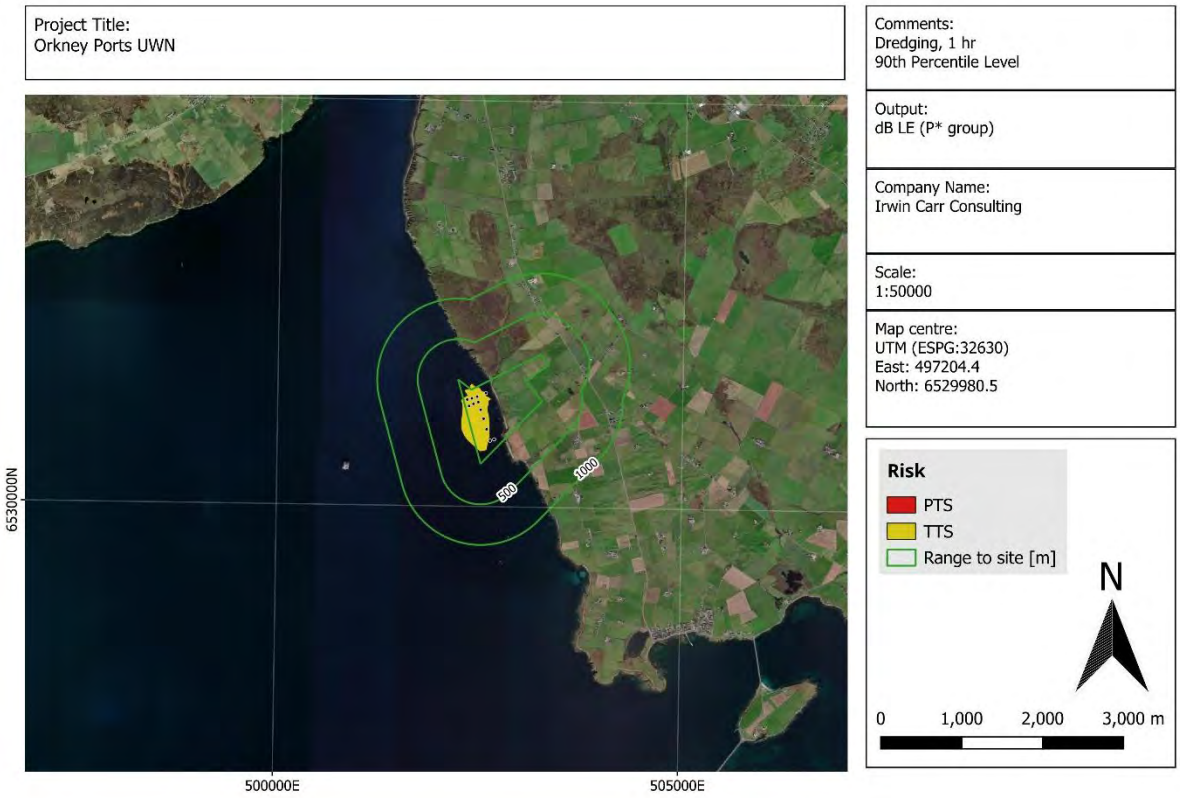
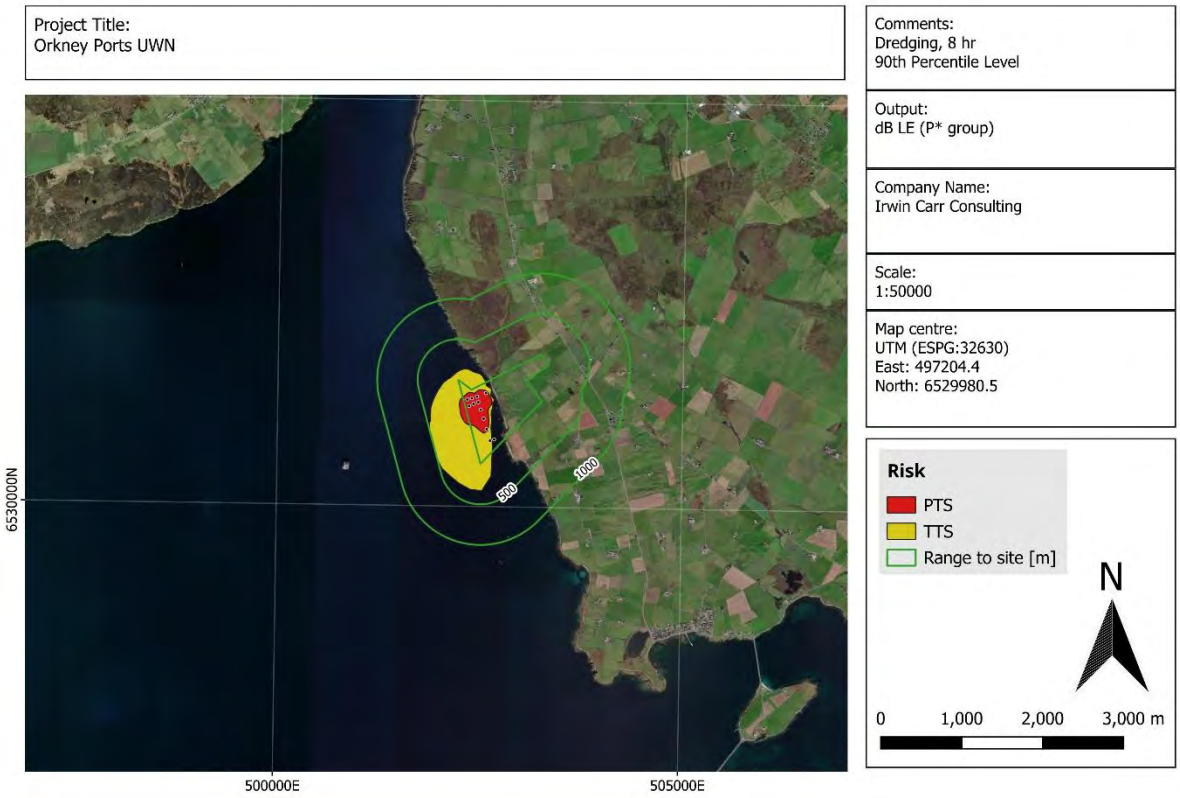


Figure 42. Dredging, L_E, 8hrs, P* group



Vibro Piling L_E

Figure 43. Vibro piling, L_E, 1 hour, LF group

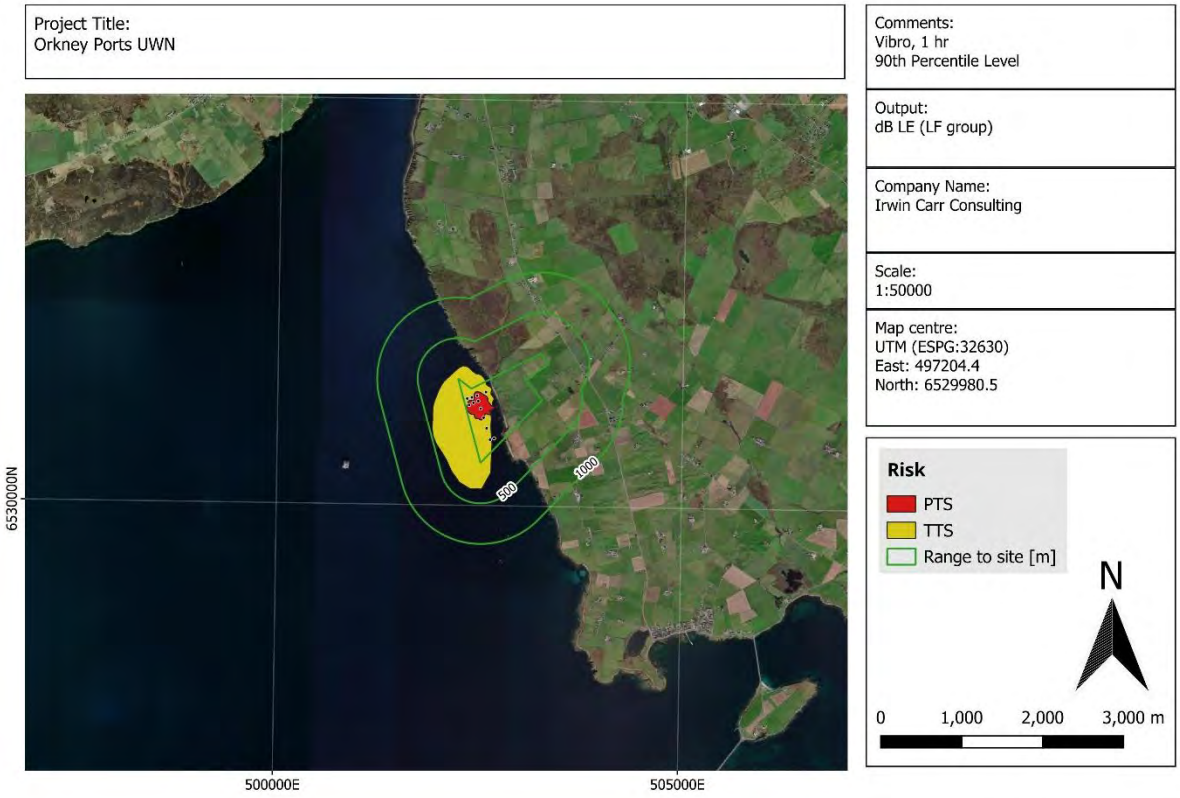


Figure 44. Vibro piling, L_E, 1 hour, HF group

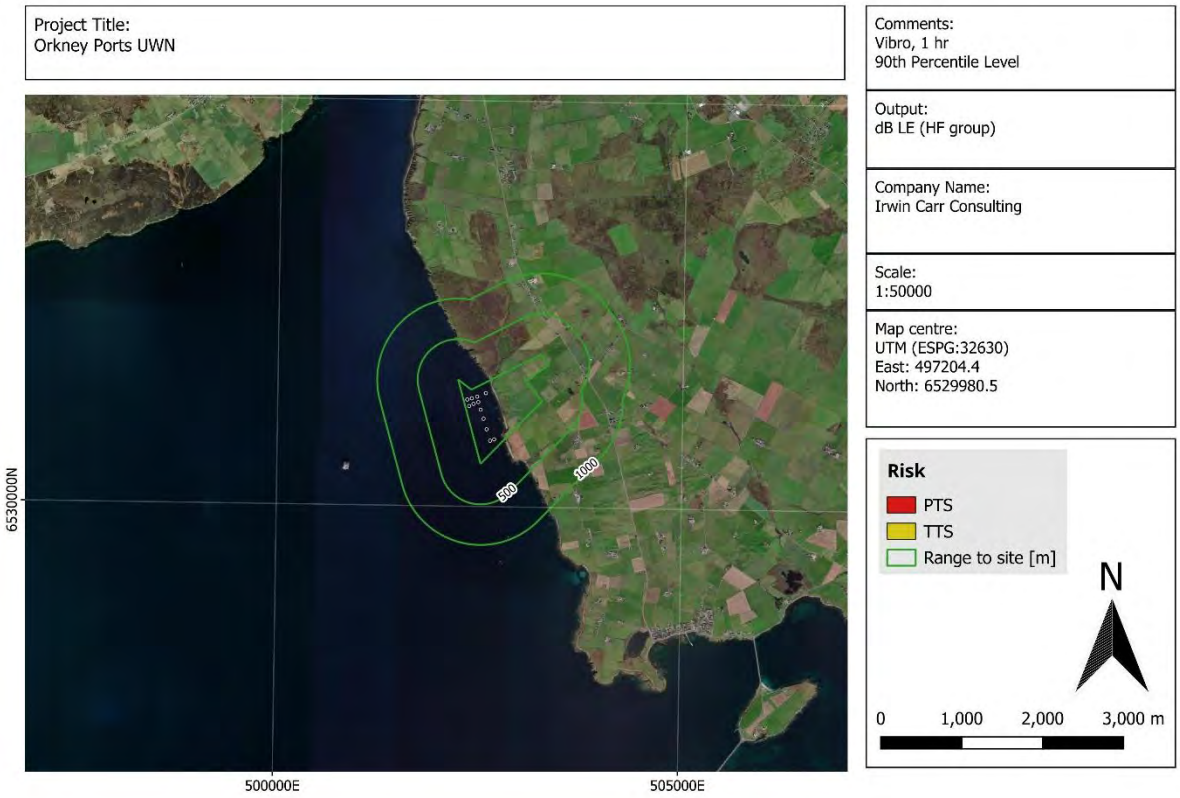


Figure 45. Vibro piling, L_E, 1 hour, VHF group

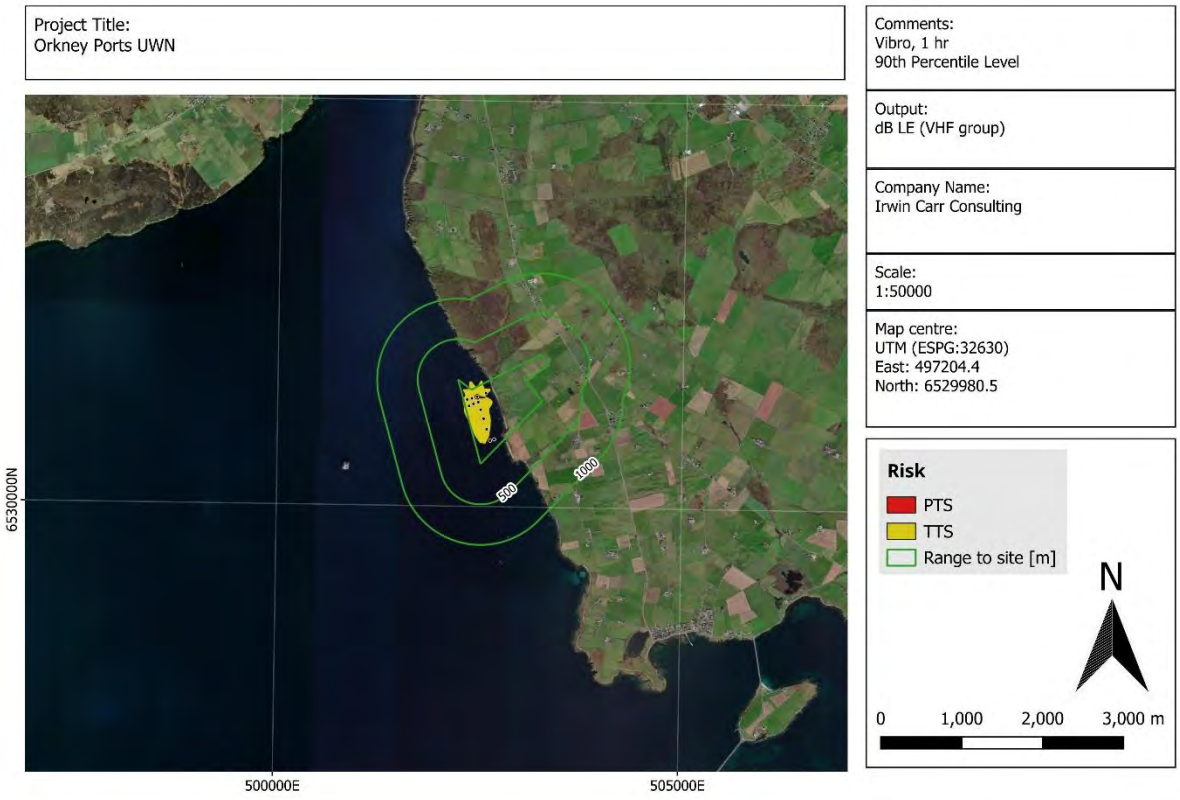


Figure 46. Vibro piling, L_E, 1 hour, PW group

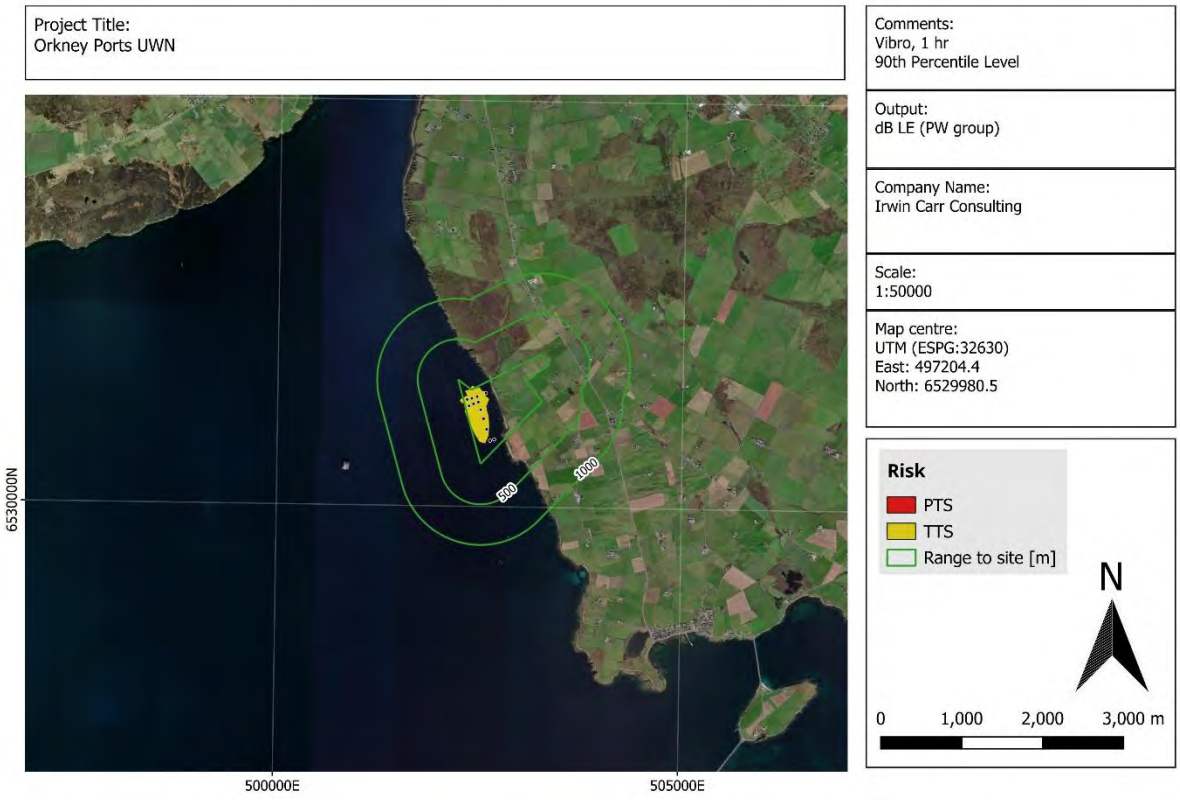


Figure 47. Vibro piling, L_E, 1 hour, OW group

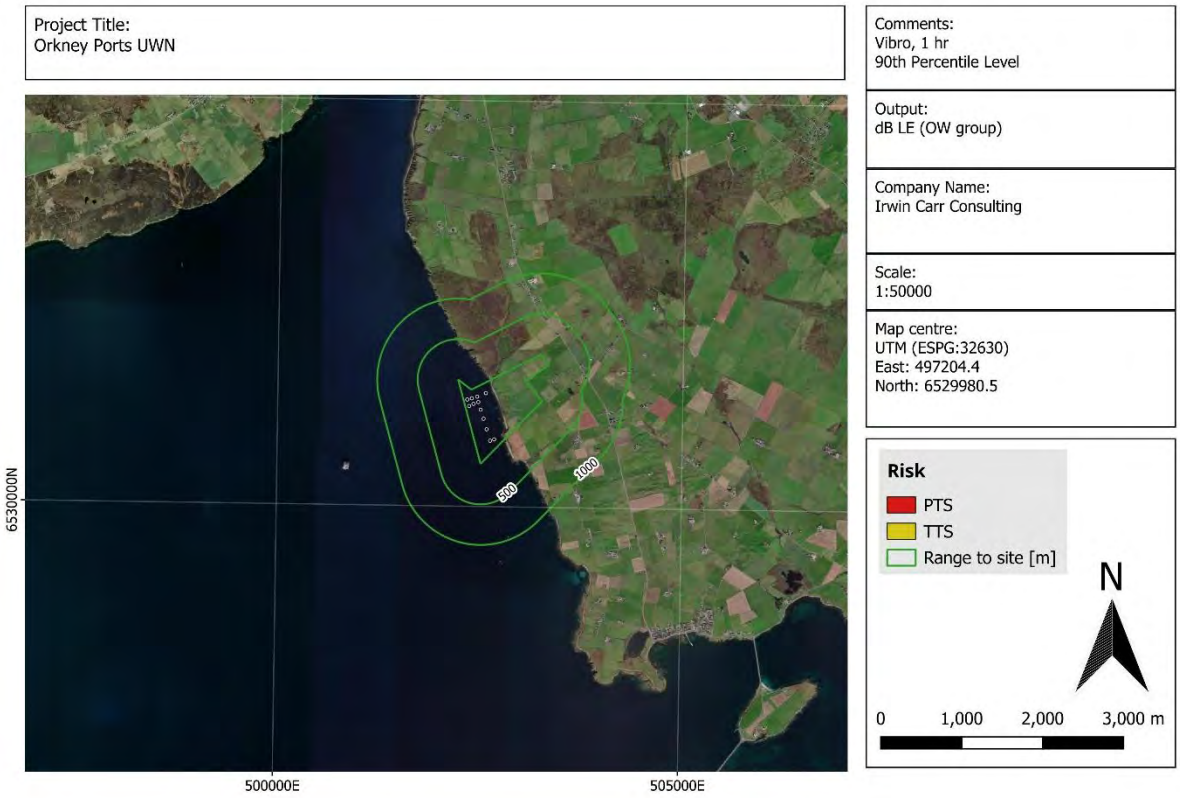


Figure 48. Vibro piling, L_E, 1 hour, P- group

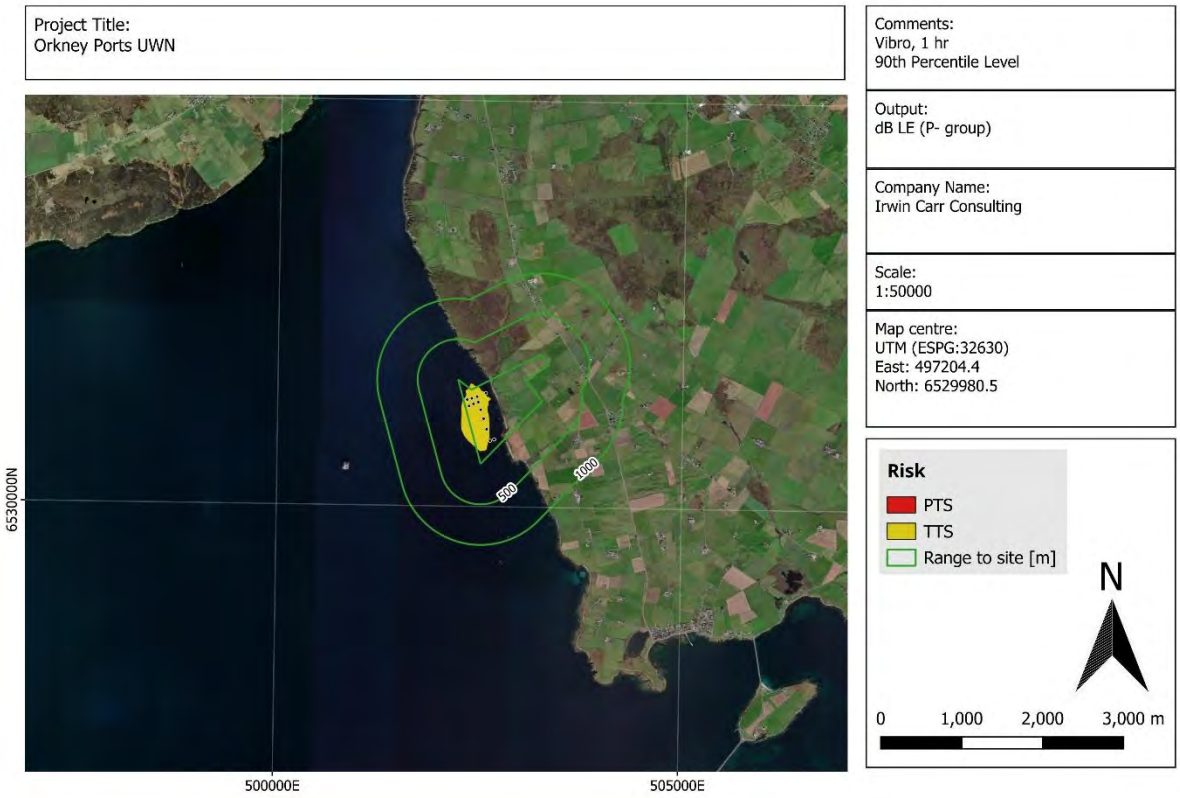
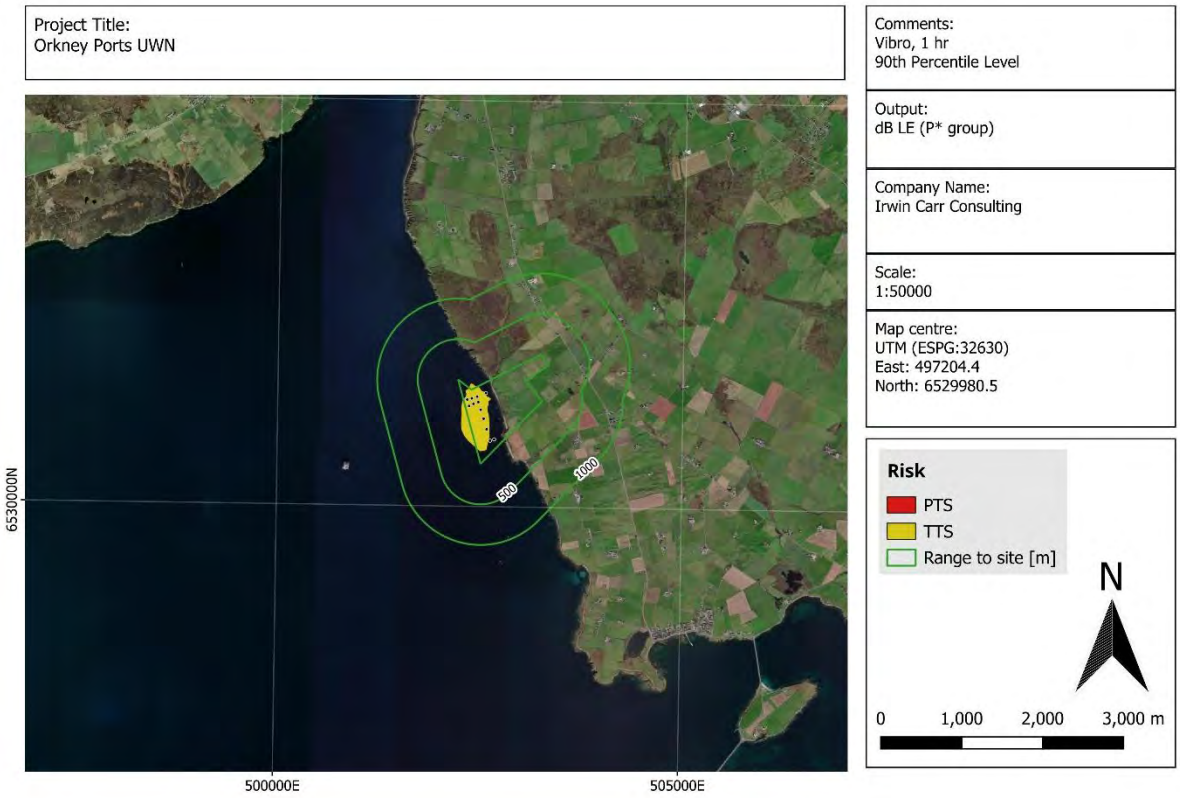


Figure 49. Vibro piling, L_E, 1 hour, P* group



Vibro piling L_P

Figure 50. Vibro piling, L_P, LF group

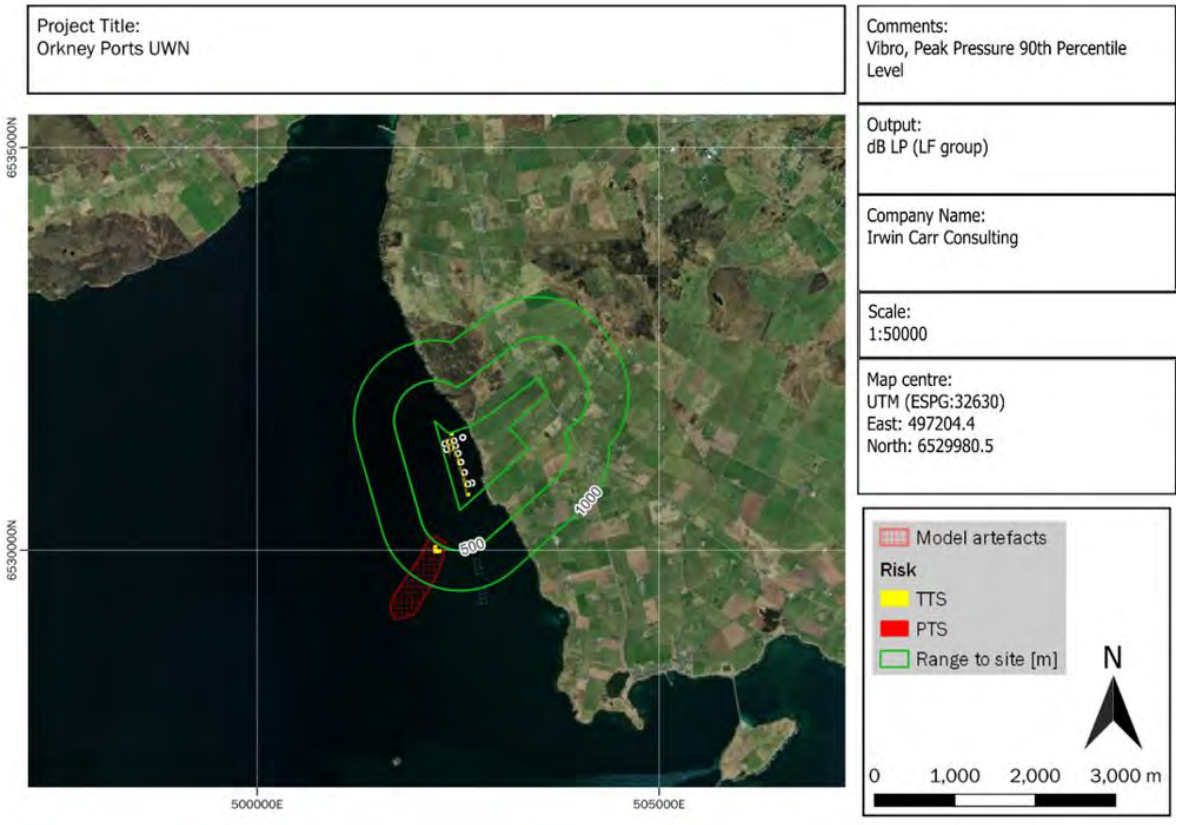


Figure 51. Vibro piling, L_P, HF group

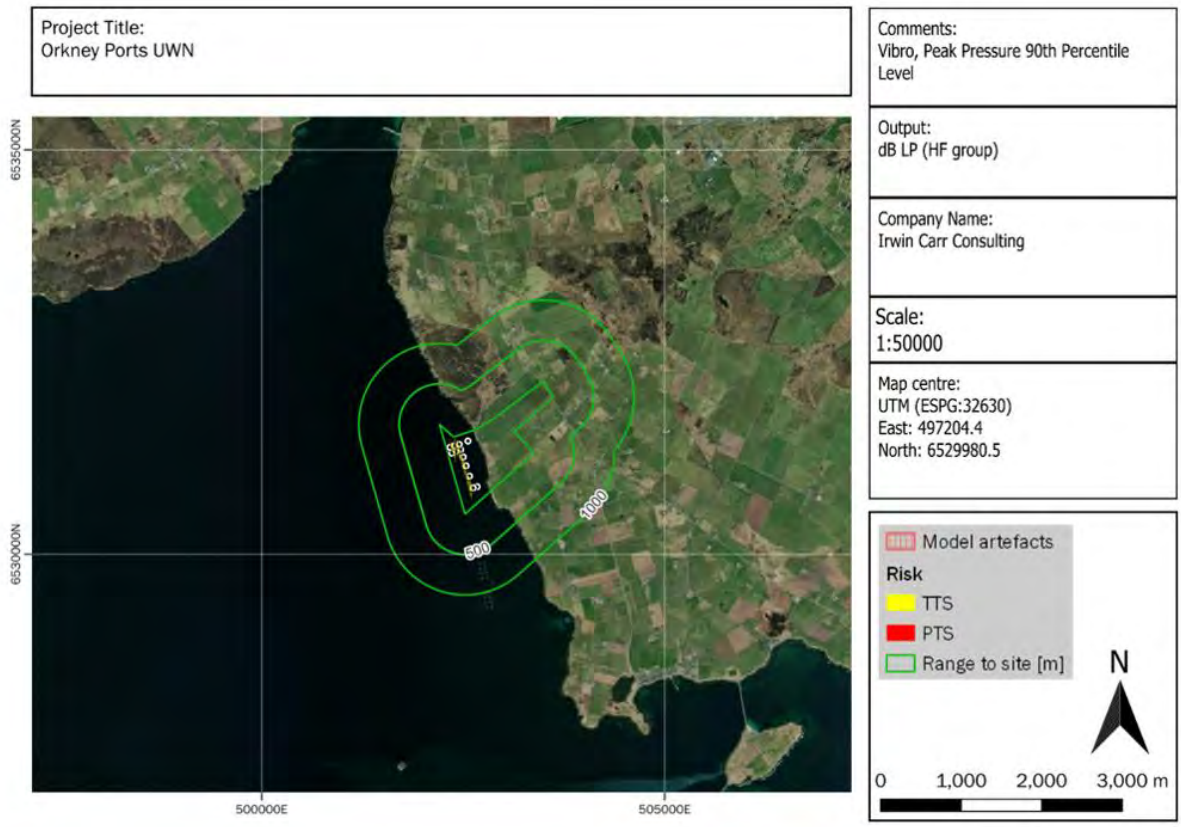


Figure 52. Vibro piling, L_P, VHF group

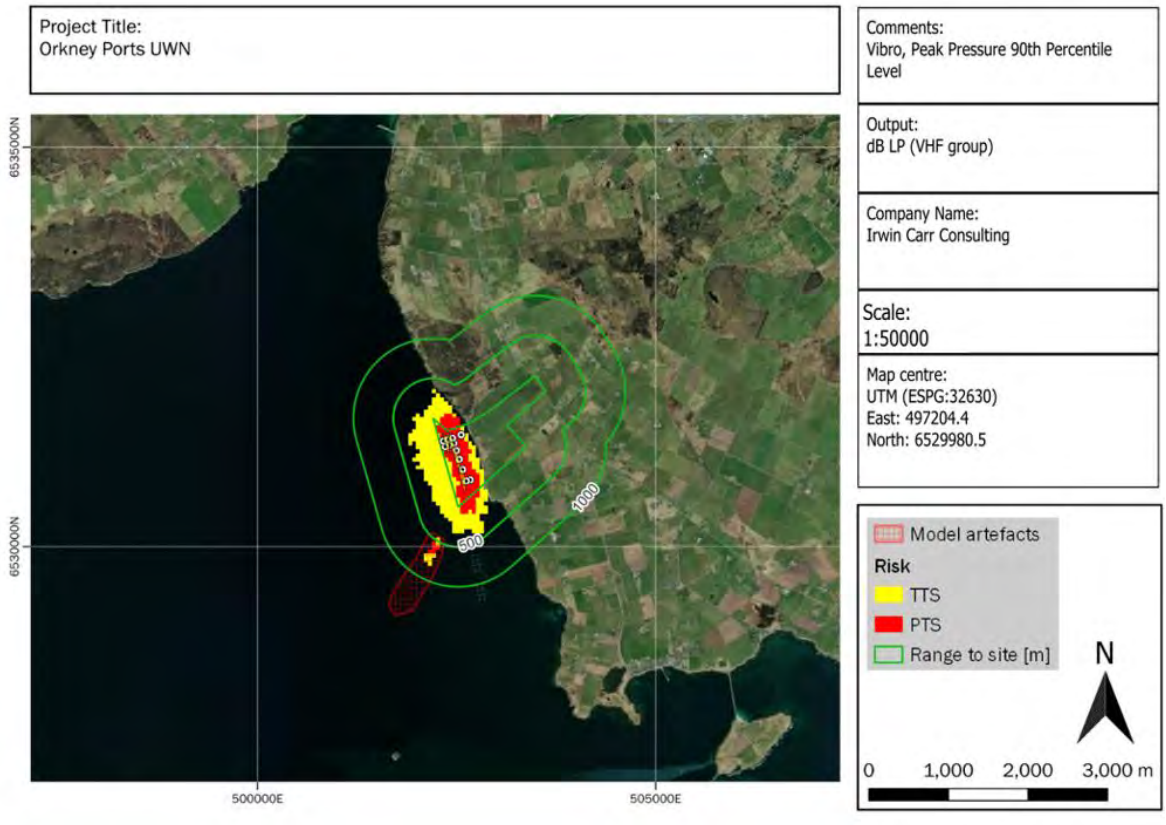


Figure 53. Vibro piling, L_P, PW group

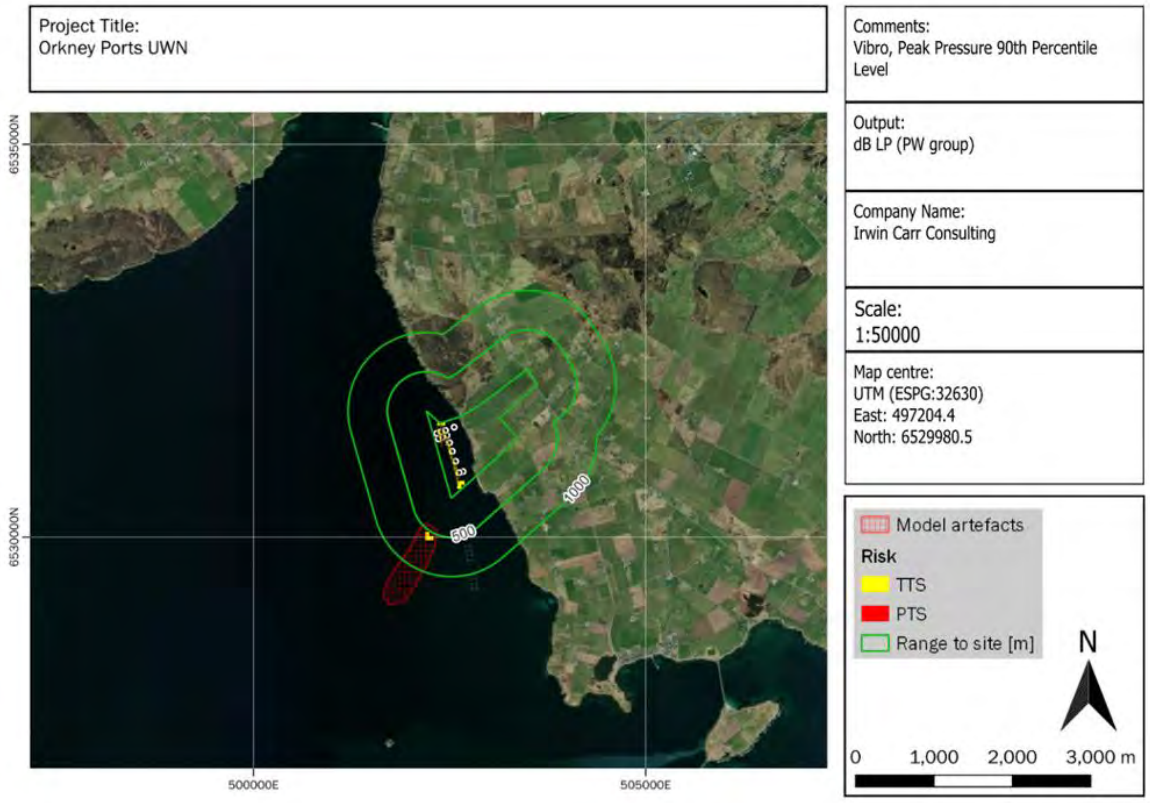


Figure 54. Vibro piling, L_P, OW group

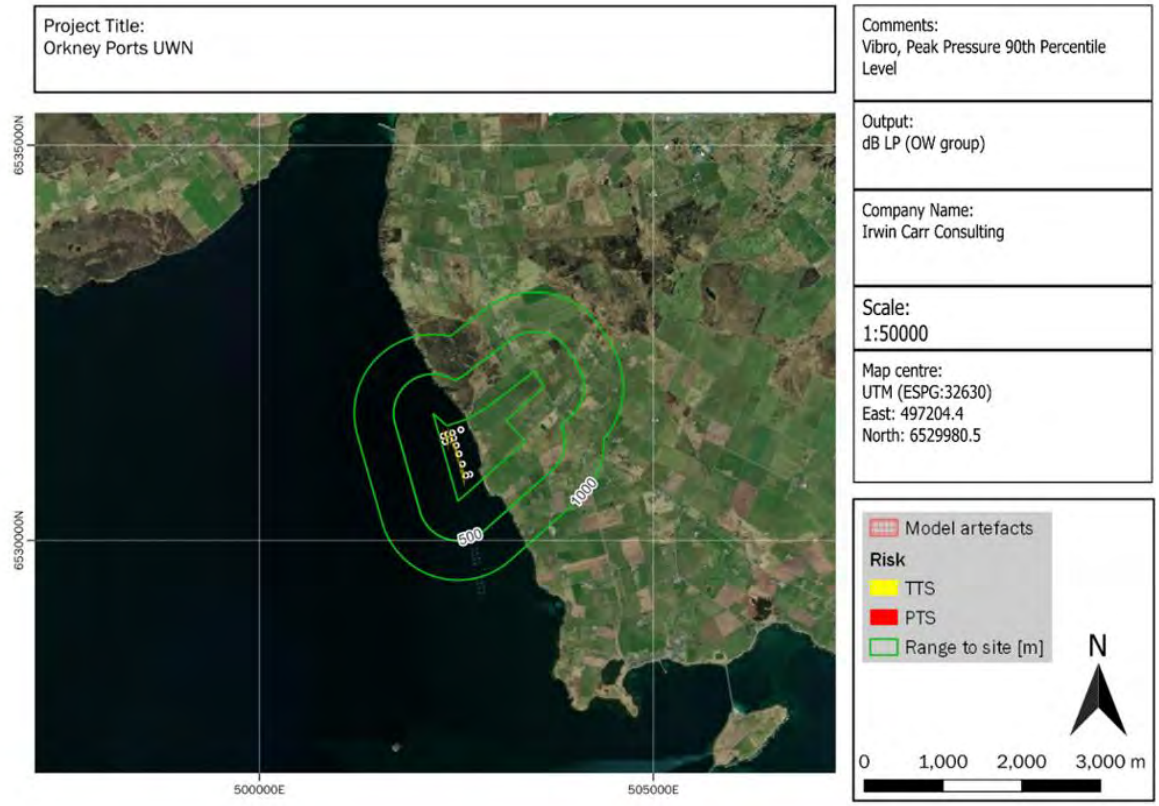


Figure 55. Vibro piling, L_P, P- group

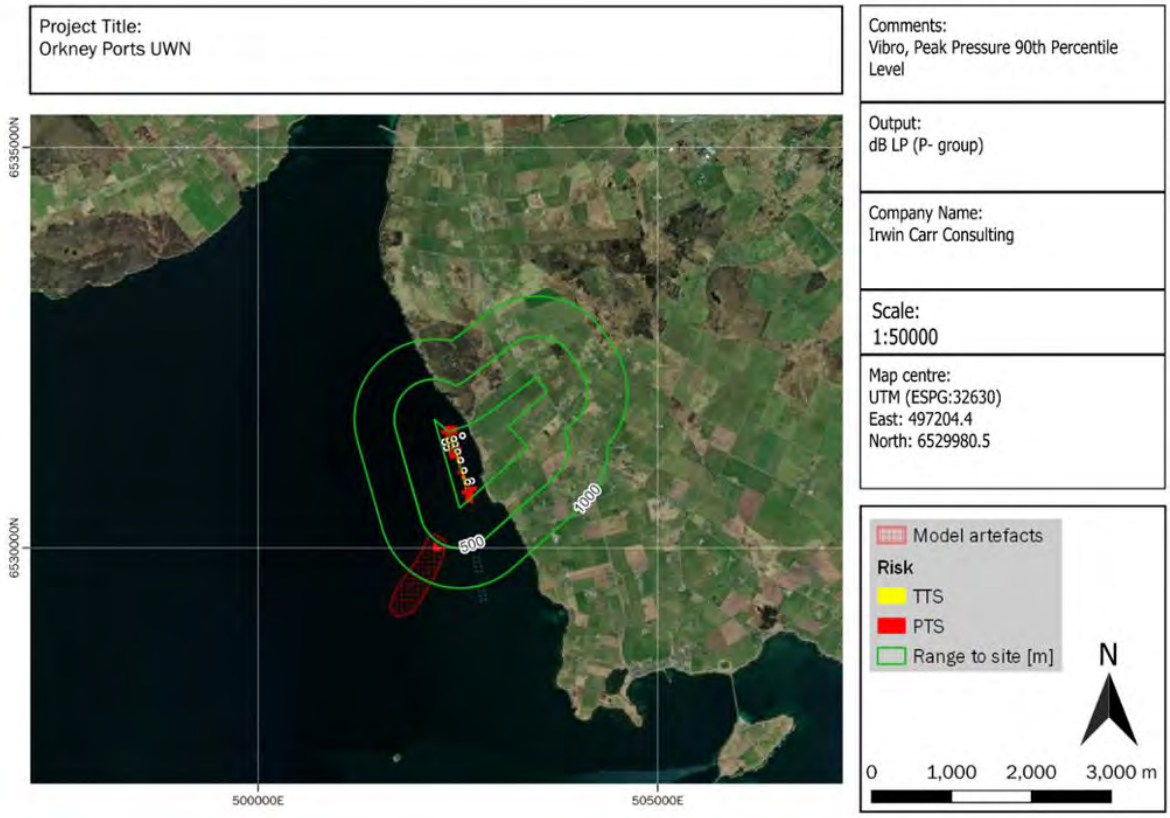
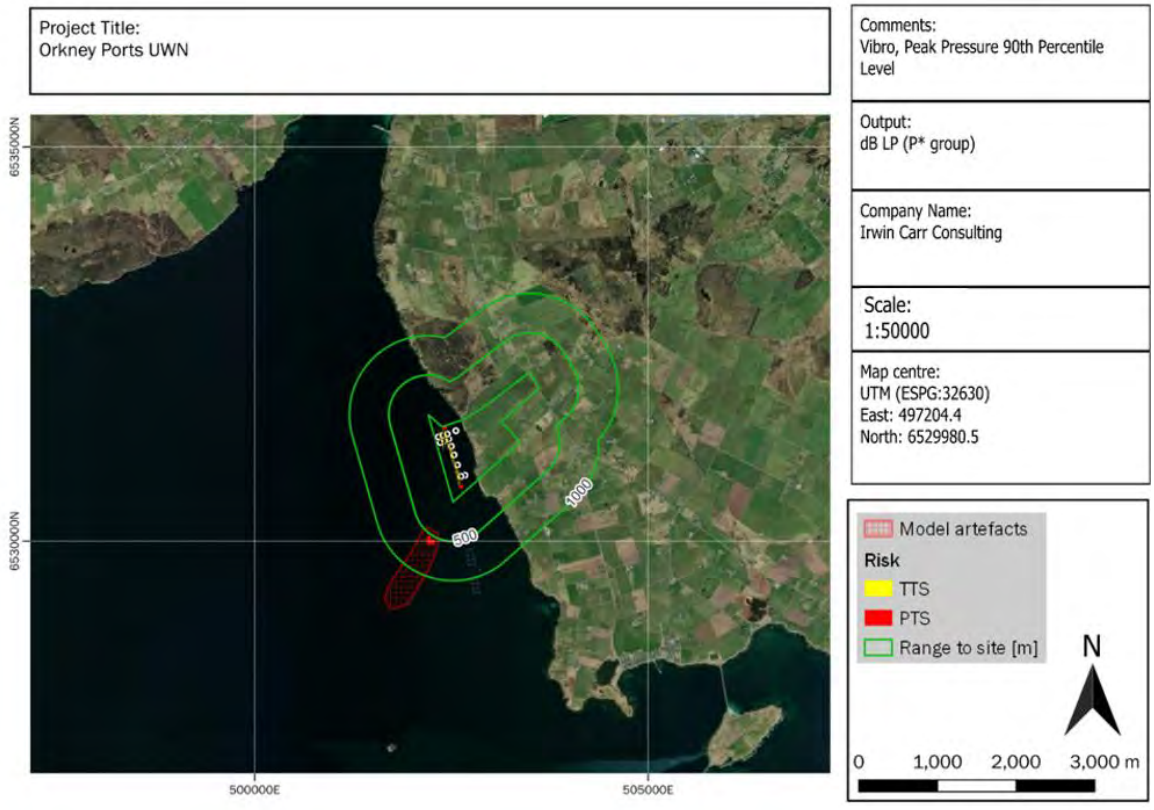


Figure 56. Vibro piling, L_P, P* group



D MARINE MAMMAL RISK ASSESSMENT

envirocentre

part of CuraTerrae

Scapa Deep Water Quay
Marine Mammal Risk Assessment



July 2026

CONTROL SHEET

Client: Orkney Island Council Harbour Authority
Project Title: Scapa Deep Water Quay
Report Title: Marine Mammal Risk Assessment
Document number: 13160
Project number: 674795

Issue Record

Issue	Status	Author	Reviewer	Approver	Issue Date
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2	FinalV2	JEP	IB	EC	16/11/2023
3	Final V3	JEP	MM	MM	21/06/2024
4	Final V4	JEP	GN	MS	19/07/2024
5	Final V5	JEP	GN	IB	30/09/2025
6	Final V6	JEP	GN	IB	21/01/2026
7	Final V7	JEP	GN	IB	10/06/2026

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EXECUTIVE SUMMARY

EnviroCentre Limited was commissioned by Orkney Islands Council Harbour Authority to undertake a Marine Mammal Risk Assessment (MMRA) to inform a European Protected Species (EPS) License Application in relation to the construction phase of the development of Scapa Deep Water Quay (SDWQ).

The site does not lie within any statutory designated sites relating to marine species (Marine Protected Areas (MPA), Special Areas of Conservations (SAC), Sites of Special Scientific Interest (SSSI)) and isn't considered to be within the Zone of Influence of any such sites

Underwater noise is considered to be the main activity which could negatively impact marine EPS, with injury, death and disturbance of individuals being a possibility. Underwater noise modelling was commissioned as part of this assessment based on the construction methods considered the most significant for generating underwater noise; dredging. The construction methods of the proposed development does not require underwater blasting, piling or drilling.

The noise from dredging has short risk ranges for Permanent Threshold Shift (PTS) for minke whale, humpback whale, killer whale, Risso's dolphin, common dolphin and pilot whales at <60m for 1 hour (hr) and 8hr periods, whilst porpoises are at 80m at close range, during short exposure (1h) and 210 m over 8hr period. Temporary Threshold Shift (TTS) risk ranges vary, with those for minke whale and humpback whale measuring from 230m -1250m for 1-8hr dredging period and those for killer whale, Risso's dolphin, common dolphin and pilot whales measuring from 60m -160m for 1-8hr period. TTS for porpoises was the greatest, ranging from 620m – 1350m for 1-8hr period of dredging. However, it is considered that there is no acute risk of noise related injury related to the dredging, and animals have time to swim away.

The development will result in increases in vessel movement in and out of the SDWQ during construction and operation. This vessel increase, would increase the risk of collision with marine mammals, potentially resulting in death or injury to individuals. Speed restrictions on vessels should be enforced.

Mitigation in the form of a Marine Mammal Protection Plan (MMPP) will be implemented and will reduce the risk of injury as well as limit the potential disturbance. The MMPP includes a Marine Mammal Observer (MMO) protocol with an exclusion zone of 800m and Passive Acoustic Monitoring (PAM).

Whilst mitigation will reduce the likelihood of impacts from underwater noise, and lessen the severity of the predicted effects, it won't be possible to completely avoid some level of disturbance to marine mammals which may be present in the area**. A derogation licence to permit disturbance from dredging to harbour porpoise, minke whale, humpback whale, fin whale, Risso's dolphin, white-beaked dolphin, short-beaked common dolphin, long-finned pilot whale and killer whale will be required for imperative reasons of overriding public interest.**

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Limited was commissioned by Orkney Islands Council Harbour Authority to undertake a Marine Mammal Risk Assessment (MMRA) to inform a European Protected Species (EPS) License Application in relation to the development of Scapa Deep Water Quay (SDWQ) at Bay of Deepdale, Scapa Flow.

1.2 Scope of Report

The aim of this report is to provide information required by Marine Directorate to determine whether a Marine EPS derogation licence can be issued. The objectives were as follows:

- Collate existing data in relation to marine EPS (primarily cetaceans) to establish which species are likely to be present within the development site and the wider zone of influence.
- Identify potential impacts to cetaceans which could occur as a result of the proposed development; and
- Detail mitigation which will be employed to reduce the risk of negative impacts.

1.3 Project Overview

1.3.1 Background to the Project

SDWQ is a major strategic port infrastructure project proposed by Orkney Islands Council Harbour Authority (OICHA, 'the Applicant') for Scapa Flow, Orkney. It is designed to provide a deep-water berth capable of accommodating floating offshore wind (FOW) assembly, integration, operations and maintenance, alongside heavy-lift capacity for large-scale turbines and foundations. The quay will also support wider marine industries and future energy transition activities. Its location offers naturally deep, sheltered water adjacent to sufficient land for laydown, with safe navigation and minimal dredging - attributes that make Scapa Flow one of the few sites in the UK capable of hosting operations at this scale. The location of SDWQ is shown in Appendix A.

A marine licence application under the Marine (Scotland) Act 2010 and a planning permission application under the Town and Country Planning (Scotland) Act 1997 were submitted in September 2023 for determination by the marine regulators, Scottish Government's Marine Directorate – Licensing Operations Team (MD-LOT) and OIC Planning Department ('the Competent Authorities'). These applications were supported by an Environmental Impact Assessment (EIA) undertaken under both the Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 ('the Terrestrial EIA Regulations') and the Marine Works (Environmental Impact Assessment (Scotland) Regulations 2017 ('the Marine EIA Regulations'). The requirement for Additional Information under the Marine and Terrestrial EIA Regulations has since been triggered four times, with this document supporting the latest Additional Information submission.

1.3.2 Site Location

The site is located adjacent to the Bay of Deepdale, approximately 8 km south of Kirkwall. It is located on the eastern coastline within Scapa Flow, approximately 4 km south of the existing Scapa Pier. A Location Plan is provided in Appendix A.

1.3.3 Main Purpose and Associated Activities

SDWQ shall provide deep-water berthing facilities for a wide range of industrial activities with the main purpose upon completion, and in the medium to long term, being the storage of components, and assembly of wind turbines serving the floating offshore wind industry. SDWQ shall be complete with additional emergency berthing facilities for small vessels. SDWQ is also identified as a potential site for the storage and supply of future fuels for the marine industry.

SDWQ is a permanent addition to the Orcadian infrastructure, and therefore decommissioning is not a planned phase of the Project and has not been considered within the assessment presented in this report.

1.3.4 Construction Programme

The key construction stages, their indicative durations and projected periods for works to be carried out therein are outlines in Table 1-1 below.

Table 1-1: Outline construction programme

Works Description	Est. Duration	Est. Works Period
Access road construction, haul road, earthworks and A961 re-alignment	60 weeks	December 2027 – February 2029
Caisson fabrication (off-site)	24 weeks	December 2027 – June 2028
Caisson transport (off-site fabrication to Orkney)	8 weeks	June 2028 – August 2028
Dredging bund construction	32 weeks	December 2027 – July 2028
Dredging	12 weeks	June 2028 – August 2028
Caisson installation (placement only)*	8 weeks	August 2028 – September 2028
Landside earthworks – Overburden removal, rock blasting and excavation	100 weeks	October 2027 – September 2029
Quay finishings	52 weeks	January 2029 – January 2030
Demobilisation	12 weeks	January 2030 – February 2030
Completion	N/A	February 2030

*Completion of the quay wall, including infilling of caisson cells and backfill to the rear of the units shall continue on to February 2029. This may or may not involve the vessel movements detailed in Table 1-2 depending on availability of suitable material on island. Vessel movements shown in Table 1-2 which refer to caisson infilling are worst case.

Terrestrial blasting is anticipated to be completed within the first 59 weeks of the landside earthworks programme. However, ground conditions may dictate a change in the blasting pattern, which may extend the blasting programme to up to 100 weeks. No more than two blasts would be carried out in any one week.

1.3.5 Outline Design Criteria

The below criteria will ensure the design provides a robust, long-lasting marine structure, ensuring safety, stability, and durability under challenging environmental conditions.

- **Dredging Requirements:** The operational depths of -15.0m Chart Datum (CD) and -20.0m CD
- **Environmental conditions:** Consideration of climate change and sea-level rise scenarios (A projected sea level rise of 0.9 m by 2100 is considered, based on national climate projections), with tidal lag (normal conditions) and wave conditions (1 in 50-year, 1 in 200-year, 1 in 570-year return periods) integrated into the design.
- **Materials:** Concrete and reinforcement materials must comply with Eurocodes and British Standards, with specifications for exposure classes, cement types, and aggregate properties.

- **Caisson design:** The caissons are designed with a focus on durability, using concrete that is resistant to degradation in marine environments. Concrete properties, cement types, and aggregate characteristics have been carefully specified to ensure a long lifespan.
- **Caisson foundations and fill:** Crushed imported rock is used as the foundation layer, with strict controls on durability and strength. Fill materials inside and behind caissons are selected for high density and internal friction to ensure stability.
- **Scour protection:** Concrete scour protection mattresses and rock armour is installed to mitigate seabed erosion caused by vessel thrusters and propellers near the quay wall.

1.3.6 Site Establishment and Access

Site establishment and access will include:

- **Access road:** 8 m asphalt carriageway with 1.8 m hard verge/service strip, 1.8 m south-side path, 1.5 m north-side soft verge, and drainage swales on both sides.
- **Access point:** formed from the realigned A961 (under separate planning permission), with reflective signage and two-way lights as required.
- **Programme role:** critical early works item enabling site access, laydown, cut-and-fill operations, and construction of the dredge containment bund.
- **Early services:** temporary service connections required early to support blasting, quarrying and earthworks.
- **Construction works:** topsoil stripping, overburden removal, rock cut, and placement of subbase and surcharge to form a haul road.
- **Environmental control:** works to account for SEPA requirements to protect groundwater dependent terrestrial ecosystems.
- **Progressive installation:** service trenching, drainage and ducting installed as works progress.
- **Completion:** surcharge trimmed and final surfacing applied at the end of the project.

1.3.7 Dredging

The dredging and reclamation areas can be seen in Figure 1-1. All suitable dredged material will be placed in a reclamation area behind a pre-constructed bund (see Section 1.3.8), with any unsuitable material disposed at the licenced sea disposal site. The volumes of material to be dredged are presented in Table 1-2.

The dredging works extend along the entire quay alignment, including the main quay as well as the small vessel berths to the northern end, and are essential for preparing the seabed for subsequent caisson installation. The structures will be founded on hard bearing strata, requiring the removal of superficial soils and hard strata from approx. -15m CD down to a maximum depth of -20.5m CD. The dredged area edge slopes depend on the material type, ranging from 1:3 in superficial soils to 1:1 in engineering rock, whilst the dredging berth pockets are required to be operative for elevations of -15m CD and -20m CD.

Dredging works will be executed in a single campaign using a cutter suction dredger (CSD) specifically selected for its capacity to operate efficiently under the anticipated soil, sea and weather conditions at Scapa Flow.



Figure 1-1: Dredging and reclamation areas

The discharging process to the reclamation area shall be carried out through the integration of the dredger pumps with the designated discharge pipeline system where the dredged material will be transported into the reclamation area. This operation will be carried out in parallel with the dredging activities, beginning at the northwest portion of the reclamation.

Turbidity meters will be installed to detect any increase in turbidity outside the reclamation area, the details of which will be included within the supporting Construction Environmental Management Document (CEMD) (see Table 7-1 in the HRA for further details).

Through the early contractor involvement design stage, it has been identified that a significant reduction in material disposed at sea could be achieved from that which was originally defined in the exemplar design. There is, however, potential for up to 82,000m^3 of glacial till which may be unsuitable for re-use, to be disposed at sea (see Table 1-2).

A 4,000m^3 capacity barge(s) will be used to transport material to the licensed offshore deposit site **FI040**. If the maximum volume (82,000m^3) is deposited, there will be 21 round trips to the sea deposit site (42 vessel movements) over 12 a week period, typically this activity will be carried out between the beginning of June to the end of August (currently 2027).

Table 1-2: Proposed dredge volumes

Description	Total volume dredged (m^3)	Volume reused on site (m$^{3)}$	Volume disposed offshore (m^3)
Hard Dredge	72,653	72,653	0
Soft Dredge	306,754	306,754	0
Total	**379,407**	**379,407**	**0**
Disposal Contingency	379,407	297,407	82,000

1.3.8 Quay Wall Construction

The quay wall will be formed from reinforced concrete caissons installed on a rock bed foundation. The main quay is composed of nine large reinforced concrete caissons, with a smaller caisson at the south end that ties into the south revetment. At the north end, the small vessel berths are formed by four caissons.

Caissons Design Criteria

- **Main quay structure:** nine large reinforced concrete caissons, plus a smaller caisson at the southern return tied into the rock armour revetment.
- **Caisson design:** varied cross-sections along the quay to suit dredge depths and ground conditions.
- **Cope level:** fixed at **+7.00 m CD**.
- **General dredge depth:** to **–15.0 m CD**, including **1 m over-dredge** allowance.
- **Southern dredge pocket:** 140 m section dredged to **–20.5 m CD**, including **1 m over-dredge** allowance.
- **Northern berths:** small vessel berths formed by a series of smaller caissons.
- **Foundation design:** dredge slopes vary by soil type to achieve founding level in engineering rock.
- **Geotechnical checks:** caissons assessed for sliding, overturning, bearing capacity and overall stability.
- **Ballasting:** each caisson will be ballasted in accordance with the design to ensure stability during transport and installation.
- **Delivery programme:** the 14 caissons will be transported to site in four shipments.
- **Direct installation:** the first caissons in each delivery batch will be installed directly from the semi-submersible delivery vessel to their final quay positions.
- **Temporary wet storage:** remaining caissons from subsequent deliveries will be towed to a temporary wet storage area within the project boundary until final installation.
- **Transport:** caissons will be dry stored during transport from Spain, reducing the risk of introducing non-native species.
- **Biosecurity:** a Biosecurity Plan will be prepared as part of the CEMD (see Table 7-1 in the HRA).
- **Mitigation measures:** the plan will set out measures to prevent the introduction of invasive non-native species in line with relevant legislation and best practice.

Caisson Unloading at Scapa Flow

Unloading operation: caisson deliveries unloaded using 3 tugboats of at least 4,000 Horsepower (3,000kW) hired locally, with operation carried out in one to two good weather days per shipment. Caissons unloaded from semisubmersible vessel directly to the quay line or to a nearby storage area.

- **Auxillary equipment installation:** caissons fitted with auxiliary equipment (e.g. winches, mooring ropes and anchors, etc.).
- **Temporary securing:** After unloading, they will be temporarily secured either by tying them together alongside the partially constructed quay or by anchoring them to the seabed close to the project site. No piling or drilling is required for this operation, and underwater noise will be negligible.
- **Final Installation:** When weather conditions permit, the caissons will be sunk into their final positions.

Caisson Installation

- **Installation Duration and Conditions:** installation typically completed during daylight hours within 6–8 hours. Operations require suitable metocean conditions:
    - Mean wave height (Hm) < 0.5 m, peak wave period (Tp) < 7 s and wind speed at 10 m above sea level (U10) < 15 m/s
- **Towing to Installation Location**: caissons are towed individually from the semisubmersible vessel or temporary storage area to the quay line. Typically, one to three tugboats are used for towing and installation support.

- **Positioning and Controlled Sinking**: during sinking using tugs and winches. Installation continues until controlled touchdown on the prepared foundation.
- **Ballasting Operations:** caissons contain independent watertight cell groups, filled simultaneously with seawater using pumps or valves.
- **Tolerance Verification and Completion**: ballast water is sourced from Scapa Flow after placement. If the caisson is within tolerance, ballasting continues until full. If tolerances are not met, the caisson is de-ballasted, repositioned, and reinstalled, typically requiring only one attempt.

1.3.9 Landside Excavation Platform

- **Earthworks and Excavation:** Soft soils excavated using mechanical methods, with rock removal undertaken through drilling and terrestrial blasting. No marine blasting is planned.
- **Programme and Blasting Frequency:** scheduled over approximately 100 weeks (provisionally October 2027 to September 2029). Blasting will occur intermittently throughout the programme. Approximately 35 blasts are anticipated. No more than two blasts will take place per week. Blast timing will depend on construction progress and cannot be restricted to specific seasons.
- **Drainage and Site Preparation:** Pre-earthworks drainage installed to manage surface water runoff.
- **Noise and Sediment Control Bund:** 6 m high bund will be constructed at least 5 m from the cliff edge before blasting commences near the coast. The bund will act as a noise barrier for marine receptors and a retention wall for sediment runoff. The bund will be removed once final site levels are achieved.
- **Blasting Methodology:** blasting will progress in 70 m-wide strips from west to east across the site. Each strip will be divided into sections sized to accommodate up to two weekly blasts. Blasting activities will be undertaken simultaneously from both ends of each strip.
- **Material Processing and Fill Operations:** processing areas established at both ends of the site. Dual processing locations reduce haulage distances for blasted material. Fill operations will be supplied from both directions, improving material distribution efficiency.

1.3.10 Reclaimed Land (Sea Filling)

- **Initial Land Reclamation:** dredge bund and enclosed reclaimed area will be completed during the dredging campaign, forming the initial phase of land reclamation. General infilling will commence once the caissons have been installed, filled, and backfilled.
- **Perimeter Closure:** rock armour revetments constructed at the north and south ends of the quay wall after caisson installation. These revetments will close the reclamation perimeter and protect the site from wave action.
- **Rock Armour Revetments:** designed for a 60-year service life and 1-in-200-year wave conditions. Revetments will include appropriately sized underlayers and geotextiles.
- **Land Reclamation Fill Materials:** Reclamation will primarily use dredged material and suitable excavated material from landside works (screened on site to remove fines before placement). Imported quarry material placed behind the caissons to meet grading and compaction requirements for caisson stability.
- **Sediment Control:** marine containment substantially established before reclamation filling progresses. Containment bund will minimise sediment discharge beyond the construction area.

1.3.11 Pollution Control

Strict pollution prevention controls implemented during land reclamation works to minimise risk via drainage systems designed in accordance with best practice and regulatory requirements, no untreated surface water to be discharged directly to surrounding coastal waters and an outline Construction Environmental Management Document (CEMD) has been prepared for the project (see Table 7-1 in the HRA).

1.3.12 Vessel Movements During Construction

The construction phase will see the following vessel movements as outlined in Table 1-3 below. In total during the entire construction phase (26 months), there will be 112 vessel movements taking place over an eight-month period between June 2028 and February 2029, inclusive.

Table 1-3: Construction phase vessel movements

Vessel	Predicted Number of Movements	Timescales (provisional)
Caisson delivery, offloading and installation	20 movements (4 deliveries) using a semi-submersible vessel (3 tugs for offloading, 1 tug for installation) Tugs deployed from nearby Scapa Pier	July 2028 – September 2028
Scour protection	10 trips (20 movements)	August 2028 – September 2028
Caisson infilling	15 trips (30 movements)	August 2028 – February 2029
Dredging	21 trips (42 movements)	June 2028– August 2028
Total	**112**	

Baseline vessel movements (as informed by the Navigational Risk Assessment (NRA); see Technical Appendix 2.3 of EnviroCentre 2024) in Scapa Flow is characterised by a high level of diverse maritime traffic year-round, with Automatic Identification System (AIS) data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow—closest to the SDWQ site—current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents only ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

The construction phase vessel movements will therefore result in an additional 21.5 vessel movements per month on average (+0.16% from baseline) during winter months (October-March) and an additional 90.4 vessel movements per month on average (+0.5% from baseline) during summer months (April-September).

1.4 Operation

The Project is likely to operate as a marine facility 24 hours per day and 7 days per week, so there is the potential for activity at any time of the day or night. This will include:

- Flatbed lorries: delivering and uplifting from site.
- HGVs: delivering and uplifting from site.
- Light vans: delivering cargo or providing maintenance and servicing to site.
- Road Tankers: delivering bulk goods and liquids to site or removing liquids and waste from site; and
- Forklift trucks: loading and unloading vehicles servicing the site. In addition to the general cargo operations, there will be:
- Minibuses/ cars collecting/ returning people working on site - vehicles not allowed in working area.
- Security staff based within the site and undertaking patrols when appropriate.
- Staff looking after the facility maintenance and assisting with vessel moorings.
- Third Party Stevedore Companies loading and unloading vessels; and
- Coaches and taxis facilitating crew changes on vessels.

The internal roadways and footpaths will be demarcated with designated routes, and barriers will be installed where necessary. There will be a security fence around the working area perimeter to protect it as well as the

public, in addition to preventing access to breakwaters, rock armour revetments etc. (access gates will be provided for maintenance). The fence will be constructed in accordance with the requirements of the International Ship and Port Facility Security Code (ISPS).

Table 1-4 provides a summary of the indicative infrastructure likely to be present upon completion of the Project. The indicative locations of quayside infrastructure services are shown on Figure 1-2.

Table 1-4: Indicative operational infrastructure

Infrastructure Type	Qty	Description
Future Marine Fuels	TBC	Possible storage and supply to vessels of very low or zero carbon fuels. Note this will be subject to further assessments and approval.
Water Tanks	4	Four water storage tanks with built-in treatment systems (as required) will be installed as indicated on Figure 1-2 outside of the main working area to supply potable water to the whole site and vessels.
Sub-station	1	Located near to the water tanks will be a 33kV /11kV/415V substation for whole site supply, including shore power for vessels, as indicated on Figure 1-2 not in main working area.
Main gatehouse / Access building	1	As indicated on Figure 1-2 outside of main working area, may contain admin offices and is the security control for site.
Car park, cycle storage and bus stop	-	Vehicle parking spaces and bicycle racks. Bus stop for use by internal bus services (drop off and pick up only).



Figure 1-2: Proposed SDWQ operational layout

1.4.1 Vessel Movements During Operation

The project is designed to be flexible so that many types of vessels can berth, subject to draught and length. While the quay is a major strategic facility, its operational profile is characterised by the infrequent arrival of large vessels, likely to be aligned with the integration and deployment schedules of major offshore wind developments. Approximately 80% of vessel activity will take place in the summer months

There is significant existing vessel activity in the wider area around the proposed SDWQ site. There will be increased vessel activity introduced by the SDWQ project in the area from the existing shipping route to the site (EnviroCentre SEIR May 2025); however, there are some existing vessel movements in this area, as shown by the vessel tracks in the EnviroCentre EIAR (2024), and in more detail in the NRA submitted with the EnviroCentre EIAR (2024 Technical Appendix 2.3). Table 1-5 outlines the annual and seasonal operational vessel activity expected for the Project.

As per Section 1.3.12. there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA (EnviroCentre EIAR 2024 (Technical Appendix 2.3)) and summarised above in section 1.3.12, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

Table 1-5: Annual and seasonal operational vessel activity

	Per year		**Per winter season (October-March)**		**Per summer season (April-September)**	
	Vessel number	**Vessel movements (return trips)**	**Vessel number**	**Vessel movements (return trips)**	**Vessel number**	**Vessel movements (return trips)**
Large vessels	28	56	6	12	22	44
Smaller vessels	12	24	2	4	10	20
Pilot boats for large vessels	56	112	11	22	45	90
Total	**96**	**192**	**19**	**38**	**77**	**154**

1.4.2 Wet Storage

There is no planned wet storage of fully constructed turbines at the Project site. Any future proposals for wet storage will be conducted in accordance with the relevant regulations/consents.

1.4.3 Quayside Cranes

- **Crane Strategy:** no fixed or permanent cranes will be installed on site. Crane activity will generally coincide with vessel arrivals and departures.
- **Weather Constraints:** lifting operations are highly dependent on weather conditions, particularly wind. Less than 20% of lifting operations are anticipated to occur during winter.

- **Vessel Movements and Crane Activity:** approximately 30 vessel trips per year (60 vessel movements) will require crane operations. Expected seasonal distribution of 24 vessel trips (approximately one per week) in summer and 6 vessel trips (approximately one per month) in winter. Vessels will typically remain berthed for 2–5 days. Estimated crane operating days of 8–20 days per month in summer and 2–5 days per month in winter.
- **Number of Cranes on Site**: in summer up to four cranes operating simultaneously (typically one vessel crane and three mobile cranes) and in winter up to two smaller mobile cranes.
- **Storage and Visual Presence:** mobile cranes will generally be stored on site during summer. In winter, cranes may remain on site or be removed for use elsewhere. When not in use, crane booms will be retracted and lowered horizontally. Stored cranes will have a height of approximately 5 m.
- **Noise and Lighting:** mobile cranes move slowly and generate limited engine noise. Mobile cranes do not normally provide their own lighting. Winter lifting operations will typically be restricted to daylight hours.

1.5 Alternative Consideration

The project was identified as part of the Orkney Harbours Masterplan. At the start of the Masterplan development, optioneering was undertaken through stakeholder discussions / workshops, OICHA internal discussions with staff, market assessments in conjunction with desk-based research. A Strategic Environmental Assessment was used to inform a draft Orkney Harbours Masterplan Phase 1 with details of the process including alternatives considered, reasons for discounting or taking forward options and potential environmental impacts as reported in the Strategic Environmental Assessment – Environmental Report.

1.5.1 Do Nothing

SDWQ is proposed to be a nationally significant deepwater quay for offshore wind. Doing nothing will not allow the long-term future of Orkney, in particular looking at facilities that ensure the decarbonisation of the industry. By doing nothing, what is considered the UK's most significant marine energy infrastructure programme ever undertaken will not be possible and as a result the UK's position for marine-based renewables in Europe and internationally will be weakened.

1.5.2 Relocation

The siting of the proposed development was originally positioned in an area to the north of the Burn of Deepdale. However, following initial site investigations and preliminary ecological surveys it was decided to move the development to its current location. The move was a result of the engineering and environmental considerations as listed below:

- The quantity of overburden and unsuitable material (for development purposes) was determined to be greatly reduced by positioning the development on the land to the south of the burn;
- The current site selected avoided crossing the Burn of Deepdale; and
- Moving the development footprint to the south avoided encroachment into the Gaitnip Local Nature Reserve (LNR) which would have been the case if it was situated to the north of the Burn of Deepdale.

1.6 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre Limited.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre Limited for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

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2 METHODS

2.1 Baseline

In order to anticipate the potential marine mammal and fish ecological sensitivities at the site, a desk study was conducted. The following sources were checked:

- Marine Directorate National Marine Plan interactive (NMPi) for
  - Location of marine designated sites;
  - Distribution of Priority Marine Features
- Marine Scotland (MS) Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters [1;]
- SCANS IV Estimates of cetacean abundance in European Atlantic Waters in summer 2022 from SCANS-IV aerial and shipboard surveys[2];
- JNCC Report No 680: Updated abundance estimates for cetacean management units in UK waters[3];
- Sea Watch Foundation (SWF) website for recent sightings of marine mammals from the Orkney region[4];
- The Hebridean Whale and Dolphin Trust (HWDT) Whale Track for recent sightings (2014-2024) within a 65km radius[5];
- Orcadian Wildlife (OW)[6];
- Scottish Marine Animal Stranding Scheme (SMASS) for records of strandings between 2001 and 2020[7];
- Orkney Marine Mammal Research Initiative (OMMRI)[8] for available species records;
- ORCA website for recent records[9]
- OMMRI Longhope Harbour Porpoise Project 2022[10]; and
- OMMRI Trustees' Annual Report April 2022-2023[11].

[1] Marine Scotland Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters, Scottish Marine and Freshwater Science, Vol 11 No 12, available at: https://data.marine.gov.scot/sites/default/files/Scottish%20Marine%20and%20Freshwater%20Science%20%28SMFS%29%20Vol%2011%20No%2012%20Regional%20baselines%20for%20marine%20mammal%20knowledge%20across%20the%20North%20Sea%20and%20Atlantic%20areas%20of%20Scottish%20waters.pdf (Accessed 07/06/2024)

[2] SCANS IV (2023), available at: https://www.tiho-hannover.de/fileadmin/57_79_terr_aqua_Wildtierforschung/79_Buesum/downloads/Berichte/20230928_SCANS-IV_Report_FINAL.pdf (Accessed 13/01/2026)

[3] IAMMWG. 2022. Updated abundance estimates for cetacean Management Units in UK waters. JNCC Report No. 680 (Revised March 2022), JNCC Peterborough, ISSN 0963-8091. Available at: https://data.jncc.gov.uk/data/3a401204-aa46-43c8-85b8-5ae42cdd7ff3/jncc-report-680-revised-202203.pdf (Accessed 09/05/2024)

[4] Sea Watch Foundation Recent Sightings Orkney available at: https://www.seawatchfoundation.org.uk/recentsightings/ (Accessed 12/12/2023)

[5] HWDT sightings data available at: https://whaletrack.hwdt.org/sightings-map/ (Accessed 06/06/2024)

[6] Orcadian Wildlife information available at: http://orcadianwildlife.co.uk/wPress/cetaceans-in-orkney/ last accessed 06/06/2024

[7] Species reported within a 10km (sea route) from 2001-2020 to Scottish Marine Animal Stranding Scheme (SMASS) available at: https://strandings.org/map/ (Accessed 07/06/2024)

[8] Orkney Marine Mammal Research Initiative data request, available at: https://ommri.org/ (Accessed 18/05/2023)

[9] ORCA Whale and Dolphin Sightings interactive map, available at: https://orca.org.uk/whale-dolphin-sightings (Accessed 27/05/2024)

[10] OMMRI Longhope Harbour Porpoise Project 2022, available at: https://ommri.org/get-involved-2/longhope-bay-harbour-porpoise-project/ (Accessed 28/05/2024)

[11] OMMRI Trustees' Annual Report 6th April 2022 to 5th April 2023, available at: https://ommri.org/wp-content/uploads/2024/03/22-23-TAR_FINAL.pdf (Accessed 28/05/2024)

2.2 Underwater Noise Modelling

Underwater noise modelling was commissioned as part of this assessment assess noise levels generated by common construction methods. Note, piling and associated drilling are no longer required for the caisson design.

Please refer to Irwin Carr Consulting report: ‘SDWQ, UW Noise Modelling’, Appendix B which details the methods and findings of the underwater noise modelling.

2.3 Disclaimer

It should be noted that the baseline is limited by the reliability of third party information and the geographical availability of biological and/or ecological records and data. The absence of species from biological records cannot be taken to represent actual absence. Species distribution patterns should be interpreted with caution as they may reflect survey/reporting effort rather than actual distribution.

3 BASELINE

3.1 Desk Study

All cetaceans present in Scottish waters are European Protected Species (EPS) and are classed as Priority Marine Features (PMFs).

Harbour Porpoise
The harbour porpoise (*Phocoena phocoena*) is widely distributed and common throughout the Orkney region. Harbour porpoise are predominantly confined to shelf waters, although sightings have occurred in deep water. Although present throughout the year, most sightings associated with Orkney occur during summer-Autumn (June to October), with peak number of records occurring July-August.

Harbour porpoises eat a variety of fish, cephalopods and crustaceans, determined by local availability. Prey species including herring (*Clupea harengus)*, sprat (*Sprattus sprattus*), pouting (*Trisopterus luscus*), sandeel (*Ammodytes tobianus*), gobies (*Gobiidae*), cod (*Gadus morhua*), saithe (*Pollachius virens*) and whiting (*Merlangius merlangus*)[12].

No sightings of harbour porpoise have been recorded within the proposed development site, however records of harbour porpoise have been recorded within Orkney waters. Table 3.1 lists records of harbour porpoise applicable to the wider area:

Table 3.1: Records of Harbour Porpoise

Resource	Date records available	Records/ Information
SWF	2022	10 records of harbour porpoise have been submitted to SWF in 2022 from Orkney, consisting of 28 individuals, the closest being approximately 10km south of the development site, offshore of Hoxa in July.
HWDT	2014-2024	65 sightings comprising 311 individuals between 2022-2024 were returned from HWDT within a 65km radius, with the closest record being 17km south west of the site.
OW	N/A	OW also state that each Autumn large numbers gather in Switha Sound to the south of Scapa Flow (approximately 15km south west).
OMMRI	1977-2020	734 records of harbour porpoise sightings (dead and alive) within 10km radius of SDWQ have been submitted to OMMRI between 1977-2020.
ORCA	2011-2022	11 sightings of harbour porpoise comprising 12 individuals have been submitted to ORCA between 2011-2022, predominantly to the east and north east. The furthest record was 36km from the SDWQ development.
Longhope Harbour Porpoise Project 2022	2022	Anecdotal evidence over the last few years suggests 150-250 harbour porpoises gather at Longhope Bay each year (approximately 21km from the SDWQ site) from the end of August to November. It is considered to the largest aggregation in the UK.

[12] SWF, harbour Porpoise fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Harbour-Porpoise.pdf (Accessed 07/06/2024)

Andrew Upton	2022 - 2024	10th April 2022 11:40-11:45 four harbour porpoises resting at surface then continued north, approximately 2.5km south from the development site. 25th April 2022 12:59 one-two harbour porpoises very briefly noted, approximately 2.3km south of the development site. 27th August 2022 several harbour porpoises moving west >3km from the development site. 29th September 2022 two harbour porpoises sighted >3km west of the development site. 26th December 2023 13:30 one-two harbour porpoises briefly observed >2km north west of the development site. 4th November 2023 p.m. several harbour porpoises recorded briefly >3km from the development site. 10th January 2024 10:50 several harbour porpoises recorded >3km south of the development site. 25th March 2024 12:30 two harbour porpoises identified approximately 3km west of the development site.
OMMRI 2022 Sightings Report	2022	Harbour porpoise was by far the most numerous cetaceans reported in 2022. Aggregations of harbour porpoise in the Longhope Bay were recorded in late August to the end of October. Four harbour porpoises were observed in Longhope Bay, Hoy on 11th December.
SMASS	1993-2022	52 records of harbour porpoise strandings between 1993-2022 within a 20km radius of the development site.

In the 2023 report on estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys, the most recent harbour porpoise abundance estimates for the assessment unit covering Orkney (North Sea (NS)) based on SCANS-IV data are 338,918 individuals (95% confidence interval: . Figure 2-1 shows predicted density for harbour porpoise in 2022 using SCANS-IV survey data. The predicted density around the development site is within the range of 0.11–0.30 animals per km², slightly below with values reported for the broader North Sea assessment unit.

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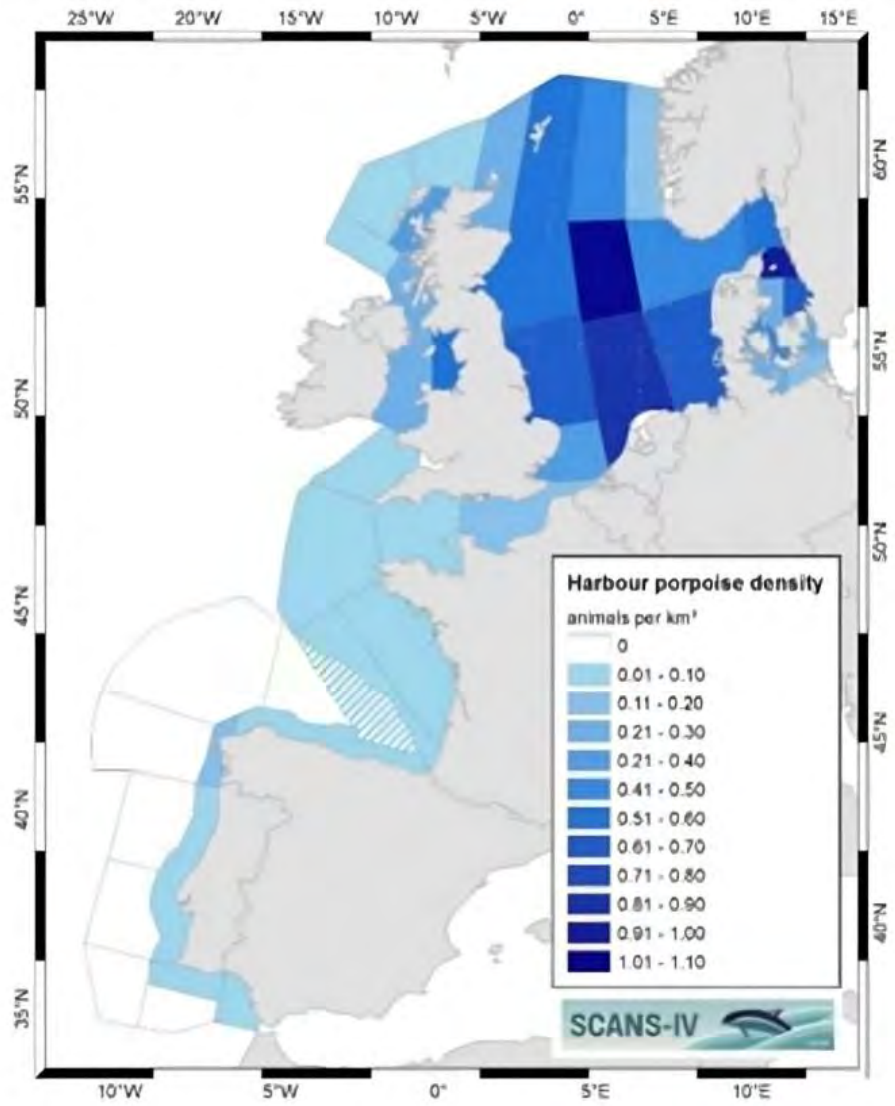


Figure 3-1: Predicted density surface for harbour porpoise in 2022 using SCANS-IV survey data.

From the information gathered (number of records and locations of records) harbour porpoise are regularly present within Scapa Flow and may be impacted by the proposed development.

Risso's Dolphin

Sightings of Risso's dolphin (*Grampus griseus*) around Orkney are amongst the furthest north in the eastern Atlantic, with most frequent sightings concentrated along the west coasts of Orkney, particularly west mainland and west Hoy, but also off North Ronaldsay and in the Pentland Firth. They are widely distributed mainly in groups of 5-25 (occasionally up to 50) individuals. Risso's dolphins have been recorded mainly over slopes of 50-100 m depth in the UK.

Sightings generally occurring between April and November, with peak number of records occurring in August. Strandings have occurred between November and March and individuals have also been observed off north-east Scotland and Shetland in winter, suggesting that the species may be present in the area year-round.

Risso's dolphin predominantly eat cephalopods, specifically octopus (*Octopoda*), cuttlefish (*Sepiida*) and various small squid (*Decapodiformes)*, but will occasionally eat small fish, including cod[13].

No sightings of Risso's dolphin have been recorded within the proposed development area, however records of Risso's dolphin have been recorded within Orkney waters. Table 3.2 lists records of harbour porpoise applicable to the wider area:

Table 3.2: Records of Risso's Dolphin

Resource	Date records available	Records/ Information
SWF	2022	Eight records of Risso's dolphin (38 individuals) off the coast of Orkney, have been submitted to SWF, with the closest sighting being approximately 10km south, offshore of Hoxa.
HWDT	2014-2024	39 sightings of 160 individual Risso's dolphin have been recorded via the HWDT, with the closest record approximately 13km south west.
OW	N/A	No information available
OMMRI	1964-2020	146 records of Risso's dolphin sightings within 10km radius of SDWQ have been submitted to OMMRI between 1964-2020.
ORCA	2021-2022	Nine sightings of Risso's dolphin comprising 41 individuals within a 38km radius of SDWQ have been submitted to ORCA between 2021-2022, predominantly to the south and east.
Andrew Upton	2022	19th February 2022 08:15, six Risso's dolphin sighted 2.3km from the development site.
OMMRI 2022 Sightings Report	2022	Four Risso's dolphin on 6th March were recorded off Stanger Head, Flotta. A pod of 12 were observed well spread-out between Hoxa, Flotta and Switha on 5th November.
SMASS	1994-2020	Six records of Risso's dolphin strandings between 1994-2020 within a 20km radius of the development site.

The most recent Risso's dolphins abundance estimates for the assessment unit covering Orkney (Celtic Sea (CS-K)) based on SCANS-IV data are 1,519 individuals (95% confidence interval: 9-5,099). Risso's dolphin density estimate for the Celtic Sea (CS-K) block based on SCANS-IV aerial survey data is 0.0376 animals per km², with a mean group size of 9.

From the information gathered (number and locations of records) Risso's dolphin are present occasionally within Scapa Flow and may be impacted by the SDWQ development.

Minke Whale

Minke whale (*Balaenoptera acutorostrata*) are widely distributed in relatively small numbers, usually observed singly or in pairs. They tend to reside mainly on the continental shelf in water depths of 200 m or less, often being observed close to land, however have been recorded at depths of 500m. Minke whales are frequently seen in coastal and inshore waters and are widely distributed throughout the North Sea. Minke whale are mostly observed along the west and south coasts of Orkney and in the Pentland Firth. The species is deemed widely distributed in small numbers, with most sightings occurring between June and October.

Minke whale are both meso- and bentho-pelagic feeders, with those in the northern hemisphere, mainly taking fish including sandeel, herring, mackerel (*Scombrus scombrus*), sprat, capelin (*Mallotus*

[13] SWF, Risso's dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/10/Rissos-Dolphin.pdf

villosus), cod, whiting, haddock (*Melanogrammus aeglefinus*), but will also take euphausiids and copepods, especially at higher latitudes[14].

Minke whale have been recorded within the proposed development area as well as within the waters associated with Orkney. Table 3.3 lists records of minke whale applicable to the development site and wider area:

Table 3.3: Records of Minke Whale

Resource	Date records available	Records/ Information
SWF	2022	One sighting submitted to SWF of minke whale was recorded approximately 13km south of the proposed development in 2022.
HWDT	2014-2024	24 sightings of 26 individual minke whale have been reported to HWDT, with the nearest sighting being 13km south.
OW	N/A	No information available
OMMRI	1951-2020	142 records of minke whale sightings (dead and alive) within 10km radius of SDWQ have been submitted to OMMRI between 1951-2020.
ORCA	2021-2022	Four records of minke whale comprising four individuals within a 44km radius of SDWQ have been submitted to ORCA in 2022, east, south and north west of the site.
Andrew Upton	2022 - 2024	10th April 2022 10:30 one minke whale observed briefly heading into Scapa Bay >2.5km north of the development site. 10th April 10:05 2022 one minke whale identified >600m from the development site. 10th April 10:40-10:53 2022 one minke whale was observed travelling south along the coast and through the development site. 16th March 2024 09:50 one minke whale identified >3km west of the development site.
OMMRI Sightings report 2022	2022	A lone minke whale was observed heading west through Scapa Flow on the 10th November.
SMASS	1994-2018	15 records of minke whale strandings between 1994-2015 within a 20km radius of the development site.

The most recent minke whale abundance estimates for the assessment unit based on SCANS-IV data are 467 individuals, with a 95% confidence interval ranging from 2-1,655. Minke whale density estimate for the CS-K block based on SCANS-IV aerial survey data is 0.0116 animals per km², with a mean group size of 1. Figure 3-2 shows predicted density for minke whale in 2022 using SCANS-IV survey data. The predicted density around the development site is within the range of 0.011–0.015 animals per km², below the values reported for the broader North Sea assessment unit.

[14] SWF, minke whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Minke-Whale.pdf

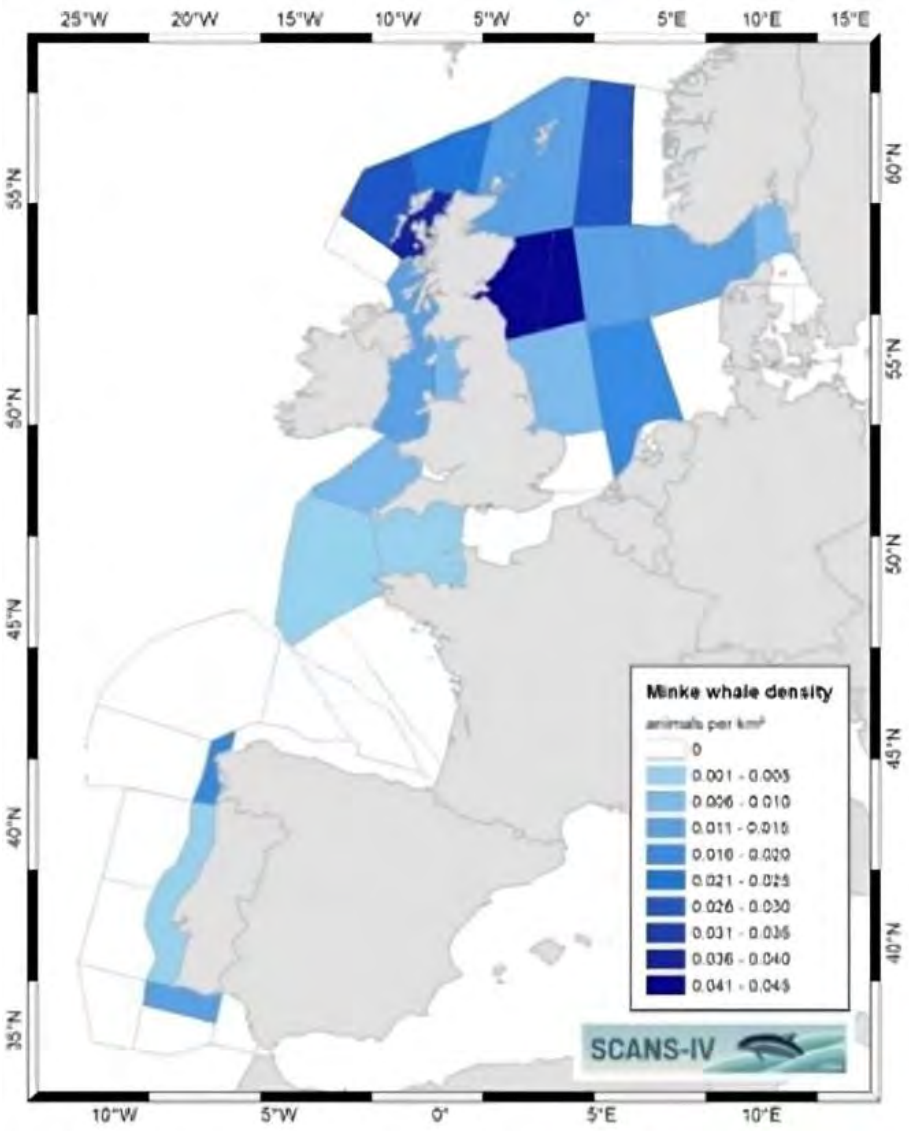


Figure 3-2: Predicted density surface for minke whale in 2022 using SCANS IV survey data

From the information gathered (number of records and locations of records) minke whale may be impacted by the SDWQ development.

Long-finned Pilot Whale

Long-finned pilot whale (*Globicephala melas*) mainly occur in deep waters (200-3,000 m), although have occasionally been observed in shallower coastal waters around northern Scotland, the northern North Sea and the Channel. Long-finned pilot whales occur in greater numbers to the north of Scotland, with little seasonality in the pattern of sightings. Long-finned pilot whale are infrequently observed in nearshore waters, but sightings have been recorded year round, with no particular area favoured, although greater sightings are recorded between November and March, when several mass strandings have also occurred.

Long-finned pilot whale are benthic and pelagic feeders, with a diet consisting predominantly of squid, with some fish, including mackerel, hake (*Merluccius hubbsi*), cod, whiting, pollack (*Pollachius pollachius*), scad (*Selar crumenophthalmus*), sea bass (*Dicentrarchus labrax*) and sandeels [15].

No sightings of long-finned pilot whale have been recorded within the development area, however records of long-finned pilot whale have been recorded within Orkney waters. Table 3.4 lists records of long-finned pilot whale applicable to the proposed development site:

Table 3.4: Records of Long-finned Pilot Whale

Resource	Date records available	Records/ Information
SWF	2022	One record of long-finned pilot whale, approximately 15km south west of the development site, offshore of Hoy, was submitted to SWF in 2022.
HWDT	N/A	No information available
OW	N/A	No information available
OMMRI	1980-2020	14 records of long-finned pilot whale sightings within 10km radius of SDWQ (at Billia Croo and Black Craig, Stromness and Warbeth) have been submitted to OMMRI between 1980-2020.
ORCA	N/A	No records.
Orkney Council	2019	Orkney Council comments to the MSLOT scoping response for Hatston[16] refer to a pod of pilot whales found within Kirkwall Bay, near to the Hatston Pier in May 2019 (approximately 45km from the SDWQ site).
OMMRI 2022 Sightings Report	2022	The only long-finned pilot whale was a single animal washed in dead at Bay of Tafts, Westray on 20th February.
SMASS	1999-2021	4 records of long-finned pilot whale strandings between 1999-2021 within a 20km radius of the development site.

No abundance estimates for the CS-K block based on SCANS-IV aerial survey data for long-finned pilot have been provided. Previous density estimates of 0.00-0.003 pilot whales/km^2 were predicted by SCANS III survey data for the Orkney region[17].

The habitat within the proposed development site is suboptimal for long-finned pilot whale and records suggest they are infrequent visitors, however there are enough records to suggest they may be present and have potential to be impacted by the SDWQ development.

Killer Whale

Killer whale (*Orcinus orca*) are widely distributed in the northern Scottish water and specifically throughout Orkney waters. Killer whales are considered to be within the waters of Orkney all year

[15] SWF, long-finned pilot whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Long-finned-Pilot-Whale.pdf

[16] Marine Scotland – Licensing Operations Team Scoping Opinion Scoping Opinion adopted by the Scottish Ministers under Part 4 of The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017. Orkney Island Council Harbour Authority Expansion of Hatston Pier and Harbour. October 2021

[17] Scottish Government: Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters, Scottish Marine and Freshwater Science Vol 11 No 12 (2020), available at: https://data.marine.gov.scot/sites/default/files/Scottish%20Marine%20and%20Freshwater%20Science%20%28SMFS%29%20Vol%2011%20No%2012%20Regional%20baselines%20for%20marine%20mammal%20knowledge%20across%20the%20North%20Sea%20and%20Atlantic%20areas%20of%20Scottish%20waters.pdf

round. Sightings of killer whales usually first appear in coastal waters around the Northern Isles and Outer Hebrides in May and June, singly or in groups numbering up to 14 individuals, with peak number of records occurring between June and October. Sightings have been reported particularly around Pentland Firth, the Scapa Flow and the North Isles. Pods of up to 150 killer whales have also been observed in the North Sea east of Orkney, closely associated with purse seine fishing activities.

Killer whale use a wide variety of foraging methods and thus have a very variable diet, including fish, such as herring, mackerel, salmon (*Salmo salar*), cod, halibut (*Hippoglossus stenolepis*), squid, rays (*Batoidea*), marine mammals, and occasionally turtles (*Testudines*) and birds[18].

Killer whale have been recorded within the development area and within the waters surrounding Orkney. Table 3.5 lists records of killer whale applicable to the development site:

Table 3.5: Records of Killer Whale

Resource	Date records available	Records/ Information
SWF	2022	10 records of killer whale (43 individuals) off the coast of Orkney, have been submitted to SWF in 2022, with the closest sighting being within Scapa Flow, in proximity to the proposed development site.
HWDT	2014-2024	30 sightings of 109 individual killer whales reported to HWDT with the nearest recorded 3km south of the proposed development site.
OW	N/A	OW also state killer whale have been sighted in the waters surrounding Orkney.
OMMRI	1978-2020	51 records of killer whale sightings within 10km radius of SDWQ have been submitted to OMMRI between 1978-2020.
ORCA	2021-2022	Two records of killer whale comprising four individuals within a 35km radius of SDWQ have been submitted to ORCA between 2021-2022, north east of the site.
Andrew Upton	2022 - 2023	20th May 2022 11:49 seven-eight killer whale sighted slowly surfacing then diving back down, briefly returned at 12:12 to a similar area, approximately 2km from the site. 20th May 2022 17:45-17:55 several killer whale were sighted moving steadily south in Scapa Bay, approximately 3km from the development site. 3rd June 2022 06:14 six killer whale (with big male) sighted travelling south >3km from the development site. 3rd June 2022 07:15 several killer whale recorded >2.5km south of the development site. 3rd June 2022 12:00-12:18 several killer whale observed travelling south through Scapa Flow with the nearest location recorded >1km from the development site. 3rd June 2022 10:55-11:12 four killer whale, were observed travelling south in Scapa Flow approximately 200m from the development site. Further south the number of individuals increased from six to several. 3rd June 2022 12:23 five-six killer whale observed travelling north >2km from the development site.

[18] SWF, killer whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2021/03/Killer-Whale.pdf

Resource	Date records available	Records/ Information
		1st December 2023 14:02 two male killer whale identified travelling south, 1km north of thew site and commuting within 500m of the development site. 1st December 2023 14:10 five female/immature killer whales recorded <1km north of the development site and travelling south through the development site and continuing south.
OMMRI Sightings report 2022	2022	Sightings of killer whales around the waters of Orkney have been returned for 2022.
SMASS	N/A	No records

No abundance estimates for killer whale are available for the Orkney region.

From the information gathered (number of records and locations of records) killer whale may be present within the vicinity of the proposed development occasionally and could therefore be impacted.

White-beaked Dolphin

White-beaked dolphin (*Lagenorhynchus albirostris*) are recorded frequently in the North Sea and are fairly common and widely distributed around Orkney. Although present year-round in near-shore waters, with most sightings occurring offshore in the northern North Sea east and south of Orkney or at either end of the Pentland Firth throughout the year, peak number of records of the species generally occur between June and October.

White-beaked dolphin eat a variety of prey items, including fish (cod, whiting, hake, haddock, sprat, mackerel, herring, scad, and gobies), cephalopods (octopus) and sometimes crustaceans[19].

No sightings of white-beaked dolphin have been recorded within the development area, however records of white-beaked dolphin have been reported within the waters surrounding Orkney. Table 3.6 lists records of white-beaked dolphin applicable to the development site:

Table 3.6: Records of White-beaked Dolphin

Resource	Date records available	Records/ Information
SWF	2022	One sighting submitted to SWF of white-beaked dolphin was recorded approximately 24km west of the proposed development in 2022.
HWDT	2014-2024	10 sightings of 57 individuals reported to HWDT, with the nearest recorded 44km west of the proposed development site.
OW	N/A	No information available
OMMRI	1976-2020	36 records of white-beaked dolphin sightings within 10km radius of SDWQ (Billia Croo, Stromness) have been submitted to OMMRI between 1976-2020.
ORCA	N/A	No records.
OMMRI 2022	2022	A small calf live-stranded at Scapa was recorded on 22nd January (refloated by members of the public, but it died in the process).

[19] SWF, white-beaked dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/White-beaked-Dolphin.pdf (Accessed 07/06/2024)

Resource	Date records available	Records/ Information
Sightings Report		
SMASS	1992-2022	22 records of white-beaked dolphin strandings between 1992-2022 within a 20km radius of the development site.

The most recent white-beaked dolphin abundance estimates for the assessment unit based on SCANS-IV data are 5,460 individuals, with a 95% confidence interval ranging from 191-12,812. White-beaked dolphin density estimate for the CS-K block based on SCANS-IV aerial survey data is 0.1352 animals per km², with a mean group size of 3.91.

From the information gathered (number of records and locations of records) white-beaked dolphin may be present within the vicinity of the proposed development site occasionally and therefore may be impacted.

Atlantic White-sided Dolphin

Atlantic white-sided dolphin (*Lagenorhynchus acutus*) are predominantly distributed north west of Britain and found in deep waters around the north of Scotland throughout the year and tend to be an infrequent visitor to the nearshore waters of Orkney. They tend to enter the North Sea mainly in summer, but little is known about seasonal movements. Atlantic white-sided dolphin are most frequently sighted around the waters to the west of Orkney out to Sule Skerry between May and October, with peak number of records occurring in August.

Atlantic white-sided dolphin are pelagic feeders, predominantly eating herring, silver pout (*Gadiculus argenteus*), blue whiting (*Micromesistius poutassou*), scad, lantern fish (*Myctophidae*), Argentine (*Argentina*) and mackerel as well as some squid and shrimps (*Caridea*)[20].

No sightings of Atlantic white-sided dolphin have been recorded within the development area, however records of Atlantic white-sided dolphin have been reported within the waters surrounding Orkney. Table 3.7 lists records of Atlantic white-sided dolphin applicable to the development site:

Table 3.7: Records of Atlantic White-sided Dolphin

Resource	Date records available	Records/ Information
SWF	N/A	No information available
HWDT	2014-2024	One sighting of five individuals were reported to HWDT located 14km south west of the proposed development site.
OW	N/A	No information available
OMMRI	1927-2015	45 records of Atlantic white-sided dolphin sightings within 10km radius of SDWQ (Billia Croo and Black Craig, Stromness) have been submitted to OMMRI between 1976-2015.
ORCA	N/A	No records.
OMMRI 2022 Sightings Report	2022	No sightings.

[20] SWF, Atlantic white-sided dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Atlantic-White-sided-Dolphin.pdf (Accessed 07/06/2024)

SMASS	1994-2018	12 records of Atlantic white-sided dolphin strandings between 1994-20218 within a 20km radius of the development site.

No abundance estimates for the CS-K block based on SCANS-IV aerial survey data. Previous abundance estimates in the MU which covers Orkney (CGNS) based on SCANS-III and ObSERVE data were 18,128, with the UK proportion of the MU being 12,293 individuals.

From the habitat preferences, reduced number of records and locations in what records have been submitted, Atlantic white-sided dolphin are considered unlikely to be impacted by the SDWQ development.

Sperm Whale

Male sperm whales (*Physeter macrocephalus*) occur mainly in waters deeper than 200m beyond the shelf break north of Scotland, but they have also been observed in near-shore waters mainly off the Northern Isles of Scotland. Sperm whale are frequently sighted between July and December.

Sperm whale eat a variety of deep sea squid. However, they will also take saithe, monkfish (*Lophius*), halibut, benthic octopus, and crustaceans[21].

No sightings of sperm whale have been recorded within the development area, however records of sperm whale have been reported within the waters surrounding Orkney. Table 3.8 lists records of sperm whale applicable to the development site:

Table 3.8: Records of Sperm Whale

Resource	Date records available	Records/ Information
SWF	1993 and 1994	SWF state that sperm whale are occasionally recorded near Orkney, with most notable records of six sperm whales that remained in Scapa Flow (in proximity to the site) between 22nd February and 25th March in 1993, and eleven sperm whales which were stranded at Backaskaill Bay, Sanday (approximately 70km north) on 7th December 1994, where they died the subsequent morning.
HWDT	N/A	No information available
OW	N/A	OW state that sperm whale have been sighted, in Scapa Flow (within proximity to the development site), however previous reports of sperm whales associated with Scapa Flow suggest accidental occurrences.
OMMRI	1990-1998	7 records of sperm whale sightings within 10km radius of SDWQ have been submitted to OMMRI between 1990-1998.
ORCA	N/A	No records.
OMMRI 2022 Sightings Report	2022	No sightings.
SMASS	2000-2008	Three records of harbour porpoise strandings between 2000-2008 within a 20km radius of the development site.

[21] SWF, Sperm whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Sperm-Whale.pdf (Accessed 07/06/2024)

No abundance estimates for the CS-K block based on SCANS-IV aerial survey data. Previous density estimates of 0.00 sperm whales/km^2 were predicted by SCANS III survey data for the Orkney regio^n.

Habitat preferences and the reduced number of records and locations in what records have been submitted, suggest sperm whale are not present regularly within the vicinity of the Proposed Development and are unlikely to be impacted.

Humpback Whale

Humpback whale (*Megaptera novaeangliae*) sightings off Orkney are unusual, with isolated records almost exclusively in waters deeper than 200m. Most sightings are recorded in summer between May and September, which is when small numbers are seen off the continental shelf west and north of Scotland.

Humpback whale eat krill (*Euphausiids*) and various species of small schooling fish, such as herring, sprat, capelin, sandeel and mackerel[22].

Humpback whale have been recorded within the development area, as well as the waters surrounding Orkney. Table 3.9 lists records of humpback whale applicable to the development site:

Table 3.9: Records of Humpback Whale

Resource	Date records available	Records/ Information
SWF	2022	One sighting submitted to SWF of humpback whale was recorded approximately 7km north west of the proposed development in 2022 off the shore of Hobbister (Scapa Flow).
HWDT	2014-2024	Five sightings of seven individuals reported to HWDT, with the nearest 32km south of the proposed development site.
OW	N/A	OW state they are observed annually, mostly in Scapa Flow in proximity to the development site.
OMMRI	2006-2015	Three records of humpback whale sightings within 10km radius of SDWQ (Billia Croo and Black Craig, Stromness, approximately 20km north west of the SDWQ site) have been submitted to OMMRI between 2006-2015.
ORCA	N/A	No records.
Andrew Upton	2023	1st December 2023 13:52 one-two humpback whale recorded <1km north of the site travelling south through the development site and continuing south.
OMMRI 2022 Sightings Report	2022	One-two humpback whale were reported breaching repeatedly at Scapa Flow off Hobbister on 29th July. Two humpback whale were identified in Scapa Flow on 15th September and considered likely to be in Scapa Flow near the Sound of Hoxa on 17th September.
SMASS	N/A	No records

No abundance estimates for humpback whale are available for the Orkney region.

[22] SWF, humpback whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Humpback-Whale.pdf (Accessed 07/06/2024)

Although a limited number of records of humpback whale have been reported, recent sightings of humpback whale within the development site area result in humpback whale being likely to be impacted by the SDWQ development.

Fin Whale

Fin whale (*Balaenoptera physalus*) are distributed predominantly at depths beyond 500m. Fin whale sightings occurring mainly between June and December and peak number of records in northern Britain occur between June and August.

Fin whale diet consists predominantly of planktonic crustaceans (particularly *euphausiids*) but will also prey upon small schooling fish including herring, capelin, sandeel, blue whiting, mackerel, and squid[23].

No sightings of fin whale have been recorded within the development area, however records of fin whale have been reported within the waters surrounding Orkney. Table 3.10 lists records of fin whale applicable to the development site:

Table 3.10: Records of Fin Whale

Resource	Date records available	Records/ Information
SWF	N/A	No information available
HWDT	2014-2024	Two sightings of two individuals reported to HWDT with the nearest recorded 23km south of the proposed development site.
OW	2019-2020	OW state fine whale have been rarely observed passing Hoxa Head (approximately 13km south of the development site) and records of two strandings in Scapa Flow (in proximity to the development site) were recorded in two consecutive years, 2019 and 2020.
OMMRI	2020	Two records of fin whale sightings within 10km radius of SDWQ (Billia Croo and Black Craig, Stromness, approximately 20km north west of the SDWQ site) have been submitted to OMMRI in 2020.
ORCA	N/A	No records.
Andrew Upton	N/A	No records.
OMMRI Sightings report 2022	2022	September 15th 2022 a single fin whale was recorded in Scapa Flow. Two fin whale were observed seen near the ship to ship transfer site in Scapa Flow on 18th September and a single fin whale (assumed to be one of the two observed on the 18th September) was identified in various locations in Scapa Flow between 19th to 21st September.
OMMRI 2022 Sightings Report	2022	A number of fin whale sightings were returned in 2022. One fin whale was reported on 15th September in Scapa Flow. Two fin whale were identified near the ship to ship transfer site in Scapa Flow on 18th and a single fin whale (assumed to be one of the two encountered on 18th) was identified in various locations in Scapa Flow between 19th to 21st September.
SMASS	2007-2020	Four records of fin whale strandings between 2077-2020 within a 20km radius of the development site.

[23] SWF, Fin whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Fin-Whale.pdf (Accessed 07/06/2024)

No abundance estimates for the CS-K block based on SCANS-IV aerial survey data. Previous density estimates of 0.00 fin whales/km^2 were predicted by SCANS III survey data for the Orkney region.

Although a limited number of records of fin whale have been reported, recent sightings of fin whale within the development site area result in fin whale being likely to be impacted by the SDWQ development.

Sei Whale
Sei whales (*Balaenoptera physalus*) have mostly been recorded in waters deeper than 200m between the Northern Isles and the Faroes (specifically in proximity to the Faroe-Shetland Channel). Infrequent sightings of sei whale have been reported in coastal waters off Shetland. In general, sightings of sei whale were mainly previously observed in July and August off the Shetland coast.

Sei whale skim the surface waters for patches of copepod, their preferred prey. However, they also feed on *euphausiids*, shoals of fish (e.g. sardine (*Sardina pilchardus*), anchovy (*Engraulidae*)) and where encountered, squid[24].

No abundance estimates for sei whale are available for the Orkney region.

From the lack of records and sub-optimal habitat sei whale are considered unlikely to be impacted by the SDWQ development.

Striped Dolphin
Striped dolphin are considered rare in UK waters, with the species normal distribution reaching its northern limits at 50º N (due to warmer temperatures) and most infrequent records reported in the South-west Channel. Striped dolphin dive between depths of 200-700m for prey.

Striped dolphin have variable diets and are classed as opportunistic feeders, depending on the region and season. Being meso- and bentho-pelagic feeders, their diet consists of fish (sprat, blue whiting, herring, mackerel, hake, sandeel, lanternfish, and cod), with crustaceans and cephalopods also making up part of their diet[25].

No sightings of striped dolphin have been recorded within the development area, with limited records within the waters surrounding Orkney. Table 3.11 lists records of striped dolphin applicable to the development site:

Table 3.11: Records of Striped Dolphin

Resource	Date records available	Records/ Information
SWF	N/A	No information available
HWDT	N/A	No information available
OW	N/A	No information available
OMMRI	1997-2012	Two records of striped dolphin sightings within 10km radius of SDWQ have been submitted to OMMRI between 1997-2012.
ORCA	N/A	No information available
OMMRI 2022	N/A	No information available

[24] SWF, Sei whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Sei-Whale.pdf (Accessed 07/06/2024)
[25] SWF, Striped dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Striped-Dolphin.pdf (Accessed 07/06/2024)

Sightings Report		
SMASS	1997-2019	Four records of striped dolphin strandings between 1997-2019 within a 20km radius of the development site.

No abundance estimates for striped dolphin are available for the Orkney region.

From the reduced number of records and locations in what records have been submitted, striped dolphin are considered unlikely to be impacted by the SDWQ development.

Cuvier's Beaked Whale

Cuvier's beaked whales (*Ziphius cavirostris*) have a preference for deep waters (1000m) and there have been only six confirmed sightings of this species in British and Irish waters. Previous sightings have occurred east of the Orkney Islands in the northern North Sea in August 1980. From the limited sightings, it has been suggested that there is likely a summer movement of Cuvier's beaked whale into UK waters between June and September.

Cuvier's beaked whale eat a variety of deep-sea squid species but will also prey upon crustaceans and fish[26].

No sightings of Cuvier's beaked whale have been recorded within the development area and limited sightings have been reported in the waters surrounding Orkney. Table 3.12 lists records of Cuvier's beaked whale applicable to the development site:

Table 3.12: Records of Cuvier's Beaked Wale

Resource	Date records available	Records/ Information
SWF	N/A	No information available
HWDT	N/A	No information available
OW	N/A	No information available
OMMRI	1963-2007	Three records of striped dolphin sightings within 10km radius of SDWQ have been submitted to OMMRI between 1963-2007.
ORCA	N/A	No information available
OMMRI 2022 Sightings Report	N/A	No information available
SMASS	N/A	No records

No abundance estimates for the CS-K block based on SCANS-IV aerial survey data. Previous density estimates of 0.00- 0.001 Cuvier's beaked whales/km^2 were predicted by SCANS III survey data for the Orkney region[17].

From the reduced number of records and locations in what records have been submitted, Cuvier's beaked whale are considered unlikely to be impacted by the SDWQ development.

Short-beaked Common Dolphin

Short-beaked common dolphin (*Delphinus delphis*) have previously been considered to not be strongly associated with the Orkney islands and in general are considered an offshore species. In

[26] SWF, Cuvier's beaked whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Cuviers-Beaked-Whale.pdf (Accessed 07/06/2024)

North Atlantic waters, short-beaked common dolphins are predominantly found in continental shelf waters, notably in the Celtic Sea and Western Approaches to the Channel.

Short-beaked common dolphin are opportunistic feeders, with their diet being very varied, but predominantly small schooling fish are preferred, with species depend upon region, including hake, horse mackerel (*Trachurus trachurus*), mackerel, sprat, sardine, anchovy, Norway pout (*Trisopterus esmarkii*), cod, scad, sandeel, herring, whiting and blue whiting. Squid is also taken depending on local availability[27].

No sightings of short-beaked common dolphin have been recorded within the development area, however records of short-beaked common dolphin have been reported within the waters surrounding Orkney. Table 3.13 lists records of short-beaked common dolphin applicable to the development site:

Table 3.13: Records of Short-beaked Common Dolphin

Resource	Date records available	Records/ Information
SWF	N/A	No information available
HWDT	2014-2024	Seven sightings of 51 individuals reported to HWDT with the nearest recorded 23km north west of the proposed development site.
OW	N/A	Short-beaked common dolphin have been rarely observed by OW.
OMMRI	1935-2020	24 records of short-beaked common dolphin sightings (dead and alive) within 10km radius of SDWQ have been submitted to OMMRI between 1935-2020.
ORCA	N/A	No information available
Andrew Upton	2022-2023	23rd June 2022 16:00 two short-beaked common dolphin observed within 2km west of the development site. 11th July 2022 12:54 two short-beaked common dolphin sighted 2.5km south west from the development site. 4th November 2023 late a.m. five-six common dolphin recorded >2km north west of the development site travelling south. 26th December 2023 11:55 seven-ten common dolphin recorded travelling north approximately 3km west of the development site.
OMMRI 2022 Sightings Report	2022	Small groups were reported in Scapa Flow in July and late August.
SMASS	1994-2021	Eight records of short-beaked common dolphin strandings between 1994-2021 within a 20km radius of the development site.

No abundance estimates for the CS-K block based on SCANS-IV aerial survey data. Previous abundance estimates for the MU which covers Orkney (CGNS) based on SCANS-III and ObSERVE data are 102,656, with the UK proportion of the MU being 57,417 individuals.

From the number of records and locations in what records have been submitted, short-beaked common dolphin are considered likely to be impacted by the SDWQ development.

[27] SWF, Short-beaked common dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Common-Dolphin.pdf (Accessed 07/06/2024)

Bottlenose Dolphin

Bottlenose dolphin (*Tursiops truncates*) are not strongly associated with Orkney islands and have been rarely recorded in the area since 1980. Bottlenose dolphin are observed in the greatest numbers between July and October (with a secondary peak number of records occurring in some localities in March-April).

Bottlenose dolphin are considered selectively opportunistic and eat a variety of fish and squid species, including cod, saithe, whiting, haddock, salmon, sprat, sandeels, pout, flatfish (*Pleuronectiformes*), and cephalopods[28].

No sightings of bottlenose dolphin have been recorded within the development area, however records of bottlenose dolphin have been reported within the waters surrounding Orkney. Table 3.14 lists records of bottlenose dolphin applicable to the development site:

Table 3.14: Records of Bottlenose Dolphin

Resource	Date records available	Records/ Information
SWF	N/A	No information available
HWDT	2014-2024	Eight sightings of 116 individuals reported to HWDT with the nearest located 26km west of the proposed development site.
OW	N/A	OW state that bottlenose dolphin have been observed offshore of Orkney.
OMMRI	2013-2020	Four records of bottlenose dolphin sightings within 10km radius of SDWQ have been submitted to OMMRI between 2013-2020.
ORCA	N/A	No information available
OMMRI 2022 Sightings Report	2022	A lone bottlenose dolphin was recorded at Finstown between 12-14th February and considered very unusual as the species is rarely observed in waters surrounding Orkney.
JNCC	N/A	The nearest statutory designated site featuring marine mammals is the Moray Firth SAC, approximately 113km from SDWQ, which is designated for supporting the only known resident bottlenose dolphin population in the North Sea (estimated to be around 130 individuals). Dolphins are present all year round[29].
SMASS	2018	One record of bottlenose dolphin strandings in 2018 within a 20km radius of the development site.

No abundance estimates for the CS-K block based on SCANS-IV aerial survey data. Previous abundance estimates for the MU which covers Orkney (Greater North Sea (GNS)) based on SCANS-III and ObSERVE data are 2,022, with the UK proportion of the MU being 1,885 individuals.

From the reduced number of records and locations in what records have been submitted, bottlenose dolphin are considered unlikely to be impacted by the SDWQ development.

Short-finned Pilot Whale

Short-finned and long-finned pilot whale species can be difficult to separate at sea. In general, short-finned pilot whale tend to be associated and reside in tropical and warm-temperate areas, whilst long-finned pilot whales occur in more cooler waters. Although the possibility exists that some of the pilot whales observed off Orkney (one record submitted to SWF in 2022) are short-finned, the conditions in

[28] SWF, Bottlenose dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Bottlenose-Dolphin.pdf (Accessed 07/06/2024)
[29] JNCC SAC Site Details available at: https://sac.jncc.gov.uk/site/UK0019808 (Accessed 07/06/2024)

these areas do not tend to suit the requirements of this species[30]. They feed mainly on squid, with octopus and fish (mackerel, hake, herring and cod) comprising some of their diet[31].

No records of short-finned pilot whales have been recorded within the development area and limited records of short-finned pilot whale have been reported within the waters surrounding Orkney. Table 3.15 lists records of short-finned pilot whale applicable to the development site:

Table 3.15: Records of Short-finned Pilot Whale

Resource	Date records available	Records/ Information
SWF	2022	One record submitted to SWF in 2022
HWDT	N/A	No information available
OW	N/A	No information available
OMMRI	N/A	No information available
ORCA	N/A	No information available
OMMRI 2022 Sightings Report	N/A	No information available
SMASS	N/A	No information available

No abundance estimates for short-finned pilot whale are available for the Orkney region.

From the reduced number of records and locations in what records have been submitted, short-finned pilot whale are considered unlikely to be impacted by the SDWQ development.

Other Cetaceans

Other rare cetacean species recorded around the shores of Orkney since 1980 include Sowerby's beaked whale (*Mesoplodon bidens*; PMF), Northern bottlenose whale (*Hyperoodon ampullatus*; PMF), false killer whale (*Pseudorca crassidens*), blue whale (*Balaenoptera musculus*), narwhal (*Monodon monoceros*) and Beluga whale (*Delphinapterus leucas*). In general, the conditions off Orkney do not tend to suit the requirements of the majority of these species and no recent records of these species were returned from SWF, HWDC, OW, OMMRI or ORCA.

3.2 Conclusion

Based on the above information, it has been assessed that the most frequently observed species in the site locale, and therefore the species considered to be of most concern within the zone of influence of the proposed SDWQ development are:

- Harbour porpoise
- Risso's dolphin
- White beaked dolphin
- Long-finned pilot whale
- Minke whale
- Killer whale

[30] No JNCC UK distribution map was available as all sightings were assumed to be of long-finned pilot whales, supported by all strandings in the study area having been of long-finned pilot whales

[31] WDC Short-finned pilot whale species guide, available at: https://uk.whales.org/whales-dolphins/species-guide/short-finned-pilot-whale/ (Accessed 07/06/2024)

- Humpback whale
- Fin whale
- Short-beaked common dolphin

The other species are less frequently observed within Orkney waters and/or the habitat within and adjacent to the site is sub-optimal and so it is highly unlikely that they will be affected by the proposed works.

4 MARINE MAMMAL RISK ASSESSMENT

4.1 Activities Affecting Marine Mammals

4.1.1 Underwater Noise Producing Activities

The Marine Scotland 'Guidance for Scottish Inshore Waters: The Protection of Marine European Protected Species from Injury and Disturbance'[32] defines what disturbance means to cetaceans as: 'Changes in behaviour which may not appear detrimental in the short-term, but may have significant long-term consequences. Additionally the effects may be minor in isolation, but may become more significant in accumulation'. Disturbance may be identified via the following behaviour:

- Changes in (direction or speed of) swimming or diving behaviour;
- Bunching together or females shielding calves;
- Certain surface behaviours such as tail splashes and trumpet blows; and
- Moving out of a previously occupied area.

The following negative effects are linked to disturbance:

- Displacement from important feeding areas;
- Disruption of feeding;
- Disruption of social behaviours such as communication, calving, breeding, nursing, resting and feeding; and
- Increased risk of injury or mortality;
- Increased vulnerability of an individual or population to predators or physical stress; and
- Changes to regular migration pathways to avoid human interaction.

At the time of underwater noise modelling being undertaken only exemplar tender designs were completed, with works originally involving dredging, piling and drilling, thus the exact details of the construction methodologies were unknown. However, to caveat for this the data used to inform the noise models was interpolated from equipment used on similar projects. Since the underwater noise modelling was undertaken, piling and associated drilling works have been removed from the design. Therefore, the construction method below is considered the most significant:

Dredging Method and Duration

Dredging for the project will involve a total of 379,407 m³ of material, comprising 72,653 m³ of hard dredge and 306,754 m³ of soft dredge, with up to 82,000 m³ of unsuitable glacial till potentially requiring sea disposal. A single dredge campaign is planned using a cutter suction dredger over an estimated twelve-week period from June to August 2028, covering the full quay alignment to depths of –15 m CD in most areas and –20 m CD in the deep pocket.

Dredged sediments will be pumped through a pipeline into a reclamation bund constructed to +4.0 m CD using screened site-won material, with an integrated weir box to manage overflow. Turbidity will be monitored outside the bund and silt booms deployed during infilling.

[32] https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2020/07/marine-european-protected-species-protection-from-injury-and-disturbance/documents/marine-european-protected-species-guidance-july-2020/marine-european-protected-species-guidance-july-2020/govscot%3Adocument/EPS%2Bguidance%2BJuly%2B2020.pdf

Ballast Water and Caisson Transport

Caissons will be transported to site on a semi-submersible vessel and kept dry during transit, which significantly reduces the risk of biofouling. After placement at Scapa Flow, ballasting operations will use local seawater, and some caissons may undergo temporary in-water wet storage before installation.

4.1.2 Increased vessel movement

Baseline Vessel Movements

Project have provided information on the current typical monthly vessel movements experienced within the eastern area of Scapa Flow. This baseline is derived from the Project NRA (see Appendix 2.3 of EnviroCentre, 2025a). Baseline vessel activity in Scapa Flow is characterised by a high level of diverse maritime traffic year-round, with AIS data showing 2,884 vessel movements in August 2023 (summer) and 2,504 movements in February 2024 (winter). Vessel types include ferries, cargo vessels, fishing boats, tankers, offshore support vessels, pilot boats, tugs, and recreational craft. Extrapolation across the seasons indicates approximately 15,342 movements during the summer period (April–September) and 13,062 during winter (October–March). Within the eastern area of Scapa Flow—closest to the Project site—current typical activity amounts to 124 vessel movements per month, including fuel tankers, ship-to-ship operations, tug trips, pilot boat operations, and occasional workboats. This local flow represents only ~5% of total Scapa Flow traffic, highlighting that while the area experiences consistent marine use, it is not one of the most intensively trafficked parts of the Flow.

Vessel Movements During Construction

As per Table 1-3, the construction phase will see a total of 112 vessel movements over the 26-month period. This includes: Caisson deliveries and tug operations; Scour protection trips; Caisson infill trips; and dredging disposal trips (barge to FI040).

Vessel movements during operation

As per Section 1.4.1. there will be an estimated 192 operational vessel movements per year (approximately 154 in the summer months [April - September inclusive] and 38 in the winter [October – March inclusive]).

Based on baseline vessel movements (as informed by the NRA; see Technical Appendix 2.3 of EnviroCentre, 2024) and summarised in Section 1.4.1, this will result in an additional 6 vessel movements per month on average (+0.3% from baseline) during winter months (October-March) and an additional 26 vessel movements per month on average (+1.0% from baseline) during summer months (April-September).

4.2 Cumulative Impacts

Other developments within Orkney are considered to have the potential to result in an in-combination effect for marine mammals. The developments that have been considered for the in-combination assessment are listed in Section 9.2.2 and 9.3.3 of the HRA [July 2026]. Please refer to these documents where this is discussed further.

4.3 Effects of Acoustic Impacts on Marine Mammals

The way in which noise affects marine mammals is dependent on several factors, including the type of noise generated, the noise level, the species of marine mammal and the distance between the animal and the source of the noise. The National Oceanic and Atmospheric Administration (NOAA) describes how different groups of marine mammals hear and are affected by sounds, which can be found in the *'Guidance for Assesing the Effects of Anthropogenic Sound on Marine Mammal Hearing'*[33]. The effects can be described as either a Permanent Threshold Shift (PTS), where an animal experiences irreversible damage to their hearing which can in turn affect their ability to forage and reproduce and in extreme circumstances result in death; or a Temporary Threshold Shift (TTS) which an animal can recover from, but may experience 'masking' which reduces its ability to communicate with other animals and locate prey, resulting in fatigue[34].

Cetaceans rely on their hearing for foraging, navigation and mating. The impact of noise to a population level is difficult to determine, however the expected impact on an individual animal's hearing ability and potential damage that could be caused by noisy activities during construction is assessed by modelling representative scenarios, taking into account environmental variables and the animal's hearing capabilities.

Two noise sources were considered for this assessment, but drilling was screened out as it was not considered loud enough to be meaningfully assessed in an environment with many vessels and general human activity. The underwater noise modelling provide a comparison of drilling noise with the other noise producing works and vessel noise which is depicted in, below.

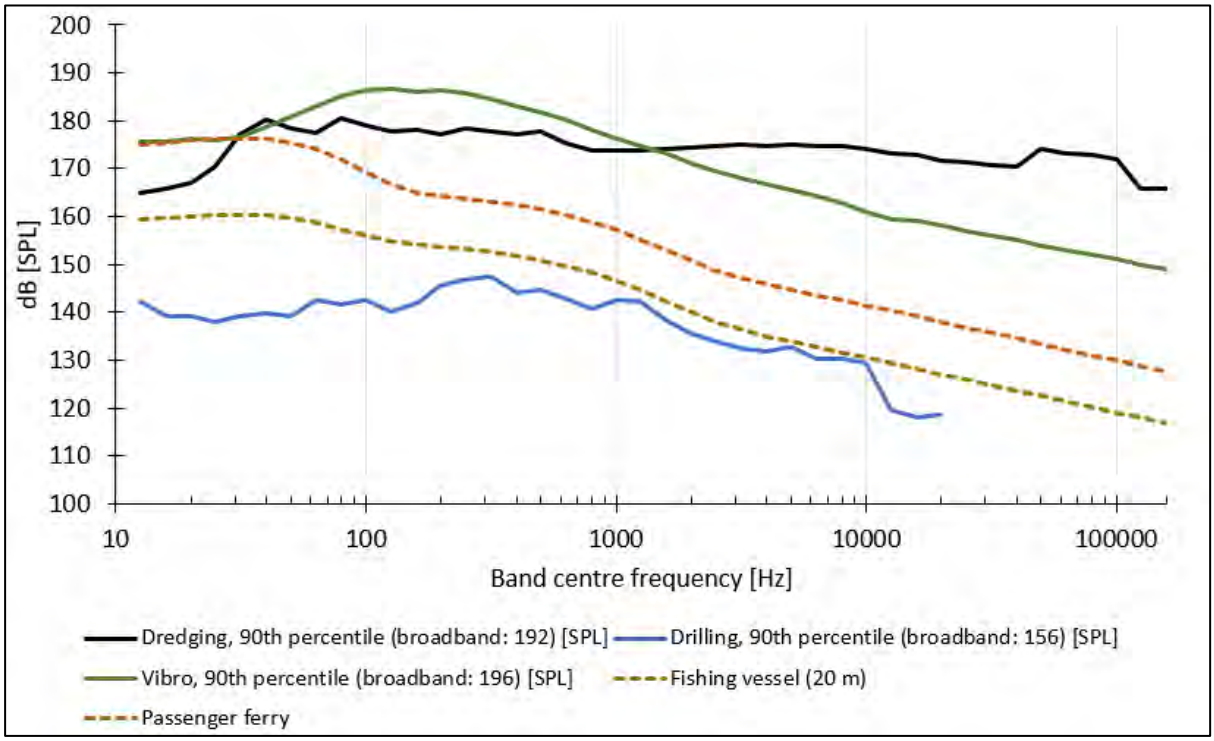


Figure 4-1: Underwater noise modelling figure 7.1 showing the three sound sources considered in the report, alongside a fishing boat and a small ferry for context.

[33] NOAA guidance available at: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm (Accessed 07/06/2024)
[34] JNCC UK Marine Noise Registry: Information Document available at: http://jncc.defra.gov.uk/pdf/MNR_Draft_InfoDoc_V1_20160808.pdf (Accessed 07/06/2024)

Dredging

The noise from dredging has short risk ranges for PTS for minke whale, fin whale and humpback whale (60 m) and killer whale, Risso's dolphin, common dolphin and pilot whales (<50 m) over an 8hr period and <50 m over 1hr period. TTS risk ranges for minke whale, fin whale and humpback whale are 1250 m and 160 m for killer whale, Risso's dolphin, common dolphin and pilot whales over an 8hr period, reducing to 230 m and 60 m respectively for 1hr period. Porpoises are at a PTS risk of 80m and TTS risk of 620 m, at close range, during short exposure (<1hr) and PTS risk of 210 m and TTS risk of 1350 m over 8hr period. Whilst dredging is being assumed to take place up to 24 hours a day, it is considered that any animals would move away from the noise source and so prolonged exposure is considered unlikely. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away.

Disposal of Dredged Materials

Following identification and screening of available disposal options by EnviroCentre[35], a combination of on land and at sea disposal were considered the most appropriate options. At sea disposal (within the disposal site) would only consist of material considered unsuitable for construction works i.e. material with high silt content. At sea disposal was considered as it would require minimal transportation requirements and low environmental risk. The selected licensed marine waste disposal site which has been 'open' since 2020, is located 24km from the proposed SDWQ development site. It has been agreed that disposal of any dredge arising, to sea, will take place out with the SPA (disposal site FI040).

Overall, the associated risk of degradation of water quality directly associated with the proposed disposal and thus impacts to marine mammals is considered to be low i.e. unlikely to cause a change in status of the waterbodies in question at both the dredge and disposal sites.

Comparisons of dredging sound for all activities associated with dredging (dredging itself, transit, placement, pumping and rainbowing – aerial discharge of dredged material in a fountain) for a 2,000ha harbour extension of the Port of Rotterdam using modelling revealed that rainbowing had the second lowest sound levels recorded out of all elements of the dredging activities (sediment consisted of sand)[36]. As such, with dredge noise levels for the SDWQ project having short risk ranges of PTS (80m) and TTS (620m), based on the modelling example, it could be assumed that disposal would have reduced risk ranges of noise output on marine mammals.

General Disturbance

Disturbance to marine mammals may occur as a result of the works occurring. The most likely disturbance to marine mammals as a result of the noise related activities include both physiological (increased stress and cortisol levels, rapid heartbeat and increased breathing rate) and behavioural disturbance (Changes in (direction or speed of) swimming or diving behaviour, bunching together or females shielding calves, surface tail splashes and trumpet blows and moving out of occupied area).

It is expected that marine mammals would be likely to exhibit a behavioural change as a result of the noise, predominantly fleeing away from the noise source, with trumpet blows and splashing occurring. In addition, physiological stress is likely to also occur. This could impact marine mammals energy and fitness levels through disturbing foraging or causing avoidance of feeding areas for periods of time.

[35] SDWQ BPEO Report Final – Rev2
[36] https://dredging.org/documents/ceda/html_page/2013-06-woda-technicalguidance-underwatersound_lr.pdf

4.4 Effects of Water quality in relation to dredging

Increases in suspended sediment concentration (SSC) arising from project dredging activities during construction have the potential to affect marine mammals indirectly by altering the availability or behaviour of their prey.

As outlined in section Technical Appendix 4.1, Volume 3 of the EIAR (EnviroCentre, 2023), the marine deposits within the dredge area comprise an approximate stratigraphic order of superficial marine deposits (loose to medium dense gravelly silty sands with shell fragments and occasional cobbles) overlying glacial till. A Dredging Best Practicable Environmental Option Report (BPEO) has been produced for the proposed development which identifies the dredge budget to consist of approximately 17% gravel, 60% sand, and 23% silt and clay.

Hydrodynamic modelling summarised in Technical Appendix 4.1, Volume 3 of the EIAR (EnviroCentre 2023) show little impact on the surrounding water column and seabed due to the low energy environment in this part of Scapa Flow. Therefore Section 8.4.1 of the EIAR (EnviroCentre, 2023) concluded that impacts on prey species for marine mammals are expected to be negligible such that their abundance and general distribution remains unchanged from the baseline. In addition, the magnitude or the sediment discharge and dispersion from dredging works will be low within the dredge area and its immediate vicinity, and negligible out with this area. Thus, the supporting habitats for marine mmmals beyond the development footprint will be maintained.

Proposed reclamation fill activities could also result in plumes and increased SSC, with a resultant impact on prey species. The fill material will be a mixture of sediment locally generated by quarries and dredging, the coarse nature of which, in combination with locally weak tidal currents, will limit the duration and spread of any plume generated.

Chapter 5 of the EIAR (EnviroCentre, 2023) states that impact on prey species will be temporary and spatially restricted (Section 5.6.3.1 of EnviroCentre, 2023) and confirmed that there is sufficient alternative habitat for foraging and commuting for marine mammals.

Construction impacts to fish species, from underwater noise and pollution, was assessed as being of low magnitude and not significant in the EIAR (EnviroCentre, 2023), due to the limited spatial extent (i.e. restricted to discrete areas near the dredging and reclamation areas), the relatively short-term duration (as it is limited to the duration of the dredging activities), intermittent nature and high reversibility.

As a precautionary measure during construction, the project proposes to undertake turbidity monitoring to protect water quality and ensure minimal environmental impact. The project proposes to monitor sediment re-suspension levels to prevent damage to the local ecosystem and aquaculture as high sediment concentrations can contribute to suboptimal conditions and may harm aquaculture fish since it affects the overall ecological balance and the fish have restricted movement. By monitoring turbidity, the project can determine potential impacts on the environment and implement corrective actions. Furthermore, silt booms will be utilised to contain fine sediments while reclamation works are undertaken, to minimise the spread of sediments and thus disturbance to prey species in the marine environment.

Measures such as silt booms and careful dredging protocols will act to limit sediment disturbance and prevent the release and dispersal of sediments.

Any SSC increases will be confined to a very small spatial area and short-term duration and will not extend into wider foraging grounds used by marine mammals. The supporting habitats for prey species beyond the project site will therefore remain unaffected.

Overall, the associated risk of degradation of water quality directly associated with the proposed disposal and thus impacts to marine mammals is considered to be low i.e. unlikely to cause a change in status of the waterbodies in question at both the dredge and disposal sites.

4.5 Effects of Terrestrial Noise from Blasting

Disturbance of marine mammals whilst at the surface on land could be caused by noise associated from terrestrial blasting, which could have a negative impact on marine mammals.

Although the majority of energy generated within the atmosphere from any surface mineral blasting will be of a sub-audible nature, there will also be a component that is audible, i.e. at frequencies greater than 20 Hz, and as such can be heard as noise and measured in terms of dB(A).

Routine blasting operations regularly generate air overpressure levels at the closest point to blast area of around 120 dB and the National Marine Fisheries Service (NMFS) predicts that marine species exposed to $\geq$100 dB (in-air) will be behaviourally harassed[37]. However, the intensity of these noise levels experienced at a distance from the blast site are affected by a range of meteorological conditions (wind speed and direction, temperature, cloud cover and humidity). For example, if a blast is detonated in a motionless atmosphere in which the air temperature is constant, then the air overpressure intensity will decrease purely as a function of distance and will, once outside of the immediate vicinity of the blast, reduce by 6 dB as the distance from source doubles. Although such conditions are very rare, the overall result is that the nominal 6 dB reduction may be greater in some directions from the source and less in others.

A 6m high bund will be formed at the seaward boundary of the site by retaining the existing land and excavating behind, creating a natural noise screen from terrestrial blasting (and other works) and will only be removed once the site is excavated to the final profile. This would reduce the effects of noise on marine mammals at the water's surface. Furthermore, a 10-minute pre-work search is to be implemented to ensure that no marine mammals in the marine environment are in the vicinity of the works that could be impacted.

In addition to bunding, a range of other controls and mitigation measures can and should be implemented when undertaking terrestrial blasting, including screens to further dampen sound, which would also reduce the effects of noise on marine mammals at the water's surface.

Due to the reduction in noise doubling from the source of blast site, doubling incrementally, it will be unlikely that marine mammals would be negatively impacted to a population level from terrestrial noise associated with blasting.

4.6 Effects of Increased Vessel Movement

Vessel movements of approximately 42 vessel movements over a 12-week period (between June – August 2028) are expected for the dredge disposal for the Project. 70 vessel movements are expected for works associated with caisson delivery, scour protection and caisson installation. This equates to 112 vessel movements in total during construction, which is considered a relatively low number of vessel movements over the length of the period of works (26 months in total).

During the operational phase, the estimated number of vessels calling at the Project Quay in the operational phase is 96 per year (192 vessel movements), comprising 28 large vessels and 12 smaller

vessels per year. Each of the 28 large vessels will have two associated pilot boat (2 vessel movements). In total, the estimated vessel movements per year is 192. The majority of these vessels (approximately 80 %) are expected to occur during the summer months (April – September), so there will be an increase of 26 vessel movements per month in summer and 6 per month in winter.

All vessels will follow designated shipping lanes, with the only area of increased vessel being the route of 2.9km (1.6 nautical miles) leading from the main shipping lane into the SDWQ.

Overall, there will be a small increase in the number of vessels in the SDWQ area, associated with the construction and operational phases of the project, with vessels mainly using existing shipping routes and the works are considered to be temporary in nature, however, more vessels increase the risk of collision with marine mammals, potentially resulting in death or injury to individuals.

The construction phase will require a variety of vessels that differ in size, speed and operating procedure. This can result in a wide range of marine mammal collision risk levels for different vessels and SDWQ development activities. Larger vessels have a greater footprint and therefore are more likely to make encounters with marine mammals than smaller vessels.

The likelihood of vessel collisions is dependent upon vessel speed, animal behaviour and vessel manoeuvrability[38]. Vessels travelling at slower speeds in general can allow time for marine mammals and vessel operators to react to avoid collisions.

In general, larger whales are considered to exhibit limited avoidance behaviours in close range to vessels. Minke whale may experience negative effects as a result of increased vessel movements, in part as the low frequency noise generated may interfere with their communication. Unlike some other species, minke whale are less able to adapt their vocalisations to adapt to increased background noise[39]. They are also less able to manoeuvre away from vessels to avoid vessel strike.

Humpback whales are considered to be vulnerable to vessel strikes throughout their range, with risks increasing in coastal areas with heavier ship traffic[40].

Harbour porpoises often live in the vicinity of vessel traffic and reactions by porpoises to various types of vessel showed only short-term negative effects from speedboats and large ferries in a study by the Sea Watch Foundation[41]. HWDC[42] indicate that as harbour porpoise are naturally shy of boats, they will for the most part avoid them, and so for most types of marine traffic the risk of collision is minimal. There is more potential for collision with fast-moving engine-powered vessels due to their speed and ability to change direction quickly and evidence of incidents where dead or stranded harbour porpoise have shown propeller damage evidence or massive trauma indicative of ship collision[43].

Risso's dolphins are rarely seen approaching vessels or bow-riding, suggesting that this species may actively avoid vessel traffic.

[38] SEER U.S. Offshore Wind Synthesis pf Environmental Effects Research: Presence of Vessels: Effects of Vessel Collision on Marine Life (2022): https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Effects-of-Vessel-Collision-on-Marine-Life.pdf

[39] Helble, T.A., Guazza R.A., Martin, C.R., Durbach, Alongi, G.C., Martin, S.W., Boyle, J.K. and Henderson, E.E (2020) Lombard effect: Minke whale boing call source levels vary with natural variations in ocean noise. The Journal of Acoustical Society of America Vol 147 (2).

[40] https://www.fisheries.noaa.gov/species/humpback-whale (Accessed 07/06/2024)

[41] Sea Watch Foundation: The Harbour Porpoise in UK Waters available at: http://seawatchfoundation.org.uk/wp-content/uploads/2012/07/Harbour_Porpoise.pdf (Accessed 07/06/2024)

[42] HWDC Harbour Porpoise information available at: https://hwdt.org/harbour-porpoise (Accessed 07/06/2024)

[43] http://ukmpa.marinebiodiversity.org/uk_sacs/activities/ports/ph3_2_2.htm

Killer whales are generally inquisitive and are observed approaching vessels, however, like other smaller cetaceans (white-beaked dolphin and pilot whales) they are fast, agile and manoeuvrable in water.

The increase in the number of vessels travelling through to SDWQ, during construction (including dredge disposal) and operation, would increase the risk of collision with marine EPS, potentially resulting in death or injury to individuals, with larger species (minke whale and humpback whale) being more at risk.

However, the effects of these impacts from vessels will be highly localised around the established shipping routes. As the majority of the vessel routes will be using existing routes, marine mammals will likely already be habituated to vessels in those areas and/ or avoid the area already. In the area of increased vessel activity close to the project site, there is a greater likelihood of vessel collision with marine mammals, however, the vessel numbers in this area are very low, and over time, marine mammals would likely become habituated to vessels using this route. The MMPP will be adhered to during operation. This includes limits on vessel speed.

Vessel movement protocols secured via adherence to the Vessel Management Plan would further mitigate risk of vessel collision to marine mammals.

Overall, the risk of injury or disturbance from vessels is considered minimal, and any effects are expected to be highly localised. The introduction of project vessels during construction and operation is not considered to be a substantive increase to baseline vessel movements. As such, when considering the proposed mitigation measures, it can be concluded that the predicted impacts on marine mammals would be limited.

4.7 Conclusion

Some of the activities associated with the SDWQ development (dredging and vessel movement) have the potential to cause disturbance, injury or in extreme circumstances, death to individual cetaceans. For the most part the activities associated with the proposed development will result in temporary avoidance of a small area of habitat available to individuals. It is considered that with mitigation described in the following Marine Mammal Mitigation Plan (MMMP) the risk of death and injury this will be greatly decreased. It is not possible to rule out some level of disturbance to individuals which might be present within the area.

Overall, the increase in the number of vessels travelling through to SDWQ, during construction, dredge disposal and operation, would increase the risk of collision with marine mammals, potentially resulting in death or injury to individuals.

Although there are some uncertainties regarding the overall population status and trends within cetaceans in UK waters, it is considered that due to the relatively small area over which individuals are likely to be affected and the temporary nature of the works, there will not be an overall negative effect on the favourable conservation of any of the local marine mammal population.

5 MARINE MAMMAL MITIGATION PLAN

The marine mammal mitigation will comprise a standard Marine Mammal Observation Protocol (MMOP) as per JNCC guidance will be implemented during dredging operations in sea states less than 4 and during times of optimal visibility This may be supplemented by use of Passive Acoustic Monitoring devices (PAMs).

Although the mitigation detailed within the Marine Mammal Mitigation Plan has been designed for those species considered to be at most risk of being within or surrounding the waters of the development, the mitigation measures devised and implemented will also inherently cover all marine mammal species, irrespective of the frequency in which they are sighted in the area.

5.1 Marine Mammal Observation Protocol

The Marine Mammal Observation Protocol (MMOP) will be implemented so that the construction and dredging works do not cause injury or unnecessary disturbance to marine mammals. This section has been designed with reference to current JNCC guidance 'Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise' (August 2010) [44].

5.1.1 Marine Mammal Observer

A suitably qualified Marine Mammal Observer (MMO), competent in the identification of marine mammals at sea, will be present during the dredging. The MMO will undertake observation for marine mammals within the mitigation zone before and during dredging and will be dedicated to that one task for the duration of any watch. The MMO will advise the contractors and crews on the implementation of the procedures set out in the agreed protocol, to ensure compliance with those procedures.

The JNCC guidance provides the following definitions of an MMO:

MMO: Individual responsible for conducting visual watches for marine mammals. It may be requested that observers are trained, dedicated and/or experienced.

Trained MMO: Has been on a JNCC recognised course.

Dedicated MMO: Trained observer whose role on board a vessel is to conduct visual watches for marine mammals.

Experienced MMO: Trained observer with three years of field experience observing for marine mammals, and practical experience of implementing the JNCC guidelines.

The MMO will be, positioned appropriately to cover the full mitigation zone and will be trained. The identity and credentials of the MMO will be agreed with Marine Directoraite.

5.1.2 MMO Equipment

The MMO will be equipped with binoculars (10X42 or similar) and/or a spotting scope (20-60 zoom or equivalent), a copy of the agreed protocol and the Marine Mammal Recording Form (MMRF), which is a Microsoft Excel spreadsheet containing embedded worksheets named Cover Page, Operations,

[44] https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf

Effort and Sightings. A Microsoft Word document named Deck forms is also available, and the MMO may prefer to use this when observing before transferring the details to the Excel spreadsheets. Although these forms were developed for seismic surveys, they can be used for dredging operations, although many columns will not be applicable. The ability to determine the range of marine mammals is a key skill for MMOs, therefore a hand-held rangefinder will be used to verify the range.

All MMO forms, including a guide to completing the forms; and instructions on how to make a rangefinder are available on the JNCC website: http://jncc.defra.gov.uk/marine/seismic_survey.

5.1.3 Communication

The contractor will be responsible for the communication channels between those providing the mitigation service and the crews working on the dredging. A formal chain of communication from the MMO to the contractor, who will start/stop dredging, will be established. In order to confirm the chain of communication and command the MMO will attend any relevant pre-mobilisation meetings.

5.1.4 Mitigation Zone

Following appointment of contractor / Ecological Clerk of Works (ECoW), logistical information will be available/ updated to provide more detailed mitigation zones for the MMO. This may change throughout the construction period due to ground levels changing and depending on the area of works which need to be viewed.

The JNCC guidance defines the mitigation zone as a pre-agreed radius around the dredging site prior to any activity. This is the area where a MMO keeps watch for marine mammals (and delays the start of activity should any marine mammals be detected). The extent of this zone represents the area in which a marine mammal could be exposed to sound that could cause injury and will be determined by factors such as water depth, the nature of the activities (for example dredging) and the effect of the substrate on noise transmission. From underwater noise modelling, minimum recommended mitigation zone of 800 metres (to account for all marine mammals) from the dredging location should be sufficient to avoid injury. The MMO should be located on the most appropriate viewing platform to ensure effective coverage of the mitigation zone (land or vessel based).

5.1.5 Passive Acoustic Monitoring (PAM)

Following appointment of contractor / Ecological Clerk of Works (ECoW), logistical information will be available/ updated to provide more detail regarding the use of PAMs.

In addition to MMOs, PAMs should be provided throughout the operation to supplement visual checks.

PAM are software systems that utilises hydrophones to detect the vocalisations of marine mammals. This will help aid in the detection of species which are less easily detected at the surface via MMOs or during unfavourable conditions.

Visual observation is an ineffective mitigation measure during periods of darkness or poor visibility (such as fog), or during periods when the sea state is not conducive to visual mitigation, as marine mammals in the vicinity of dredging will not be detected. JNCC views PAM as the only available

mitigation technique that can be used under these conditions, and that it can also be used to enhance the detection of certain marine mammal species[45].

Specialist PAM operatives are needed to set up and deploy the equipment and interpret the detected sounds. The PAM hydrophones should be situated as close as possible to the site of dredging, and sacrificial hydrophones may therefore be required.

Hydrophones deployed from standby vessels can be used for acoustic monitoring, but a disadvantage of these systems (in regard to dredging) is that they will move away from the site of dredging when the vessel moves and may then be too far away to detect any marine mammal vocalisations within the mitigation zone. Remotely operated static PAM systems, which can be left at the initial dredging site, may be an option, but they may not always be commercially available, or best suited for operations in shallow coastal environments.

PAM can provide a useful supplement to visual observations undertaken by MMOs. However, in many cases it is not as accurate as visual observation for determining range, and this will mean that the mitigation zone will reflect the range accuracy of the system. Some PAM systems do not have a reliable range determination facility or can only calculate the range for some species. In such cases, the detection of a confirmed cetacean vocalisation should still be used to initiate postponement of the dredging if the PAM operator is able to make a judgement about the range of the marine mammal (dependent on species) from the works, because of experience gained in differentiating between distant and close vocalisations. In the absence of PAM systems capable of range determination, this expert judgement will constitute the basis for deciding whether an area is free from marine mammals prior to the dredging.

PAM operators will submit a method statement and details of the equipment to be used to MD-LOT for approval before the equipment is deployed.

5.2 Dredging Protocol

The standard JNCC protocol is outlined below:

1. The MMO should be situated in location that provides the best viewing platform and is likely to be closest to the dredging activities. For example, an elevation area of the coast or a vessels bridge that allows 360 degree cover (depending upon the size of the mitigation zone more than one MMO viewing platform (and therefore more than one vessel) may be required to ensure that the entire mitigation zone can be observed).

2. At least 30 minutes before any type of works, a visual watch and, if required, acoustic monitoring, known as the ‘pre-works search’, should be carried out in the mitigation zone. The pre-works search should continue until the MMO advises that the mitigation zone is clear of marine mammals, and the dredging works can start.

3. The MMO will scan the waters using binoculars or a spotting scope and by making visual observations. Sightings of marine mammals will be appropriately recorded in terms of date, time, position, weather conditions, sea state, species, number, adult/juvenile, behavior, range etc. on the JNCC standard forms. Communication between the MMO and the contractor and the start/end times of the activities will also be recorded on the forms.

[45] JNCC Guidelines for minimising the risk of injury to marine mammals from using explosives (2010), available at: https://data.jncc.gov.uk/data/24cc180d-4030-49dd-8977-a04ebe0d7aca/JNCC-Guidelines-Explosives-Guidelines-201008-Web.pdf (Accessed 07/06/2024)

4. Dredging should not be undertaken within 20 minutes of a marine mammal being detected within the mitigation zone.

5. If a marine mammal is observed, or acoustically detected, within the mitigation zone, it should be monitored and tracked until it moves out of range. The MMO should notify the relevant chain of command of the detection and advise that the operation should be delayed. If the marine mammal is not detected again within 20 minutes, it can be assumed that it has left the area and the works may commence.

6. If an animal has been detected acoustically, the PAM operative should use a range indication and their judgement to determine whether the marine mammal is within the mitigation zone.

7. A soft-start will be employed, with the gradual ramping up of dredging (where possible). The soft-start duration will be a period of not less than 20 minutes. This will allow for any marine mammals to move away from the noise source.

8. If a marine mammal enters the mitigation zone during the soft-start then, whenever possible, the works will cease until the marine mammal exits the mitigation zone and there is no further detection for 20 minutes.

5.3 Reporting

As per the JNCC guidance, reports detailing the dredging activity and marine mammal mitigation (the MMO reports) will be sent to Marine Directorate at the conclusion of dredging activity. Reports will include:

- Completed MMRFs;
- Date and location of the dredging activities;
- A record of all occasions when dredging occurred, including details of the duration of the pre-dredging search and soft-start procedures, and any occasions when dredging activity was delayed or stopped due to presence of marine mammals;
- Details of watches made for marine mammals, including details of any sightings, and details of the dredging activity during the watches;
- Details of any problems encountered during the dredging activities including instances of non-compliance with the agreed dredging protocols; and
- Any recommendations for amendment of the protocols.

5.3.1 Terrestrial Noise Considerations - Blasting

Following appointment of contractor logistical information will be available/ updated to provide more detail regarding terrestrial blasting protocols and blasting methods will be determined by the contractor once commissioned.

The MMO protocol implemented for dredging will also be undertaken for terrestrial blasting.

In addition, the following mitigation methods should be considered to be implemented for terrestrial blasting:

During terrestrial blasting, minimising air overpressure at the source, such that, even under unfavourable weather conditions, all such energy is within acceptable criteria at distance, remains the best practicable approach. It is an approach that all surface mineral sites are obliged to follow under the provisions of The Quarries Regulations 1999.

Detonating cord should be used as sparingly as possible, and any exposed lengths covered with as much material as possible. Just a few feet of exposed cord can lead to significant amounts of audible energy and, hence, high air overpressure levels. Stemming release can be controlled by detonation technique, together with an adequate amount of good stemming material. It should be noted however that detonation cord and stemming release have been virtually eliminated with the use of in hole initiation techniques.

If the use of exposed detonating cord is avoided the characteristic noise of a blast is no longer a sharp crack but rather a dull thump. This is partly due to the detonating sequence and partly due to natural energy dissipation and reduction. Whilst some of the noise perceived by a neighbouring resident would be directly from the blast itself, the lower frequency components of the air overpressure might well induce secondary rattling of windows and ornaments within a property which could augment the overall effect.

Thus, in terms of noise control or reduction in the care and attention to blast design and subsequent implementation, including initiation, necessary for the control of air overpressure is equally applicable to noise.

BS 6472-2:2008 states that “The highest [air overpressure] levels normally measured in the United Kingdom are generally less than 1% of the levels known to cause structural damage.” Therefore, by implementation of the best practice measures, effects due to air overpressure generation by the Proposed Development are anticipated to have a negligible effect on marine mammals when at the water’s surface.

5.4 Vessel Movement Mitigation Protocol

The Harbour Authority implement speed restrictions on vessels within Orkney waters, additionally, leaflets can be created to provide additional advice to port users to avoid disturbance to and/or collision with marine mammals during construction which should include, but is not limited to the following:

- A strict speed limit for both onshore and marine traffic will be implemented to reduce risk of collision with marine mammals (4 knots within the water).
- Implementation of a Vessel Management Plan including agreed routes and speed limits, and incorporation of the Scottish Marine Wildlife Watching Code[46].
- Safe vessel operation to minimise risk of collision with marine mammals to be promoted to users. Training courses such as those provided by the WiSe scheme[47] could be offered at regular intervals.

Additionally (where possible) leaflets can be created to provide additional advice to quay users to avoid disturbance to and/or collision with marine mammals which should include, but is not limited to the following:

- Keep a safe distance from marine mammals. Never get closer than 100m (200m if another boat is present), but if within 100m, switch the engine to neutral;
- Never drive head on to, or move between, scatter or separate marine mammals. If unsure of their movements, simply stop and put the engine into neutral;
- Spend no longer than 15 minutes near the animals;
- Special care must be taken with mothers and young;
- Maintain a steady direction and a slow ‘no wake’ speed; and

[46] https://www.nature.scot/doc/scottish-marine-wildlife-watching-code-smwwc
[47] Information available at: https://www.wisescheme.org/ (accessed 02/06/2023)

- Avoid sudden changes in speed.

Wildlife code of conduct methods have been created by NatureScot and are available on their website[48].

5.5 Additional Good Practice Recommendations

If any dead marine mammals are anecdotally observed during construction or operation, it should be reported to the Scottish Marine Animal Stranding Scheme (SMASS) (www.strandings.org) and live marine mammal strandings will be reported to British Divers Marine Live Rescue (www.bdmlr.org.uk).

The MMO should keep a record of all marine mammal sightings, whether in the mitigation zone or not, to be issued to NatureScot. An understanding of the location of species is essential to appropriately assess the impacts of a proposed development and plan and target effective mitigation, therefore this data could be used to inform future projects. Biodiversity data are extremely important as, aside from use in planning and decision making, they are key to delivering state of environment reporting, education, modelling trends in species and habitat distribution, and research and policy making.

[48] https://www.nature.scot/sites/default/files/2017-06/Publication%202017%20-%20The%20Scottish%20Marine%20Wildlife%20Watching%20Code%20SMWWC%20-%20Part%201%20-%20April%202017%20%28A2263518%29.pdf

6 MARINE MAMMAL LICENSING

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

The licensing of Marine EPS in Scotland is shared between several regulators depending on the purpose and location of the activity in question. For activities taking place within 12 nautical miles of the coast (the Scottish Territorial Sea), EPS are protected under the 1994 Regulations. For commercial activities, including geophysical or seismic surveys (including those related to oil and gas), port and harbour developments and the installation of renewable energy devices Marine Directorate (on behalf of the Scottish Ministers) is the licensing authority under the 1994 Regulations: Regulation 39 (1) (a). For activities relating to scientific research or conservation, Scottish Natural Heritage is the licensing authority.

A licence may be granted to undertake such activities if certain strict criteria are met:

- There is a licensable purpose.
- There are no satisfactory alternatives.
- The actions authorised will not be detrimental to the maintenance of the population of the species concerned at favourable conservation status[49] in their natural range.

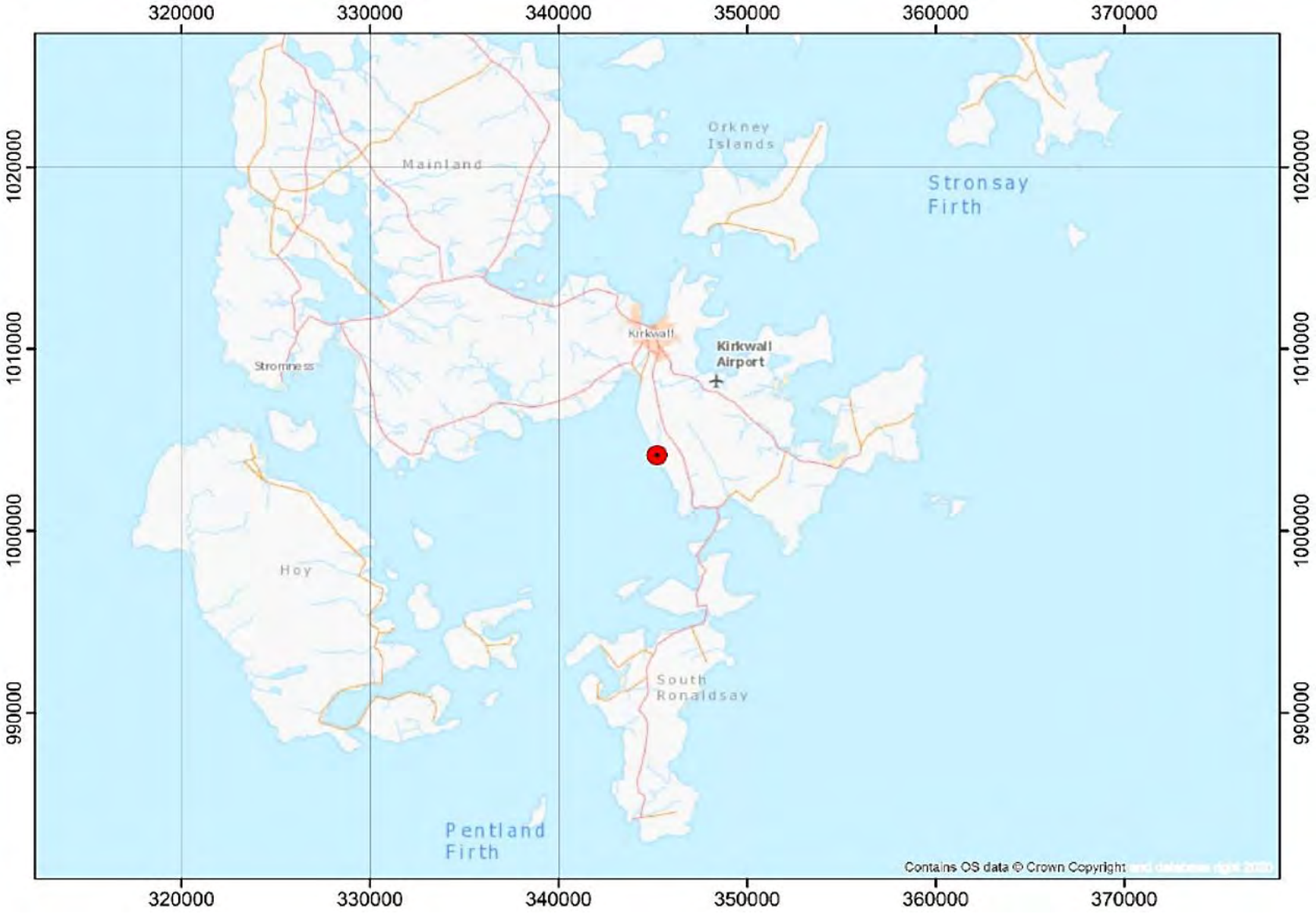
As highlighted in section 3.4, the risk of disturbance from dredging cannot be ruled out completely and so a derogation licence for disturbance will be required.

[49] The ultimate objective of the Habitats Directive is to ensure that the species covered reach what is called a 'Favourable Conservation Status' and that their long-term survival is deemed secure across their entire natural range within Europe. Article 1(i) of the Habitats Directive defines Favourable Conservation Status (FCS) of a species as follows:
"Conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within its natural range.
The conservation status will be taken as 'favourable' when:
- population dynamics data on the species concerned indicates that it is maintaining itself on a long-term basis as a viable component of its natural habitats; and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis."

APPENDICES

A PROPOSED SDWQ LOCATION AND DISPOSAL SITE FI040

Site Location



Location of Disposal Site FI040

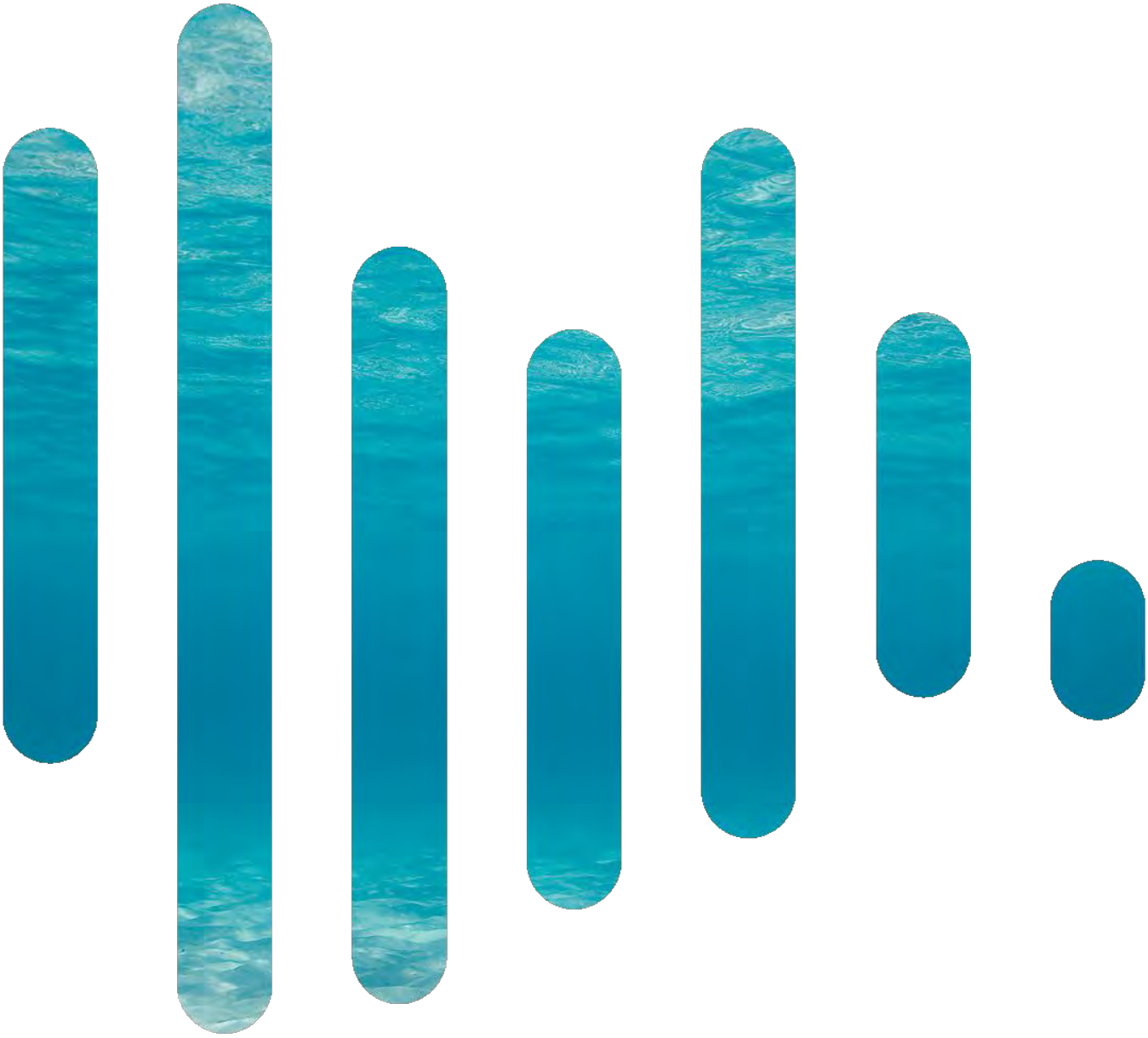


Source: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=712

B UNDERWATER NOISE MODELLING REPORT

Note – Piling and Associated Drilling No Longer Required for the Caisson Design)

IRWIN CARR
CONSULTING



Scapa Deep Water Quay, UW Noise Modelling

Kirkwall, Orkney

RP001 Rv4 2022248 (Scapa DWQ, UW Modelling)

19 May 2025

PROJECT: SCAPA DEEP WATER QUAY, UW NOISE MODELLING

PREPARED FOR: ENVIROCENTRE

8 EAGLE STREET,

CRAIGHALL BUSINESS PARK,

GLASGOW, G4 9XA

SCOTLAND

ATTENTION: EMMA CORMACK

REPORT NO.: RP001 2022248 (Scapa DWQ, UW Modelling)

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EXECUTIVE SUMMARY

BRIEF DESCRIPTION OF WORK

In relation to the construction of a deep-water port in Scapa Flow, both dredging, drilling and piling is planned. The noise from these activities can adversely affect local fauna either through direct injury of sensory systems or indirect harm from noise pollution drowning out communication and foraging sounds. Noise modelling has been carried out in respect to the various noise sources and local animals to estimate impact from noise and what mitigation can/needs to be employed to keep impacts below levels of significant harm to the local wildlife.

Source sources (dredging, piling and blasting) are modelled from a combination of empirical models (based on recorded data) and numerical models (calculated source levels from inputs).

CONCLUSION & RESULTS SUMMARY

Dredging

The noise from dredging, while presenting a significant Permanent Threshold Shift (PTS (hearing injury) risk to ranges <210 m for the Very High Frequency (VHF) group (e.g., porpoise), this is only for animals staying close to the activity for extended periods (> 1 hour) and assumes continuous dredging with the dredger level as given by the 90th percentile. For the best estimate (model mean) the PTS risk range is 210m after 8 hours exposure. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away. Further the area ensonified does not “block” access through a channel or strait.

Vibro piling

Prolonged exposure to vibro piling at close range (<50 m) carries some auditory risk for the animals assessed, specifically groups LF, VHF and P- (baleen whales, porpoises and salmon/trout), where the peak pressures in the noise have risk ranges up to 300 m for the VHF group. We therefore suggest surveillance takes place prior to piling to minimise the risk of impact on porpoises. While this is a significant risk for animals close to the activity, we stress that we have used a very conservative approach to estimating the source levels, and the realised emission will likely be significantly lower.

Further, animals will tend to move around, or away from noise, which will limit exposure. In Figure 16, p. 23 and Figure 18, p. 24 we show an example of the effect of using moving receivers (animats, modelled animals) to estimate what might be the effect of movement.

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Abbreviations and Definitions:

PTS	Permanent Threshold Shift
VHF	Very High Frequency
SOFAR	Sound Fixing And Ranging
SSP	Sound Speed Profile
SPL	Sound Pressure Level
Hearing group	Refers to the Southall 2019 hearing groups (Southall, et al., 2019).
"," and "."	Comma "," is used as thousands separator, while dot "." Is used as decimal separator.
TL, PL	Transmission Loss, Propagation Loss. Used interchangeably in this document.
Psu	Practical salinity unit, equivalent to parts per thousand as g/kg, mass of salts per mass of water.
Noise	Sound that causes, or is assumed to cause, annoyance or disadvantage. No automatic significance of impact is associated with this term.
Solver	Mathematical algorithm for calculating sound transmission losses in water.
[]	Square brackets are used throughout to denote units, e.g.: "Pressure [Pa]" means pressure in Pascals.
Degrees	Either angular degrees (0-360) or degrees Celsius
3rd octave, decidecade	Refers to the subdivision of octaves (doublings of frequency) and decades (10x frequency). Using the appropriate base frequency, the two are identical for practical purposes.
Worst case	Used as "reasonable worst case". E.g. use of MHWS instead of historical maximum for max water level. Or 90th percentile as representative of worst-case.
Mean case	The expected case, both median and mean values will inform this.
Signature, Impulse	When in relation to a sound, this refers to the time-pressure signal associated with that sound, normally as a time-series of pressures relative to ambient pressure, in pascals.
Vibro	Vibration pile driving
MSL	Mean Sea Level
β, Log multiplier	Symbol used to denote the factor multiplied by the base ten Log in equations like: "$TL = \beta \times Log_{10}(range)$"
SL, Source level	Apparent monopoint source level as viewed from the acoustic far field

1 INTRODUCTION

In relation to the construction of a deep-water port in Scapa Flow, both dredging, drilling and piling is planned. The noise from these activities can adversely affect local fauna either through direct injury of sensory systems or indirect harm from noise pollution drowning out communication and foraging sounds. Noise modelling has been carried out in respect to the various noise sources and local animals to estimate impact from noise and what mitigation can/needs to be employed to keep impacts below levels of significant harm to the local wildlife.

Source sources (dredging, piling and blasting) are modelled from a combination of empirical models (based on recorded data) and numerical models (calculated source levels from inputs).

1.1 Underwater Acoustics Basics

Underwater acoustics modelling is the application of physical models to characterise the behaviour of sound in environments under the surface of the sea and in the top layers of the seabed. As some familiarity with in-air acoustics is assumed the focus here is on key differences between in-air acoustics and underwater acoustics, making waterborne propagation more efficient than airborne propagation.

This chapter only gives reader a quick overview, please see APPENDIX B – Underwater Acoustics Basics APPENDIX *for more detail.*

1.1.1 SOUND SPEED

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[1] much as 340 m/s is in air.

The soundspeed changes with depth, “sound speed profile”, this is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR (Sound Fixing And Ranging) channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

1.1.2 SPREADING LOSS

Most of the propagation loss (loss in dB from source to receiver, “PL”) that occurs initially is governed by “spreading loss”. It is the simple “thinning out” of acoustic energy as it spreads away from the source, usually in all directions – spherically. This means a reduction in received level of 6 dB per doubling of distance

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Here we expect spreading loss to be ~3 dB per doubling of distance.

1.1.3 ABSORPTION

Besides the “thinning out” of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is salinity dependant. Frequencies under 1 kHz experiences almost no absorption, while high frequencies, over 10 kHz, can be attenuated by over 10 dB / km.

Small bubbles, wind or wave induced, will further attenuate especially the high frequencies.

1.1.4 SEDIMENT

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

[1] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies.

1.1.5 SOUND LEVEL UNITS

All references to sound pressure levels (SPL), peak pressure levels (L_p) and sound exposure levels (L_e) refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 1: Definitions.

Unit	Definition	Comments
SPL (dB_{RMS}) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p ($dB_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}}^2$
$L_{p\text{-}p}$ ($dB_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[2] equivalent to $L_P + 6.02\ dB$
L_E (dB_{SEL}) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-}"time"}$ or $L_{E\text{-single blow}}$.

If the averaging period for SPL is equal to the total even duration then SPL is equal to "Leq" the "equivalent constant level".

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

[2] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

2 SITE AND LOCAL ENVIRONMENT

The site is located in Orkney, Scotland:

- Scapa DWQ at Lat: 58.920345, Lon: -2.965084. Mean water depths 5-30 m.

The site is sheltered from oceanic swell, with little current and with no major outflows from rivers, meaning that the conditions important for sound propagation are quite stable. The sediment is generally a soft upper layer of mud/silt and gravel overlaid a layer of weathered sedimentary rock, before a stronger layer of sedimentary rock (silt-/mud-/sand-/lime-stone).

Figure 1. General location of Scapa DWQ development (in red circle) on Main Island of the Orkney Islands. Hatston site (just north west of Kirkwall, shown for completeness).

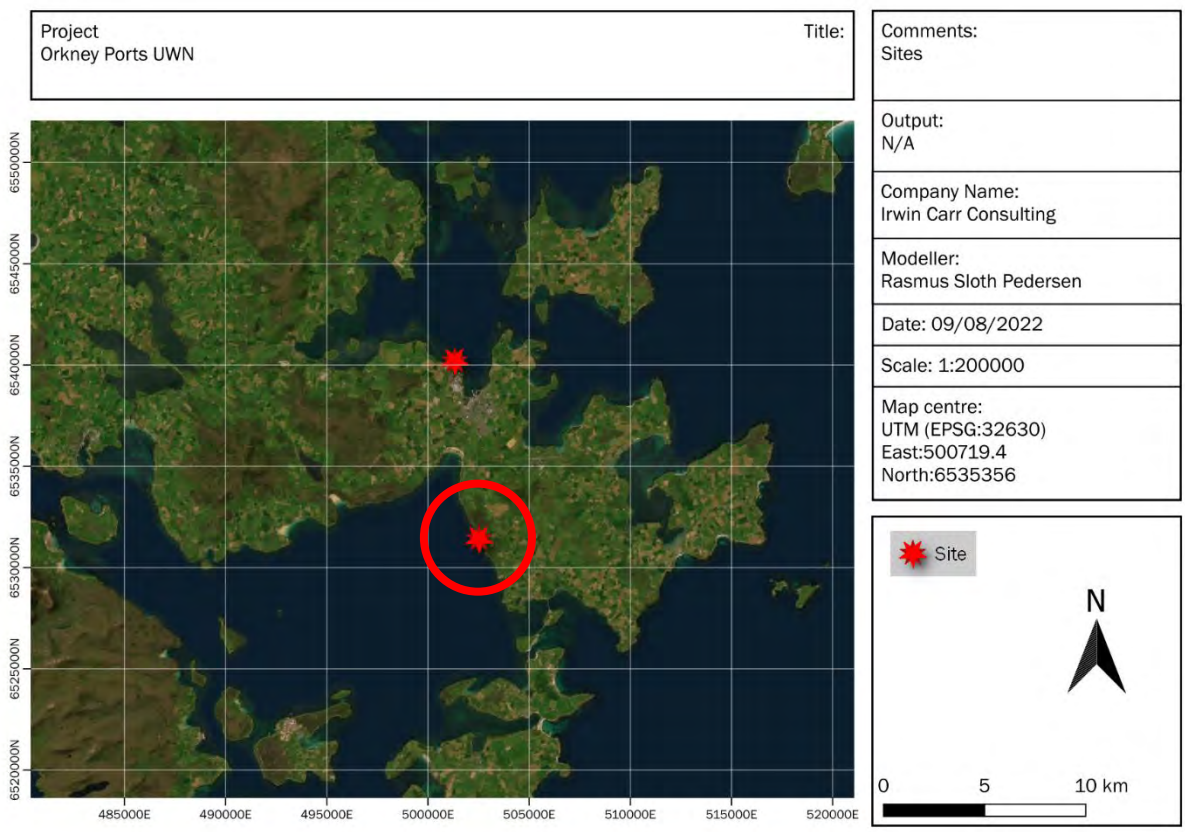
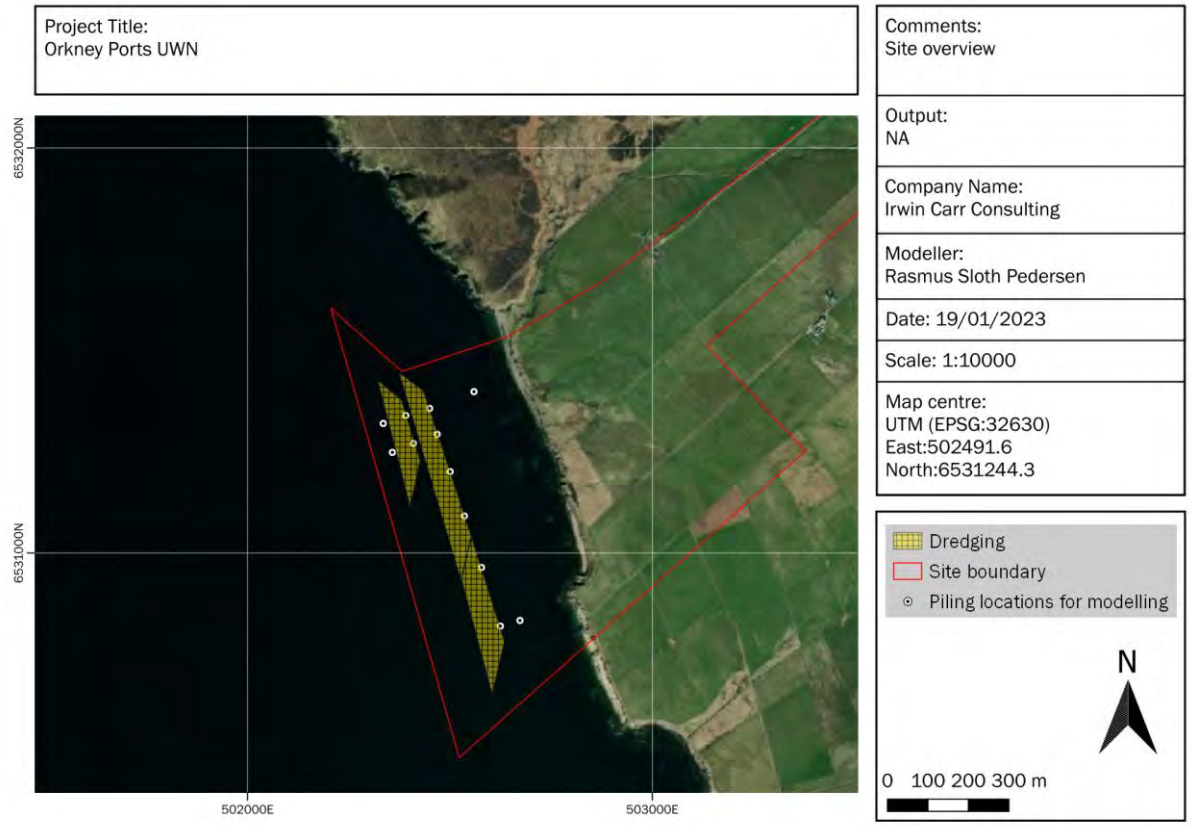


Figure 2. Overview of piling locations for modelling and approximate areas to be dredged.



2.1 Depth, Bathymetry

Depth data for the sites were collected from 3 sources:

- The proponent, detailed data near the site, 4 m resolution.
- EMODNet (European Marine Observation and Data Network, 2019), long range data, ~90 m resolution.
- Nautical charts such as http://fishing-app.gpsnauticalcharts.com, medium range data, variable resolution.

These were corrected to MSL and combined (using a mosaic method) to give the best possible total cover of the area.

For the "worst case" scenario the MHWS (Mean High Water Spring) level is used (deeper water decreases sound transmission loss).

2.2 Water properties

The water properties are important for the sound propagation. Generally the two sites have no major outflows of fresh water so salinity is expected to be near 35 psu (confirmed by (Marine Scotland, 2022)).

2.2.1 TEMPERATURE

The temperature was measured with the inbuilt thermometer of the Soundtrap hydrophone (used for on-site measurements).

Average water temperature at Scapa site during monitoring: 8.9 °C

The water columns are assumed to be well-mixed, given lack of nearby freshwater outflows, windy location, evaporation and generally shallow depths (<30 m).

2.2.2 SOUNDSPEED PROFILE

Given the water properties presented above, we assume the water soundspeed to be constant at all depths, with no significant deviations from the expected values.

The sound speed calculation is based on a widely used model for sound speed in water (Leroy, Robinson, & Goldsmith, 2008), with input of temperature, depth and salinity.

Sound speed in the water is calculated as 1486 m/s

2.3 Sediment properties

Given the project is a construction project there are sediment cores available for sediment characterisation provided by "Causeway Geotech". These give good coverage in the areas close to the Scapa DWQ. For general sediment outside the development area, we have used data from British geological survey (British Geological Survey, 2022).

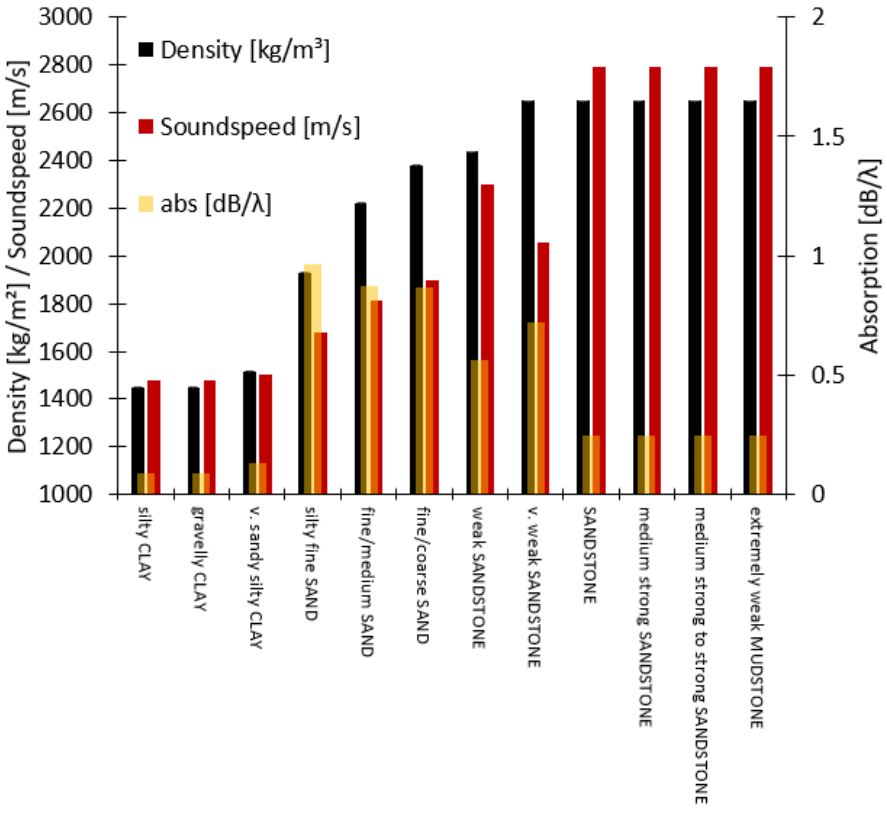
Where samples were taken we mapped the descriptions in the sediment core reports in relation to their Udden-Wentworth or Folk sediment description where these matched the nomenclature well. For other sediment types, e.g. sandstone/mudstone/limestone we have used given values for nominal "sandstone" (Jensen, Kuperman, Porter, & Schmidt, 2011; Boyce, 1981). The cores also contain classifications such as "weak sandstone" this was interpreted as loose, sandy sandstone, and we characterised this with density and soundspeed between that of sandstone and sand. This interpolation was based on an assumption that the scale "very weak-, weak-, medium weak-, sandstone" corresponds to linear interpolation between sand and sandstone (see Table 2 below). We have not changed the properties for categories indicating harder than usual sediments, such as "medium strong", "very strong".

Table 2. Example of interpolation scheme for Sand-sandstone.

Material	Interpolation value	Density [kg/m³]
Sand	0	1931
Very weak sandstone	0.25	2111
Weak sandstone	0.5	2291
Medium weak sandstone	0.75	2470
Sandstone	1	2650

Where we had no direct properties (density, sound speed, absorption) for the sediment we have used a modelling approach to estimate them, following (Ainslie, 2010).

Figure 3. Sediment types. Note that absorption is read on the right vertical axis.



2.4 Background/Ambient Noise

Baseline noise monitoring was carried out on 29-30 November 2022. On both days the weather was very calm (< sea state 1) with no detectable current. The Scapa site was unexpectedly noisy with ~130 dB SPL for all measurements (unaffected by range to our vessel). There were multiple other vessels in the bay, but all far away (> 1km). The most likely source was the small oil platform stationed a few km to the south. This could have some active machinery causing the noise, indicated by the tonal components (seen as horizontal bands in spectrogram in Figure 4).

Note that ambient noise here excludes noise from nearby vessel passes, it is meant as the ambient noise with no identifiable noise sources.

Table 3. Typical background noise levels.

Site	SPL [dB]
Scapa	129.9
Hatston	107.2

Figure 4. Spectrogram of ambient noise at Scapa.

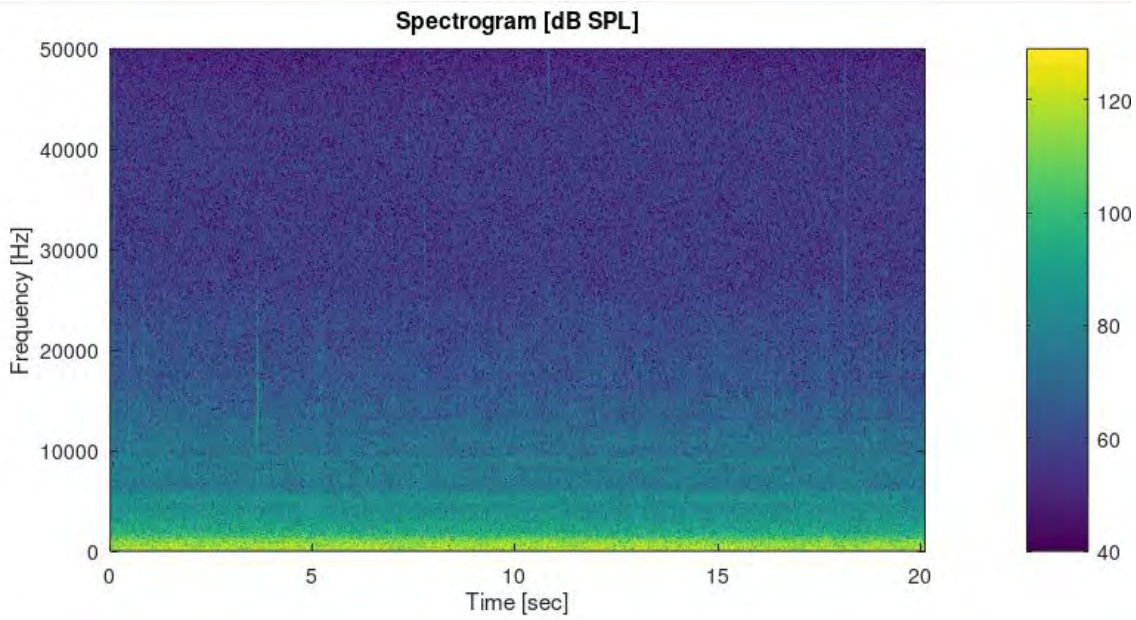


Figure 5. Spectrogram of ambient noise at Hatston.

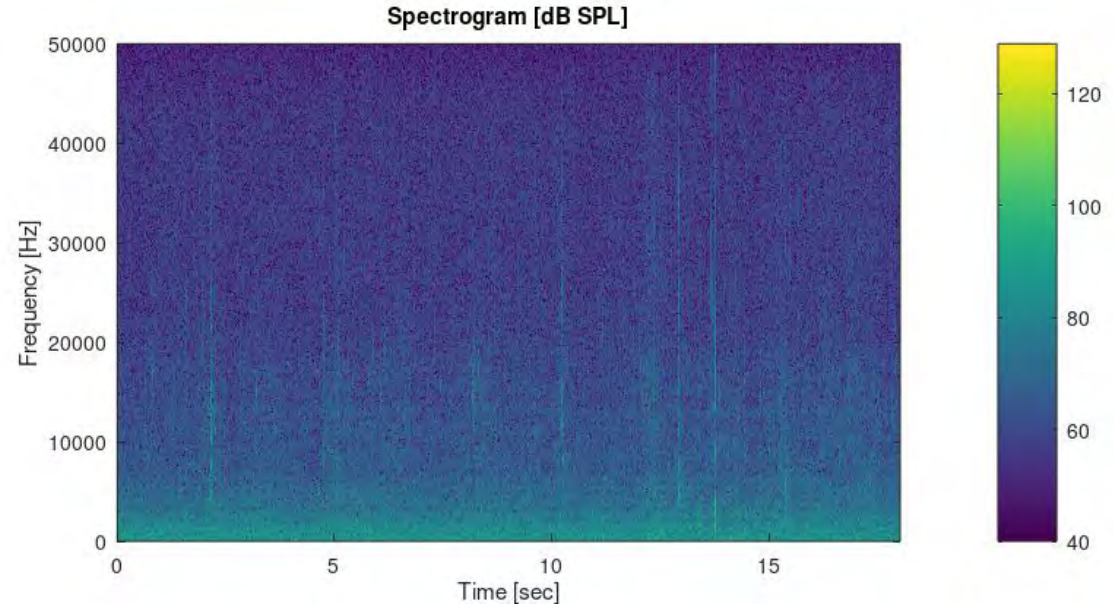
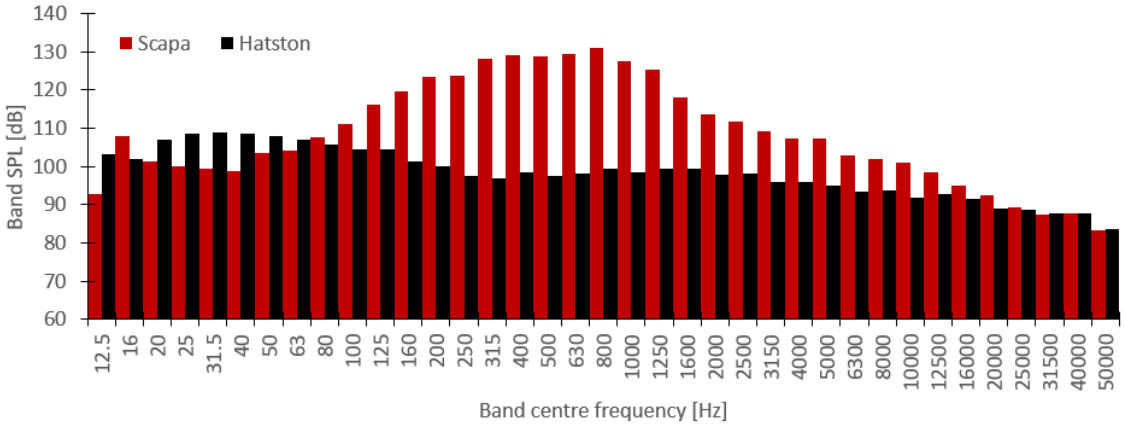


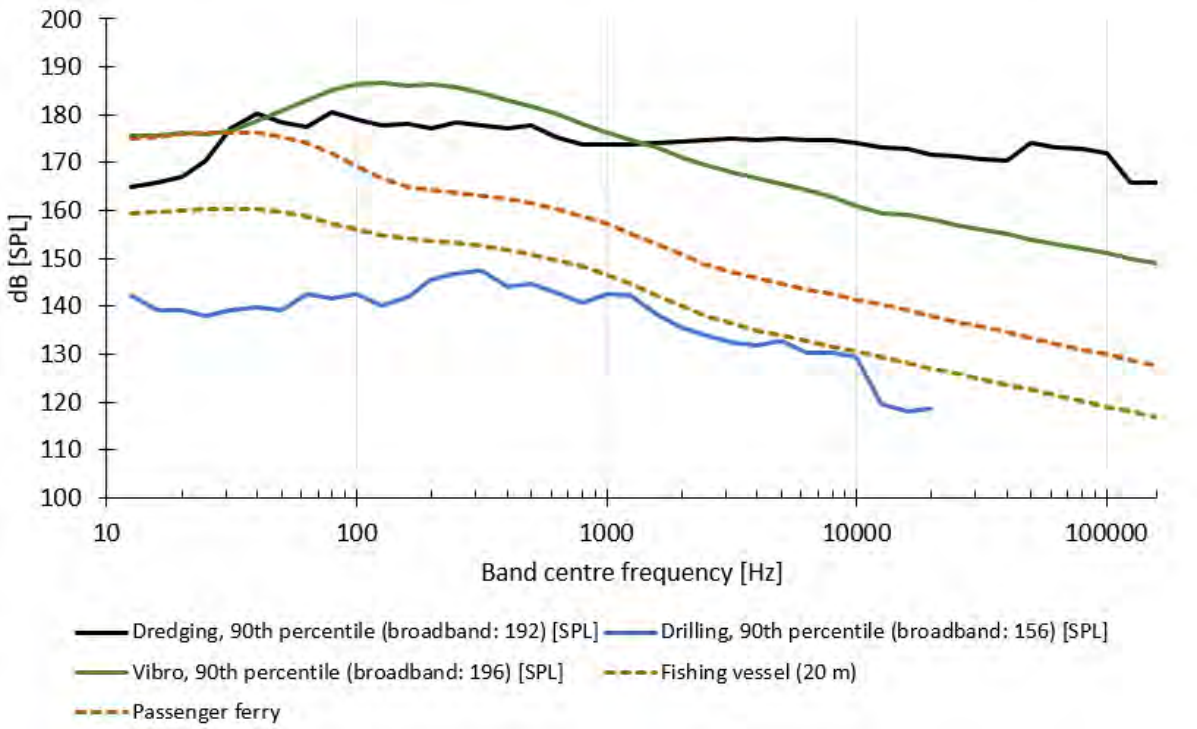
Figure 6. Typical band levels of ambient noise at Scapa and Hatston.



3 SOUND SOURCE MODELLING

We have considered three noise sources for this assessment, but have screened out the drilling as it is not loud enough to meaningfully assess in an environment with many vessels and general human activity (compare with vessel noise in Figure 7, below).

Figure 7. The three sound sources considered in this report. A fishing boat and a small ferry has been added for context.

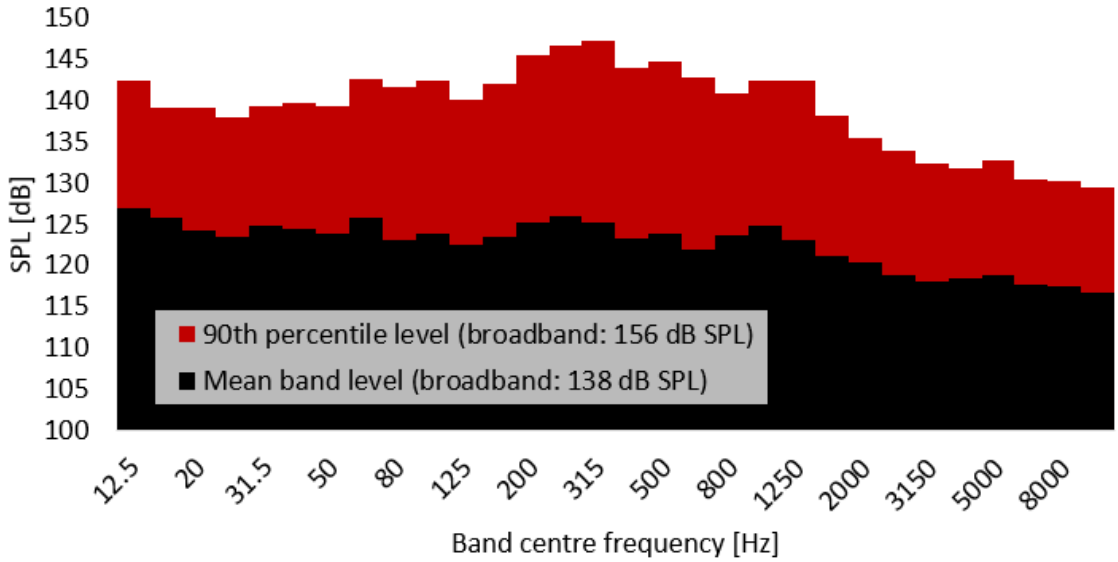


3.1 Drilling

As some hard sediment is expected round piles might be placed in pre-drilled holes, based on the range of noise levels presented in Figure 8, the drilling noise is assumed to be insignificant to the marine life.

The measured levels presented are a summary of 13 different recorded drilling episodes shows noise levels to vary considerably between sites and equipment, and there is no clear connection between drill size, power or sediment type to the emitted noise level. However, given the modest broadband level of even the 90th percentile level (156 dB SPL) this noise source can be ignored.

Figure 8. Example of drilling noise band levels. Data from various drills, diameter 0.1-1.2 m and various rock types.



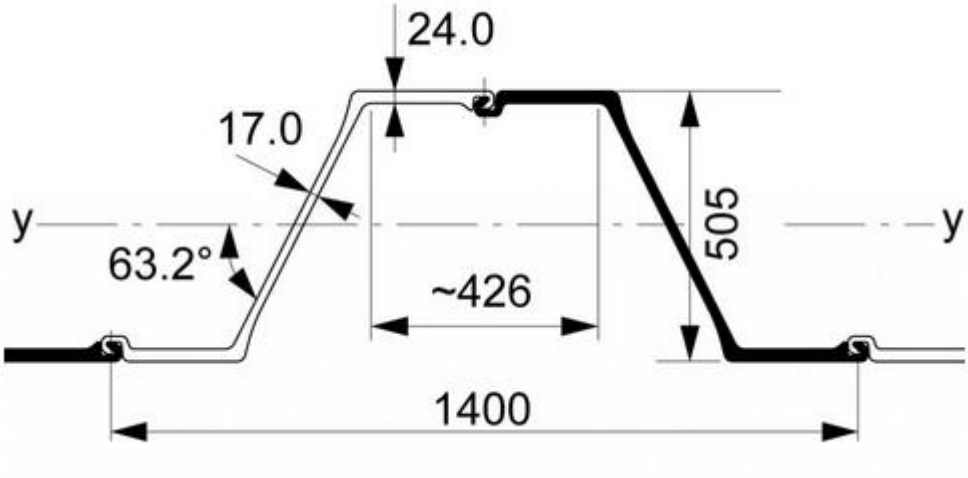
3.2 Vibration Piling Model

Two types of piles are expected to be used:

1. Tubular piles, expected to have a diameter of 2.1 m
2. Sheet piles (Arcelor Mittal AZ52-700[3]).

Both will be vibrated into the sediment or into holes left by the drilling campaign.

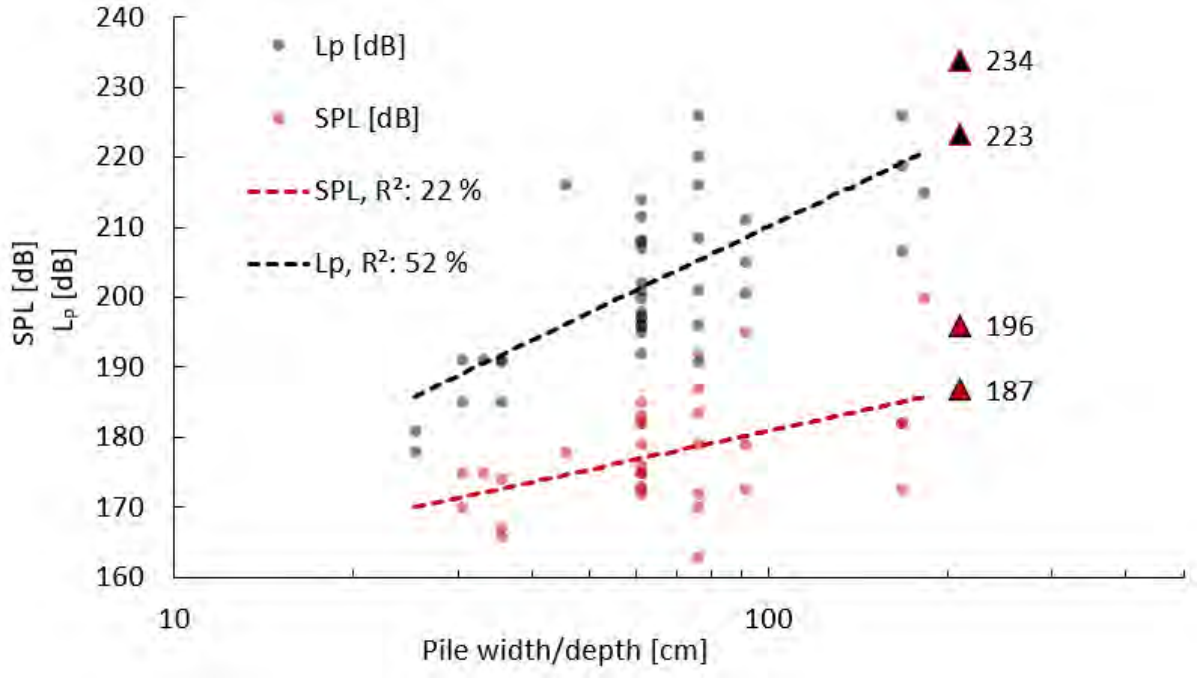
Figure 9. Schematic of the sheet piles.



The diameter of the tubular pile (210 cm) is used a basis for an empirical model based on 50 recorded levels as from CalTrans (CalTrans, 2015).

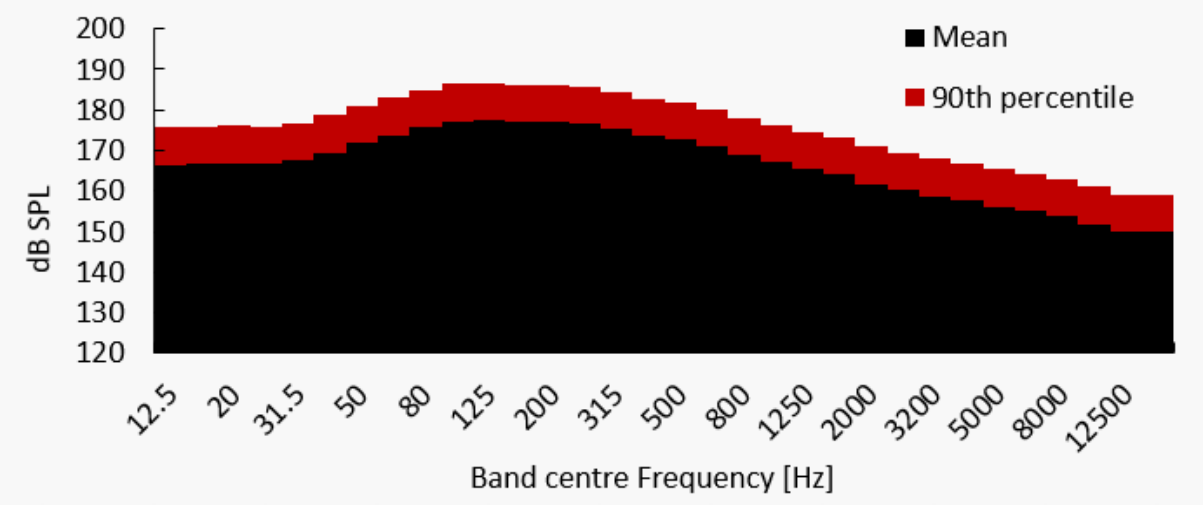
[3] https://sheetpiling.arcelormittal.com/products/az-52-700/

Figure 10. Basis of vibro piling broad band source level as a function of pile size (210 cm diameter).



Given the low confidence we have in this approach (low R^2 values) we use the 90th percentile level as the broadband source level. L_P is estimated to be 234 dB and SPL 196 dB. The frequency content is assumed to be identical to that of the impact piling.

Figure 11. Band levels for vibro-piling.



3.3 Dredging

Dredging is done to chart Datum -15 metres, meaning this will likely be done with a cutter suction dredger (Max reach 15 m) and possible assistance from a backhoe dredger. For the cutter suction dredger a cutter power of 540 kW is assumed, equivalent to the Boskalis "Seine"[4] cutter suction dredger. For cumulative modelling it's assumed that the dredging is potentially active 24 hours per day. The Backhoe dredging is quieter and has been ignored in favour of using the louder method for the assessment.

[4] https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwibnqWF-sH8AhUQg1wKHfYmBVoQFnoECB8QAQ&url=https%3A%2F%2Fboskalis.com%2Fmedia%2Fqbjnfdlv%2Fseine_cutter_suction_dredger.pdf&usg=AOvVaw1bBD75xRPcFc3H0TUXTFkD

Figure 12. Approximate extent of dredging campaign (yellow hatched area).

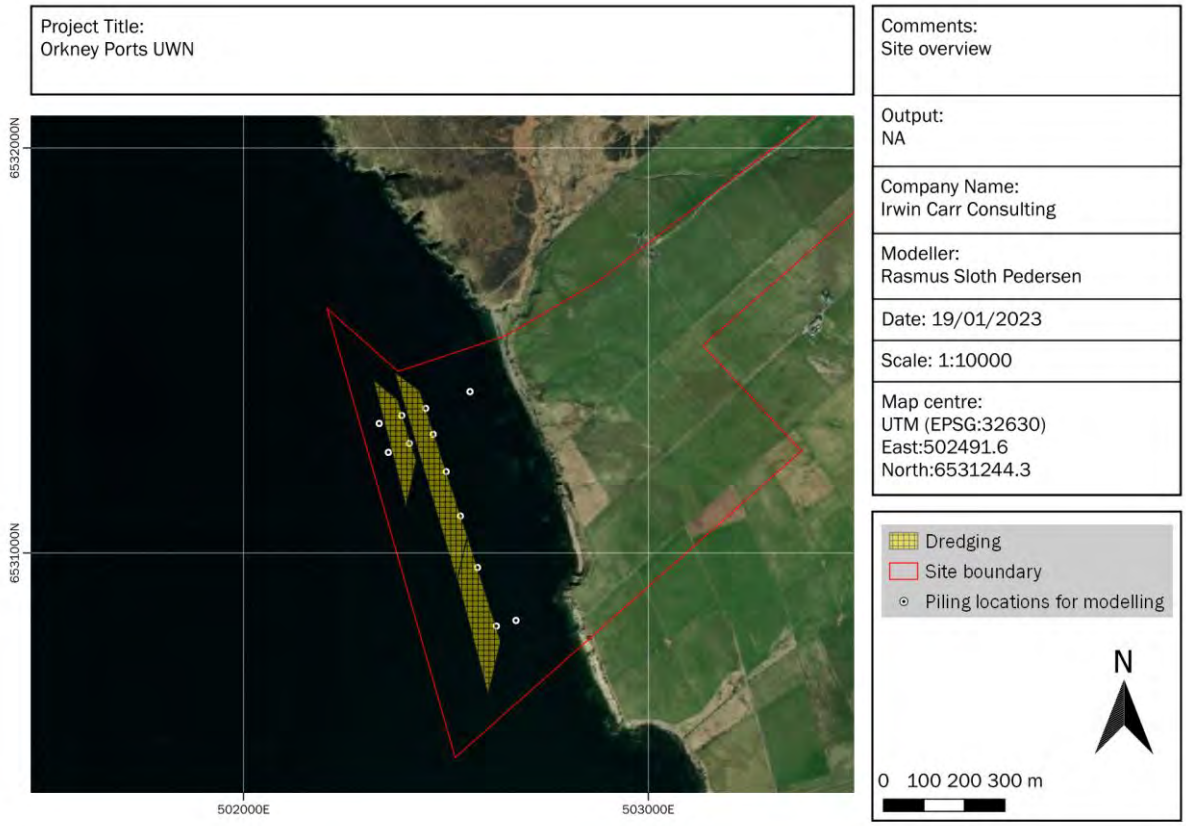
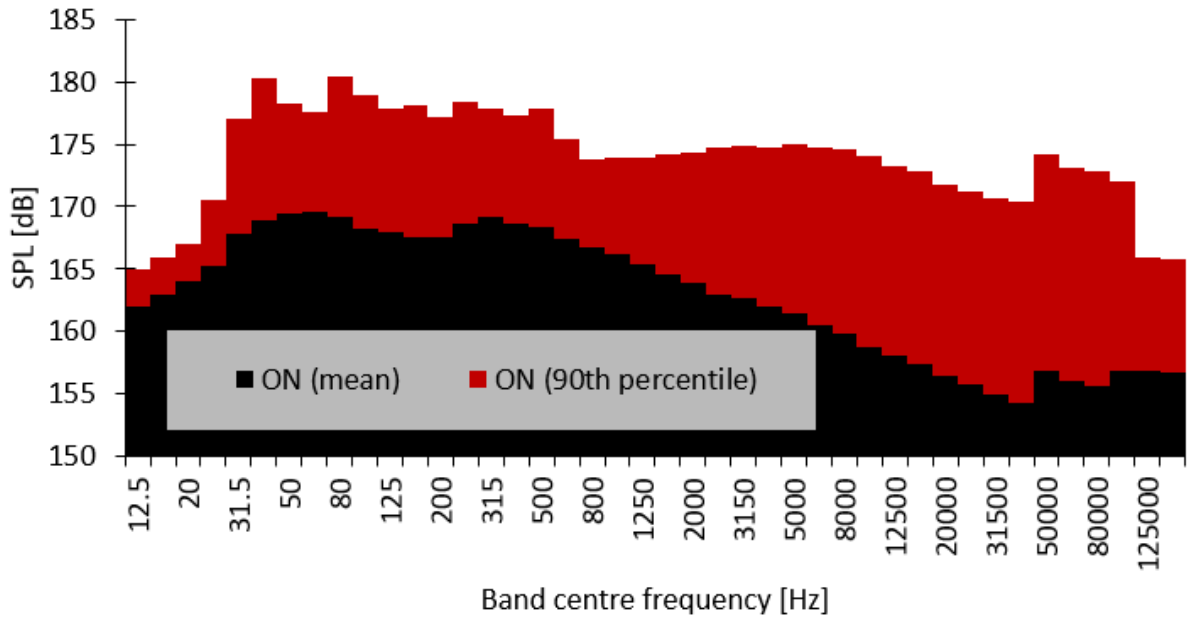


Figure 13. Band levels as modelled for a 540 kW cutter suction dredger with coarse sediment. "ON" refers to active dredging.



4 TRANSMISSION LOSS MODELLING

Transmission loss modelling is done using dBSea underwater noise modelling software.

This software is partially developed by us and can model frequencies from 10 Hz to 168 kHz, normally as 3rd octave bands, but any logarithmic band-spacing can be used. All solvers are range dependent (meaning all conditions can change with range not just depth).

Further details of this modelling software package can be found in APPENDIX A - dBSea.

The sound sources from section 3, Sound Source Modelling, p. 14, was used sources for the model, both as band levels when modelling energy transmission losses (L_E, SPL) and as timeseries/impulse for modelling peak pressure (L_P).

Previous to this assessment measurements of the actual transmission loss for the two sites were measured along two transects for each site. The modelling has been calibrated to match the measurements of these recordings (details in APPENDIX D – MODEL CALIBRATION).

The measurements show a broadband transmission loss consistent with ~12 × Log_{10}(range) at Scapa. However, these are frequency specific, and these losses are not consistent across all frequencies. We have matched the frequency-wise transmission losses to the extend that they are less than 20 × Log_{10}(range) as we find it unlikely that a transmission loss, even for higher frequencies, of > 20 × Log_{10}(range) is sufficiently representative for the site as a whole.

5 ASSESSMENT CRITERIA

5.1 Reporting units

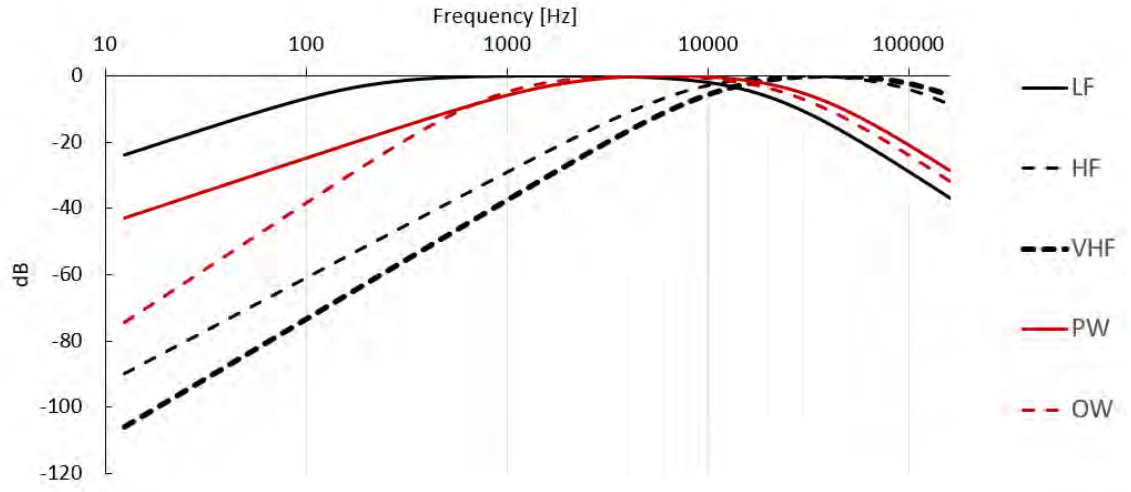
See 1.1.5, p. 8 for definitions.

5.2 Weighting of Noise Levels

When not reporting L_p or $L_{p\text{-}p}$ levels, the noise levels are often weighted according to a generalised hearing sensitivity profile for up to ten different hearing groups. This is done to better reflect the actual impact on the species in question, much like dB(C) level unit for humans.

See Table 4, for full group names and limits.

Figure 14. Weightings for various hearing groups. For L_E levels, the weightings are applied to the noise level to give the weighted noise level (similar to dB(A) or dB(C)-weighted noise for humans).



5.2.1 MARINE MAMMAL WEIGHTINGS

For the marine/aquatic mammals present we will adhere to the thresholds described in “Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing” (National Marine Fisheries Service, 2018), which determines impact from an assessment of area wherein the noise will induce either

"Temporary Threshold Shift" (TTS) or "Permanent Threshold Shift" (PTS)[5] as judged by the weighted SEL level (L_{E-24}) over a typical 24-hour period or by L_P levels, for the different hearing groups.

Please note that the Southall 2019 thresholds and weightings are identical to the NMFS 2018 criteria, only the nomenclature has changed (Southall, et al., 2019; National Marine Fisheries Service, 2018).

Thresholds for behavioural disruption are set by NOAA fisheries[6]. These are 120 dB RMS[7] for continuous noise and 160 dB SPL[8] for impulsive noise.

The hearing groups from the Southall 2019 and the NMFS 2018 guidance were specified by collating available information on marine mammal hearing and generalising their hearing sensitivity into representative groups. This grouping represents a significant research effort and are reviewed by the leading experts (academic, industrial and conservation) on the topic. Because of the large amount of work this represents and the widespread acceptance of the method, the thresholds and the methodology associated, have become de-facto standards for assessing noise impact on marine mammals and represents best available knowledge and practise.

Along with weighting curves, similar in function to the human dB(C) curves, a set of thresholds for hearing impact and injury is associated with the framework and allows for conversion of threshold exceedance into ranges with risk of impact. E.g. we might see that the PW group (true seals) has a risk of PTS at ranges shorter than 50 meters, and a risk of TTS at ranges shorter than 200 meters.

All marine mammal species are covered by the hearing groups and a full list of species in the different groups can be found in the "Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects" (Southall, et al., 2019), but in general the groups cover the following species:

Table 4. Summary of Southall 2019 thresholds and groups with species examples. For full species list see source (National Marine Fisheries Service, 2018; Southall, et al., 2019)

Hearing group	Species examples	Non-impulsive TTS/PTS threshold [$L_{E-24\ hours}$]	Impulsive TTS/PTS threshold [$L_{E-24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
PW	Harbour seal, Grey seal	181/201	170/185	212/218
OW	Otters	199/219	188/203	226/232
LF	Minke whale, Humpback whale	179/199	168/183	213/219
HF	Sperm whale, Common dolphin, Bottlenose dolphin, Killer whale, Risso's dolphin, Pilot whales	178/198	170/185	224/230
VHF	Porpoise	153/173	140/155	196/202

It's important to note that the assessment is thus based on the received level of receptors with the above-described auditory sensitivity and not based on the sensitivity of the individual species.

[5] TTS/PTS. A temporary/permanent change in hearing sensitivity caused by acoustic stimuli.

[6] Available from: https://archive.fisheries.noaa.gov/wcr/protected_species/marine_mammals/threshold_guidance.html

[7] Here taken as meaning "SPL"

[8] Assumed to be SPL of 90 % of energy in one impulse or SPL of total duration (L_{EQ}).

5.3 Fishes etc.

Impacts of noise on fishes is less well established than for marine mammals, but a review from 2014 (Popper, et al., 2014) provides guidelines on exposure limits for fish and turtles. The report does not directly use the PTS nomenclature (as above for mammals) as many fish have the capacity to repair structural damage to their ear, and even structural damage then cannot be said to be "permanent".

We use "PTS" here to cover the categories "Mortality and potential mortal injury" and "Recoverable injury".

Note that we use the impulsive limits from piling for all impulsive sources as the information for explosions is rather less well documented (and limits are significantly higher).

TTS is directly used in the report, and we use it in the same way here.

As there are no TTS/PTS limits for non-impulsive noise, we apply the limits for cumulative impulsive noise.

Table 5. Overview of Impact piling thresholds from (Popper, et al., 2014) (Table 7.3). We use these for all impulsive noise, even though explosions have separate thresholds (Table 7.2 in report)).

Hearing group	Species examples	Impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
P* (Fish with no swim bladder)	Sharks, Rays	186/216	TTS not specified/213
P- (Fish with swim-bladder, but not involved in hearing)	Salmon, Trout, Cod, Herring	186/203	TTS not specified/207
P+ (swim-bladder used in hearing)	Carp, Catfish	186/203	TTS not specified/207

5.4 Threshold Interpretation

5.4.1 THRESHOLD TYPES

The three threshold types refer to different ways that sound can affect the hearing of an animal and are ***important to keep in mind*** when evaluating the results of this report:

5.4.1.1 Non-impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***continuous***[9] sound received by the animal over a typical 24-hour period as sound exposure, L_E.

When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within the zone. Alternatively this can be thought of as the total sound-dose limit over 24 hours.

Weightings are applied for non-impulsive L_E (for mammals only[10]).

5.4.1.2 Impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal over a typical 24-hour period as sound exposure, L_E.

[9] Please see (National Marine Fisheries Service, 2018) for definitions of "non-impulsive" and "impulsive". For quick reference, if a sound is shorter than 1 second and is clearly intermittent in nature, it is impulsive – otherwise, it's continuous.

[10] When assessing for fish groups levels are not weighted.

When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within this zone.
Alternatively this can be thought of as the total sound-dose limit over 24 hours.

5.4.1.2.1 Impulsive $L_{E\ single\ impulse}$ / $L_{E\ \#\ impulses}$

It is sometimes useful to assess the impact of a single/a number of impulse(s). When we do this, we will refer to it as "LE single impulse / LE # impulses".
Like for the Lp, when single-impulse LE is presented as an impact zone, this refers to the area, within which, an animal would suffer the effect acutely/instantly.

Weightings are applied for Impulsive L_E (for mammals only).

5.4.1.3 Impulsive, L_p

The threshold over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal at any instant as maximal peak pressure.
When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect acutely/instantly and from just one exposure.
Weightings are ***not*** applied for Impulsive L_P.

5.4.2 MASKING

Levels that are not over threshold can still cause significant impact, if that noise makes foraging, navigation or communication harder due to masking or where biologically relevant sounds are "drowned out" by the anthropogenic noise. Continuous noise is more likely than impulsive noise to cause this form of impact.

5.4.3 DISPERSAL

Many animals can recognise sounds and might be dispersed from an area at noise levels well below TTS limits. Quantifying a level of dispersal from desk-spaced studies is very challenging and not done here.

6 CONCLUSION & RESULTS SUMMARY

Dredging

The noise from dredging, while presenting a significant PTS risk to ranges >500 m for the VHF group, this is only for animals staying close to the activity for extended periods (> 1 hour) and assumes continuous dredging with the dredger level as given by the 90th percentile. For the best estimate (model mean) the PTS risk range is 450 m after 8 hours exposure. There is no acute risk of noise related injury related to the dredging, and animals have time to swim away. Further the area ensonified does not "block" access through a channel or strait.

There is no issue identified for species outside the VHF range.

Vibro piling

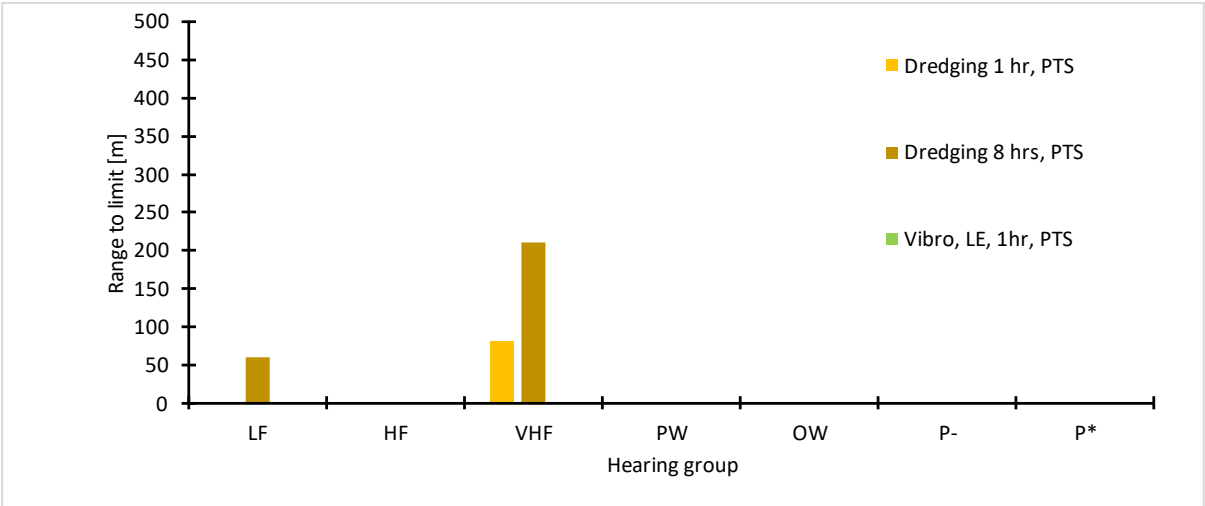
Prolonged exposure to vibro piling at close range (<100 m) carries some auditory risk for the animals assessed, specifically groups LF, VHF and P- (baleen whales, porpoises and salmon/trout), where the peak pressures in the noise have risk ranges up to 300 m for the VHF group. We therefore suggest surveillance takes place prior to piling to minimise the risk of impact on porpoises. While this is a significant risk for animals close to the activity, we stress that we have used a very conservative approach to estimating the source levels, and the realised emission will likely be significantly lower.

Further, animals will tend to move around, or away from noise, which will limit exposure. In Figure 16 and Figure 18 we show an example of the effect of using moving receivers (animats, modelled animals) to estimate what might be the effect of movement.

Table 6. Overview of maximal ranges to limits [m].

Activity	Dredging				Vibro piling			
Dose	1 hr L_E		8 hrs L_E		1 hr L_E		Peak pressure L_P	
Hearing group	TTS	PTS	TTS	PTS	TTS	PTS	TTS	PTS
LF	230	<50	1250	60	760	<50	<50	<50
HF	60	<50	160	<50	<50	<50	<50	<50
VHF	620	80	1350	210	180	<50	550	300
PW	70	<50	250	<50	100	<50	100	<50
OW	<50	<50	<50	<50	<50	<50	<50	<50
P-	120	<50	600	<50	390	<50	<50	125
P*	120	<50	600	<50	390	<50	<50	<50

Figure 15. Overview of PTS risk ranges



7 RESULTS

The noise maps for each activity and hearing group are presented in APPENDIX E – Results.

7.1 Dredging

While exposure to 8 hours of dredging has significant PTS risk ranges (< 210 m) for 2 hearing groups: LF (baleen whales) and VHF (porpoises), but only after prolonged exposure (> 1 hour). The relatively low (compared to limits) source level of the dredging means that there is not acute risk from noise and animals have time to swim away.

Using a model approach to have moving receivers (animats, see Figure 18, p. 24) we can estimate the impact on moving animals. The animats in the model move 0.5-4 m/s depending on the received level and evade levels >120 dB.

Figure 16. Summary of total exposure (L_E) of 225 animats of the VHF group in the soundfield of the dredging. 44 exceeded TTS limit (20 %), none exceeded the PTS limit.

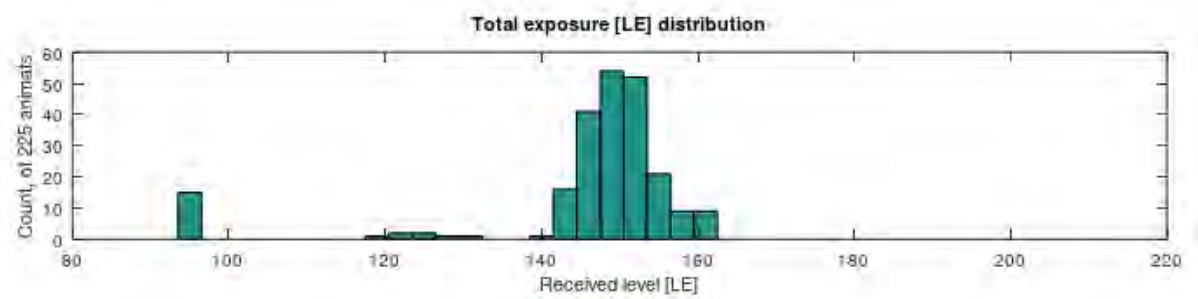


Figure 17. TTS and PTS risk ranges for all groups.

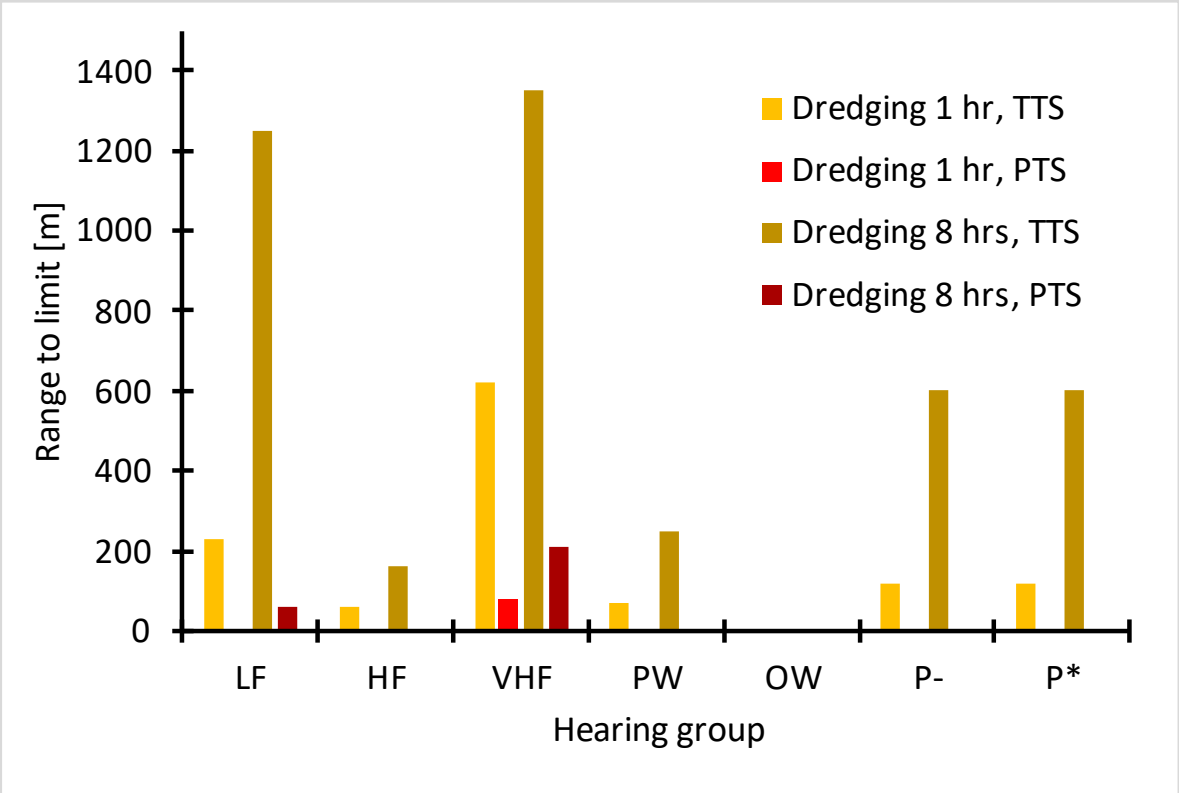
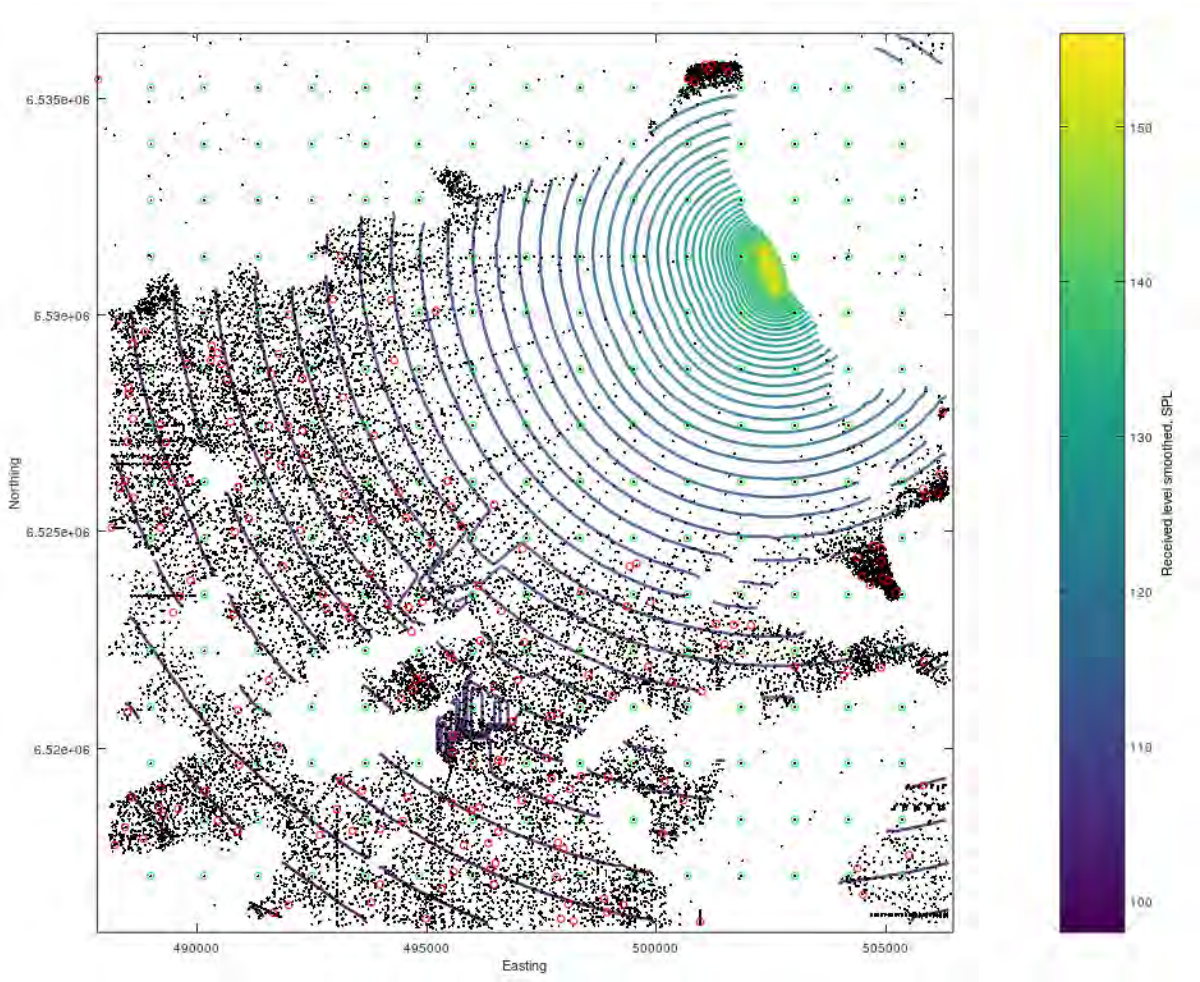


Figure 18. 225 “animats” in the dredger soundfield for 8 hours. Green spots are starting points, and red spots end points. Area covers Scapa Flow.a



7.2 Vibro piling

Longer exposures (> 1 hour) lead to significant PTS risk zones within 50 for all groups, but the proposed duration of vibro piling on this site is less than 1-hour per day.

The peak pressures in the vibro piling have a PTS risk zone max range of 50m. While the risk for the LF and P- groups is only for prolonged exposure, the risk to the VHF group is acute, i.e. the animal has no chance to swim away to avoid the risk.

Figure 19. TTS and PTS risk ranges for all groups.

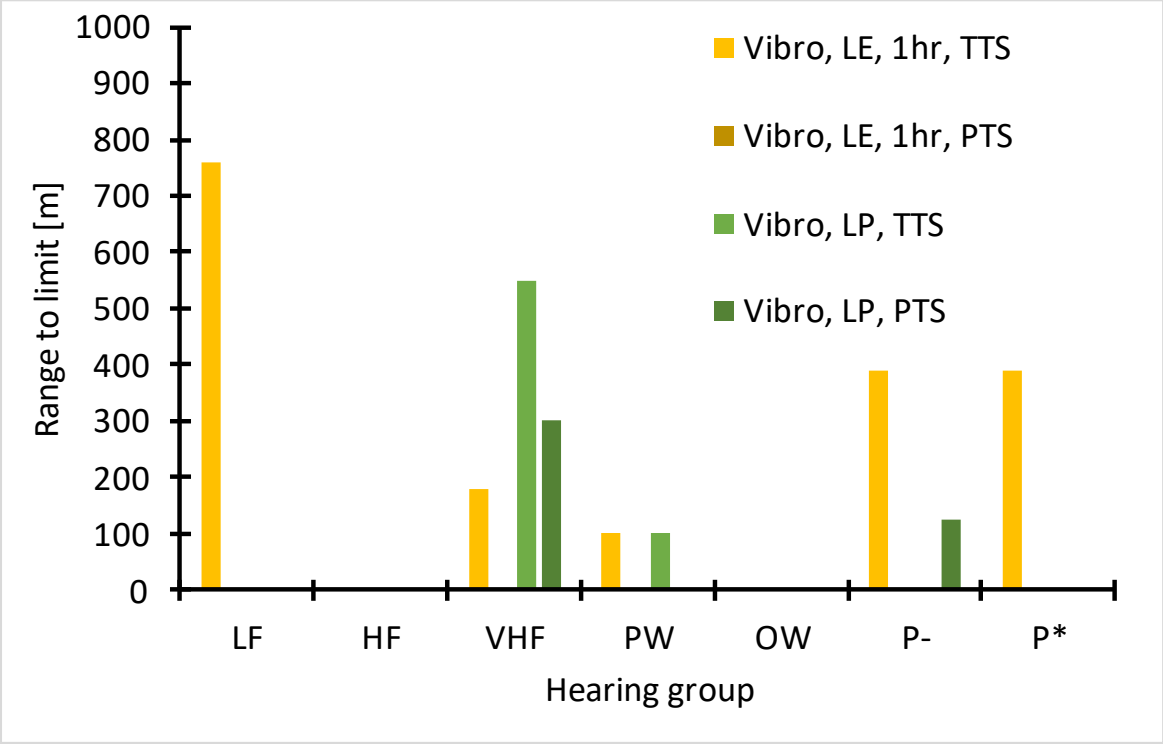
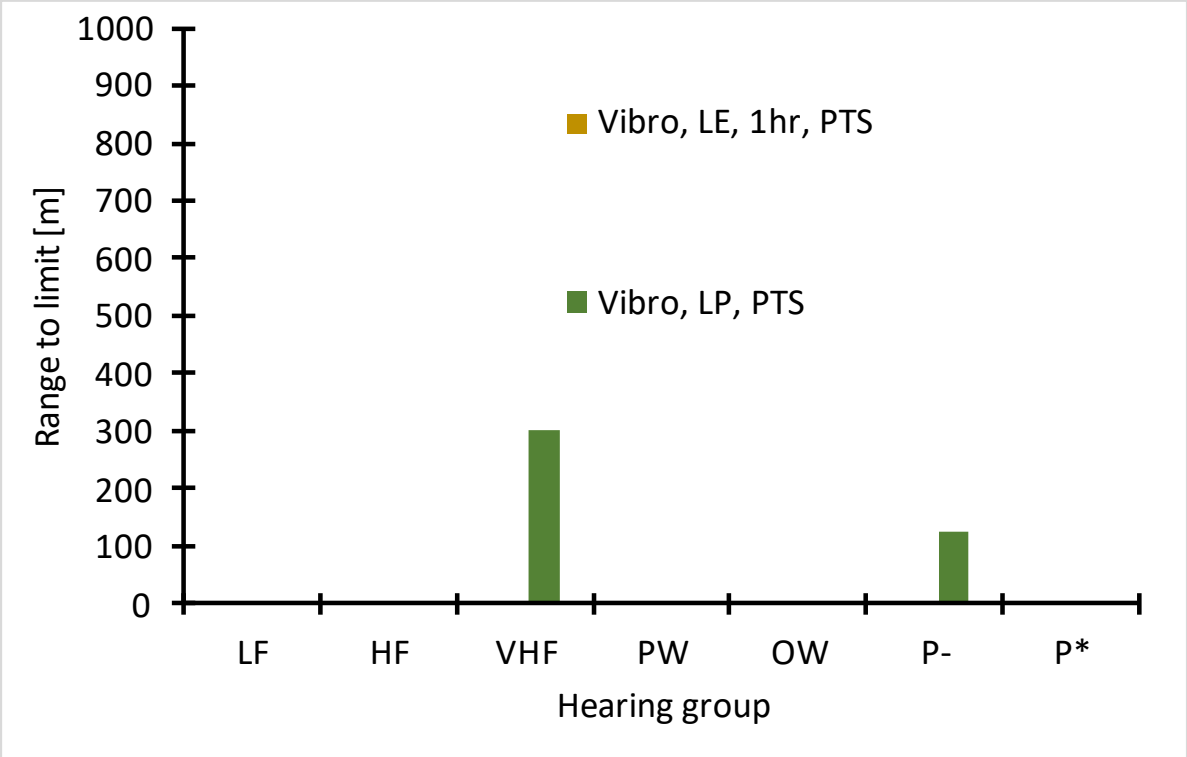


Figure 20. PTS risk ranges for all hearing groups.



8 BIBLIOGRAPHY

Ainslie, M. A. (2010). *Principles of Sonar Performance Modelling.* Heidelberg: Springer. doi:10.1007/978-3-540-87662-5

Audoly, V. M. (2020). Accounting for sea floor properties in the assessment of underwater noise radiated from ships in shallow water. *Proceedings of Meetings on Acoustics* .

Boyce, R. E. (1981). *LABORATORY-DETERMINED SOUND VELOCITY, POROSITY, WET-BULK DENSITY, ACOUSTIC IMPEDANCE, ACOUSTIC ANISOTROPY, AND REFLECTION COEFFICIENTS FOR CRETACEOUS-JURASSIC TURBIDITE SEQUENCES AT DEEP SEA DRILLING PROJECT SITES 370 AND 416 OFF THE COAST OF MOROCCO.* La Jolla: Scripps institution of Oceanography.

British Geological Survey. (2022, June 30). *Geology of Britain Viewer*. Retrieved from British Geological Survey: https://mapapps2.bgs.ac.uk/geoindex/home.html

CalTrans. (2015). *Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish, CALTRANS.* Sacramento: California Department of Transportation.

European Marine Observation and Data Network. (2019, May 01). *Bathymetry portal*. Retrieved from EMODnet: http://portal.emodnet-bathymetry.eu/

Jensen, F. B., Kuperman, W. A., Porter, M. B., & Schmidt, H. (2011). *Computational Ocean Acoustics, Second Edition.* Springer. doi:10.1007/978-1-4419-8678-8

Leroy, C. C., Robinson, S. P., & Goldsmith, M. J. (2008). A new equation for the accurate calculation of sound speed in all oceans. *The Journal of the Acoustical Society of America*, 2774-2782.

Marine Scotland. (2022, 12 12). *Salinity*. Retrieved from Marine Scotland: https://marine.gov.scot/sma/assessment/salinity

National Marine Fisheries Service. (2018). *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0).* Silver Spring: U.S. Department of Commerce.

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J., . . . Travolga, W. (2014). Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. *Springer Briefs in Oceanography, S3*.

Southall, B. L., Finneran, J. J., Reichmuth, C., E.Nachtigall, P., Ketten, D. R., Bowles, A. E., . . . Tyack, P. L. (2019). Marine Mammal Noise Exposure Criteria:Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals*, 125-232. doi:10.1578/AM.45.2.2019.125

APPENDIX A - DBSEA

A summary of dBSea's models in standard scenarios can be found in the document (online):
http://www.dbsea.co.uk/media/30782/dBSea-Benchmark-Testing.pdf
(also see Figure 23, p. 29 for one example).

All solvers in dBSea are based on Jensen et al. 2011 (Jensen, Kuperman, Porter, & Schmidt, 2011)

dBSea has four primary models of calculation:

- **Range dependent Parabolic Equation model - dBSeaPE**
  dBSeaPE uses a split-step, wide angle parabolic equation method. It uses either Greene's approximation or several Padé terms (as set by user) to get very wide propagation with low phase error.

  dBSeaPE is best suited to deeper scenarios (>50 m) or where sediment interaction is not dominant relative to sound speed profile. The model is very efficient for low frequencies and only suffers a small efficiency penalty for higher frequencies.

  dBSeaPE will generally be used for deeper/long range scenarios in the frequency interval 10-1000 Hz.
- **Range dependent Normal Modes model - dBSeaModes**
  dBSeaModes is especially suited to shallower and sediment dependent scenarios and will typically be used where water is shallower than 50 m and depth changes are a large proportion of the total depth, or where sediment effects are thought to play a significant role. dBSeaModes incurs a significant efficiency-penalty at high frequencies and will normally be used in the frequency range 10-1000 Hz.
- **Ray tracing**
  dBSea uses a Gaussian raytracing method, dBSeaRay, to calculate transmission losses for higher frequencies (scenario dependent, but normally from 500 Hz). dBSeaRay compares favourably with the opensource BELLHOP model, in that it is accurate to lower frequencies and agrees well with PE and NM models.
- **Full waveform propagation**
  dBSeaRay also supports full waveform propagation in the frequency range 10 Hz to 168 kHz (limited by the waveform sample rate). Used in this way dBSeaRay takes into account all scenario range dependence (as models above) as well as the arrival time, phase information and transmission loss of all significant paths to any number of receivers in the scenario (the results grid).

General notes:

- dBSea is an "Nx2D" solver, meaning it models transmission losses in "N" number of vertical radial slices from the source (Figure 22, p. 28). There is no backwards propagation towards the source, and no sideways reflection/refraction (We're testing dBSea with full 3D solvers currently).

- dBSea models the sediment propagation only for compressional waves, not for shear waves. This generally means that the transmission loss will be slightly underestimated as no energy is transferred into shear waves, and also means that dBSeaRay does not propagate into the sediment, but relies on a complex reflection coefficient (calculated from the sediment layers) to calculate the reflection/refraction properties of the sediment. Given that dBSeaRay is generally only used for higher frequencies, this has very little practical effect, as higher frequencies will only interact weakly with deeper layers of the sediment.

- The individual sources in a scenario are modelled radially (radial coordinates) from the source at several depths. In post-processing levels are transferred to a cartesian "results grid". This results grid stores levels from all sources so that the cumulative level at any point in the scenario can be investigated immediately.

- Levels can be, and are often post-processed to apply a conservative margin and smooth results (Figure 21, p. 28). Radial smoothing (triangular kernel of variable width) is carried out to mitigate modelling artefacts arising from low environment sampling density or chance occurrences. Levels are often made to decrease monotonically from the source to make general trends more visible and decrease the risk of misinterpreting impact ranges.

- When refereeing to a level at a certain range, this usually refers to the greatest level at any depth at that range (unless specifically mentioned otherwise).

Figure 21. Post-processing to eliminate artefacts and ease interpretation. Level are radially smoothed by default, and are made to be monotonically decreasing with increasing range from the source.

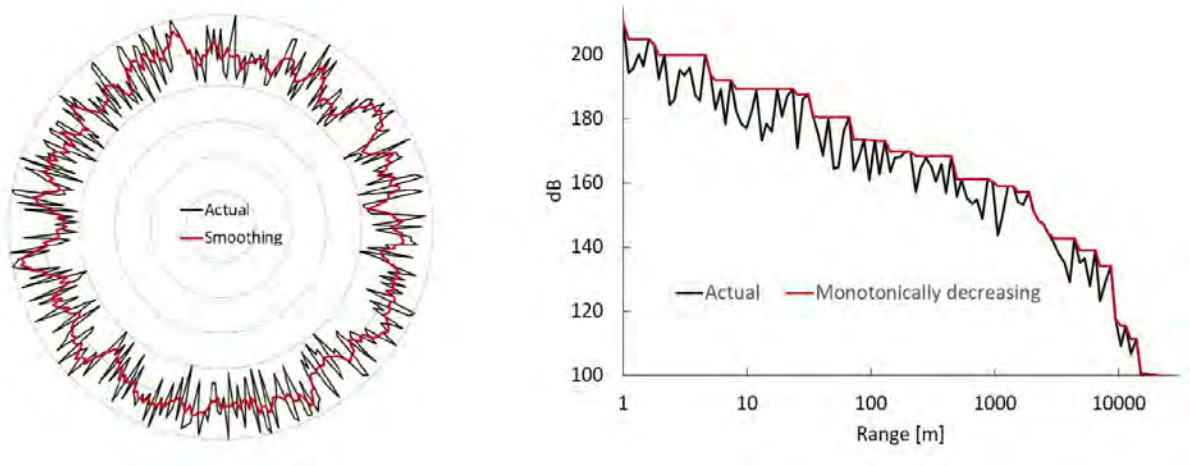


Figure 22. Low resolution schematic of the dBSea modelling space. Source transmission loss is modelled radially from the sources at a number of depths. Results are extracted from a "square" 3D grid that hold cumulative levels from all sources in the scenario.

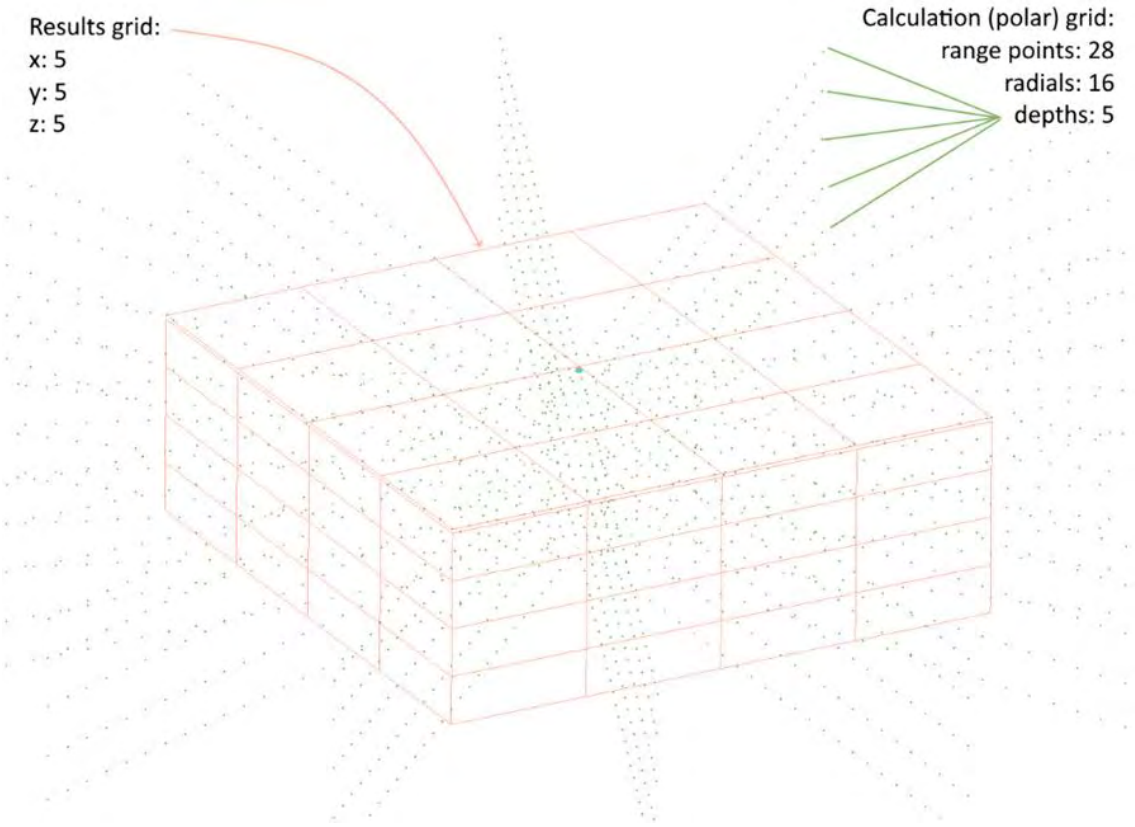
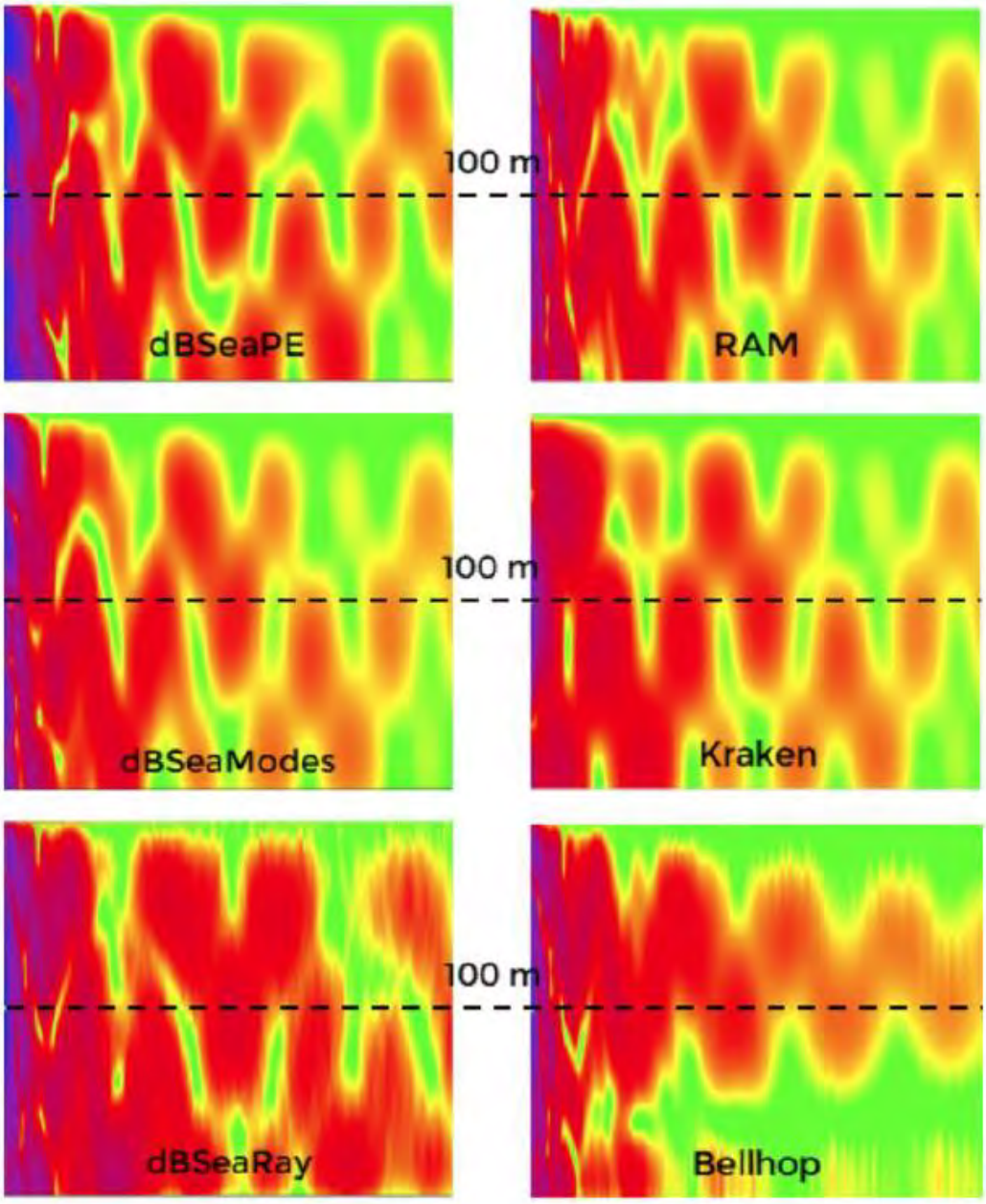


Figure 23. the "Pekeris" standard problem, a low frequency problem. Note that due to sediment effects, neither dBSeaRay nor Bellhop should be relied upon for low frequency problems, and are only include for completeness.



APPENDIX B – UNDERWATER ACOUSTICS BASICS

Sound Speed

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[11] much as 340 m/s is in air. Soundspeed is given by the following equation:

$$c = \frac{Z}{\rho}$$

$$Soundspeed\ [m/s] = \frac{Acoustic\ impedance\ \left[\frac{kg}{m^2 \cdot s}\right]}{Specific\ density\ [kg/m^3]}$$

Because changes to pressure, salinity and temperature occur with changes in depth, the specific density and acoustic impedance of water changes with depth, and thus the soundspeed changes as well.

The soundspeed profile is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. This change is quantified in "Snell's Law" and results in sound being "bent" towards the depth of minimal soundspeed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

Spreading loss

Most of the propagation loss (loss in dB from source to receiver, "PL") that occurs initially is governed by "spreading loss". It is the simple "thinning out" of acoustic energy as it spreads away from the source, usually in all directions – spherically.

For a sound source in an unbound medium the initial PL will be dominated by spherical PL:

$$Received\ level = Source\ level_{at\ reference\ range} - 20 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction in received level of 6 dB per doubling of distance and explains the rapid reduction in received levels often seen close to the source, e.g.: with a reference range of 1 m, at 16 meters range, there has been 4 doublings of distance, and thus 24 dB loss (4×6 dB).

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Also, at greater ranges a doubling of distance is no longer trivial as the PL from spherical spreading loss from 500 m to 1000 m is also just 6 dB.

Sound Channels and Wave guides

In bounded mediums where the sound energy is confined to cylindrical spreading, the PL (ignoring absorption) is often well-characterised by:

$$Received\ level = Source\ level_{at\ reference\ range} - 10 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction of received level of 3 dB per doubling of distance. Depending on the sediment this kind of "waveguide" can sustain efficient transmission of sound over long ranges, provided the sediment is acoustically hard and there is low absorption (such as is the case for low frequencies or in low salinity).

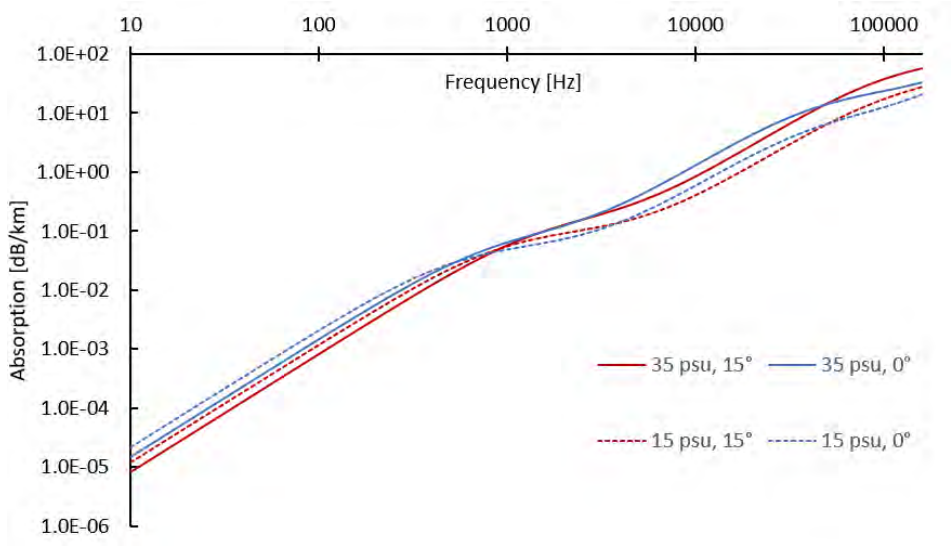
In absence of a bounding from the surface or the seabed, a soundspeed profile with a clear low-speed region, surrounded by higher soundspeeds can act a sound channel, by focusing the sound towards a single depth (with lower soundspeed), limiting the PL from spherical to cylindrical (a SOFAR channel is formed).

[11] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

Absorption

Besides the "thinning out" of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is mostly governed by the concentration of boric acid and magnesium sulphate and is very dependent on the frequency, with lower frequencies, <1 kHz, experiencing almost no absorption, while high frequencies, > 10 kHz, can be attenuated by over 10 dB / km.

Figure 24. Absorption comparison at salinities of 35 psu & 15 psu and temperatures of 0° and 15°. Both scales are logarithmic. Note how increased salinity increases high-frequency absorption (solid v dashed lines), while a decrease in temperature increases absorption at lower frequencies (red v blue lines).



Small bubbles, wind or wave induced, will further attenuate especially the high frequencies, but as modelling is often done to estimate a worst-reasonable case, or for weather sensitive activities, fair weather with little wind and waves are assumed, thus ignoring this attenuation effect.

Sediment

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies. This effect coupled with the high absorption at high frequencies often leads to the soundscape being dominated by frequencies from a few hundred hertz to a few thousand hertz. In deeper water, or with an upward refracting soundspeed profile, low frequencies will tend to dominate the soundscape away from sound sources, as there is no efficient mechanism for attenuating them.

A "cut-off[12]" frequency, below which, there will be high sediment-associated attenuation can be approximated by:

$$f_{cut-off} = \frac{c_{water}}{4 \cdot D \cdot \sqrt{1 - \left(\frac{c_{water}}{c_{sediment}}\right)^2}}$$

With "C_{water}" and "$C_{sediment}$" being the soundspeed in the water and the sediment respectively, and "D" the local depth (Jensen, Kuperman, Porter, & Schmidt, 2011).

[12] The cut-off is not an immediate loss of energy in frequencies under this frequency, but rather something like a high pass, 1st-order, Butterworth filter (Audoly, 2020).

In water with lower salinity and less absorption, the soundscape will tend to have a relatively higher content of high frequencies as these are absorbed much less efficiently when the salinity is lower.

Sound transmission Across Interfaces

Sound waves are reflected and refracted (Snell's law) as they travel through interfaces. Also, depending on acoustic impedance and interface angles only a proportion of the incident acoustic energy is transmitted through that interface (the rest is reflected).

In the following: W: Watt; Pa: Pascal; s: second; m: metre; N: Newton; J: Joule; θ: angle; v: soundspeed; Z: acoustic impedance; p: pressure from ambient;

Snell's law:

$$\frac{\sin\theta_{in}}{\sin\theta_{out}} = \frac{v_{in}}{v_{out}}$$

- rearranged to give transmission angle from incidence angle and soundspeeds:

$$\sin^{-1}\left(\frac{\sin\theta_{in}}{\frac{v_{in}}{v_{out}}}\right) = \theta_{out}$$

Transmission fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{2\cdot Z_{out}\cdot\cos\theta_{in}}{Z_{out}\cdot\cos\theta_{in} + Z_{in}\cdot\cos\theta_{out}}$$

Reflection fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{Z_{out}\cdot\cos\theta_{in} - Z_{in}\cdot\cos\theta_{out}}{Z_{out}\cdot\cos\theta_{in} + Z_{in}\cdot\cos\theta_{out}}$$

It follows from these relations that for transmission from an acoustically relatively slow medium like water to an acoustically faster medium here exists an incident angle above which there is total reflection, and thus no transmission of acoustic energy through the interface (real interfaces are rugged and lumpy, and perfect reflection is not realistic).

For the water/sediment interface presented here (sediment is sand with a soundspeed of 2000 m/s) this occurs at 0.84 radians (~48.5 degrees) from normal incidence.

The fraction of pressure transmission from water (soundspeed 1500 m/s) to sediment (2000 m/s) is around 146 % at normal incidence and drops as the incidence angle increases away from normal, much faster for water-to-sediment than for sediment-to-water.

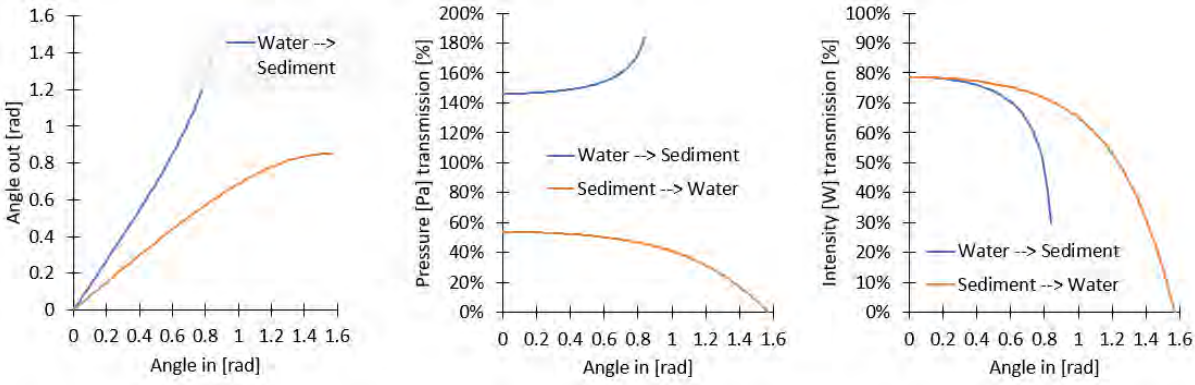
While it may seem counter-intuitive that pressure can increase after transmission over an interface, remember that the energy in the sound is a function of pressure *and* acoustic impedance:

$$I = \frac{p^2}{Z}$$

$$With\ units: [W] = \frac{[Pa]^2}{\left[\frac{Pa\cdot s}{m^3}\right]} = \frac{\frac{N^2}{m^4}}{\frac{N}{m^2}\cdot s} = \frac{N^2\cdot m^3}{m^4\cdot\frac{N}{m^2}\cdot s} = \frac{N}{m\cdot m^{-2}\cdot s} = \frac{J\cdot m}{m^{-1}\cdot s} = \frac{J}{s} = W$$

Thus, if the transmitted intensity fraction is 80 % then the reflected intensity is 20 %; there is energy conservation.

Figure 25. Transmission angles [radians] and fractions as function of incident angle between water and sediment (sand). Note that total reflection from water to sediment occurs around incident angle of 0.84 [rad] (48.5 degrees), meaning there is no transmission of sound at greater incidence angles.



Simplified Propagation Loss Model

Taking all the above into account we can construct a simplified model, that will give a good indication of the expected propagation loss (PL) in scenarios of constant depth:

$$PL = \begin{Bmatrix} r < D \ : & -20 \cdot \log_{10}\left(\frac{r}{r_0}\right) \\ r > D \ : & -20 \cdot \log_{10}\left(\frac{D}{r_0}\right) - 10 \cdot \log_{10}\left(\frac{D}{r_0}\right) \end{Bmatrix} - \alpha(f) \cdot r - l(f) \cdot r$$

Where:

- "r" is horizontal range from source.
- "D" depth at source.
- "r_0" the reference range of the source (often 1 m).
- "f" the frequency,
- "l" the frequency specific leakage loss to the sediment.
- "α" the frequency specific absorption.

Sound Level Units

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 7: Definitions.

Unit	Definition	Comments
SPL (dB_{RMS}) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p ($dB_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}{}^2}$
$L_{p\text{-}p}$ ($dB_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[13] equivalent to $L_P + 6.02\ dB$
L_E (dB_{SEL}) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-}"time"}$ or $L_{E\text{-}single\ blow}$.

If the averaging period for SPL is equal to the total even duration, then SPL is equal to "Leq" the "equivalent constant level".

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

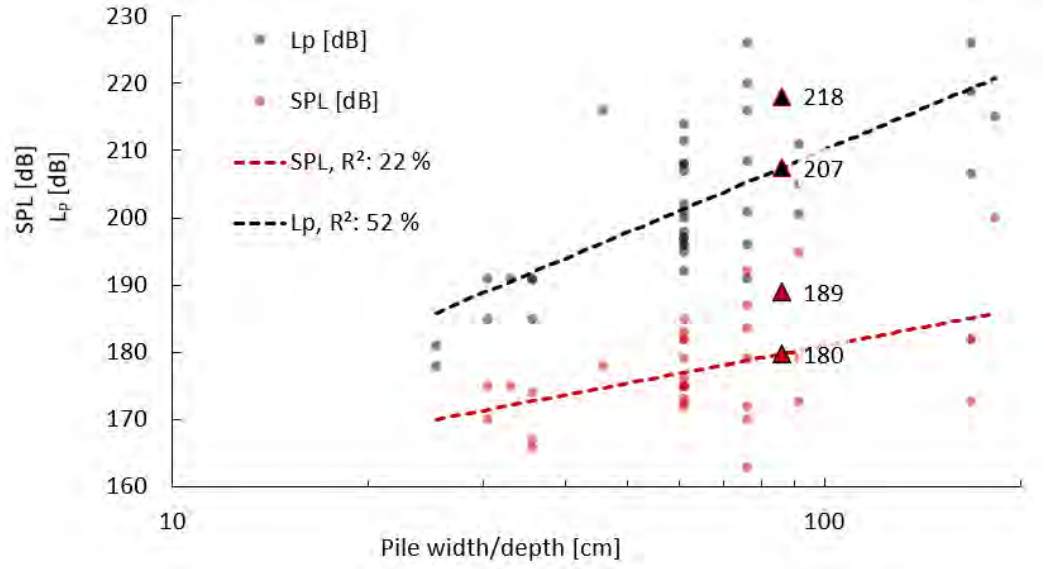
[13] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

APPENDIX C – SOURCE MODELS

Vibration piling model

We only have a few recordings (50) from vibration piling and have no dedicated source model for this type of piling. Instead, we rely on published recorded levels as from CalTrans (CalTrans, 2015).

Figure 26. Basis of vibro piling broad band source level as a function of pile size.



Given the low confidence we have in this approach (low R^2 values) we use the 90th percentile level as the broadband source level. L_P is estimated to be 218 dB and SPL 189 dB. The frequency content is assumed to be identical to that of the impact piling.

Table 8. Sources decidecade band levels.

Band centre frequency [Hz]	Dredging, Mean (broadband: 182) [SPL]	Dredging, 90th percentile (broadband: 192) [SPL]	Drilling, Mean (broadband: 138) [SPL]	Drilling, 90th percentile (broadband: 156) [SPL]	Vibro, Mean (broadband: 187) [SPL]	Vibro, 90th percentile (broadband: 196) [SPL]
12.5	162	165	127	142	166	176
16	163	166	126	139	167	176
20	164	167	124	139	167	176
25	165	170	123	138	167	176
31.5	168	177	125	139	168	177
40	169	180	124	140	169	179
50	169	178	124	139	172	181
63	170	178	126	143	174	183
80	169	180	123	142	176	185
100	168	179	124	142	177	186
125	168	178	123	140	178	187
160	168	178	123	142	177	186
200	168	177	125	146	177	186
250	169	178	126	147	177	186
315	169	178	125	147	175	184
400	169	177	123	144	174	183
500	168	178	124	145	173	182
630	167	175	122	143	171	180

800	167	174	124	141	169	178
1000	166	174	125	142	167	176
1250	165	174	123	142	165	175
1600	165	174	121	138	164	173
2000	164	174	120	135	162	171
2500	163	175	119	134	160	169
3150	163	175	118	132	159	168
4000	162	175	118	132	158	167
5000	162	175	119	133	156	165
6300	161	175	118	130	155	164
8000	160	175	117	130	154	163
10000	159	174	117	129	152	161
12500	158	173	110	120	150	159
16000	157	173	109	118	150	159
20000	156	172	109	119	149	158
25000	156	171			148	157
31500	155	171			147	156
40000	154	170			146	155
50000	157	174			145	154
63000	156	173			144	153
80000	156	173			143	152
100000	157	172			142	151
125000	157	166			141	150
160000	157	166			140	149

APPENDIX D – MODEL CALIBRATION

Recorded Transmission losses

Scapa

Broadband transmission losses for exposure levels (L_E) show good consistency between measurements and a transmission loss consistent with -14.7 × Log_{10}(range), suggesting a sediment with some ability to reflect sound back into the water column and form a waveguide.

Transmission loss for peak pressure levels (L_P) were near spherical spreading loss which is consistent with a poorly reflecting bottom resulting in little overlap in arrival times for the source impulse.

There was a clear pattern in the transmission losses versus frequency, with higher frequencies experiencing much higher losses, likely due to interaction with a rough sediment resulting in a lot of scattering.

*Note that for the bands 50 – 1250 Hz the ambient noise at Scapa was above the source level, while we have tried to compensate for this, those values are still subject to considerable uncertainty (*Figure 28*).*

Figure 27. Broadband transmission losses at Scapa. L_P losses follow a near spherical loss pattern while L_E shows a tendency to follow a waveguide with some absorption losses. Thick lines are best fit of logarithmic loss, while thin lines are for loss accounting for the depth at the source. Error bars are expected 95 % of measurements.

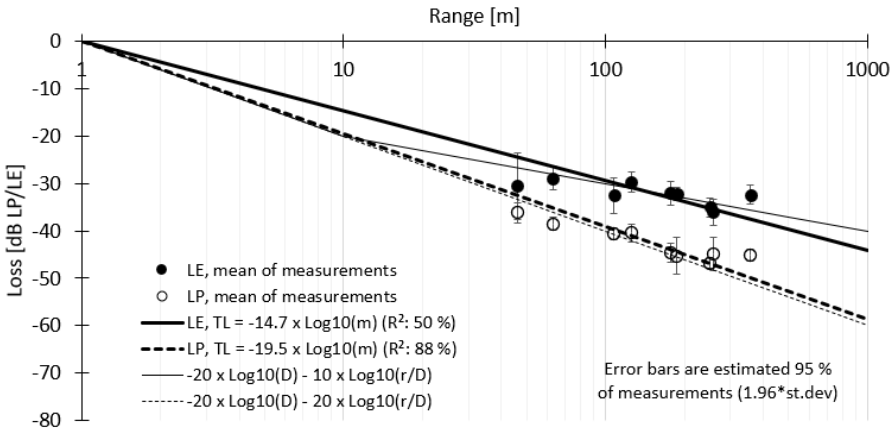
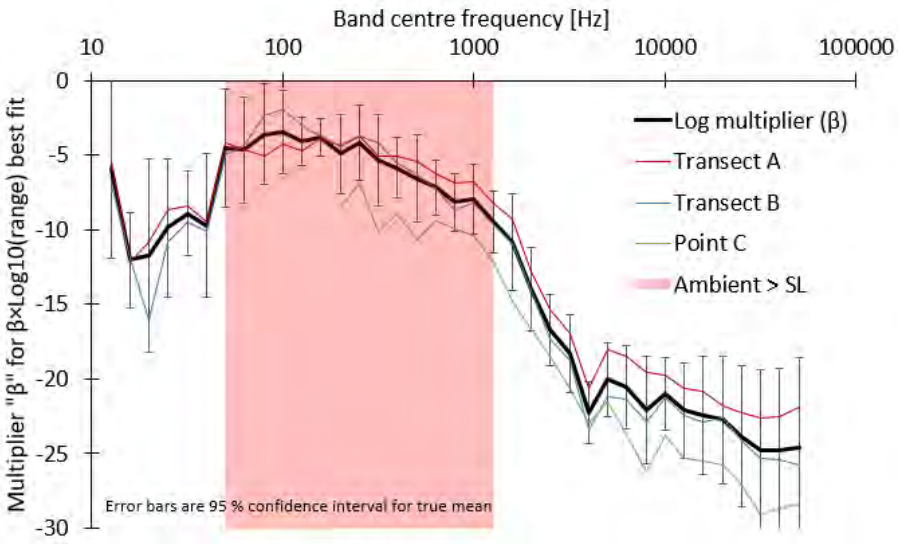


Figure 28. Transmission losses per band shown as the best fit multiplier "β" for a simple logarithmic transmission loss. Error bars are 95 % confidence interval for the true mean. While Transects A & B have some difference, this was not significant at a 10 % level in a t-test. Bands 50 – 1250 Hz have been corrected for contributing ambient noise as ambient noise was near or above recorded levels (red band).



APPENDIX E – RESULTS

Maps are presented with impact for different hearing groups as summarised here

Note that some maps have areas marked as “model artefacts”, these are areas where the levels are assumed to not be realistic, but rather an example of a digitisation problem with the bathymetry.

Group	Description	Example species
LF	Low frequency, baleen whales	Mike whale, Fin whale, Blue whale
HF	High frequency, most dolphins	Common dolphin, Risso’s dolphin, beaked whales, Bottlenose dolphin, Sperm whale, Killer whale
VHF	Very high frequency, few dolphins and porpoises	Harbour porpoise, Hourglass dolphin
PW	Phocid water, True seals	Harbour seal, Grey seal
OW	Otariid + other water, Fur seals, walruses and aquatic mammals	Walrus, Otter, Polar bear
P-	Fish with swim bladder, not coupled to inner ear	Salmon, Trout, Cod, Herring
P*	Fish with no swim bladder	Sharks and rays

Dredging L_E

Maps are provided for 90th percentile source levels for 1 hours and 8 hours.

Figure 29. Dredging, L_E, 1hr, LF group

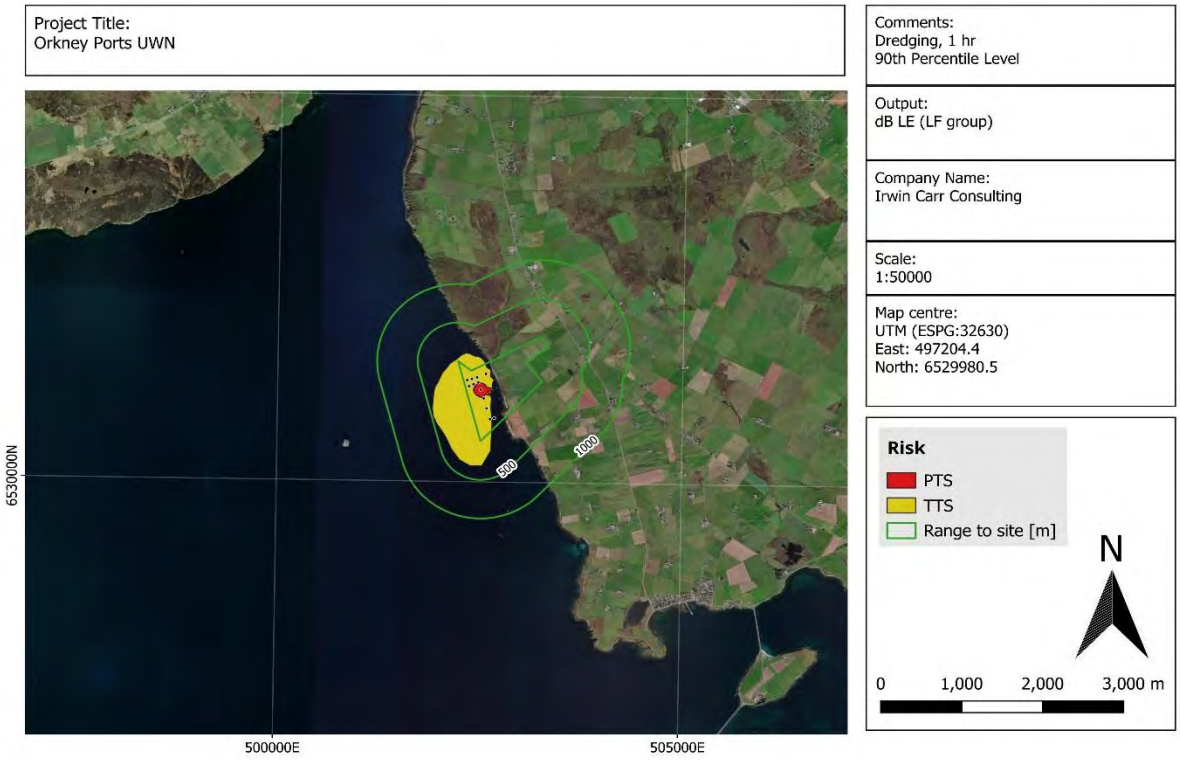


Figure 30. Dredging, L_E, 8hr, LF group

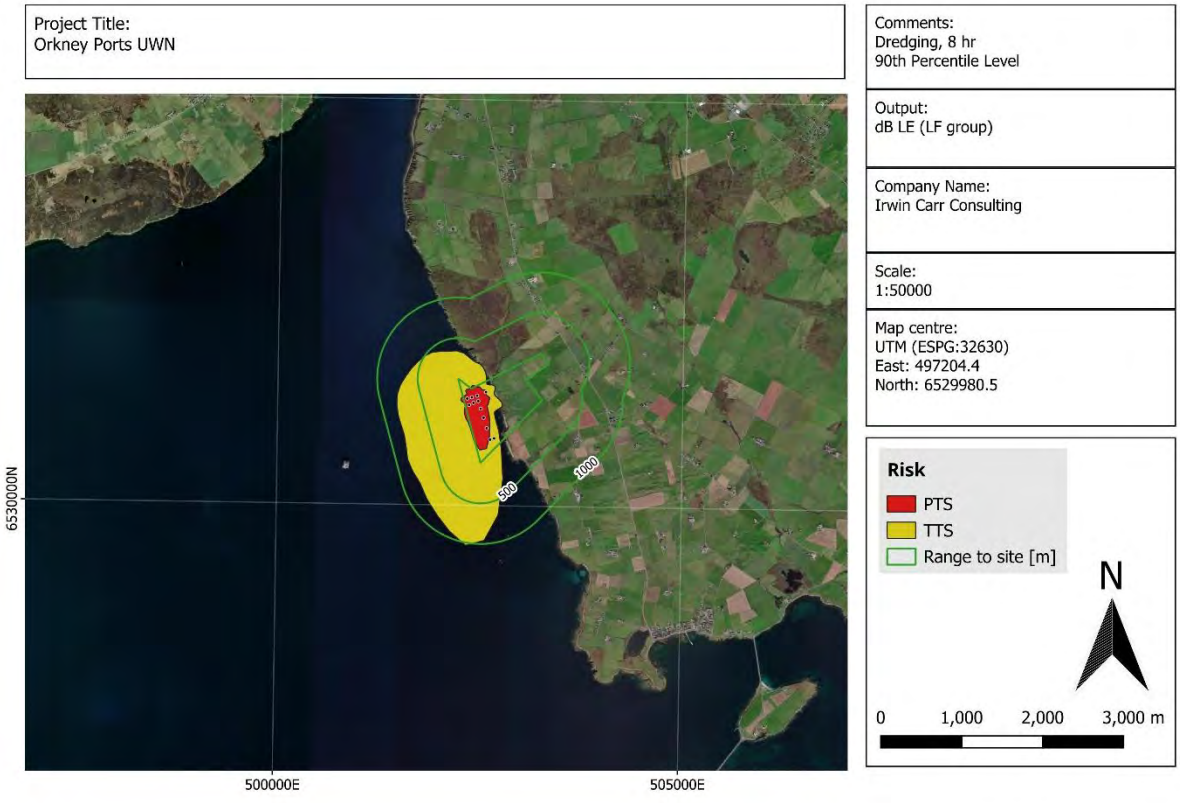


Figure 31. Dredging, L_E, 1hr, HF group

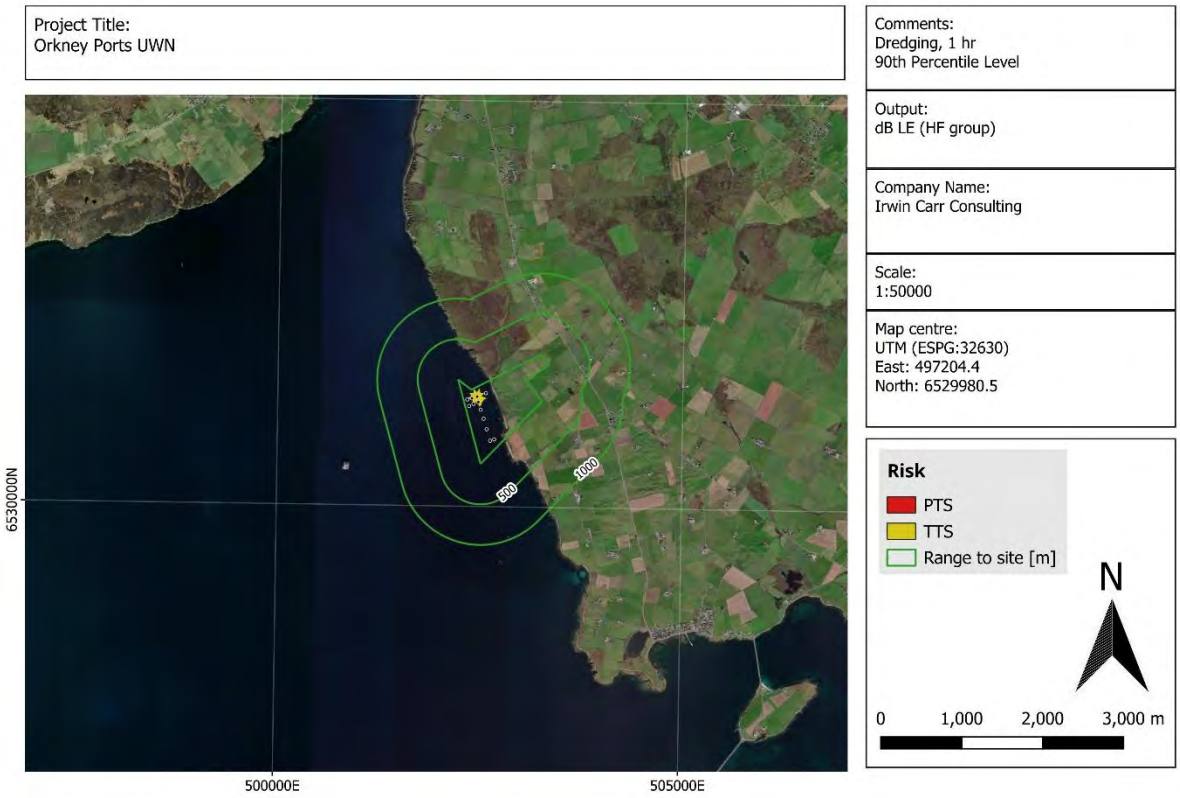


Figure 32. Dredging, L_E, 8hrs, HF group

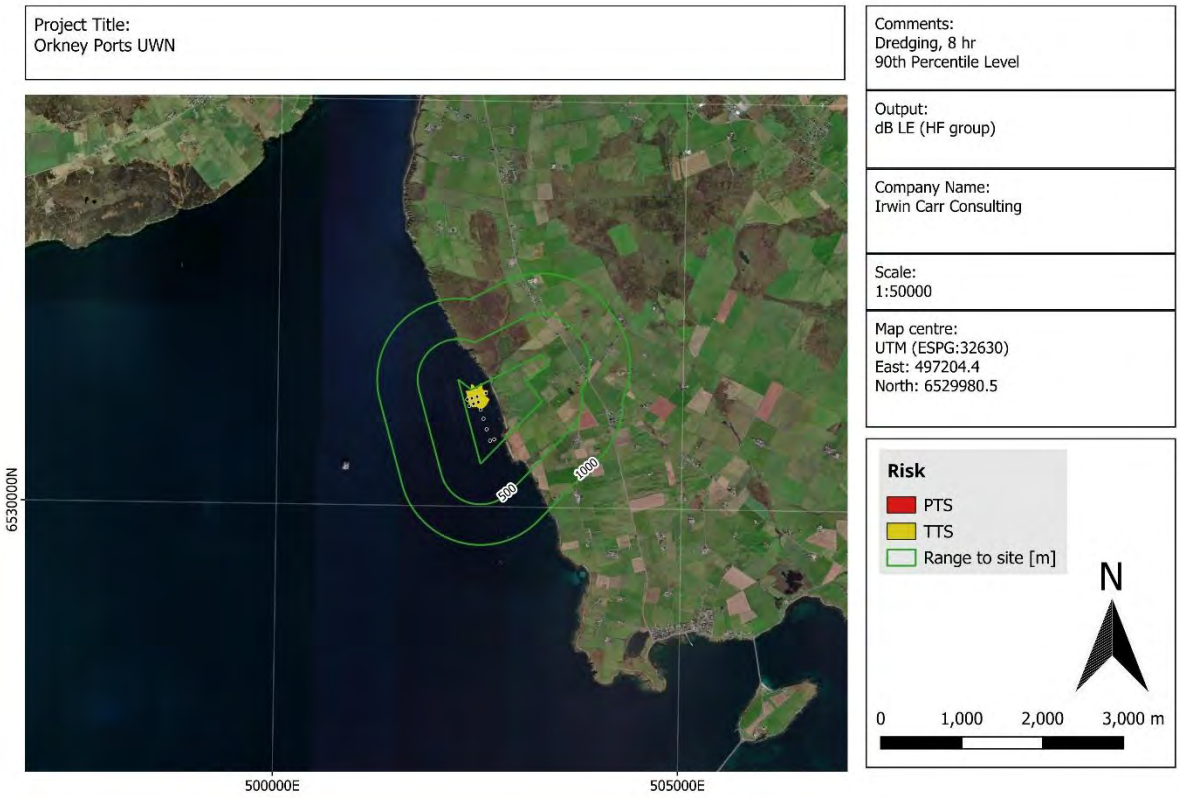


Figure 33. Dredging, L_E, 1hr, VHF group

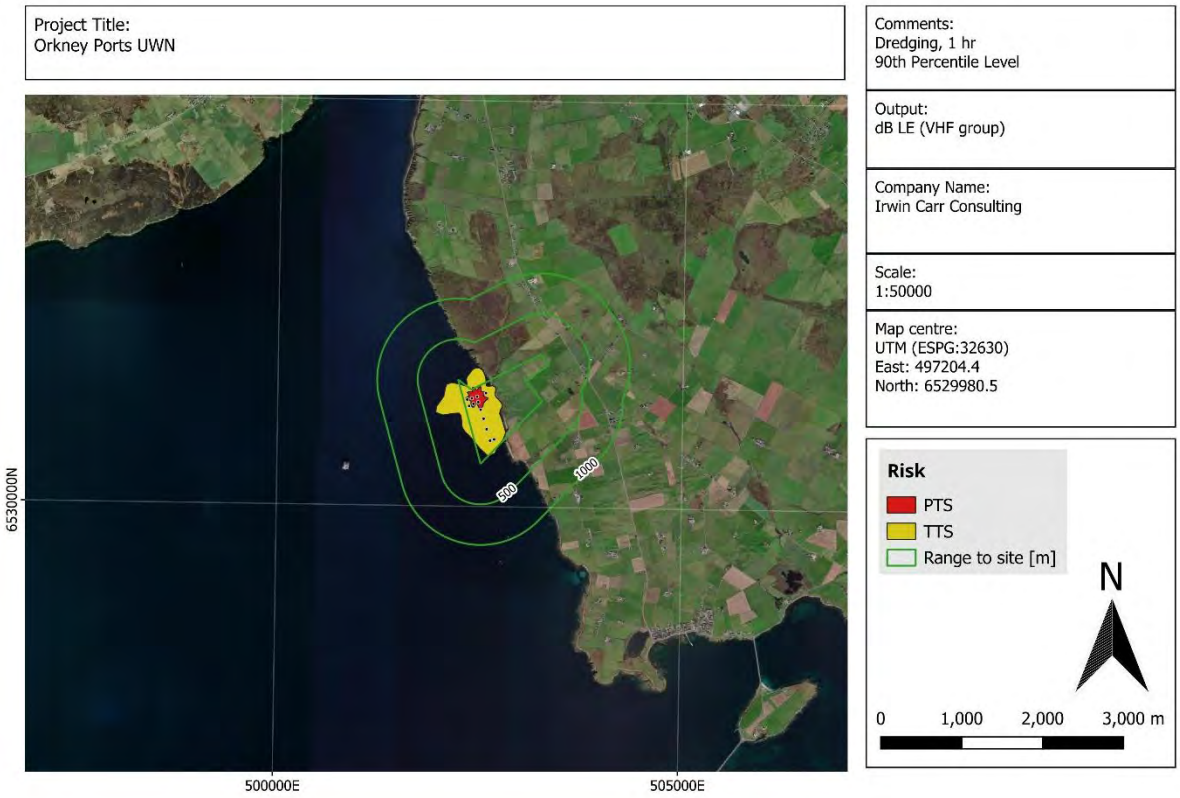


Figure 34. Dredging, L_E, 8hrs, VHF group

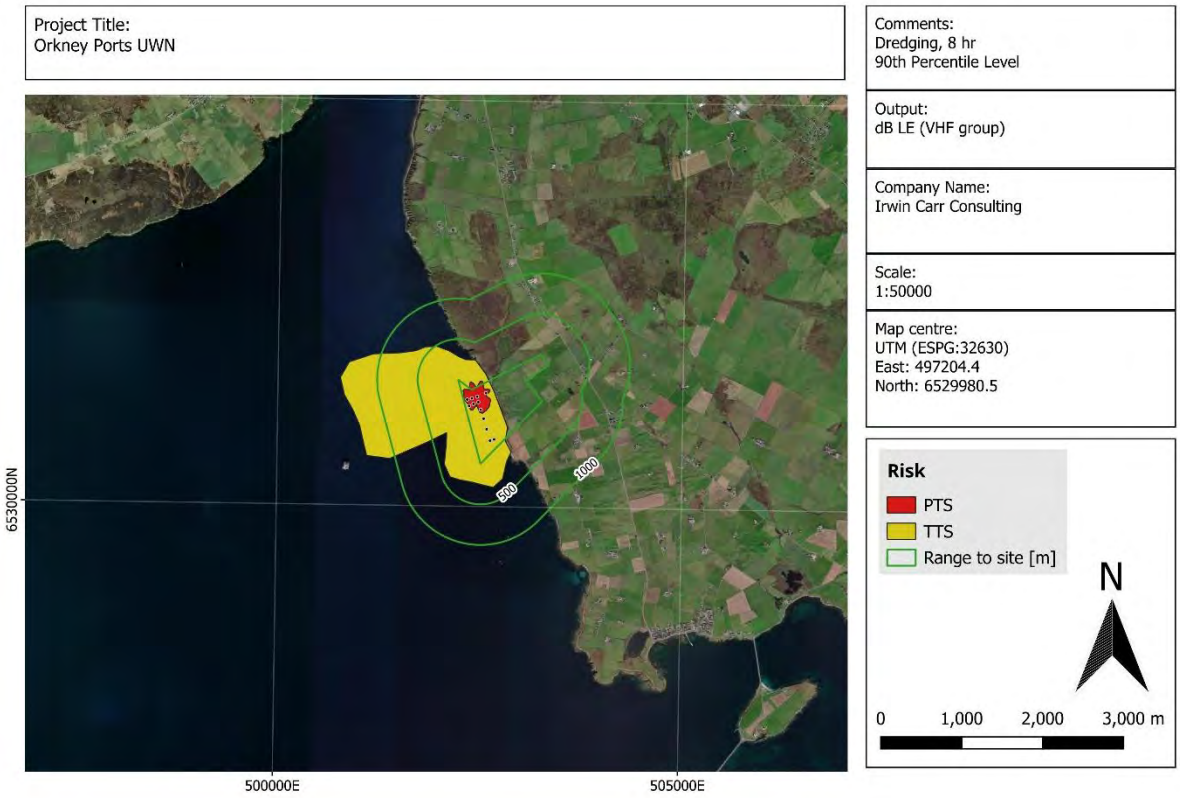


Figure 35. Dredging, L_E, 1hr, PW group

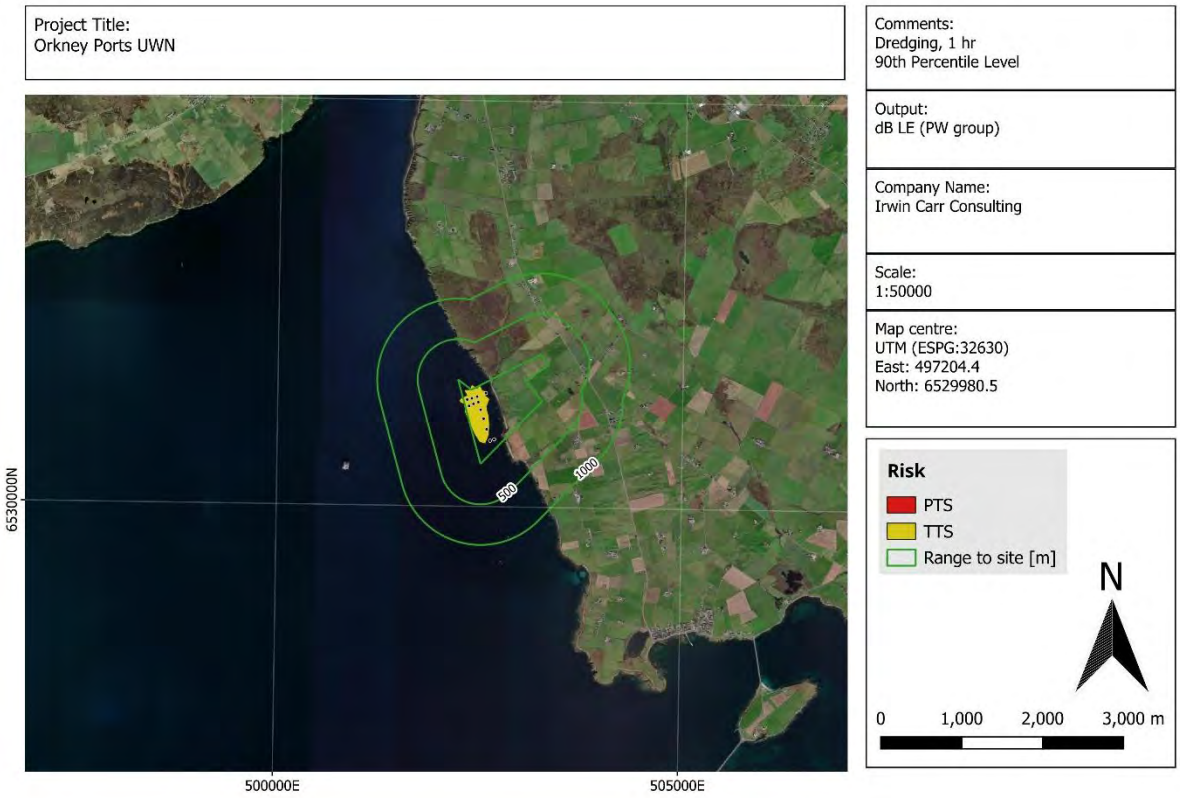


Figure 36. Dredging, L_E, 8hrs, PW group

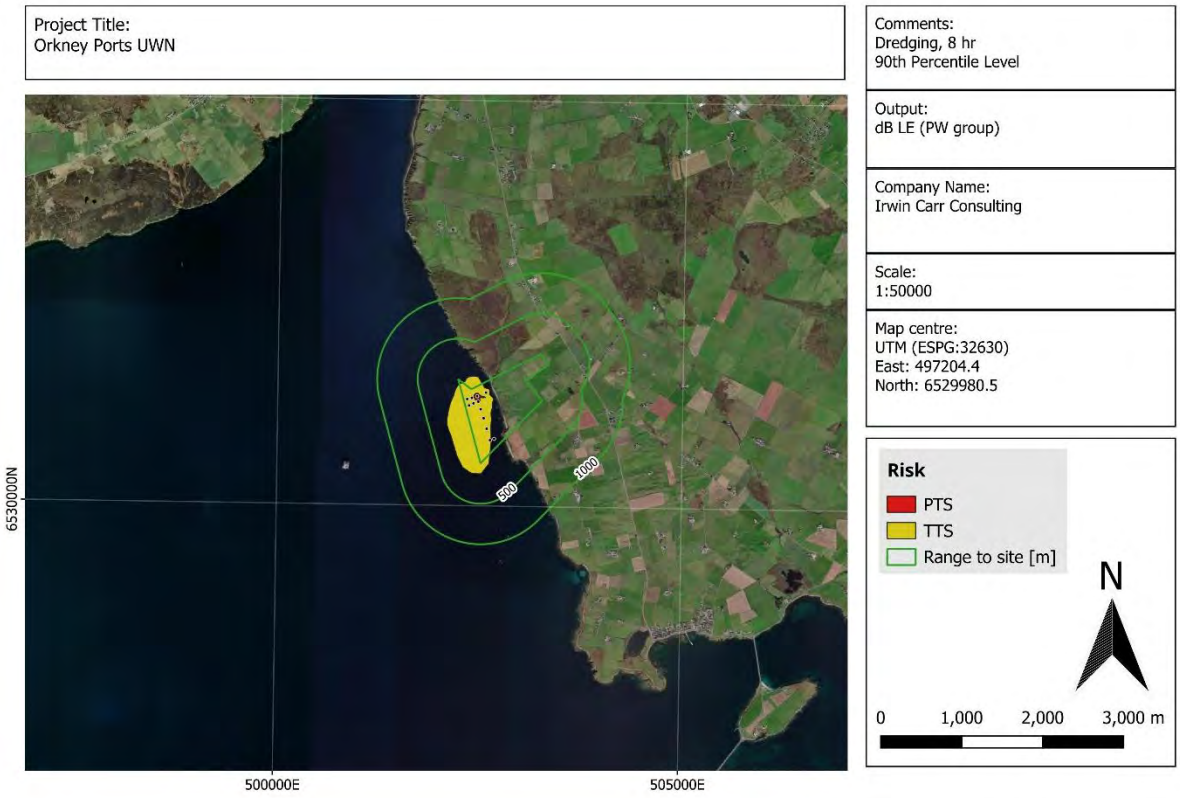


Figure 37. Dredging, L_E, 1hr, OW group

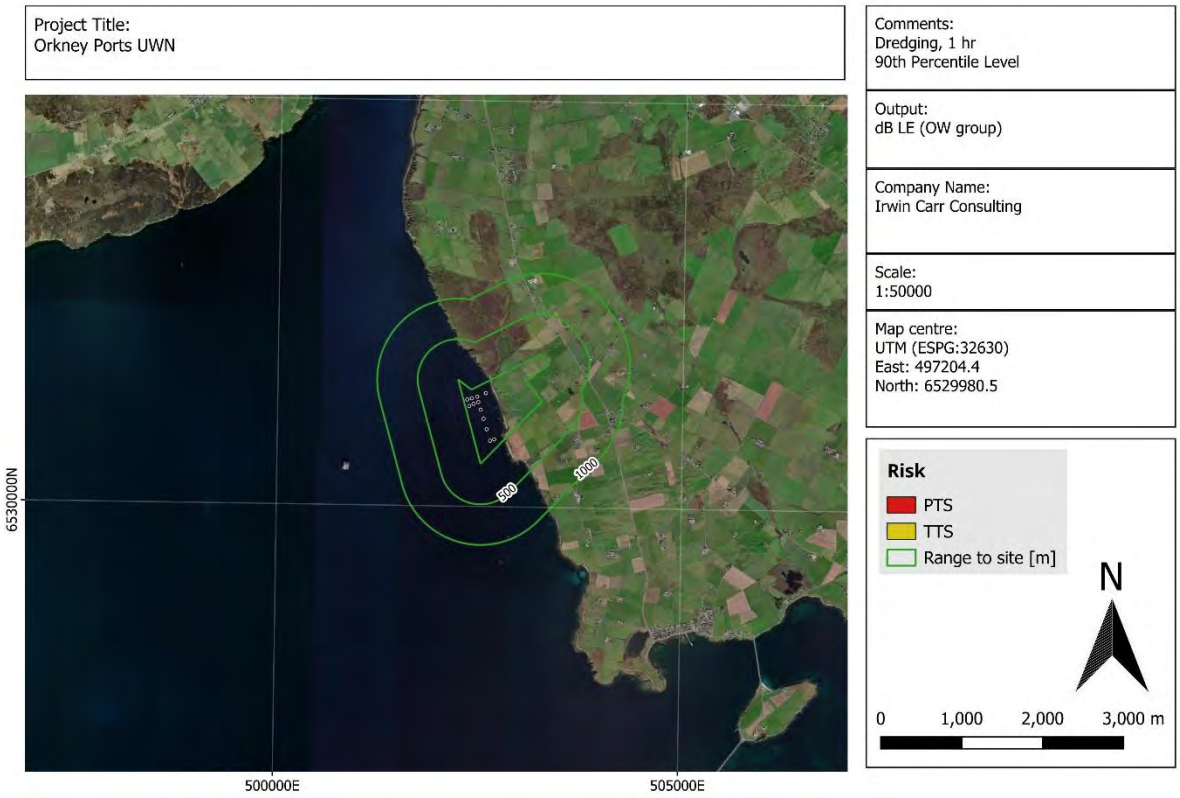


Figure 38. Dredging, L_E, 8hrs, OW group

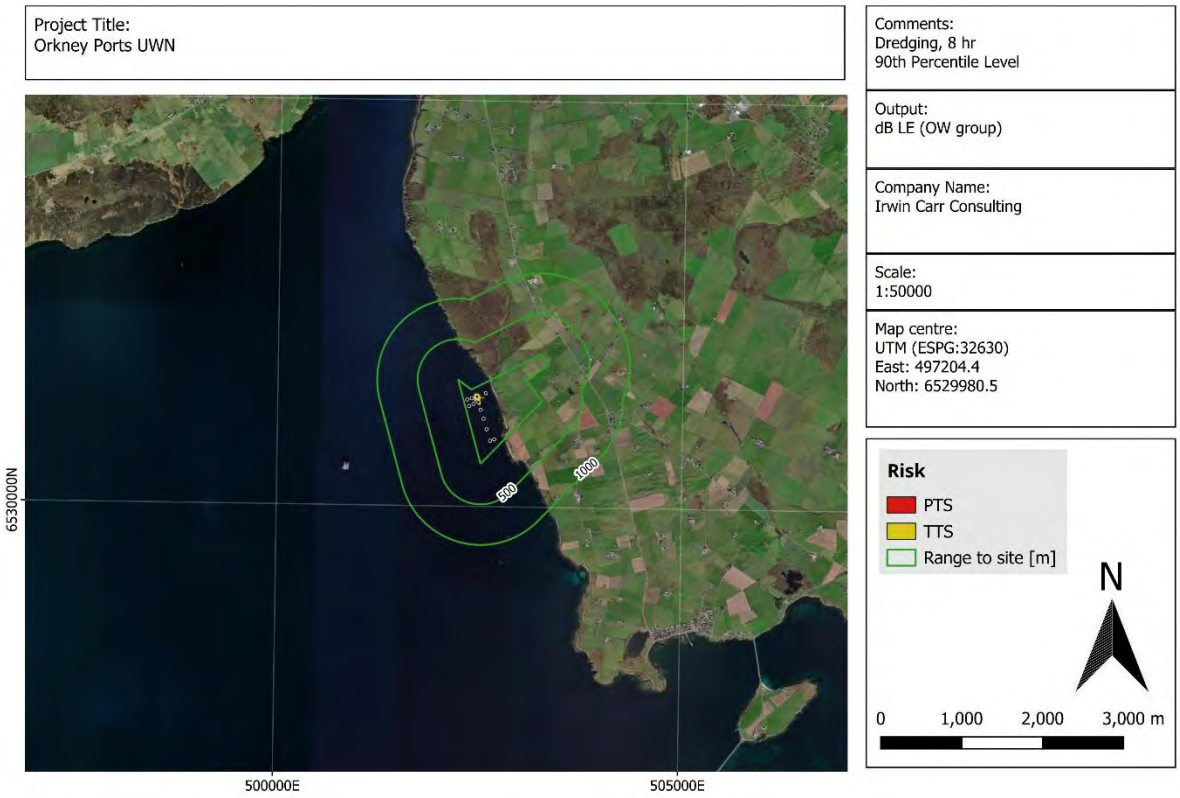


Figure 39. Dredging, L_E, 1hr, P- group

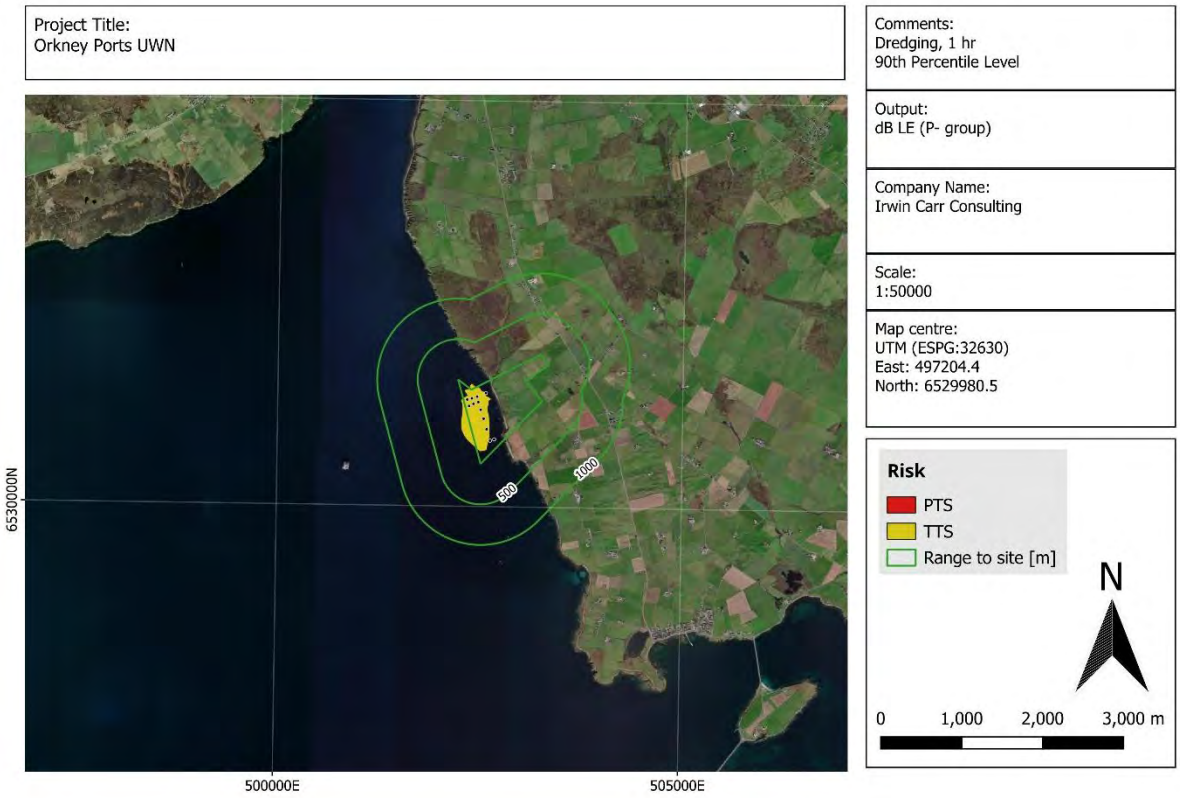


Figure 40. Dredging, L_E, 8hrs, P- group

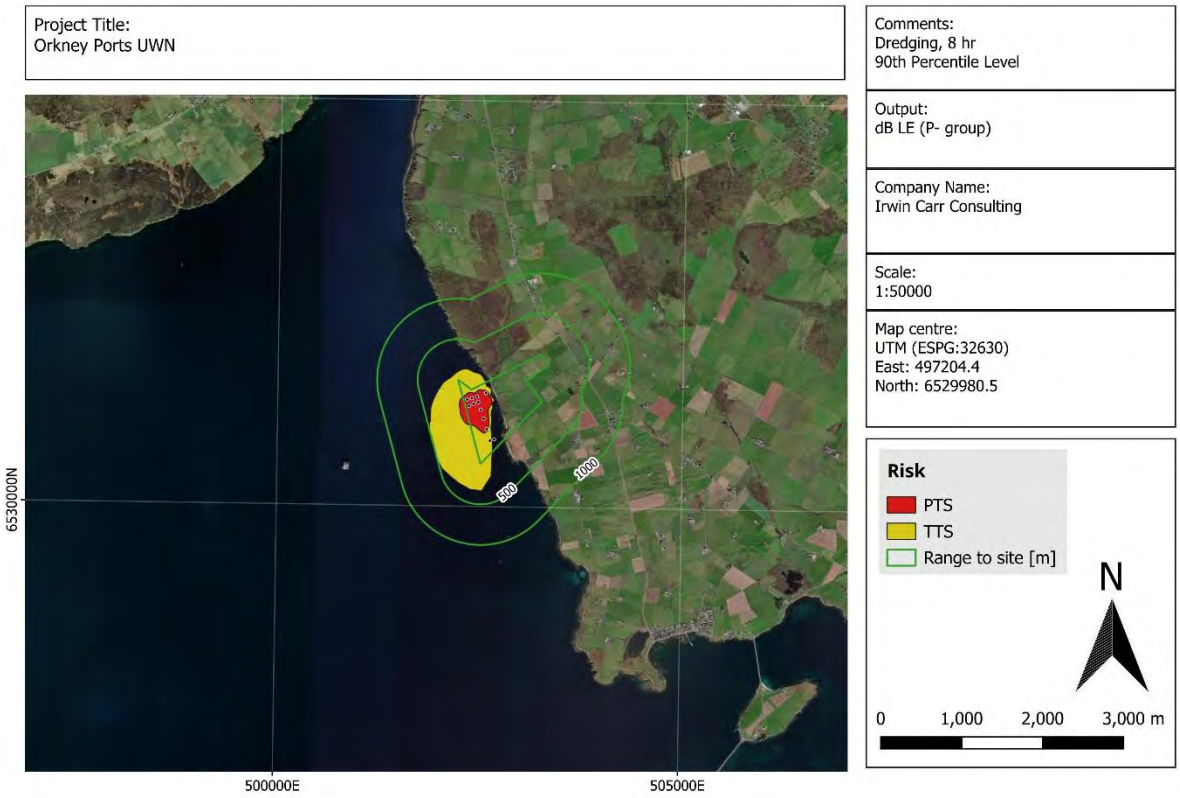


Figure 41. Dredging, L_E, 1hr, P* group

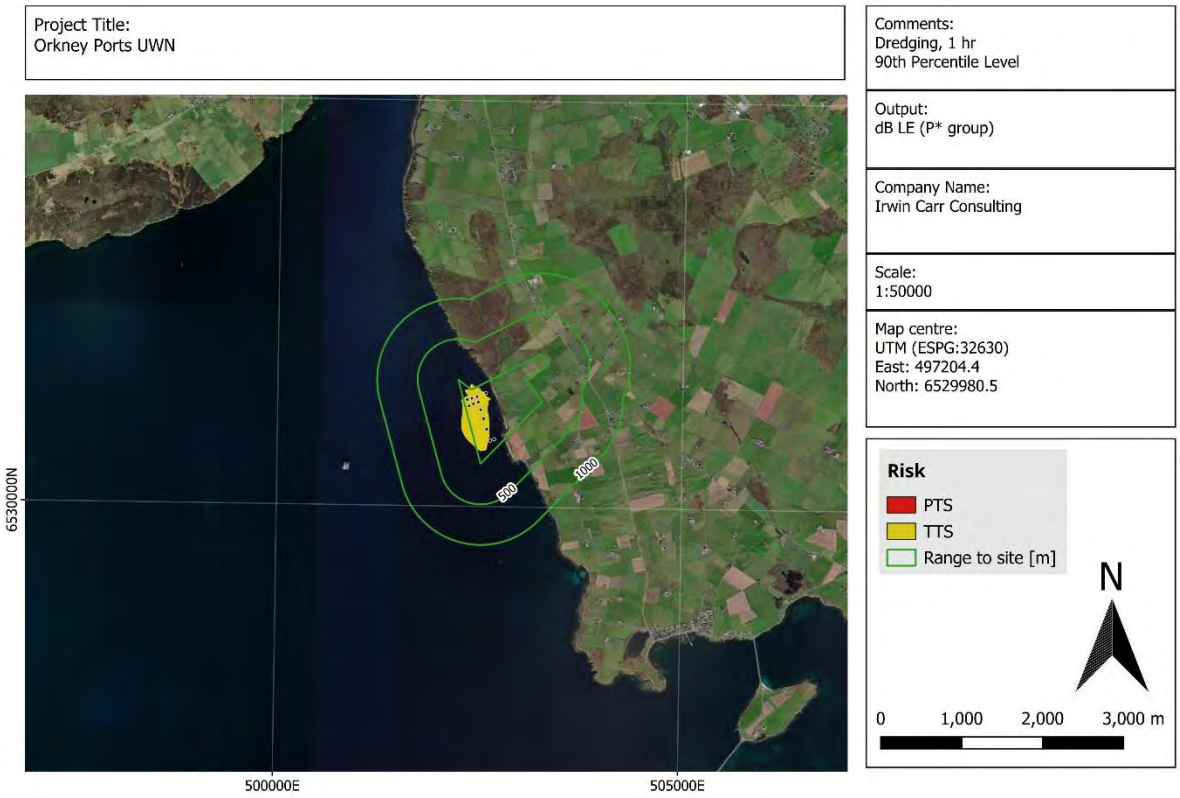
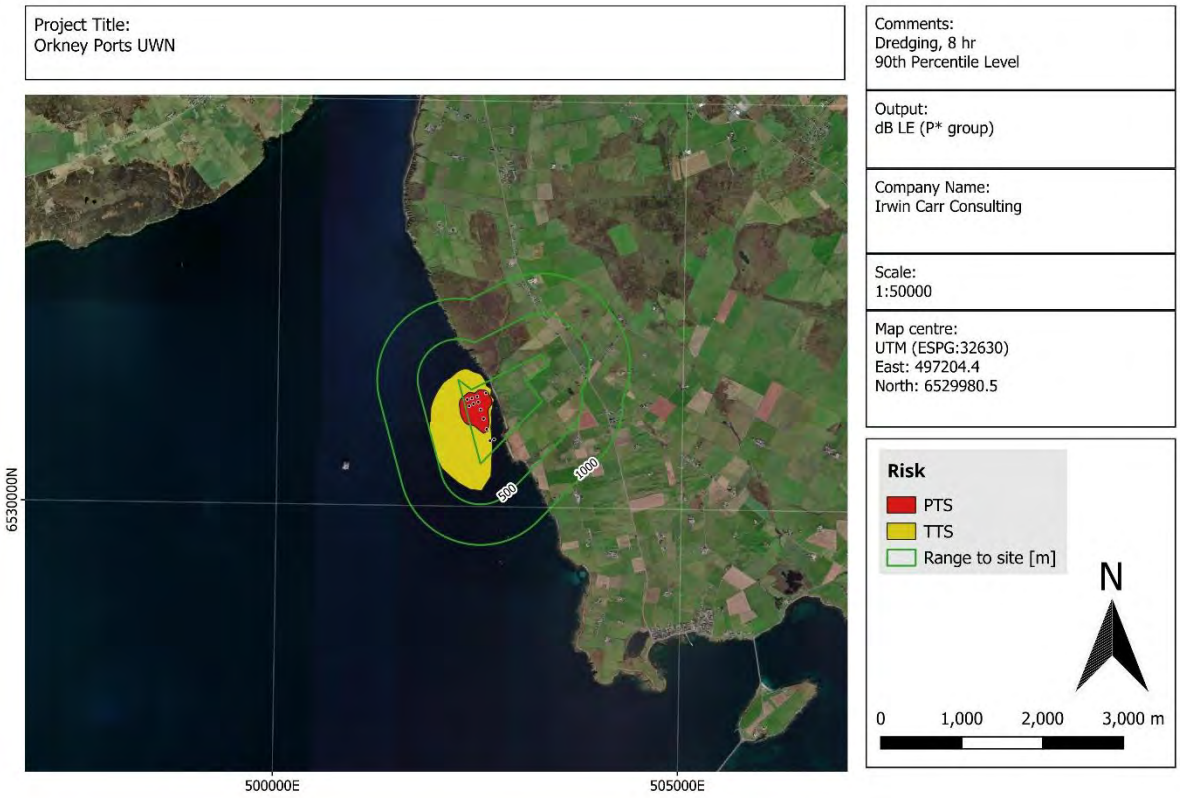


Figure 42. Dredging, L_E, 8hrs, P* group



Vibro Piling L_E

Figure 43. Vibro piling, L_E, 1 hour, LF group

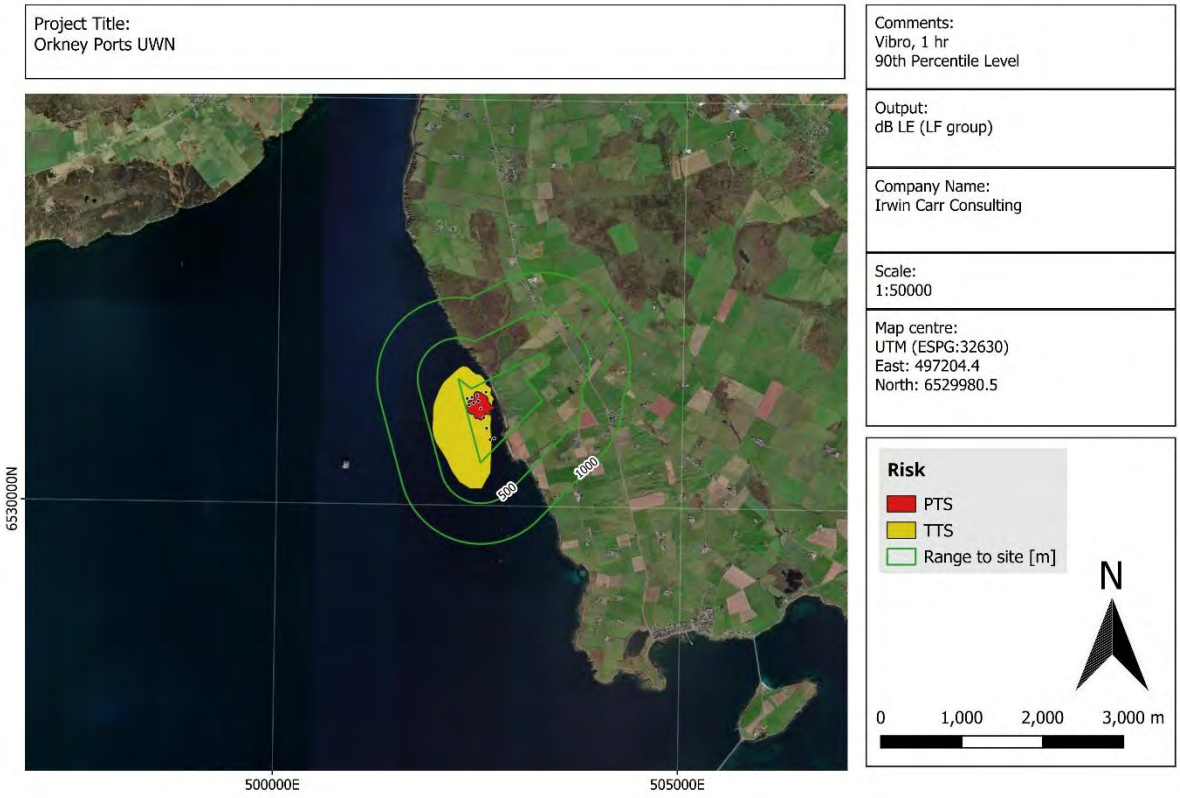


Figure 44. Vibro piling, L_E, 1 hour, HF group

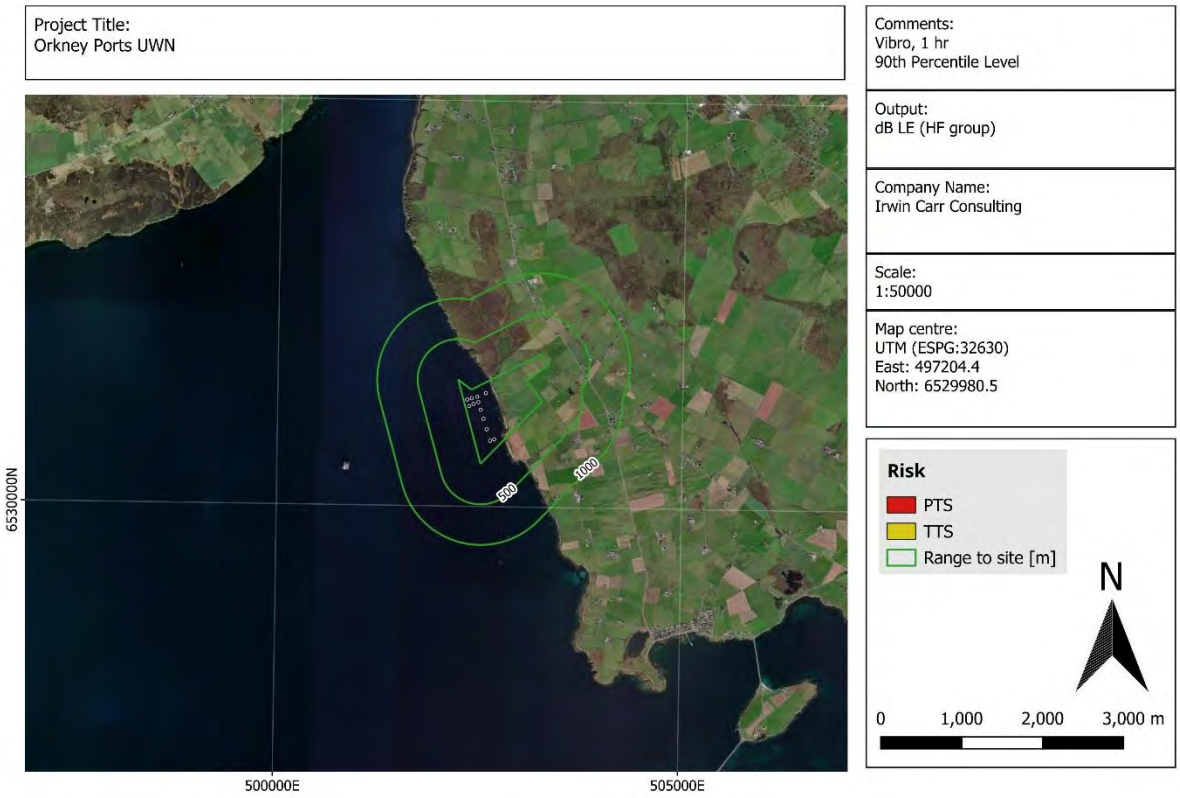


Figure 45. Vibro piling, L_E, 1 hour, VHF group

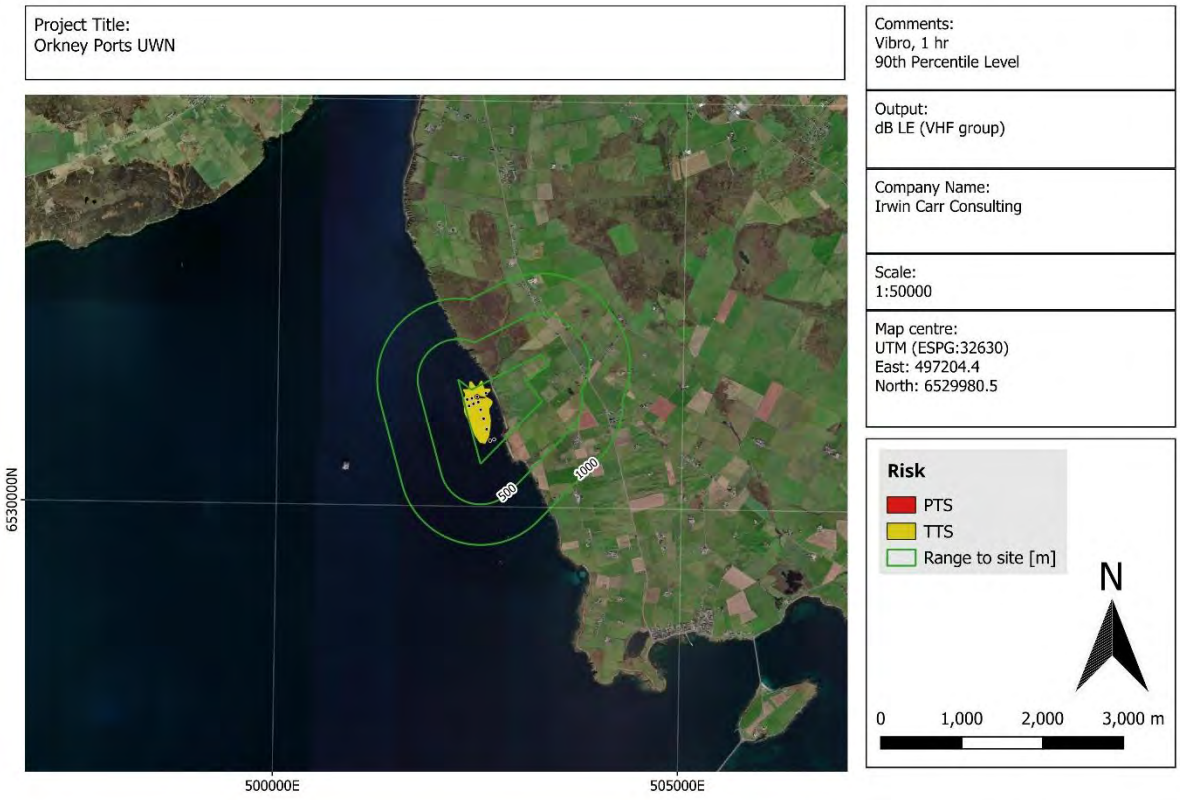


Figure 46. Vibro piling, L_E, 1 hour, PW group

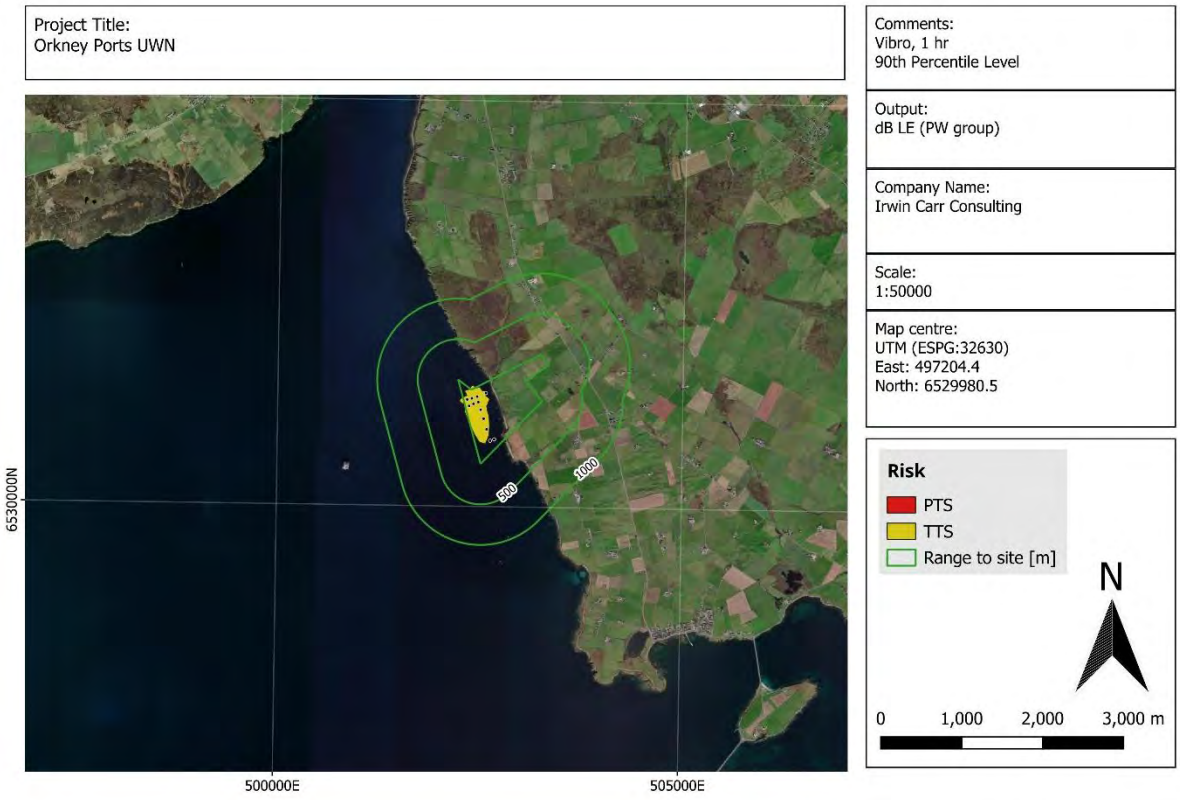


Figure 47. Vibro piling, L_E, 1 hour, OW group

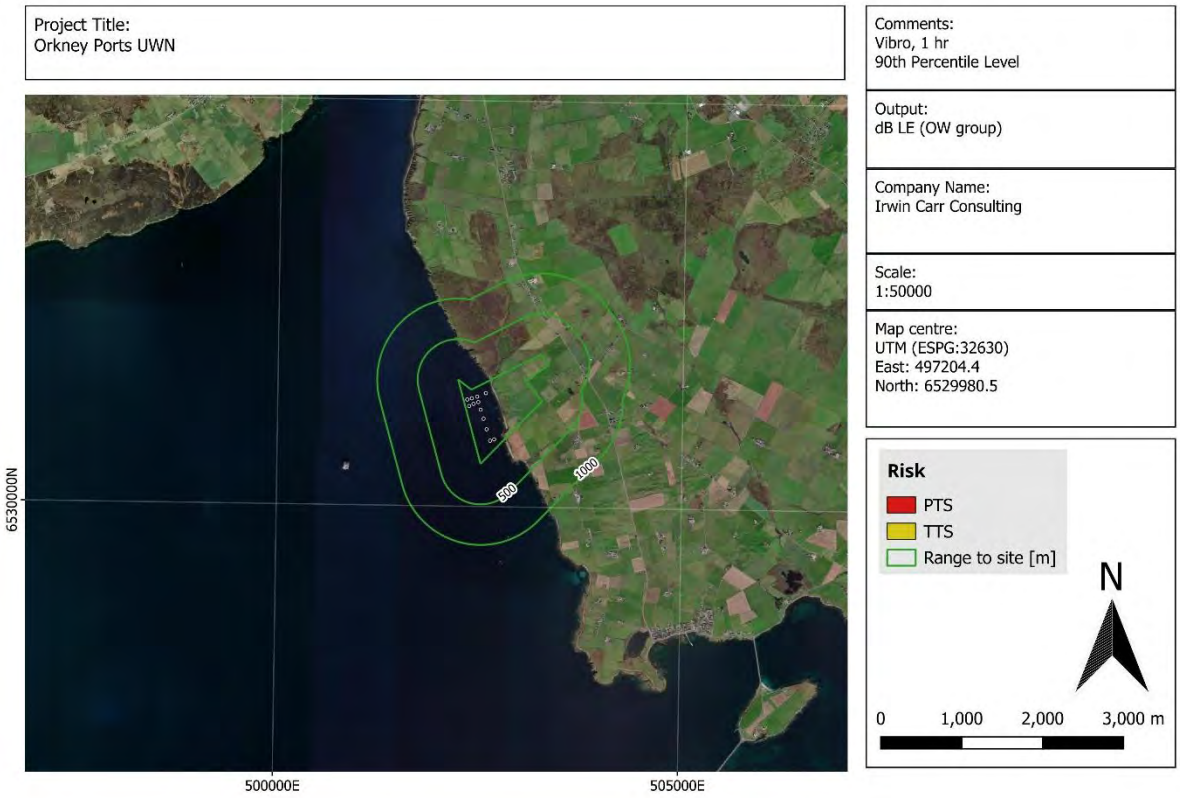


Figure 48. Vibro piling, L_E, 1 hour, P- group

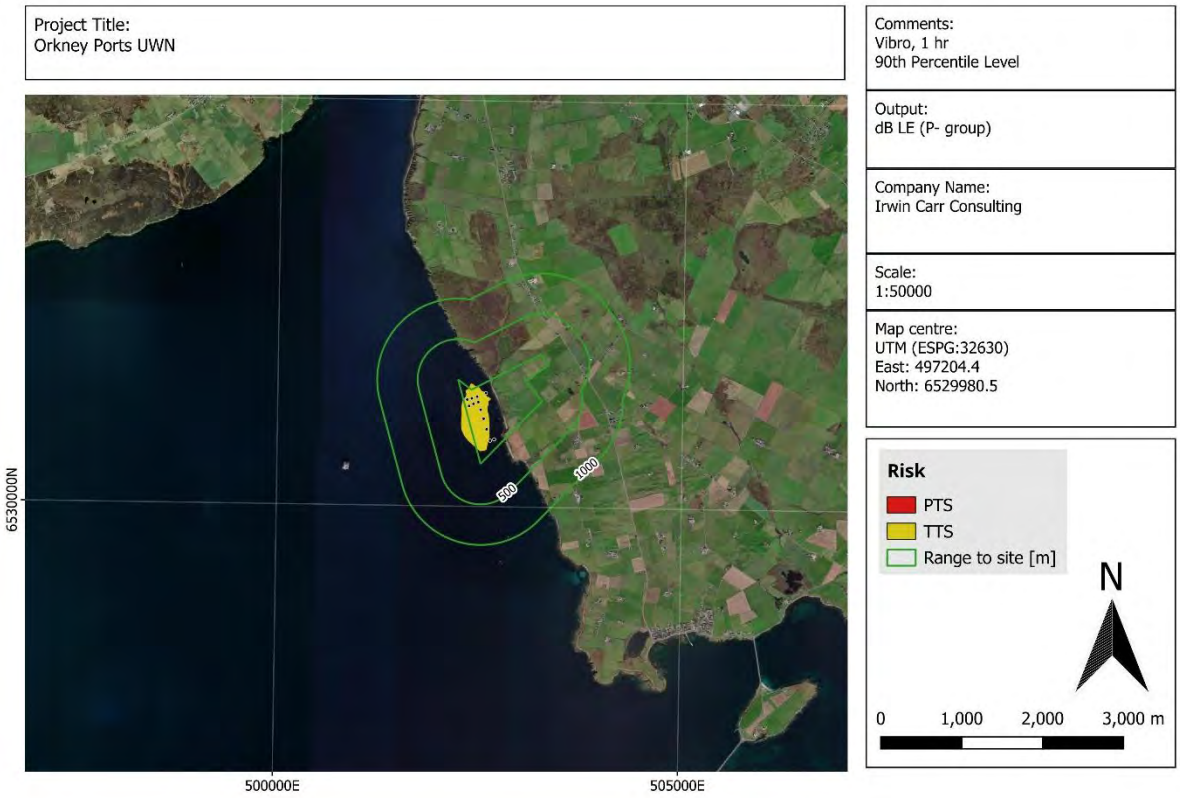
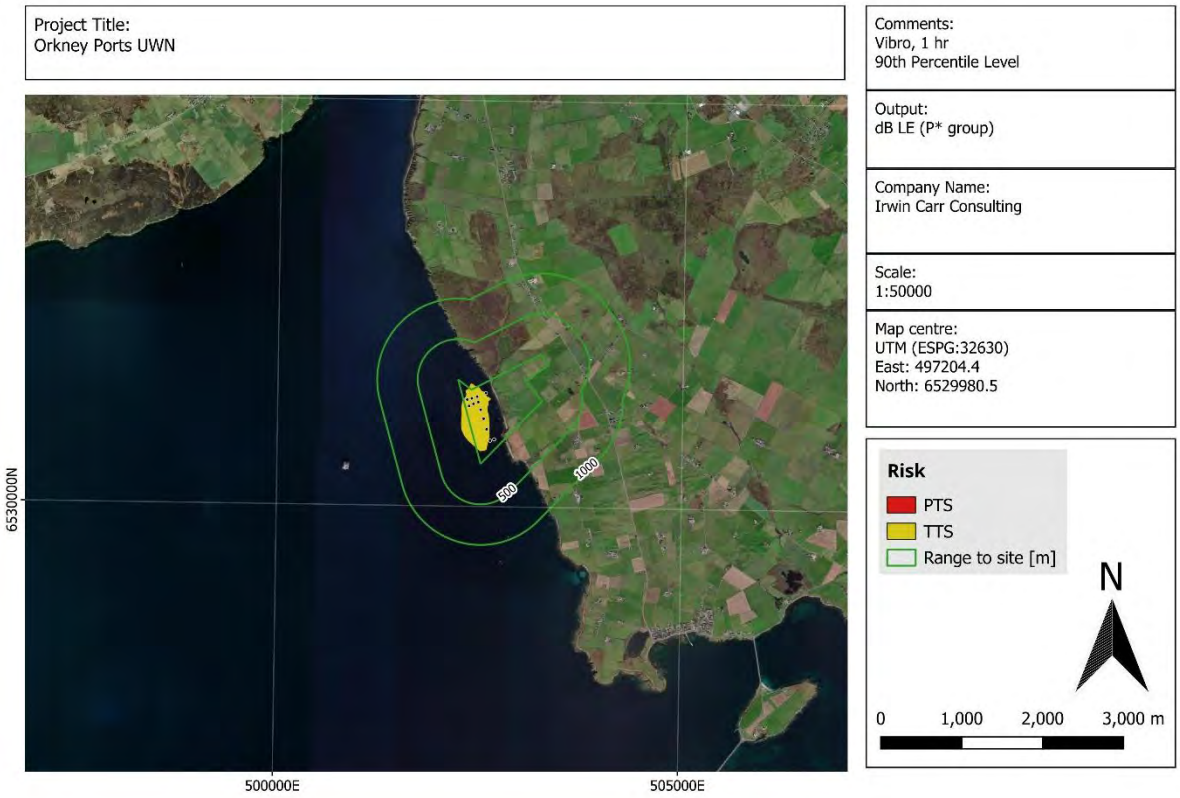


Figure 49. Vibro piling, L_E, 1 hour, P* group



Vibro piling L_P

Figure 50. Vibro piling, L_P, LF group

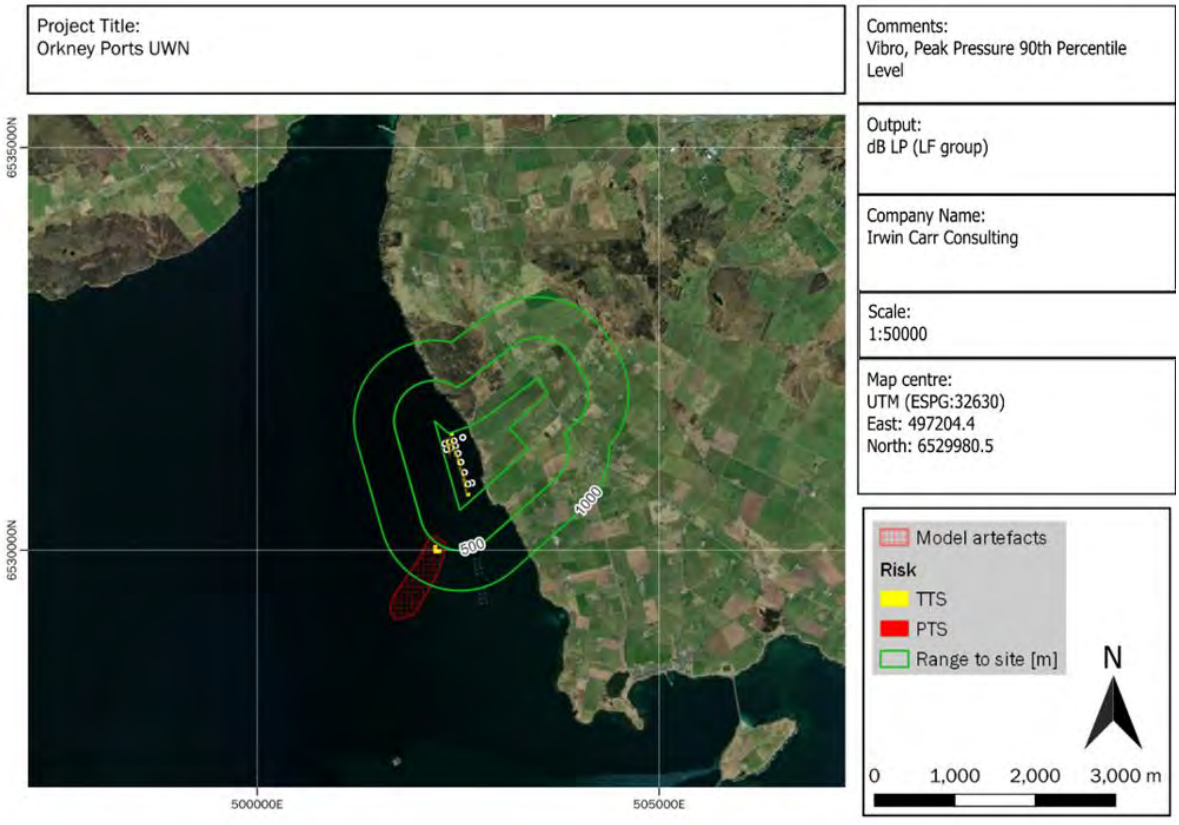


Figure 51. Vibro piling, L_P, HF group

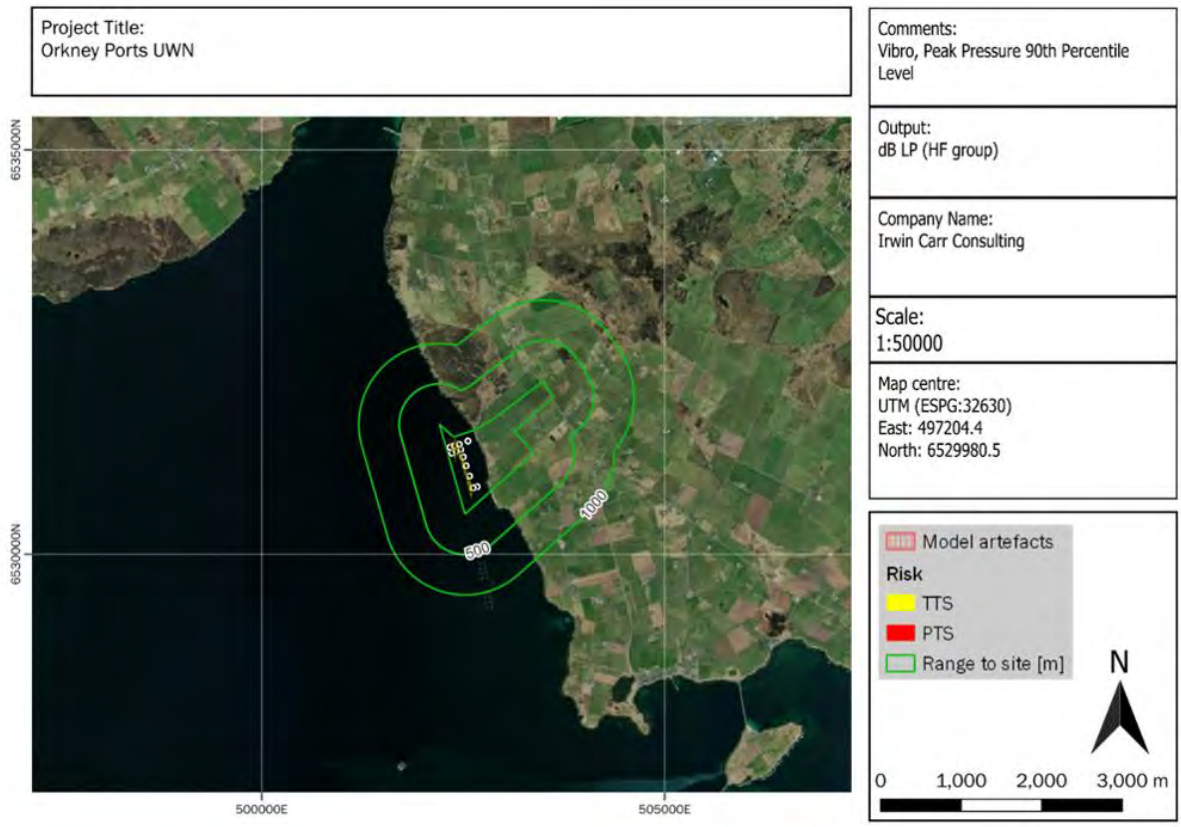


Figure 52. Vibro piling, L_P, VHF group

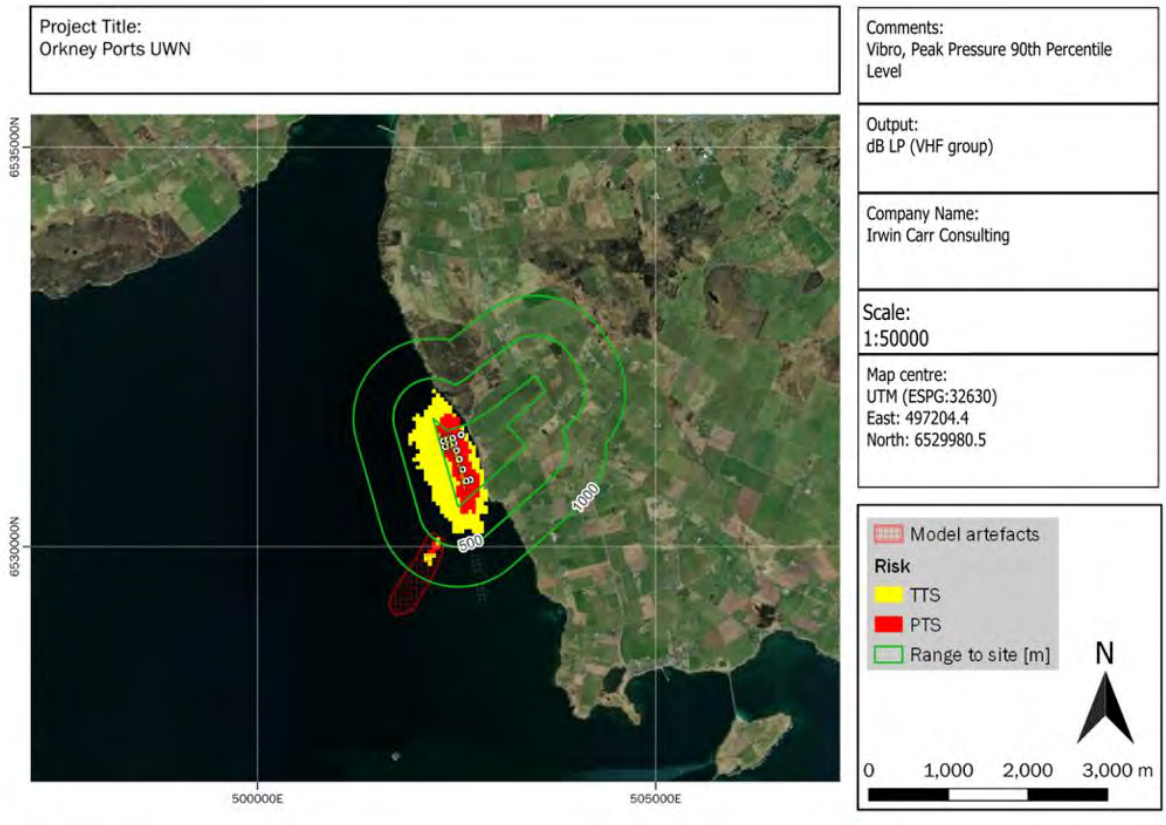


Figure 53. Vibro piling, L_P, PW group

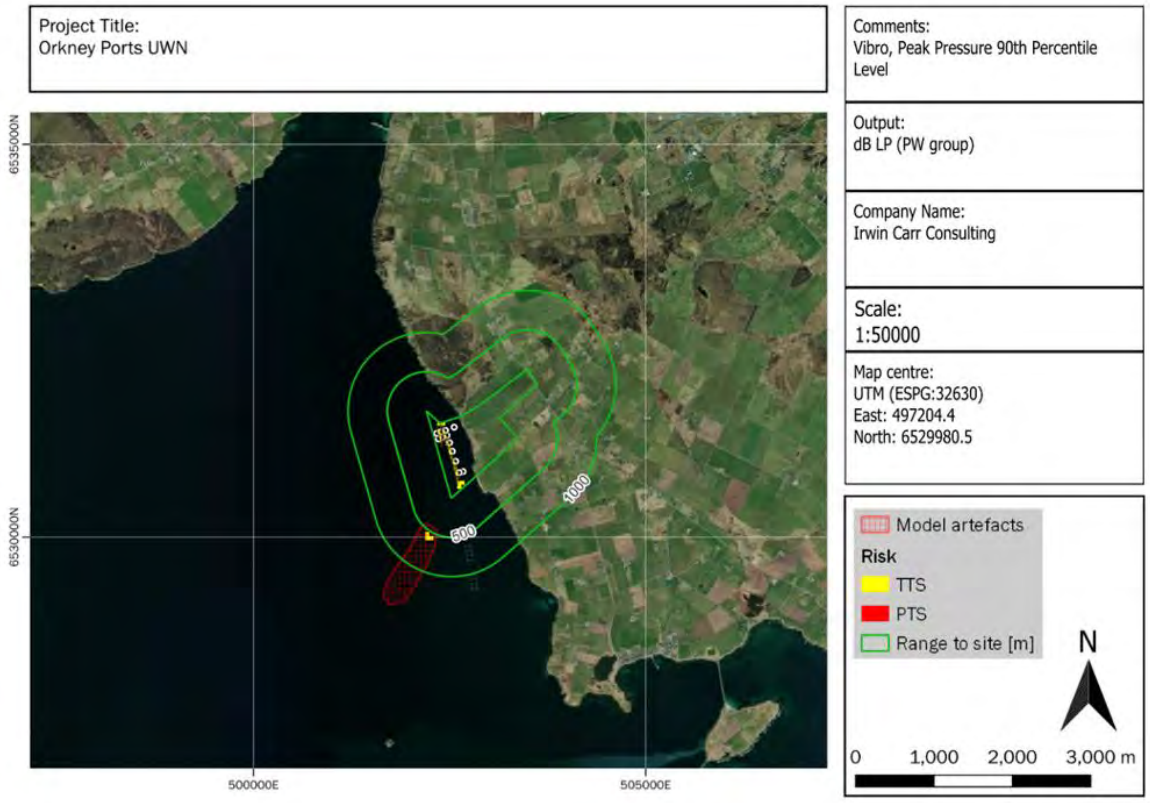


Figure 54. Vibro piling, L_P, OW group

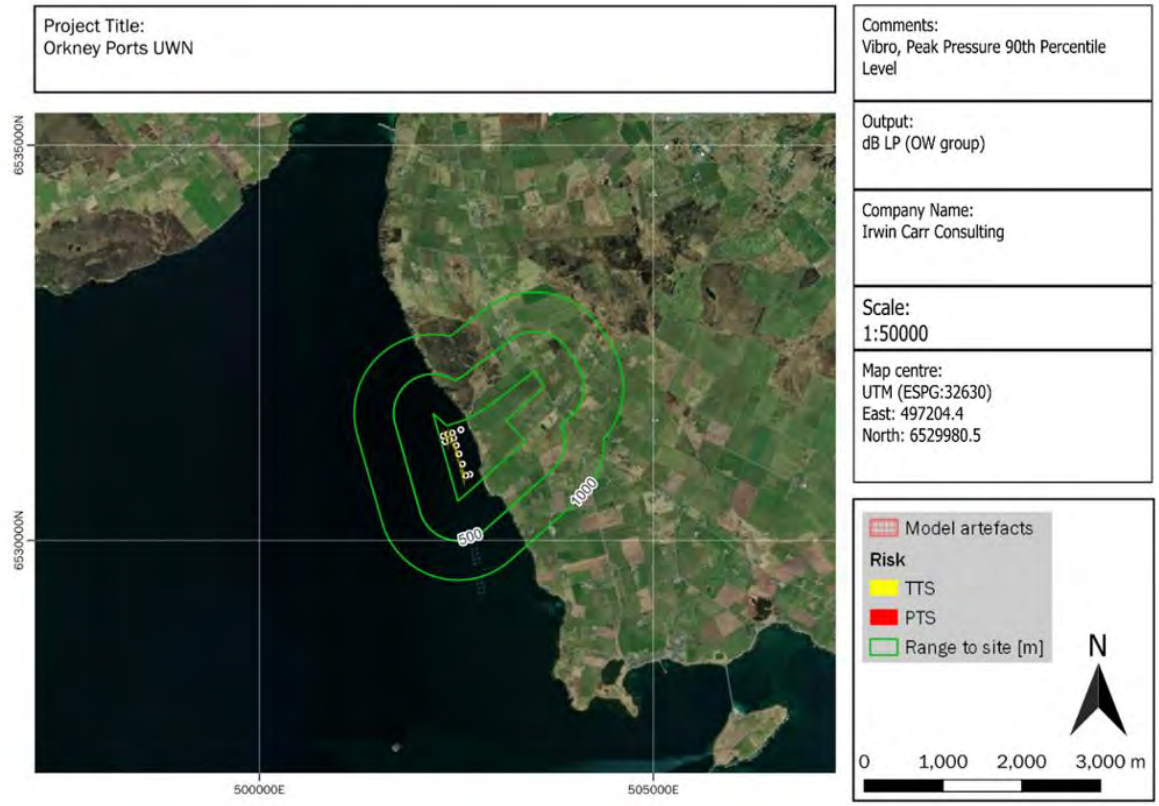


Figure 55. Vibro piling, L_P, P- group

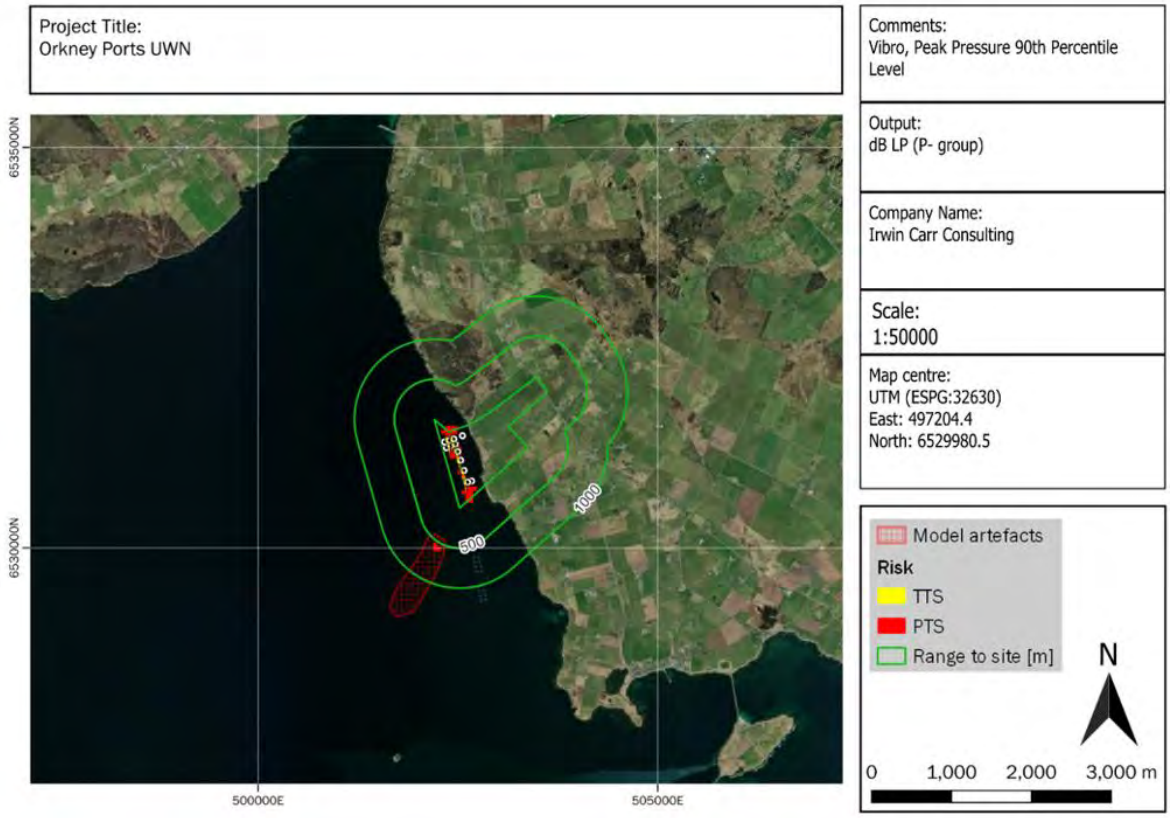


Figure 56. Vibro piling, L_P, P* group

