Hunterston Construction Yard
Construction Environmental Management Plan

May 2024

CONTROL SHEET

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of Clydeport Operations Ltd. to produce a Construction Environmental Management Plan (CEMP), which will form the main document outlining environmental protocols during dredging and construction activities related to the upgradation of the existing Hunterston Construction Yard (HCY) into a harbour facility with a large working platform suitable for renewable industries. It has been prepared with awareness of The Highland Council Guidance Note '*Construction Environmental Management Process for Large Scale Projects*' (2010). It should be noted that this is the definitive guidance for CEMPs in Scotland.

The CEMP also takes cognisance of *British Standard (BS) 42020:2013, Biodiversity — Code of practice for planning and development*.

Although this document has been produced by EnviroCentre, EnviroCentre do not accept any responsibility for the contents of assessments, plans or construction procedures that are carried out or added by other parties. This document is considered to be 'Live' and will be populated and amended as works progress.

The development is to be constructed safely and in accordance with relevant health and safety legislation and guidance minimising the risk to both the workforce and the public throughout the dredging and construction phase.

It must be noted that this document is not a Health and Safety Protocol.

1.2 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.

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1.3 Legal Compliance

Considerable environmental legislation applies to the works to be undertaken. Prior to commencement of dredging or construction works, all relevant legislation, including requirements for licences, permits and / or consents, shall be identified, and the appointed Main Contractor will be required to provide details of how compliance is to be achieved, as part of the Plan for delivering the CEMPs.

A list of key legislation is provided in below. This list is not exhaustive, but the CEMP Manager or Deputy will be responsible throughout the course of the project for identifying any further legislation that may be relevant to the project, and for ensuring compliance with it.

- Control of Pollution Act 1974 40 Part II, as amended;
- Environmental Protection Act 1990, as amended;
- Natural Heritage (Scotland) Act 1991, as amended;
- Controlled Waste Regulations 1992, as amended;
- Clean Air Act 1993, as amended;
- Noise and Statutory Nuisance Act 1993, as amended;
- Conservation (Natural Habitats etc.) Regulations 1994, as amended;
- Environment Act 1995, as amended;
- Special Waste Regulations 1996, as amended;
- Groundwater Regulations 1998, as amended;
- National Parks (Scotland) Act 2000, as amended;
- Contaminated Land (Scotland) Regulations 2000, as amended;
- Air Quality (Scotland) Regulations 2000, as amended;
- Noise Emission in the Environment by Equipment for Use Outdoors Regulations 2001, as amended;
- Control of Substances Hazardous to Health (COSHH) Regulations, as amended;
- Control of Noise (Codes of Practice for Construction and Open Sites) (Scotland) Order 2002, as amended;
- Nature Conservation (Scotland) Act 2004, as amended;
- Environmental Noise (Scotland) Regulations 2006, as amended;
- Climate Change (Scotland) Act 2009, as amended;
- Flood Risk Management (Scotland) Act 2009, as amended;
- Environmental Liability (Scotland) Regulations 2009, as amended;
- The Air Quality Standards (Scotland) Regulations 2010, as amended;
- Waste Information (Scotland) Regulations 2010, as amended;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended;
- Waste Management Licensing (Scotland) Regulations 2011, as amended;
- Pollution Prevention and Control (Scotland) Regulations 2012, as amended;
- Waste (Scotland) Regulations 2012, as amended;
- The Environmental Protection (Duty of Care) (Scotland) Regulations 2014, as amended;
- The Sulphur Content of Liquid Fuels (Scotland) Regulations 2014, as amended; and
- The Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019, as amended.

The principal contractor will undertake the works with regard to the following SEPA guidelines[1]:

- Guidance for Pollution Prevention 1: Understanding your environmental responsibilities – good environmental practices (GPP 1);
- Guidance for Pollution Prevention 2: Above ground oil storage (GPP 2):
- Use and design of oil separators in surface water drainage systems (GPP 3);

[1] https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/

- Guidance for Pollution Prevention 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (GPP 4);
- Guidance for Pollution Prevention 5: Works and maintenance in or near water (GPP 5);
- Guidance for Pollution Prevention 6: Working at construction and demolition sites (GPP 6);
- Pollution Prevention Guidelines 7: Safe Storage – The safe operation of refuelling facilities (PPG 7);
- Guidance for Pollution Prevention 8: Safe storage and disposal of used oils (GPP 8);
- Guidance for Pollution Prevention 13: Vehicle washing and cleaning (GPP 13):
- Pollution Prevention Guidelines 18: Managing fire water and major spillages For Identifying equipment and techniques available to prevent damage to the water environment caused by fires and major spillages. (PPG 18);
- Guidance for Pollution Prevention 21: Pollution incident response planning (GPP 21);
- Guidance for Pollution Prevention 22: Dealing with spills (GPP 22); and,
- Guidance for Pollution Prevention 26: Safe Storage - Drums and intermediate bulk containers (GPP 26).

2 SITE INFORMATION & CONSENTED DEVELOPMENT

2.1 General

This section sets out background information and general operational control procedures which should be followed by site operatives during the dredging and construction activities.

2.2 Site Description

The site is a relatively flat area of land approximately 40 Ha in size (800m x 500m at its widest point). It is accessible from the A78 via the Hunterston Roundabout and power station road leading onto Oilrig Road. The site is centred at Grid Reference NS 185 530.

HCY has historically been used for industry and currently comprises an access road, service infrastructure, deep dry dock (approximately 20m deep) cut off from the Firth of Clyde by a sand bund and a hammerhead quay, the site is armour stone protected. The site is currently vacant although a planning application (ref 23/00606/pp) has been submitted for preparation works, establishment of compound area and initial groundworks including landscaping and other required infrastructure associated with a proposed aquaculture facility on the northeastern corner of the yard. In addition, there will be temporary use of the site for the Fastrig demonstration project.

2.3 Proposed Development

The proposed development includes the following key elements:

Planning permission is being sought for development including the following activities:

- Demolition of existing structures;
- Infilling of the dry dock to form a working platform;
- Formation of 450m quay wall 500mm back from MHWS i.e. in the terrestrial environment;
- Formation of a temporary working platform;
- Removal of the existing rock armour on the western boundary;
- Removal of the existing bund on the western boundary;
- Installation of sub-surface revetments for the new quay wall;
- Installation of fenders and other quay wall infrastructure i.e. drainage outfalls, mooring bollards, safety ladders and navigational aids ;
- Erection of port infrastructure including lighting columns, substations, drainage, security fencing, access gates, access road improvements (including resurfacing) and CCTV; and
- Erection of temporary site offices and staff welfare buildings to accommodate site workforce.

Marine licences are being sought for the following activities:

- Formation of a temporary working platform;
- Removal of the existing rock armour on the western boundary;
- Removal of the existing bund on the western boundary;
- Installation of sub-surface revetments for the new quay wall;
- Capital Dredging to a depth of -12m CD to enable access to the 450m quay wall;
- Disposal of dredging spoil to a licensed marine spoil disposal site;
- Construction of up to 5 mooring dolphins;

- Installation and removal of a temporary grounding pad to facilitate vessel birthing as required;
- Installation of fenders and other quay wall infrastructure i.e. drainage outfalls and safety ladders; and
- Installation of navigational aids.

2.4 Risk Assessments

All activities undertaken on site would be subject to an environmental risk assessment. Risk assessments would be undertaken by trained staff which would:

- Identify the significant environmental impacts that can be anticipated;
- Assess the risks from these impacts;
- Identify the control measures to be taken and re-calculate the risk; and
- Report where an inappropriate level of residual risk is identified so that action can be taken through re-scheduling of work or alternative work methods in order to reduce the risk to an acceptable level.

The results of the risk assessments, and their residual risks, are only considered acceptable if: the severity of outcome is reduced to the lowest practical level; the number of risk exposures are minimised; all reasonably practical mitigating measures have been taken and the residual risk rating is reduced to an acceptable minimum. The findings of the risk assessment and in particular the necessary controls would be explained to all operatives before the commencement of the relevant tasks using an agreed instruction format (e.g. Toolbox Talks).

2.5 Method Statements

Method statements for the actual construction of the proposed development would be completed on behalf of the principal contractor or sub-contractor by appropriately experienced personnel, in consultation, where necessary, with environmental specialists. Their production would include a review of the register of environmental impacts and risk assessments, so that appropriate control measures are developed and included within the construction process.

Method statements would be reviewed by the "CEMP Manager", the principal contractor or sub contractor’s appointed environmental manager and, where necessary, by an appropriate environmental specialist. Where necessary, method statements would be submitted to the enforcement agencies (Scottish Environment Protection Agency (SEPA), NatureScot, Environmental Health Officer etc.). Method statements would most likely contain the following:

- Location of the activity and access/egress arrangements;
- Work to be undertaken and methods of construction;
- Plant and materials to be used;
- Labour and supervision requirements;
- Health, safety and environmental considerations; and
- Any permit or consent requirements.

Contractors will be required to comply with all relevant environmental legislation and to take account of published standards, accepted industry practice, national guidelines, and codes of practice appropriate to the scheme. For the duration of the contract, the environmental performance of the contractor(s) will be monitored through site inspections and periodic reviews.

All construction works shall be undertaken in accordance with best practice as outlined in the relevant Guidance for Pollution Prevention (GPPs) and Pollution Prevention Guidelines (PPGs) .

A detailed construction method statement (CMS) will be developed and take cognisance of this CEMP and incorporates good practice measures to protect the environment during construction.

3 GENERAL SITE MANAGEMENT

3.1 Introduction

This CEMP identifies the management structure roles and responsibilities with regard to managing and reporting on environmental impacts during the dredging and construction phase.

The overall environmental objectives that will be applied to the Hunterston Construction Yard project are:

- All practicable steps shall be taken to minimise the environmental effects of dredging and construction works;
- All activities shall be conducted in accordance with the CEMP, relevant legislation/ regulation. Standards, Codes of Practices, Guidelines, and any local environmental procedures;
- Environmental licences, permits, and consents and other statutory requirements are to be obtained prior to works commencing, and fully complied with;
- All staff (including sub-contractors) shall be aware of the environmental issues relevant to the Project through the provision of site-specific information on the environmental impacts of dredging and construction and the mitigation measures to be applied during inductions, briefings and toolbox talks; and
- Regular reviewing of the environmental requirements of the project and ensuring that environmental controls remain adequate throughout the duration of the project.

3.2 Site Access

It is anticipated that there will be a short period of mobilisation when plant and equipment will be brought to site and remain there until no longer required. Due to the marine source of the infill material, it will be brought to site via sea for deposit in the existing dry dock. All other construction materials (including piles, sheet piles) associated with these proposed works will be brought to site and unloaded at Hunterston deep water jetty or imported to site via road from other areas.

In order to minimise the potential impact to the local area and residents from the traffic emanating from the site, the arrival and departure of HGVs be controlled where possible and practicable.

Defined on-site haul routes have been established to ensure the potential impacts from physical damage, noise, dust as well as contaminative effects are minimised and adequately controlled.

In the event of unusual activities or events that can be anticipated (e.g., road closures, roadworks, wide loads, etc), these will be notified to North Ayrshire Council, and to relevant property owners or occupiers, wherever possible, in advance of the activity. The relevant activities and receptor properties will be determined by agreement with North Ayrshire Council once the detailed programme of dredging and construction is defined. Key activities requiring prior notice may include:

- Any necessary night-time, weekend or evening working (outside core areas) which may affect properties (although this is not anticipated for this development);
- Road or footpath closures/diversions and movements of wide loads; and
- Work on or affecting land used by others.

However, no such eventualities are envisaged.

3.3 Hours of Working

With the exception of environmental management activity, in cases of emergency or unless agreed in writing with North Ayrshire Council, the normal working hours for construction are expected to be as follows:

- Monday – Saturday 7am to 7pm
- Sunday 7am until 2pm.
- Dredging and drilling would be 24 hours, 7 days a week.

Any work which is intended outside these hours will be subject to prior agreement, and/or reasonable notice, to North Ayrshire Council.

All sub-contractors including suppliers shall be made aware of the permitted working hours.

3.4 Loading & Unloading of Plant & Materials

The loading and unloading of plant and materials will be confined to designated areas to minimise the impact of noise, dust and debris.

3.5 Security On-Site

- Contractors shall exercise adequate security to prevent unauthorised entry to or exit from the Compounds and Sites;
- Visitors will be directed (by signage at the entrance gate and by any personnel present on the locked gate) to the site office where they will sign in and be inducted (as appropriate for the nature of their visit) by the Site Manager, prior to being permitted out on-site;
- Appropriate H&S Signage will be placed around the site guiding traffic routes, giving warnings of hazards and potential dangers (such as “Danger: Keep Out” etc.) and instructing conduct within the site boundaries (such as “Do not remove security fencing” / “Appropriate PPE must be worn…” etc.).
- Gates shall be closed and locked when there is no site activity and site security provisions are set in motion;
- While security and safety lighting are required, there will be a balance between achieving appropriate lighting levels and avoiding unnecessary light spillage, pollution and glare;
- The use of artificial lighting will be minimised; and
- All construction personnel shall visibly carry identification.

3.6 Storage of Fuels

All liquids and solids of a potentially hazardous nature (e.g., diesel fuel, oils, solvents) will be stored on surfaced areas, with bunding, to the satisfaction of SEPA in accordance with current guidance.

All fuel and/or chemical storage tanks located on site should also be bunded in order to limit the impact of any leakages that occur. The containment area should be capable of holding 110% of the volume of the largest tank or 25% of the total volume likely to be stored for multiple containers, whichever is greater. Any fuel tankers entering the site should only be permitted to park in designated areas in order to reduce the potential for fuel to leak into watercourses or to damage construction materials present on-site.

Storage areas should also be organised providing space for materials to be removed with ease when they are required. If heavy machinery is required to move materials, this should also be considered allowing space for machinery to manoeuvre.

Contractors shall establish within the site an area for the refuelling of plant and vehicles away from the watercourses and on a surfaced area. The area shall always be kept clean.

Any spillages or leaks of fuel shall be cleaned up immediately by Contractors. No refuelling shall be carried out outside the designated refuelling area.

3.7 Site Welfare Facilities

Welfare facilities in accordance with Schedule 2 of the CDM Regulations 2015 **MUST** be in place prior to construction works commencing on-site. The site will have the following welfare facilities within the site compound.

Table 3-1: Welfare Facilities

Type of facility	Used by	Location	Maintenance/ Cleaning Frequency
Adequate Toilets for anticipated numbers on site	All	Site Compound	Daily
Canteen for preparation and consumption of food	All	Site Compound	Daily
Changing Room with facility for drying clothes	All	Site Compound	Daily
Site Managers Office & Meeting Room	SM	Site Compound	Daily

3.8 Putrescible Waste

Adequate waste bins will be placed in work areas, storage areas and temporary site compounds for the depositing of mixed welfare wastes. Regular inspections will be carried out to monitor housekeeping and initiate action to clear litter and debris. Personnel are encouraged to avoid littering and to clear litter where it occurs within site boundaries.

All food and drink are to be consumed within the mess rooms/ canteens or else off the site. Consumption of food outside of the welfare facilities encourages the spread of vermin causing further potential occupational risks, e.g., leptospirosis (Weil's disease).

All food and drink will be disposed-off within a lidded container and emptied on a regular basis.

3.9 COSHH Assessments

Where harmful substances cannot be substituted with less harmful substances, each sub-contractor will be required to maintain and issue a register containing all harmful substances that they intend to use on this project.

For each hazardous substance or process identified, the sub-contractor responsible shall produce a task specific COSHH Assessment and issue a Material Data Sheet for the substance. These will be maintained within the site manager's office.

When using hazardous substances, the sub-contractor must provide evidence that the findings of each COSHH Assessment has been communicated to their operatives and those affected by the use. These records will be maintained within the site manager's office.

3.10 Fire Safety

The site safety officer, appointed by the Principal Contractor will be responsible for ensuring that:

- Fires are prohibited on site;
- All combustible materials and waste are stored at least 6m from welfare cabins and houses;
- Diesel tanks are bunded;
- Gas is stored in caged containers;
- The site electrics are tested every 3 months;
- Hot Works permits are issued;
- Site is clear of waste and debris;
- Fire extinguishers are located in designated areas;
- Means of escape from houses are kept clear;
- Audible warning devices are available;
- Assembly area is accessible;
- Emergency procedures are displayed on site and explained at site induction;
- No flammable materials / products are stored within houses;
- Waste bins are emptied daily;
- All personnel must be aware of the escape routes from buildings and comply with instructions given from the fire plan during induction;
- The fire assembly point is located at the car park area at the compound; and
- No smoking in welfare facilities, site offices, plots under construction, completed properties or near flammable gasses or liquids.

3.11 Roles & Responsibilities

This section describes the roles and responsibilities of key members of the project team and provides contact details for the relevant personnel (Table 3-2). Additional members, to be contracted for Audit purpose are provided in Table 3-3.

Table 3-2: CEMP Roles & Responsibilities

Roles and Responsibility Definitions	
Roles	**Responsibility**
CEMP Manager	Client to appoint senior member(s) of staff to manage the works. This person will be involved in higher level decision making. Client may appoint the principal contractor as the lead CEMP Manager.
CEMP Deputy	The CEMP Manager will appoint a deputy who will act as cover, for example when the CEMP Manager is on annual leave, is unavoidably unavailable etc.

Table 3-3: Additional members

Roles	**Responsibility**
Environmental Clerk of Works (EnvCoW)	An independent Environmental Professional to undertake Audit and report on adherence to the CEMP as well as any other relevant planning consents, environmental permits, legislation and mitigation.
Ornithological Clerk of Works (OCoW)	An independent Ornithologist to undertake disturbance monitoring during the construction phase, particularly during potential sensitive activities such as piling on the eastern side of the marine yard and access road resurfacing works.

3.11.1 CEMP Manager/Deputy

The CEMP Manager (or deputy) will be responsible for implementation of the CEMP during dredging and construction phase. The duties of CEMP Manager/Deputy will include:

- Ensure that all staff and operatives receive site specific health, safety and environmental induction prior to starting work on-site and are provided with relevant information concerning environmental sensitivities and protection measures;
- Maintaining records of induction training and tool box talks;
- Identify the environmental competence of all contractors (and sub-contractors) working on the project;
- Undertake site inspections and environmental audits;
- Ensuring compliance with all relevant legislation;
- Ensuring provision of welfare facilities;
- Review risk assessment method statements and ensuring an appropriate programme of toolbox talks are developed and effectively communicated;
- Review method statements for environmental aspects and advise of any suggested improvements prior to work commencing;
- Continuously review the CEMP;
- Notifying SEPA of notable incidents; and
- Act as a main point of contact between the contractors and the project team on environmental issues.

The CEMP Manager role will be undertaken by: **TBC nearer the time of dredging/construction.**

The CEMP Deputy roles will be undertaken by: **TBC nearer the time of dredging/construction.**

It should be noted that the Responsible Persons are currently unknown until a contractor has been appointed and will be updated at a later date.

3.11.2 Principal Contractor

The role of Principal Contractor will be fulfilled by **Name: ……**

The Principal Contractor will report on environmental activities to the CEMP Manager/ Deputy and will be responsible for the following:

- Day to day activities for implementing and maintaining environmental controls and mitigation measures contained in the CEMP on site;
- Monitor dredging and construction activities to ensure that identified and appropriate control measures are effective and in compliance with the CEMP;
- Ensuring best working practice and guidance for working including those contained in industry Code of Practice documents;
- Monitoring housekeeping on-site;
- Regularly communicating with personnel, providing information about the progress of the dredging and construction works, milestones achieved, upcoming challenges, safety incidents and local activities.
- Attend to any spills or environmental incident that may occur on site;
- Report any activity that has resulted, or has the potential to result, in an environmental incident immediately to the CEMP Manager/ Deputy;
- Undertake corrective actions to address non-compliances identified during audits;
- Complete a daily environmental log; and

- Maintain the waste register and ensure correct waste management procedures are being implemented.

3.11.3 Site Staff & Subcontractors

Staff and subcontractors have responsibility to:

- Work as per agreed plans, methods and procedures to eliminate and minimise environmental impacts;
- Understand the importance of avoiding environmental pollution on site and how to respond during such incident to avoid/limit environmental impact;
- Report all incidents immediately to their line manager;
- Monitor the workplace for potential environmental risks and alert the line manager if any risk is observed; and
- Co-operate as required, during site inspections and audits.

3.12 Training, Awareness & Competence

In accordance with the CDM regulations, all construction personnel will undergo a site-specific induction to include health, safety and environmental issues, before commencing work on the site.

All personnel will be made aware of their responsibilities with respect to the CEMP. A training programme will ensure that all staff fully understand:

- the CEMP and its implementation on-site;
- the environmental sensitivity of the site;
- dealing with unforeseen environmental incidents; and
- the roles of the Contractor's staff and stakeholders with respect to environmental issues.

Site personnel shall be competent to perform tasks that have the potential to cause a significant environmental impact. Competence is defined in terms of appropriate education, training and experience. All personnel, whose work may cause a significant impact on the environment, will receive environmental training (Table 3-4).

Table 3-4: Training, Awareness & Competence

Training	Participants
Environment & sustainability element of site induction	All those working on site
Site Environmental Awareness Training	Delegated Duty Holders (Site Based)
Ecology and Biodiversity	Delegated Duty Holders (Site Based)
Water Protection	Delegated Duty Holders (Site Based)
Waste Management	Delegated Duty Holders (Site Based)
Pollution Prevention and Emergency Spill Response	Delegated Duty Holders (Site Based)
Toolbox Talks on spillage, biodiversity, noise prevention, and other issues relevant to the works	Workforce

The training provided will be documented and records maintained, including the quantity and type of training received.

3.12.1 Inductions

The CEMP Manager/Deputy is responsible for induction training and will ensure that personnel receive induction training specific to the site and to the type and place of work. This is to take place before the site operative commences work for the first time on site. The induction will concentrate on the management provisions, site rules, safety provisions as well as the specific site risks involved with the project and the environmental & ecological considerations of the project. Evidence of all induction training carried out and names of personnel, who have undertaken formal induction training together with when they were inducted, must be recorded and filed on-site.

During the induction process, operatives will be informed of housekeeping matters, particularly the need to respect surrounding neighbours to the site and the need to keep noise to a minimum; particularly when entering and leaving the site. Working hours and restrictions on timing/method of deliveries will be clearly explained. Any radios/entertainment devices should only be used at a level which will not cause undue disturbance to the neighbouring areas. They will also be informed of the necessity to ensure that all parking is within the site boundary and given clear instructions as to how to deal with deliveries of materials etc., to prevent any congestion on the public highway.

Environmental topics covered during induction shall include, but will not be limited to:

- Ecologically sensitive areas and any protected species restrictions;
- Water resources;
- Waste management and housekeeping;
- Duties and responsibilities;
- Relevant procedures;
- Consents and licenses;
- Legislation;
- Environmental best practice
- Pollution prevention;
- Emergency response procedures;
- Management structure; and
- Incident reporting.

Contractors working on-site employed by others (e.g., Utilities), shall be inducted as will all other site operatives and visitors. Information concerning their works and co-ordination / co-operation with other site operatives shall be discussed and agreed with the CEMP Manager and the Principal Contractor prior to commencement of their works on-site, as appropriate.

3.12.2 Toolbox Talks

Toolbox Talks will be conducted by the CEMP Manager/ Deputy regularly (as appropriate) to highlight issues of concern and to disseminate new information not previously provided. They will also offer site personnel with the opportunity to provide feedback.

Toolbox talks shall include, but will not be limited to, instances where:

- Work is being undertaken in environmentally sensitive areas;
- There are significant changes in environmental conditions, e.g., Heavy rainfall;
- There is a change to existing legislation, which requires an operational change; and
- Site inspections or audits have identified corrective actions which require rolling out.

Toolbox talk topics for environmental management shall include, but will not be limited to:

- Ecologically sensitive areas;
- Protected species;
- Waste management and segregation:
- Environmental incident and reporting; and
- Water management.

Records of all Toolbox talks, and attendance will be kept in the site office.

3.13 Communication

Throughout the duration of the project, the Principal Contractor will ensure that there is regular communication with personnel, providing information about the progress of the dredging and construction works, milestones achieved, upcoming challenges, safety incidents and local activities.

The CEMP will be distributed to the project team, including sub-contractors, to ensure that the environmental requirements are communicated effectively. Key activities and environmentally sensitive operations will also be briefed to staff and Contractors. Project and company environmental policies, where available, should be displayed on site.

Site Notice Boards shall display relevant statutory and non-statutory advice and guidance; and any other relevant information. These Notice Boards shall be situated in prominent positions in the main reception area of the site office.

The CEMP Manager/Deputy will define procedures for internal and external communication. Any communication with external parties such as environmental regulators or the public will be undertaken by CEMP manager/Deputy or nominated client representative only.

Internal communication includes regular progress meetings, which should cover:

- Training undertaken;
- Progress reports;
- Inspections, audits and non-conformance;
- Complaints received;
- Visits by external bodies and the outcome or feedback from such visits; and
- Objective / target achievement, including reporting on environmental performance.

Table 3-5: Site Communication

Communication Method	Frequency	Attendees	Environmental Points for discussion
Contractor / Subcontractor Meetings	Fortnightly / Monthly or as required	TBC	Any pertinent, Waste Management, Nuisance, Environmental Incidents
Toolbox Talks	As required	All site personnel	Toolbox talks to cover specific task related matters of environmental risk.

3.14 Monitoring, Continual Improvement & Review

3.14.1 Monitoring

Environmental monitoring will be undertaken in order to provide information to be considered during dredging and construction and to evaluate the environmental effects of the dredging and construction process.

The CEMP Manager/Deputy shall ensure that the CEMP is reviewed regularly (and no less frequently than monthly) to ensure that:

- The objectives and requirements of the CEMP are still valid and are being met;
- Identify any negative impacts from developmental activities;
- Assess the effectiveness of control measures;
- Identify if further controls/corrective action is required;
- Forthcoming activities are reviewed and any necessary amendments to the CEMP are put in place before the relevant work begins; and
- Any updates to the CEMP to be submitted to the Council as Planning Authority as soon as reasonably practicable.

3.14.2 Inspection & Audit

The CEMP Manager/ Deputy will be responsible for conducting weekly site inspections on a regular basis to confirm that processes are being carried out effectively. The findings of these inspections and any associated actions shall be appropriately documented on the Weekly Checklist and will be disseminated to the relevant management levels for review and action.

Site management shall meet as necessary to review activities on site and the potential environmental impacts and mitigation measures relevant to those activities that will be implemented.

Inspections carried out on the project by external representatives will be recorded by the CEMP Manager/ Deputy and any actions will be disseminated to the relevant project personnel.

Records of compliance and non-compliance, derived from audits and other inspections by the CEMP Manager/Deputy, will be held at the site office. Records will be available for inspection as required.

All environmental documentation shall be retained on site and be available for inspection by internal and external auditors and regulators, as well as the client. Site personnel shall be made aware immediately if any significant changes in work procedures are implemented.

Relevant documentation shall include the following:

- Weekly Site Checklist;
- Environmental Risk Assessment(s);
- Environmental Management Plan;
- Pollution Prevention Plan including emergency response; and
- Training and Responsibilities.

3.14.3 Non-conformance & Corrective Action

If criteria within the CEMP are not fulfilled and appropriate and corrective action is not taken a non-conformance may be raised by the CEMP Manager/ Deputy. Examples of circumstances where this may arise include:

- Receipt of a complaint regarding pollution or other environmental impact(s) caused by the project;
- Departure from approved or agreed procedures; and
- Non-conformance identified as a consequence of any self-assessment, formal audit or other environmental survey or inspection.

The non-compliance will be notified to the Principal Contractor as soon as practicably possible. Should it be identified that there is potential for mitigation measures or legislation to be breached the work or activity will stop immediately. Work will only recommence once measures are implemented to ensure the situation is remedied.

Following notification, a non-conformance/corrective action report will be issued to the principal contractor by the CEMP Manager/ Deputy. It is the responsibility of the principal contractor to immediately initiate corrective actions (if not already done so) and, once completed, provide details of the actions undertaken on the non-conformance/corrective action report and return it signed to the CEMP Manager/ Deputy within an agreed timeframe. If the non-conformance is considered to breach legislative requirements, the breach should be reported to the appropriate public body.

Corrective action may include changes to work instructions, alterations to the CMS, further site personnel training etc. Non-conformances should be reviewed by the CEMP Manager/ Deputy and form part of construction meeting agendas.

3.14.4 Complaints & Enquiries

It is important that members of the public or interested parties can make complaints regarding the dredging/construction of the scheme. Complaints provide a valuable feedback mechanism helping to minimise potential impacts on sensitive features and allowing dredging and construction practices to be refined and improved.

All complaints received will be investigated and a response (even if pending further investigation) is to be given to the complainant as soon as reasonably practicable.

Designated staff will be appointed to deal with any complaints and enquiries that are received. The nominated individual(s) will be named at the site entrance, with a contact telephone number, and will be identified to the client prior to the commencement of dredging or construction, and whenever a change of responsibility occurs (if any).

All complaints will be logged on-site using dedicated proforma and reported to the client as soon as practicable, with provisions for addressing the complaint (also logged on the proforma) including time scales. The required actions will be different for each specific complaint, depending on the issue concerned; however, this may include such actions as monitoring or investigating the matter further, alteration of the operation, equipment or location, or applying extra controls. The formal procedure for handling project complaints/concerns will be agreed between the Principal contractor and the CEMP Manager/Deputy prior to works commencing.

The CEMP will thereafter be updated with the agreed procedure.

3.14.5 Change Control Process

Where any amendments and variations to the CEMP are required, either as a result of changes to construction methods, design or mitigation, the method of recording the change will be agreed between the principal contractor and the CEMP Manager/Deputy prior to works commencing.

3.14.6 Control of Records

Environmental records, including waste management records, will be maintained in accordance with the respective company procedure and legal requirements. The records are to be maintained, in either hard copy or electronic format as required by the individual procedure that the records relate to, in such a way that they are readily identifiable.

4 DREDGING ENVIRONMENTAL MANAGEMENT

4.1 Potential Environmental Impacts

The primary impacts associated with dredging are as follows:

1. Seabed disturbance including;
    - Physical removal of the substrate and its associated flora and fauna from the dredge site;
    - Smothering of the seabed at the offshore dredge spoil placement site; and
    - Smothering of the seabed within the approved reclamation area.

(Note: These impacts are unavoidable in order to carry out the approved works so are accepted impacts)

2. The suspension of fine sediment in the water column which can form plumes 'down current' of the site and the spoil placement areas, and the resulting blanketing and water quality impacts from the settling of sediment in the plume areas;
3. The re-suspension of fine sediment from the offshore disposal site and the potential for blanketing and water quality impacts on sensitive areas;
4. Marine incidents involving vessels, oil/fuel or dredge sediment spills, collisions with large marine fauna, or spillage of material in transit to the disposal site;
5. The possibility of contaminants in some of the sediment to be released at or from the disposal site;
6. Dust arising from spoil deposited to land for use within the boundary of the harbour;
7. Odour associated with spoil deposited to land for use within the boundary of the harbour and disposal off-site;
8. Waste arising as a result of the dredging and disposal works;
9. Translocation of marine pests on dredging plant / machinery.

4.2 Environmental Management Strategies

4.2.1 Marine Mammals

A Marine Mammal Protection Plan as detailed in Appendix A will be implemented to reduce the risk of underwater noise causing injury to marine mammals (and basking shark). This will involve the use of Marine Mammal Observers (MMOs). The MMPP also details protocols to be implemented to reduce collision risk.

The following management measures will be implemented to manage risk of impacts to marine mammals:

- Site inductions for all vessel crew and awareness programmes covering procedures to be undertaken to minimise disturbance to marine fauna.
- Prior to commencement of dredging and disposal, designated crew will observe for marine mammals, record sightings and actions to be taken in event of sightings, injury or mortality.
- Vessel speeds will be under the control of the Vessel Master who will ensure that all vessels operate in a safe manner with due respect to ongoing operations, navigational constraints and environmental considerations.
- The Vessel Master will be advised of environmental matters from on-site environmental staff.

- The dredge/disposal vessel(s) will be required to maintain a watch for marine mammals, and if they are spotted, vessels will avoid impacting the fauna (within safe operational constraints of the vessel).
- All vessels will follow standard maritime procedures and follow long established navigation routes, together with maintaining low speeds, typically less than 10knots, which is considered to be sufficiently low to enable marine mammals to safely vacate vessel transit routes.
- Should marine mammals approach dredging/ disposal vessels during general transit, the direction of travel and speed should be maintained, with sudden changes in course and speed avoided. These procedures are standard for commercial maritime vessels.
- If a marine mammal is sighted within 300m, a maximum vessel speed of 6 knots will be applied.
- Any injuries or mortalities of marine mammals will be documented and reported to Marine Scotland.

4.2.2 Navigation

- A Vessel Traffic Management(VTM) review will be conducted by the client to review the provision of VTM, specifically with consideration to their Local Port Service resource to monitor marine dredge craft.
- A Project Liaison Officer will be appointed, and a Marine Management Plan will be developed to ensure effective communication and coordination among stakeholders. This proactive approach will help identify and address potential risks in real time.
- Regularly reviewing and updating towage guidelines and pilotage directions will ensure that vessels receive appropriate assistance in challenging navigation areas, reducing the risk of incidents.
- Conducting regular reviews of Aids to Navigation (AtoN) will ensure that these markers remain effective and accurate, enhancing navigational safety.
- Continuous monitoring of vessel traffic flows will enable proactive management of congestion and risks associated with navigation.
- Providing prior notice of dredging activities to mariners will mitigate risks associated with changes to navigation channels and the risk of collision in confined waters.
- Providing education and training sessions for personnel involved in recreational navigation and will enhance awareness of safety protocols and best practices, fostering a safety-conscious culture.
- Updating and disseminating the Clyde Leisure Navigation Guide will inform recreational vessels users of recommended routes and safety precautions, reducing the risk of collisions and navigational incidents.
- Establishing recommended routes for leisure vessels will minimize interference with commercial traffic and reduce the risk of accidents in high-traffic areas.

4.2.3 Water Quality

- Trained operators will be used to ensure minimal loss of turbid water from the backhoe dredge;
- Dredging is to be undertaken from well maintained and inspected vessels which are free from structural defects and potential sources of leakages;
- Well-maintained barges will be used for transport of dredged material;
- The backhoe dredge should be fitted with a suitably accurate positioning system, that ensures reasonable accuracy of dredging both horizontally and vertically;
- Material placed on shore should be suitably bunded and managed to prevent the direct discharge of turbid return water.
- The dredge plume should be monitored visually on a daily basis to confirm that the plume is not spreading outside anticipated area. These observations will be undertaken from an elevated

location and will include information on the plume extent, plume direction and prevailing conditions and any other notable visual characteristics of the plume or dredging activity.

- A daily log of observations of the plume will be maintained and provided to CEMP Manager on demand and at the conclusion of the dredging works.
- If turbidity is more extensive or persistent than anticipated, additional monitoring will be undertaken to determine the plume extent. If exceedance of turbidity levels is attributable to the dredging, CEMP Manager would liaise directly with the dredging contractor to determine the following:
    - Which part of the process is likely responsible for the exceedance, and;
    - What can be done in the context of the operating environment on the day to change this factor.
- The hierarchy of controls to be employed would include:
    - Modify dredging operations;
    - Modify loading operations; and
    - Modify dredging cycle.

4.2.4 Hydrocarbons

- All refuelling is to be done by licensed fuel suppliers in accordance with their Standard Operating Procedures.
- Refuelling will take place at wharves suited to tanker access. In the event that it is necessary for the contractor to refuel vessels or plant in the works area operations will be in accordance with industry standards.
- Refuelling activities will be continuously monitored to ensure no leak or spillage of hydrocarbons.
- The dredge contractor will maintain an oil spill response capability commensurate with its risk of oil spill;
- Relevant staff will be trained to use oil spill response equipment;
- A Risk Assessment will be performed before refuelling activities (if required); and
- All hydrocarbon spills to the marine environment (regardless of volume) will be reported to the CEMP Manager. This will set in motion the process for marine oil pollution response and official communication protocol.

4.2.5 Spillage

- The contractor vessels shall be equipped with suitable spill kits and will be operated in accordance with the Maritime Safety;
- Spill kit contains bilge socks, heavy duty absorbent polypropylene pads, floating booms and blowback refuelling collars on vessels for use in the event a substance is spilled either on deck or to waters to handle a spill of up to 160 litres;
- Minimum volume of fuel, lubricant and oil will be stored in discrete containers on vessels. Any visible or reasonably suspected fuel, lubricant or hydraulic fluid loss will be treated as an ‘incident’ and handled in accordance with ‘Pollution Incident Response Plan’;
- A register of Materials Safety Data Sheets (MSDS) relating to all hazardous substances on board, will be maintained;
- Vessel crew are to regularly check storage areas, containers and equipment for evidence of leaks and fitness of hydraulic hoses and seals, and conduct maintenance or repairs as necessary to prevent drips, leaks or likely equipment failures. Inspections of the dredge, pipelines, pump(s) will be undertaken daily;
- A copy of up-to-date emergency contact list will be maintained;
- In the event of a spill, the spill source will be immediately isolated, stopped and contained; and

- For major spills, undertake actions as specified in the approved vessels Pollution Incident Response Plan.

4.2.6 Dust and Air Emission

- The principal contractor will appoint a person responsible for monitoring dust levels throughout the duration of the works;
- The name and contact details of person(s) accountable for air quality and dust issues will be displayed on the site boundary in advance of any works commencing;
- The appointed person (or appointed deputy during holiday periods etc.) will be contactable 24 hours per day, 7 days per week throughout the duration of the works;
- During normal site working hours, dust monitoring will consist of regular visual checks by the appointed person(s). Details of such checks will be documented in a monitoring schedule with details such as date, time, location, weather conditions and observations recorded;
- Record any exceptional incidents that cause dust and/or air emissions, either on or offsite, and the action taken to resolve the situation in the log book;
- The appointed person(s) will be supported by employees throughout the site who will report any problems with dust levels in their area to the appointed person(s);
- The weather forecast will be checked by the appointed person(s) prior to the end of each working day;
- If it is deemed that dust is likely to arise from any particular works when combined with actual/forecast weather conditions, the affected area will be controlled with a suitable measure to prevent dust becoming airborne;
- Staff will be trained in the control of dust and will ensure the site is monitored for levels of surface dust. Should dust build up this will be damped down with hosepipes;
- If dry and windy weather is expected over the duration which the site is closed, then measures, dependent on the type of activity in progress will be implemented as far as reasonably possible so that these weather conditions do not lead to high levels of dust/debris becoming airborne until the next working day;
- Traffic speed on site will be monitored to prevent the generation of dust, not exceeding the site speed limit; and
- Any dust complaints that are received or issues relating to dust resulting from operations will be directed to the above noted individual.
- Vehicles, vessels and equipment, including generators, will be turned off when not in use.
- The Contractor will carry out regular visual monitoring to identify equipment producing excessive visible emissions.
- Regular maintenance of dredging equipment will be scheduled and carried out by the Contractor.

4.2.7 Control of Odour

- Odour from anaerobic sediments containing hydrogen sulphide from dredging is rarely more than a temporary problem. Typically, when dredging channels discharged sediment is initially anaerobic. When first discharged it may smell, but the smell is lost within a few days of its exposure to air.
- Before discharging sediment, client shall ensure that residents in the immediate vicinity are aware of the proposed dredging and assured that any smell will be lost with a few days exposure to air. This should be done by notices placed near the discharge point and at the most public vantage point.
- Identify prevailing wind direction and strength and the potential for odours to reach sensitive receptors;

- In exceptional circumstances, limit the rate of dredging to reduce the odour emissions.
- Where odour complaints received, the contractor in collaboration with the client, will investigate the cause of odours and implement appropriate management actions to reduce odours associated with dredging where practicable.
- The contractor will notify the CEMP Manager/Deputy of any adverse odours identified during dredging.
- Log books will be maintained to record instances where adverse odours are apparent, and what corrective action was taken.
- The dates and outcomes of visual emissions monitoring will be reported by the contractor to the CEMP Manager/Deputy fortnightly.

4.2.8 Non Native Species

- The client will act in accordance with The Code of Practice on Non-Native Species (approved by the Scottish Government in 2012 and made under 14C of the Wildlife and Countryside Act 1981).
- Prior to the dredge mobilising to site, an appropriate risk assessment (supported by relevant documentation) of the dredge, associated equipment and vessels should be undertaken to demonstrate, to the satisfaction of Marine Scotland, that the vessels and associated equipment present a low risk in terms of the introduction of non-indigenous marine organisms e.g. in sediment, as biofouling (or in ballast water).
- A project specific Biosecurity Plan has been developed, Appendix B and should be referred to, this is a working document and should be updated to reflect any new method statement for works at the site.
- Remove any visible plant, fish, animal matter and mud from the vessel, in particular the hulls should be cleaned regularly.
- Safely dispose of any plant and animal material removed from the vessel.
- Provide toolbox talks and posters to aid identification of non-native species. These will aid on the management and control of marine non-native species.
- Ideally, all equipment and vessels required will be from within biogeographic regions where possible, and have undergone the necessary inspections prior to arriving on site.
- Documentation demonstrating compliance with the above will be provided to the CEMP Manager/Deputy before the arrival of vessels to site.
- Should marine non-native species be identified on site, these sightings should be reported to the relevant authority. Useful contacts are listed below:
    - Marine Scotland: marinescotland@scotland.gsi.gov.uk
    - Scottish Natural Heritage (SNH): info@sears.scotland.gov.uk

5 CONSTRUCTION ENVIRONMENTAL MANAGEMENT

This section of the CEMP sets out general operational control procedures which should be followed by site operatives during the construction period.

5.1 Environmental Management Strategies

5.1.1 Ecological Management

- A speed limit of 15mph to be in place along the access road to the marine yard.
- Loss of Open Mosaic Habitats on Previously Developed Land (OMHPDL) will be compensated for via the enhancement and creation of habitats as described in the Environmental Impact Assessment Report.
- All reasonably practicable measures will be employed to minimise harm to, and disturbance of, wildlife caused by noise, dust, waste and pollution;
- Ensure no activities outside the works zone through clear delineation of the works area, and communication during site inductions;
- Where fauna may be entrapped, suitable escape measures are put in place;
- Regular inspections will be undertaken to check that detrimental impacts on ecological features are being minimised;
- Ensure appropriate waste management (lidded bins), including food scraps, to reduce potential for feral species to become established on-site;
- The use of artificial lighting during construction will be minimised to reduce the impact on terrestrial and marine fauna. Temporary lights used during construction will be fitted with shades to prevent light spillage out with the working area. Reference will be made to the Royal Commission on Environmental Pollution (RCEP) Report on Artificial Light in the Environment[2] and Guidance Notes for the Reduction of Obtrusive Light GN01:2011[3].
- Piling will not commence during periods of darkness or poor visibility (such as fog), or during periods when the sea state is not conducive to visual mitigation, as there is a greater risk of failing to detect the presence of marine mammals[4].
- The mitigation zone will be monitored visually by a Marine Mammal Observer (MMO) for an agreed period prior to the commencement of piling. This will be a minimum of 30 minutes.
- The MMO will scan the waters using binoculars (10X42 or similar) or spotting scopes (20-60 zoom or equivalent) 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, behaviour, range etc. on the JNCC standard forms. Communication between the MMOs and the contractor and the start/end times of the activities will also be recorded on the forms.
- Piling will not commence if marine mammals are detected within the mitigation zone or until 20 minutes after the last visual or acoustic detection. The MMO will track any marine mammals detected and ensure they are satisfied the animals have left the mitigation zone before they advise the crew to commence piling activities.

[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/228832/9780108508547.pdf.pdf

[3] https://theilp.org.uk/publication/guidance-note-1-for-the-reduction-of-obtrusive-light-2020/

[4] There is a 'variation of standard piling protocol' allowed in the guidance if required.

- A soft-start will be employed, with the gradual ramping up of piling. The soft-start duration will be a period of not less than 50 minutes. This will allow for any marine mammals to move away from the noise source.
- If a marine mammal enters the mitigation zone during the soft-start then, whenever possible, the piling operation will cease, or at least the power will not be further increased until the marine mammal exits the mitigation zone and there is no further detection for 20 minutes.
- When piling at full power this will continue if a marine mammal is detected in the mitigation zone (as it is deemed to have entered voluntarily[5]).
- If there is a pause in the piling operations for a period of greater than 10 minutes, then the pre-piling search and soft-start procedure will be repeated before piling recommences. If a watch has been kept during the piling operation, the MMO should be able to confirm the presence or absence of marine mammals, and it may be possible to commence the soft-start immediately. However, if there has been no watch, the complete pre-piling search and soft-start procedure will be undertaken.

5.1.2 Water Quality

- The location of the dewatering outfall will also be chosen to avoid sensitive areas and have minimal impact on the coastal environment. The discharge will be regulated by SEPA under the Controlled Activities Regulation which will detail the specific quality parameters which the discharge will require to meet. Specific water processing measures may be required to meet these discharge parameters.
- Fuel and other potentially polluting chemicals will either be in self-bunded containers or will be stored in a secure impermeable and bunded area (minimum capacity 110%).
- Fuelling and maintenance of vehicles and machinery, and cleaning of tools, will be carried out in a designated area where possible in line with PPG7;
- All fixed plant used on site is to be fitted within an integral bund.
- Mobile plant is to be in good working order, kept clean and fitted with plant ‘nappies’ where appropriate.
- Concrete batching will take place on an impermeable designated area and at least 10m from any waterbody;
- Equipment and vehicles will be washed out in a designated area that has been specifically designed to contain wet concrete/ wash water;
- A closed loop system will be used for wash waters. Wash waters will be stored in a contained lined pond for settlement before being reused (e.g. for mixing and washing); and
- No discharge of wash waters will occur on-site. All excess wash water that cannot be reused will be disposed off-site.
- Concrete wash water will be adequately contained, prevented from entering any drain, and removed from site for appropriate disposal at a suitably licenced waste facility.
- During periods of heavy rain and or high flow levels in water courses construction works are to be ceased on the tasks that effect the surrounding environment.
- Construction waste / debris are to be prevented from entering any surface water drains.
- Any site welfare facilities will be appropriately managed, and all foul waste disposed of by an appropriate contractor to a suitably licenced facility. Any liquids exposed and / or spilt from redundant pipework / infrastructure will also be disposed of at a suitably licenced facility.
- The site workers are to regularly check equipment for evidence of leaks and fitness of hydraulic hoses and seals, and conduct maintenance or repairs as necessary to prevent drips, leaks or likely equipment failures;

[5] The guidance states that there is no scientific evidence for this voluntary hypothesis, instead it is based on a common sense approach. Factors such as food availability may result in marine mammals approaching piling operations, in particular, the availability of prey species stunned by loud underwater noise may attract seals into the vicinity.

- Inspections of pipelines, pump(s) etc. are to be undertaken daily;
- Plant and equipment will be in good working order, kept clean and fitted with drip trays where appropriate;
- All plant and equipment will be checked daily for oil and fuel leaks, and a record of such checks kept;

5.1.3 Hydrocarbons

- Petrol will be segregated from other flammable materials and stored away from sources of ignition. Containers are to be secured to prevent them falling over.
- Diesel fuel will be segregated from other flammable materials. Containers are to be secured to prevent them from falling over.
- Fuel/oil, of 200 litres or more, must be stored in secondary containment (bund) which contains at least 110% of the maximum capacity. If more than one container the bund must be capable of storing 110% of the biggest container's capacity or 25% of the total capacity, whichever is greatest.
- Fuel should only be transported in suitable Jerry cans.
- Storage for oil and fuels on site will be designed to be compliant with GPP2 and GPP8;
- The storage and use of loose drums of fuel on site will not be permitted;
- The storage area will be a no-smoking zone.
- Re-fuelling to be carried out on hardstanding and not within 10m of the water's edge.
- All refuelling is to be done by licensed fuel suppliers in accordance with their Standard Operating Procedures and will be supervised by site personnel with spill kit / emergency response training.
- A Risk Assessment will be performed before refuelling activities (if required); and
- All hydrocarbon spills (regardless of volume) will be reported to the CEMP Manager. This will set in motion the process for Pollution Incident Response Plan and official communication protocol.

5.1.4 Spillage

- A register of Materials Safety Data Sheets (MSDS) relating to all hazardous substances, will be maintained;
- Drip trays will be used while refuelling;
- The contractor will maintain an oil spill response capability commensurate with its risk of oil spill;
- Relevant staff will be trained to use oil spill response equipment;
- Minimum volume of fuel, lubricant and oil will be stored in discrete containers;
- Concrete acidity (pH) will be as close to neutral (or site-specific pH) as practicable as a further precaution against spills or leakage;
- Pouring of concrete will take place within well shuttered pours to prevent egress of concrete from the pour area;
- Pouring of concrete during adverse weather conditions will be avoided;
- Any visible or reasonably suspected fuel, lubricant or hydraulic fluid loss will be treated as an 'incident' and handled in accordance with 'Pollution Incident Response Plan';
- Multiple spill kits will be available in compound, works areas and large items of plant;
- In the event of a spill, the spill source will be immediately isolated, stopped and contained;
- Contaminated spill kit material will be safely (temporarily) stored prior to disposal to a licenced waste facility; and
- For major spills, undertake actions as specified in the approved vessels Pollution Incident Response Plan.

5.1.5 Construction Traffic Management

Shipping and Navigation

- A Vessel Traffic Management(VTM) review will be conducted by the client to review the provision of VTM, specifically with consideration to their Local Port Service resource to monitor marine construction craft.
- A Project Liaison Officer will be appointed, and a Marine Management Plan will be developed to ensure effective communication and coordination among stakeholders. This proactive approach will help identify and address potential risks in real time.
- Regularly reviewing and updating towage guidelines and pilotage directions will ensure that vessels receive appropriate assistance in challenging navigation areas, reducing the risk of incidents.
- Conducting regular reviews of Aids to Navigation (AtoN) will ensure that these markers remain effective and accurate, enhancing navigational safety.
- Vessel traffic flows will be continuous monitored enabling proactive management of congestion and risks associated with navigation.
- Issuing regular Notices to Mariners will keep stakeholders informed of changes and hazards in the area, promoting safer navigation practices.
- Providing education and training sessions for personnel involved in recreational navigation and will enhance awareness of safety protocols and best practices, fostering a safety-conscious culture.
- Updating and disseminating the Clyde Leisure Navigation Guide will inform recreational vessels users of recommended routes and safety precautions, reducing the risk of collisions and navigational incidents.
- Establishing recommended routes for leisure vessels will minimize interference with commercial traffic and reduce the risk of accidents in high-traffic areas.

Site Access and Road Traffic

- Approved routes will be communicated to all site operatives, contractors and suppliers ahead of arrival, and in accordance with North Ayrshire Council requirements;
- CEMP Manager/Deputy will ensure that properties potentially affected by passing construction traffic will be notified ahead of site commencement.
- Information will be notified/displayed on signs to inform for other road users of construction traffic.
- Site Signage/Directional Signage will be erected to indicate construction traffic route as per plan and site entrance.
- All site roads where possible will be wide enough to enable vehicles to pass. Where not possible suitable signage will be provided regarding priority.
- Speed limit for unmade roads is 10mph and 15mph for surfaced roads.
- Where conditions dictate that provision of turning point is not practical then a banksman must be used to assist vehicle/plant when reversing.
- Access for pedestrian to the site will be provided via a dedicated walkway and crossing point.
- Internal pedestrian access/walkways will be located close to the site access and centrally between welfare and compound areas.
- There will be strictly no on-street parking/manoeuvring/unloading by construction traffic. All vehicles will be parked/unloaded within the site perimeter, to ensure emergency accesses are maintained at all times.
- All site parking for contractors will be restricted to the dedicated parking area on site. Visitor parking will be provided at the site office.
- Site personnel, construction plant and HGVs will be required to observe the clockwise traffic flows around the central materials compound of the site.
- Vehicles may park temporarily on site to unload stores/tools.

- Delivery vehicles will proceed around the site via the access road to the designated storage areas.
- Access to the site for delivery vehicles will be restricted to site working hours and to avoid, where possible, peak traffic times.
- All plant and materials will where possible be delivered in suitable sized loads to ensure lorries have sufficient turning areas within the confines of the site.

5.1.6 Dust and Air Emissions

- Plan site layout so that machinery and dust causing activities are located away from sensitive receptors, as far as is possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site
- Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- Cover, seed or fence stockpiles to prevent wind whipping.
- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g., suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
- Avoid bonfires and burning of waste materials.
- Avoid scabbling (roughening of concrete surfaces) if possible
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.
- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.

- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- Wind-blown dust, generated from dry, exposed ground or soil and wastes stockpiles, will be prevented generally with the use of water sprays.
- Surfaces and stockpiles will be damped down to minimise dust as necessary.
- In wetter conditions, deposits of mud on roads, pavements and areas of hard standing may need to be cleared.
- Small occurrences will be cleared manually with a broom and shovel; elsewhere road sweepers will be called upon.
- Vigilance of weather conditions and potential for dust clouds will be undertaken and recorded on a daily basis.
- The principal contractor will appoint a person responsible for monitoring dust levels throughout the duration of the works;
- The name and contact details of person(s) accountable for air quality and dust issues will be displayed on the site boundary in advance of any works commencing;
- The appointed person (or appointed deputy during holiday periods etc.) will be contactable 24 hours per day, 7 days per week throughout the duration of the works;
- During normal site working hours, dust monitoring will consist of regular visual checks by the appointed person(s). Details of such checks will be documented in a monitoring schedule with details such as date, time, location, weather conditions and observations recorded;
- Record any exceptional incidents that cause dust and/or air emissions, either on or offsite, and the action taken to resolve the situation in the log book;
- The appointed person(s) will be supported by employees throughout the site who will report any problems with dust levels in their area to the appointed person(s);
- The weather forecast will be checked by the appointed person(s) prior to the end of each working day;
- If it is deemed that dust is likely to arise from any particular works when combined with actual/forecast weather conditions, the affected area will be controlled with a suitable measure to prevent dust becoming airborne;
- Staff will be trained in the control of dust and will ensure the site is monitored for levels of surface dust. Should dust build up this will be damped down with hosepipes;
- If dry and windy weather is expected over the duration which the site is closed, then measures, dependent on the type of activity in progress will be implemented as far as reasonably possible so that these weather conditions do not lead to high levels of dust/debris becoming airborne until the next working day;
- Traffic speed on site will be monitored to prevent the generation of dust, not exceeding the site speed limit; and
- Any dust complaints that are received or issues relating to dust resulting from operations will be directed to the above noted individual.
- Vehicles and equipment, including generators, will be turned off when not in use.
- The Contractor will carry out regular visual monitoring to identify equipment producing excessive visible emissions.

6 POLLUTION INCIDENT RESPONSE PLAN

6.1 General Arrangements

The main priority is to avoid spillages and emergency situations. This will be achieved through minimising the risk of spillage at source through avoiding the use of polluting materials where possible. Where the use of polluting materials is unavoidable, then suitable containment in a sensible location is essential.

Refer also to Pollution Prevention Plan, which will be prepared with reference to GPP 21: Pollution Incident Response Planning

6.1.1 Responsibilities

All persons working for or on behalf of the client have responsibilities to ensure they are aware or have been made aware of the processes and equipment in place to deal with emergency incident.

6.2 General Incidents

6.2.1 Navigation

- Deploying a safety boat during the construction phase will provide immediate response capabilities in case of emergencies or incidents on the water.
- Conducting simulation exercises for navigation and port operations will allow for the testing of emergency response plans and identification of potential weaknesses in planned operations.
- Implementing protocols for controlled emergency vessel departures will ensure swift response capabilities during critical situations, such as if winds are to excessive to remain berthed safely alongside.
- Developing and implementing a Port Emergency Plan will establish clear procedures and responsibilities for responding to emergencies effectively.
- Regular audits and inspections of quaysides in accordance with Pollution Prevention Guidelines (PPG) will maintain safety standards and prevent environmental hazards as well as help prevent trips slips and falls.
- Reviewing and updating mooring and berthing guidelines will enhance safety during docking and departure operations.
- Designating safety areas on the quayside will help provide a visual indication to workers as to where it may be unsafe to stand unless actively engaged in activities such as mooring a vessel.
- Using storm moorings (usually made from steel wire) will secure vessels during severe weather events, reducing the risk of damage or accidents.

6.2.2 Significant Incident Reporting Procedures

In the event of a potential harmful or polluting incident, spillage or discharge, the actions listed below will be followed to notify the appropriate organisations of the occurrence:

- Should an incident occur, the CEMP Manager/ Deputy shall inform client of the occurrence of an incident at the site as soon as practicably possible following awareness of the incident.

- The CEMP Manager/ Deputy shall notify client in writing the next working day after the incident, detailing the time and nature of the incident; and
- The CEMP Manager/ Deputy shall investigate the incident and notify client of the outcome as soon as practicably possible.

6.2.3 Emergency Procedures

Emergency procedures in the event of fire, accident, contact with live services, dangerous occurrence or a significant environmental incident will be displayed throughout the site facilities.

Where an environmental incident occurs, competent personnel should firstly assess and where appropriate, deal with the incident. Where the nature or scale of the environmental incident is outside the capability of the competent person/s they shall notify without delay, the client who will contact an appropriate environmental incident containment organisation to deal with the incident and mitigate any impact to the environment.

All persons working for or on behalf of the client have a responsibility to report the occurrence of any environmental incident regardless of magnitude to their superior.

The client has the responsibility to ensure environmental incidents are reported through the appropriate incident review process and where applicable oversee the implementation of improvement actions, both immediate and preventative.

The client has the responsibility to, where appropriate, notify the relevant agency or organisation of the occurrence of an environmental incident should this be required.

The Management representative(s) or nominated person(s) are responsible for reviewing environmental incidents and ensuring the appropriate correction and corrective actions have been conducted and relevant preventative actions have been implemented.

A site-specific Emergency Response Plan will be developed by the contractor and will detail the response to any environmental incidents on site. The Emergency Response Plan shall, as a minimum, include:

A Site Plan showing:
- layout and access details;
- access routes and meeting points for emergency services;
- areas used to store raw materials, products and wastes; and
- location of hydrants, ‘fireboxes’ and pollution prevention equipment and materials.

6.2.4 Planning & Prevention

Risk assessments are routinely conducted for all developmental activities and contain an assessment of the potential of an activity, process or substance to cause an incident.

Where the risk is considered small or insignificant actions are identified within the assessment.

Where the potential for a medium, large or significant risk is identified the appropriate operational controls may be implemented to ensure risks are minimised or eliminated and if and when an incident occurs, response actions are known and effective.

6.2.5 Routine Testing

Where practicable the contract/site shall conduct periodic testing of applicable emergency preparedness and response procedures. Where testing is conducted the results of the test and any improvement actions will be recorded.

6.2.6 Response Equipment

The most likely source of environmental incident is spillage of liquids and substances either accidentally or during handling or transfer.

Prior to attempting to tackle any environmental incident personal safety is paramount. The use of correct Personal Protective Equipment (PPE) may prevent an incident becoming even more serious with response personnel sustaining injury. When considering whether to tackle an environmental incident even with the use of PPE if exposure is likely to cause injury the job is best left to the experts. PPE used for this purpose should be located near to spill and containment equipment and should be confirmed as being suitable for the hazard.

Suggested PPE includes:

1. Coverall overalls or aprons
2. Wellington boots or safety shoes
3. Rubber or nitrile gauntlets or gloves
4. Respiratory protective equipment (note that this must be face fit tested)
5. Head protection (may be required if working in a restricted space)

For small liquid spillages of substance releases containment can be effective by the placement of spill or release containment equipment local to the potential sources of an incident which can effectively cleaned up preventing any environmental risk.

For larger spills or releases, containment equipment should be sufficient to prevent spills or releases contaminating the environment and provide an additional time break to conduct an effective clean-up operation, with or without the help of specialists.

The provision of spill or release containment equipment should be appropriate to the potential hazard.

The template Pollution Prevention Equipment Inventory will be completed before construction works commence.

6.2.7 Dealing with Spills

The precise contents and capacity of the spill kits will depend on the detailed inventory of products that will be stored and handled on site, however they are likely to contain:

- Absorbent mats;
- Drain covers;
- Gloves;
- Floating “booms” or “sausages”;
- Knives;
- Oil-absorbent granules;
- Polythene sheeting and bags;
- Shovels; and

- String.

Spill kits will be clearly marked, sign-posted and held close to the area where materials are stored and handled.

Spill or release containment equipment provided for emergency response purposes should:

- Not be used for routine operations. Daily equipment or materials should be provided for these purposes.
- Have its location identified on site plans.
- Be readily accessible.
- Be appropriate to the potential hazard i.e., chemical or oil specific.
- Have its inventory logged, periodically checked and any used equipment replaced.
- Be replaced if used for an emergency situation.
- Be disposed of in accordance with relevant legislation if contaminated (hazardous/special waste).

Spill kits should ideally contain:

Oil specific spill kits should be suitable to absorb hydrocarbons but repel water and contain absorbent pads, socks and cushions, plugging compound and disposal bags and ties.

Chemical specific spill kits should absorb acids and caustics and should be used when unsure of the spilt liquid and contain absorbent pads or roll, socks, cushions, plugging compound and disposal bags and ties.

The provision of drain covers should be considered especially where spills could enter the water system.

A number of specialist spill contractors will be identified that can be called upon should there be a requirement to control a major spill.

6.2.8 Spill Management

A supply of spill containment and treatment equipment and materials will always be available near storage areas containing hazardous materials in sufficient quantities to deal with small-scale spillages and all staff will be aware of where this equipment is stored.

An incident of pollution at the construction site will be contained using equipment stored within the sensitive area, mopped up quickly using pads and granules and removed from the area for safe storage prior to permanent removal from site. Any contaminated ground will be removed immediately and stored outside the sensitive area for testing and removal from site.

All incidents occurring within the Site must be immediately reported to the CEMP Manager/ Deputy in order for them to notify the nominated clean-up contractor (if required). The incident will be recorded, and the CEMP Manager/ Deputy will investigate the cause and effect of the incident, recommending an appropriate change in procedures where necessary.

In the event a spill occurs the following actions will be taken:

- When a spill occurs the CEMP Manager/ Deputy will be informed immediately;
- In dealing with the spillage the personal safety of the site-workers and the general public will not be compromised;
- Where required to stop or contain the spillage, work will be halted;
- The cause of the spillage will be stopped;

- The spill will be contained. Particularly pathways to any drains and water courses will be blocked as soon as possible; and
- The spilled materials will be removed and disposed of in accordance with the relevant waste regulations.

In the event of major or complicated spills, the following additional actions will be taken:

- The CEMP Manager/ Deputy will assess the incident and if appropriate request a specialist spill contractor to attend the site.

After an incident all waste generated by clean-up activities will be disposed of in accordance with current legislative requirements and the site waste management plan and copies of all transfer notes retained.

6.2.9 Fire

Health and Safety procedures and processes shall be established to minimise the risk of, and the appropriate management of a fire emergency. Consideration shall be given to the appropriate management of any subsequent fire water (the run-off generated from firefighting activities), such as temporary storage on-site.

This water should be considered contaminated and it has the potential to cause pollution. In developing strategies for dealing with a fire emergency, consideration shall be given to minimising the risk to the environment associated with fire water. The guidance on the control of fire water detailed in SEPA's PPG18: Managing Fire Water and Major Spillages shall be followed as appropriate.

6.2.10 Incident Reporting

If during the course of site staff duties an Environmental / Health and Safety incident is noted, then the incident will be reported, immediately to the client.

The client shall co-ordinate any actions that are required to make the area safe or limit environmental impacts resulting from the incident.

In the event of a potential harmful or polluting incident, spillage or discharge, the actions listed below will be followed to notify SEPA of the occurrence:

- Should an incident occur, the client shall inform the regulator of the occurrence of an Environmental incident at the site as soon as practicably possible following notification of the incident.

- The client will notify the Regulators in writing the next working day after the incident, detailing the time nature of the incident; and

- The client will investigate the incident and notify the Regulators of the outcome within 14 days of the incident.

6.2.11 Emergency Response Training

Relevant site personnel shall be trained in the use of pollution control equipment.

6.3 Incident Response

Incident response will be in line with the provisions of Guidance for Pollution Prevention (GPP) 21: Pollution Incident Response.

6.4 Emergency Contacts

In the event of an emergency occurring in or adjacent to the site, contact the emergency services including Police Scotland, Scottish Ambulance Service, HM Coastguard and Scottish Fire & Rescue Service on: 999 or HM Coastguard on VHF Channel 16 (International Distress, Safety and Calling Channel).

In addition to the foregoing, the operator is committed to complying with the Port Marine Safety Code and 2018 Guide to Good Practice on Port Marine Operations.

Table 6-1: Emergency Contact Information

Role	Organisation	Responsibilities	Key Person	Contact Details
Client	Clydeport Operations Limited	Clydeport Operations Limited will make development decisions.	To be confirmed	
Principal Contractor	To be confirmed	The principal contractor will ensure the safe management of the project.	To be confirmed	
EnvCoW	To be confirmed	Provision of ecological/ environmental advice as required		

Accident & Emergency	Royal Alexandra Hospital- Accident and Emergency Department, Corsebar Rd, Paisley PA2 9PN
Health & Safety Executive	0345 300 9923
Scottish Fire & Rescue Services	999
Scottish Ambulance Service	999
Police Scotland	999
HM Coastguard	999 or VHF Channel 16
Person(s) acting as 24-hour contact with SEPA in an emergency (i.e. if there is an imminent risk of pollution or where pollution is occurring)	Name :…… Role:…… Email:. …… Contact No: ...……
Reference to use when contacting SEPA	CAR License application number ……
SEPA, 24hr Pollution Hotline	0800 80 70 60
SEPA	Law House. Todd Campus, West of Scotland Science Park, Maryhill Road, Glasgow G20 0XA Tel: 0141 945 6350
NatureScot	Business Park, 8 South Ave, Clydebank G81 2NR. Tel: 01313146750

SSE Power Distribution (Electric)	Emergency Call Centre
National Gas Helpline – SGN / SSE (Gas)	Emergency Call Centre
Openreach (BT)	Emergency Call Centre
Scottish Water (Water)	Emergency Call Centre
North Ayrshire Council	Environmental Health Section, Cunninghame House, Friars Croft, Irvine KA12 8EE
Marine Scotland The Marine Scotland Duty Officer is not a replacement for contacting the usual Emergency Services (Fire, Police, Ambulance and Coastguard) where these are required	0300 244 4000 and ask for the Marine Scotland Duty Officer. MS.SpillResponse@gov.scot or spillresponse@marlab.ac.uk. A marine emergency includes oil and or chemical pollution incidents from shipping and offshore installations (and the application of chemical dispersants and deployment of containment equipment) and marine mammal stranding.

7 CONSTRUCTION NOISE MANAGEMENT PLAN

This section of the CEMP sets out the approach to managing noise impacts during the construction of the development.

7.1 Implementation and Organisation

The Construction Noise Management Plan (CNMP) will be implemented by the client through contracts with individual contractors.

The CEMP Manager will be responsible for ensuring that the CNMP are correctly implemented. The CEMP Manager will review all documentation relating to construction noise before it is issued.

7.2 Lines of Communication

The CEMP Manager is responsible for ensuring the requirements of the CNMP is explained to all staff and contractors working on the site. The aim is to ensure they are fully aware of the environmental sensitivities and the control/mitigation measures in place to protect against adverse noise effects. If required, specific training will be provided for site personnel.

7.3 Monitoring and Review

The CEMP Manager shall ensure that the CNMP is reviewed regularly (and no less frequent than monthly) to ensure that:

- The objectives and requirements of the CNMP are still valid and are being met; and
- Forthcoming activities are reviewed and any necessary amendments to the CNMP are put in place before the relevant work begins.

7.4 Public Engagement

A key aspect of this CNMP is public engagement. A site contact for the public for the duration of the works will be appointed. The site contact will communicate with the local community on the following construction noise issues:

- Individual notification will be provided (where applicable), and meetings offered to residential neighbours in close proximity to construction works;
- Further information will be regularly provided to all residential neighbours with an update on the progress of the works, and the specific activities (including locations) due to be undertaken next. Updates will be provided every two or three months; and
- Prior to any particularly noisy processes identified in a construction noise management schedule is undertaken, the nearest affected residential neighbours will be contacted individually (where applicable). Neighbours will be informed of the proposed timing of the specific works and where practicable any times which are particularly sensitive for neighbours will be avoided.

7.5 Complaints

Any noise complaints that are received or issues relating to noise resulting from abnormal operations will be directed to the Site Manager.

The CEMP Manager will investigate the source of the complaint / abnormal activity and implement mitigation measures (if required) as soon as practicably possible.

The source and nature of the complaint including the mitigation measures implemented (if undertaken) will be documented in an incident register.

7.6 Selection and Use of Equipment

The table below lists the plant that could be deployed on site during the construction phase and therefore the information listed is for guide purposes only.

Estimated noise levels for each piece of equipment have been taken from library data in British Standard BS 5228:2009[6], as described in Table 7-1.

Table 7-1: Estimated noise levels for plant to be used

Equipment	Type	Estimated L_{Aeq} at 10m (dB)	Data reference
Excavator	20 ton	74	BS 5228:2009*, Table C.3-24
Excavator	15 ton	73	BS 5228:2009, Table C.2-24
Dump truck	10 ton	76	BS 5228:2009, Table C.4-5
Tractor and pipe trailer		79	BS 5228:2009, Table C.4-75
Mobile concrete mixer		61	BS 5228:2009, Table C.4-23
Hydraulic rock breaker		74	BS 5228:2009, Table C.1-8
Generator		66	BS 5228:2009, Table C.1-8
Concrete vibrator		69	BS 5228:2009, Table C.4-34

***** BS 5228-1:2009+A1:2014: Code of practice for noise and vibration control on construction and open sites.

7.7 Control Measures

All site works will be undertaken in such a way that best practice is followed at all times to minimise construction noise emissions. During construction works all necessary measures will be implemented as far as reasonably possible to reduce the potential for construction noise to be a nuisance to surrounding residential receptors.

The general control measures provided below shall be adhered to by contractors. These lists are not exhaustive and additional actions may be identified as a result of source-pathway-receptor reviews, future improvements in best practise techniques, etc. The performance target is no nuisance to surrounding residential properties as a result of construction noise.

Should the measures detailed below be inadequate to control construction noise emissions due to unforeseen circumstances on site, the CEMP Manager will liaise with the council to establish a suitable solution.

[6] BSI Standards Publication, 2009. BS 5228-1:2009+A1:2014: Code of practice for noise and vibration control on construction and open sites - Noise, London: BSI.

7.7.1 General site works

- Where possible, static items, such as generators, will be sited away from sensitive receptors, and where necessary, noise control means, such as barriers, enclosures, or silencers, will be utilised to further reduce noise;
- As far as is reasonably practicable, sources of significant noise will be enclosed. The extent to which this can be done depends on the nature of the machines to be enclosed and their ventilation requirements;
- Acoustic screening will be placed immediately around noisy plant or at strategic places, where appropriate, to provide a degree of noise attenuation during the construction activities where the noise level and proximity to sensitive receptors is likely to have a negative impact;
- Construction traffic will use specified routes when travelling to and from the site;
- Equipment will be regularly maintained in accordance with manufacturer's instructions by trained personnel;
- Drop heights to be minimised;
- Plant and equipment to be started-up sequentially rather than all together;
- Prevent unnecessary revving of engines;
- Switch off equipment when not required; and
- Regularly maintain site roads and repair "pot-holes" where necessary.

7.7.2 Dredging Operations

- The dredging would be scheduled such that backhoe dredging is not undertaken during the night in close proximity to the isle of Great Cumbrae. If that is not possible, the distance between backhoe dredging operations and the Quay wall would be reduced to either of the following:
    - 350 metres: The effects may be raised but are unlikely to be of importance in the decision-making process.
    - 125 metres: No effect, not significant, noise need not be considered as a determining factor in the decision-making process.
- Trailing suction hopper dredging may be employed at the northwestern extent of the dredge area, if needed, during both daytime and night-time;
- Selecting inherently quiet plant;
- Vessel crew will undergo site inductions and clear briefings covering procedures to be undertaken to minimise disturbance to marine fauna provided by appropriately qualified personnel;
- Existing acoustic controls on noise-generating equipment will be implemented to reduce noise at source;
- Where practical the practice of leaving engines, thrusters and auxiliary plant on standby or running mode will be avoided;
- Daily review of records and compliance will be undertaken (i.e. marine fauna observations undertaken, dredge logs etc.);
- A log of all visual observations of marine mammals will be maintained by the dredging contractor and available to CEMP Manager/Deputy on request.
- Incidents (including breaches of this management strategy or marine fauna procedure) to be reported immediately to the CEMP Manager/Deputy.

7.7.3 Plant and equipment

- Modern, silenced and well-maintained plant will be used at all times, conforming to standards;
- Excessively noisy plant shall be removed from site for repair or maintenance;

- Plant and equipment to be used for the works will be properly maintained, silenced where appropriate, and operated to prevent excessive noise;
- Construction contractor will include a requirement to meet the guidance in BS:5228 (Parts 1 and 2)[7];
- When operating plant, use noise-control equipment such as jackets on pneumatic drills, covers on compressors, shrouds on cranes. Manufacturers should be consulted about what is appropriate.
- Consider placing additional screening around the plant such as plywood screens;
- Equipment and vehicles to be shut down when not in use;
- Static construction plant (e.g., compressors) should be installed such that it is appropriately enclosed or screened unless the location can be shown not to require it;
- Semi-static equipment is to be sited and oriented as far as is reasonably practicable away from noise sensitive receptors and will have localised screening if deemed necessary;
- Items of plant operating on the site in intermittent use will be shut down in the intervening periods between use:
- Generators and water pumps required for 24-hour operation will be super silenced or screened as appropriate; and
- Where possible, mains electricity to be used instead of generators.

7.7.4 Construction

- Contractors shall control noise on the working areas in accordance with BS 5228: Noise Control on Construction and Open Sites.
- Site inspections shall include checks to ensure that plant is being operated with any specified acoustic covers in place.
- Quieter construction methods will be used, where required and where considered reasonable and feasible.
- The construction works will comply with BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites.
- All Contractors and Sub-contractors will be required to produce a ‘Register of Plant & Equipment and Statutory Certification’ within their ‘Health & Safety Method Statement’ which is reviewed prior to construction works commencing.
- Where reasonable and feasible, haulage routes will be located as far away as possible from residential receivers. Truck movements would be restricted to identified haulage routes. Where possible loading and unloading are to be undertaken away from residences.
- Equipment and excavation work sites should be oriented, where possible, to reduce noise emissions to sensitive receivers.
- The Principal Contractor shall aim to be a proactive and considerate neighbour; any potentially affected residents shall be approached in advance of any potential disturbance and kept informed of works progress. A noise complaint handling procedure will be established and responded to quickly. Where work is required outside of standard hours, the Principal Contractor should provide information such as total construction time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur, to affected residents, reasonably ahead of time.
- Monitoring will undertake when justified nuisance complaints have been identified at residential properties and when method statements indicate adverse (noise) effects due to construction work being undertaken within close proximity at occupied residential properties;

[7] BSI Standards Publication, 2009. *BS 5228-1:2009+A1:2014: Code of practice for noise and vibration control on construction and open sites - Noise,* London: BSI.

- Care to be taken when erecting or striking scaffolds to avoid impact noise from banging steel. All operatives undertaking such activities to be instructed on the importance of handling the scaffolds to reduce noise to a minimum;
- Drop heights of materials from lorries and other plant will be kept to a minimum;
- The use of barriers to absorb and/or deflect noise away from noise sensitive areas will be employed where required and reasonably practicable;
- Large concrete pours (for which an extension of working hours may be necessary) will commence as early as possible within normal working hours so that activities can be completed within normal working hours as far as possible.

7.7.5 Management of works programme

- The majority of deliveries to be programmed to arrive during normal working hours only;
- Routes and programming for the transport of construction materials, fill, personnel etc. are to be carefully considered in order to minimise the overall noise impact generated by these movements;
- Personnel will be instructed on measures to reduce noise and vibration as part of their site induction training; and
- Use of radios is to be prohibited except where two-way radios are required for reasons of safety and communication.

7.7.6 Construction Vibration

It is possible to employ a number of physical and operational measures to reduce the potential effects resulting from construction generated vibration. These may include:

- Adoption of low vibration working methods. Consideration should be given to use of the most suitable plant;
- Where processes could potentially give rise to significant levels of vibration, on-site vibration levels should be monitored regularly by a suitably qualified person; and
- The provision of cut-off trenches to interrupt the direct transmission path of vibrations.

8 SITE WASTE MANAGEMENT PLAN

The purpose of Site Waste Management is to ensure that waste generated during the dredging and construction phases will be managed and disposed of in a manner that ensures the provisions of environmental and waste legislation are complied with. It will also ensure that optimum levels of waste reduction, re-use and recycling are achieved.

There are a number of documents used to inform the Site Waste Management, including:

- Waste (Scotland) Regulations 2012[8]
- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites[9]
- Promoting the Sustainable Reuse of Greenfield Soils in Construction[10]

8.1.1 Objectives

- To take all reasonable steps to ensure that waste management controls are observed including Duty of Care;
- To minimise the amount of waste generated and maximise the amount of waste reused and recycled;
- To reuse as much waste as possible on-site. Where reuse on-site is not possible to identify the most appropriate waste management option in line with the waste hierarchy;
- To manage waste as close as possible to site location; and
- To provide training to improve awareness of waste management issues for all employees and contractors and to ensure correct waste management practices are followed on-site.

8.1.2 Waste Arising

Information relating to the precise volumes of waste materials that are likely to be generated is not currently available. There are, however, a number of tools that allow early-stage prediction of waste volumes. As a guide, prior to detailed calculations of the likely waste volumes, the BRE's Waste Benchmarking Data tool can be used to estimate the total volume of waste that will be generated from new build civil engineering projects based on building footprint.

8.1.3 Roles and Responsibilities

The CEMP Manager/Deputy is responsible for reviewing, revising and refining site waste management plan as necessary, to ensure roles and responsibilities are clear as the project progresses.

The CEMP Manager/Deputy shall ensure that waste documents are updated as work progresses and ensure all site personnel, including sub-contractors, understand and comply with the plan.

[8] Scottish Government, 2011. The Waste Management Licensing (Scotland) Regulations 2011. [Online] Available at: https://www.legislation.gov.uk/sdsi/2011/9780111012147/contents
[9] Department for Environment Food and Rural Affairs (DEFRA), 2009. Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, London: DEFRA.
[10] Scottish Environmental Protection Agency (SEPA), 2010. Promoting the sustainable reuse of greenfield soils in construction (Regulatory guidance), Edinburgh: SEPA.

Site Inspections will be carried out on a weekly basis and will incorporate inspection and monitoring of the requirements of site waste management.

The Principal Contractor will indicate how waste shall be managed on site and identify:

- The wastes, and their category, that will be generated by the project;
- Opportunities for reuse and / or recycling;
- Proposed methods of storage, segregation, handling and transportation of waste;
- Means of disposal including licensing requirements of carriers and destination sites;
- Recording of all waste movements from the site; and
- Reporting and monitoring process.

The responsibilities in relation to site waste management are set out below. The 'principal contractor' will be responsible for site waste management. Duties include but are not limited to:

- Ensuring waste is managed on site. This includes ensuring appropriate segregation of waste on-site, making arrangements for the removal of waste from the site etc.
- Ensuring all employees and contractors understand their duties in relation to site waste management. This includes organising appropriate training and giving toolbox talks.
- Ensuring that records and documents are maintained and retained.
- Ensuring compliance with Duty of Care and other relevant legislation.

The principal contractor is the point of contact for all employees, contractors and waste contractors in relation to site waste management and waste management issues. All persons working on site are responsible for adhering to the SWMP. This includes attending training as specified and following arrangements for the movement and segregation of waste on site.

8.1.4 Training and Awareness Raising

The CEMP Manager/Deputy will provide on-site briefing via induction, of appropriate separation, handling, recycling, re-use and return methods to be used by all parties and at appropriate stages of the Project where applicable. Toolbox talks will be carried out regularly on waste issues and all subcontractors will be expected to attend. This will ensure that everyone feels they are included and that their participation is meaningful.

8.1.5 Duty of Care

Section 34 of the Environmental Protection Act 1990 (as amended) places a legal duty of care on all those who produce, keep or manage controlled waste, including waste carrier and brokers. The act introduces a system of monitoring, control and recording of the management of waste en-route and at its destination. This duty has no limit and extends until the waste has either been finally disposed of or fully recovered.

The client has a Duty of Care to take all reasonable measures to:

1. Prevent the unauthorised or harmful disposal of your waste by another person by storing waste appropriately and use only licensed companies for removal off site.
2. Prevent the escape of the waste from your or any other person's control (even when it has been passed onto another party).
3. On the transfer of the waste ensure that:
    a. The transfer is to an authorised person or to a person for authorised transport purposes;

b. There is a written description of the waste, to enable other people to avoid the unauthorised or harmful disposal of the waste and to comply with their own Duty of Care. Use transfer notes to record each removal.

To comply with the Duty of Care, the following shall be undertaken:

- A log will be maintained of all materials that come onto the site, and details will be obtained from the waste disposal company of the exact amount of waste materials removed from site.
- Continually review the type of surplus materials being produced and change the site set up to maximise reuse or recycling.
- Application of the waste hierarchy to the management of waste and promote 'high quality' recycling.
- Present glass, metal, plastic, paper and card (including cardboard) for separate collection.
- Take steps to maintain the quality of dry recyclables presented for separate collection.
- Take care of the waste to prevent escape.
- Ensure waste is transferred to someone who is authorised to receive it, for example, a registered waste carrier or waste manager with the relevant authorisation.
- Complete a waste transfer note for any transfer of waste, including a full description of the waste, and retain a copy of this note for two years.
- Describe the waste accurately and provide information for the safe handling, transport, treatment, recovery or disposal by subsequent holders.
- Take reasonable measures to ensure that the waste does not cause pollution or harm to human health.
- Visit any waste transfer facility to ensure effective discharge of 'Duty of Care'

8.1.6 Professional Waste Collectors or Transporters

The Waste Management Licensing (Scotland) Regulations 2011[11] (as amended) introduced the need for all waste transporters (e.g., to a waste contractor, scrap metal merchant, recycler, local council or skip hire company) to be on the SEPA Register of Professional Collectors and Transporters of Waste. It is therefore important that CEMP Manager/Deputy audit registrations to ensure the waste recipient is suitably authorised to receive and manage the waste. This includes confirmation of the correct permits and licenses, as well as registrations.

8.1.7 Waste Transfer Notes

Waste shall only be transferred only to licensed waste disposal contractors.

A Waste Transfer Note (WTN) must be completed and signed by both the person handing over the waste and the person receiving it. The WTN must contain enough information about the waste for it to be handled safely and either recovered or disposed of legally. The WTN must include:

- A description of the waste.
- Any processes the waste has been through.
- How the waste is contained or packaged.
- The quantity of the waste.
- The place, date and time of transfer.
- The name and address of both parties.
- Details of the permit, licence or exemption of the person receiving the waste.

[11] Scottish Government, 2011. The Waste Management Licensing (Scotland) Regulations 2011. [Online] Available at: https://www.legislation.gov.uk/sdsi/2011/9780111012147/contents

- The appropriate European waste catalogue (EWC) code (SEPA: consolidated version of the EWC).
- The standard industry code (SIC) of the business.

8.1.8 Special Waste Consignment Notes

All movements of special waste must be accompanied by a Special Waste Consignment Note (SWCN) rather than a transfer note. This is required to comply with the Special Waste (Scotland) Regulations 1996 (as amended).

- Prior to the removal of special waste, a Special Waste Consignment Note and a special waste code is to be obtained from SEPA (this is usually done by the waste contractor). The SWCN must accompany the transport of special waste and replaces the need for a waste transfer note.
- Ensure the special waste has been described using the EWC 6-digit code.
- Part A and B of the SWCN must be completed for each load of special waste to be removed unless second/subsequent loads in a succession are dispatched (can be set up for a maximum of a year).
- The pre-notification copy of the consignment note is to be received by SEPA at least three days (no more than a month) prior to removal (usually arranged by the waste contractor). If the Agency has not responded, then the transfer is able to continue.
- When collected ensure the Carrier checks the load against the SWCN and any discrepancies are noted in Part C. Site Management must complete Part D and retain the Consignor (producer's) copy.
- At the disposal facility the waste disposer completes Part E. The completed SWCN is sent to the local SEPA office
- All special (hazardous) waste produced in Scotland must be consigned using a SEPA issued consignment note or code regardless of its final destination within the UK. Pre-notification to SEPA is required when removing waste from Scotland.

For further information refer to the SEPA Document 'A Guide to Consigning Special Waste' (Scottish Environment Protection Agency (SEPA), 2022). It covers the types of consignments (i.e., single, succession, carrier's round), multiple carriers, rejected loads and pre-notification charges.

8.1.9 Waste Identification, Storage and Handling

A dedicated area shall be laid out and labelled to facilitate the separation of materials for potential recycling, salvage, reuse and return. Recycling and waste bins are to be kept clean and clearly marked to avoid contamination of materials.

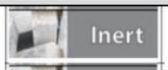
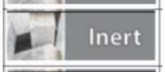
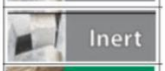
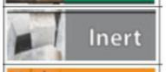
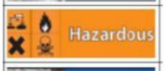
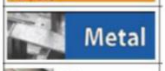
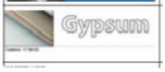
A site plan will be located in the site office highlighting the location of waste / recycling areas.

Basic principles for storing waste properly are:

- Store waste in areas isolated from surface drains, watercourses and settlement facilities.
- Segregating different types of waste as they are generated. It is illegal to mix special and non-hazardous waste.
- Mark waste containers clearly with their intended contents. Consider using colour coding.
- Use containers suitable for their contents. Check that containers are not corroded or worn out.
- Minimise the risk of accidental spillages or leaks.
- Special waste should be kept separate when mixing is likely to occur.

Recycling and waste receptacles are to be kept clean and clearly identifiable to avoid contamination of materials. The labelling systems shall be the Waste Awareness Colour Coding Scheme (Table 8-1).

Table 8-1: National Colour Coding System for Wastes

Waste Types e.g. bricks	Waste Category	European Waste Codes EWC	Colour Codes	Origin of Waste
Concrete	Inert	17 01 06*		Site Strip
Tarmac	Inert	17 03 01*		Site Strip
Brick/ Block	Inert	17 01 06		Site Strip
Timber		17 02 01		Construction
Subsoils	Inert	17 05 04		Site Strip
Subsoils	Hazard	17 05 03*		Site Strip
Metals	Non-hazardous	17 04 07		Construction
Plasterboard	Non-hazardous	17 08 02		Construction
Packaging		15 01 01 *see note 1* 15 01 02 *see note 2* 15 01 03 *see note 3*		
Construction	Mixed	17 09 04		Construction

Note 1 – 15 01 01 is the EWC code for paper & cardboard packaging
Note 2 – 15 01 02 is the EWC code for plastic packaging
Note 3 – 15 01 03 is the EWC code for wooden packaging
Note 4 – Table 8-1 does not include all construction waste likely on site.

All waste shall be separated into distinct waste streams for re-use, recycling, and disposal. Suitable, secure, clearly labelled containers indicating the type of waste to be disposed of shall be provided in a designated waste compound area, to be established prior to construction. Waste on site will be collected using mini skips and segregated into distinct waste streams using colour coded containers.

The colour scheme refers to labels that can be fitted to waste skips, indicating the types of waste that can be placed in them, thus helping with waste segregation, and reducing disposal costs. The generic colour scheme is as follows[12]:

- **White:** Gypsum – gypsum and plasterboard products (do not contaminate these materials with other substances as this will affect their recyclability.)
- **Grey:** Inert – clean concrete, rubble, hardcore, brick and block etc. that will not decompose or create a hazard when buried.
- **Black:** Mixed general waste – any waste except contaminated waste that cannot be recycled in other skips on the site.
- **Blue:** Metal – all types of clean metal, including rebar offcuts, scrap metal (no empty paint tins, as these are considered hazardous) etc.
- **Green:** Wood – all types of clean, untreated timber or wood products (treated timbers may contain hazardous preservatives.)
- **Brown**: Packaging – cardboard, paper products etc. (not polythene sheeting or ties, this should go in the "mixed" skip.)

[12] Considerate Constructors Scheme, 2017. *Best Practice Hub: Colour Coded Waste Skips.* [Online] Available at: https://ccsbestpractice.org.uk/entries/colour-coding-waste-skips/?search_term=Colour%20Coded%20Skips

- **Orange:** Hazardous – only for contaminated waste such as asbestos, paint tins, mastic tubes, tarmac, or any product fitted with a COSHH label etc.

The colour scheme system will assist contractors comply with waste legislation, reduce cost, and enable recycling where possible.

8.1.10 Inert and Non-Hazardous Materials – Storage and Segregation

Inert materials and waste will be stored within the site compound with the provision for small temporary storage of materials across the wider development site dependent on working needs.

The materials storage area within the main compound will be split into two main designated areas; for the delivery and storage of new materials; and for the storage and collection of waste materials. Further segregation of materials within both designated areas will be carried out to prevent cross-contamination.

8.1.11 Hazardous Materials and Special Waste – Oil Storage

All oil, fuel and chemical storage, chemical mixing, fuel deliveries, re-fuelling operations and machinery maintenance tasks will be confined to the main construction compound.

Any diesel, petrol and lubricating oils required during this phase shall be stored in double bunded tanks (bunded to 110% capacity) within the construction compound. Waste oils and oily rags will be stored in appropriate sealed containers in a secure bunded area and will be collected by an authorised contractor for recovery and/or disposal.

8.1.12 Hazardous Materials and Special Waste – Liquid Waste

Any run-off from the bunded storage area within the construction compound, and wastewater from machinery wash down will drain to foul sewer or to an appropriate water treatment and recycling system, either a combination of an oil/water separate and a dedicated reed bed or a mechanised cleansing unit.

8.1.13 Fires

No burning of waste materials shall be permitted on site.

8.1.14 Waste Management Monitoring

The Site Management Team must ensure that legislatively required waste management documentation is either reviewed and / or verified so as to assure regulatory compliance by:

- Confirming that the waste carrier and broker is registered to remove the waste via accessing the Scottish Environment Protection Agency's public register database[13]. This list of carriers registered with SEPA is NOT meant to provide the public register of carriers of controlled waste as required by regulation 3 of the 1991 regulations. It is placed on the site to enable interested parties to carry out simple checks at any time to establish whether a

[13] Scottish Environmental Protection Agency (SEPA), 2022. Register of Waste Carrier and Brokers. [Online] Available at: https://www2.sepa.org.uk/wastecarriers

company/partnership or individual is registered. To confirm whether a registration is in place for a Professional Collector and Transporter of Waste contact the SCC on 03000 99 66 99.

- Checking with the waste carrier where the waste is to be taken and making sure that the destination is authorised to receive it i.e., obtaining a full copy of the waste management licence or exemption.

APPENDICES

A MARINE MAMMAL PROTECTION PLAN

Hunterston Construction Yard
Marine Mammal Risk Assessment

May 2024

CONTROL SHEET

Client: Peel Ports Group
Project Title: Hunterston Construction Yard
Report Title: Marine Mammal Risk Assessment
Document number: 13934
Project number: 176482

Issue Record

Issue	Status	Author	Reviewer	Approver	Issue Date
1	FINAL	JEP	MM	GD	10/05/2024
2					

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EXECUTIVE SUMMARY

EnviroCentre Limited was commissioned by Arch Henderson on behalf of Clydeport Operations Ltd., to undertake a Marine Mammal Risk Assessment (MMRA) to inform a European Protected Species (EPS) License Application in relation to the upgrade of the existing Hunterston Construction Yard (HCY) into a harbour facility with a large working platform suitable for renewable industries.

The most frequently observed species, and therefore the species considered to be of most concern within the zone of influence of the development, are harbour porpoise, Atlantic white-sided dolphin, bottlenose dolphin, short-beaked common dolphin, long-finned pilot whale, minke whale, fin whale and killer whale.

Underwater noise modelling was commissioned as part of this assessment based on activities that would have direct continuity with the water environment.

Dredging has a low impact on all marine mammals, with risks of <10 m for Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) for 1 second exposure (instantaneous risk) of continuous noise, with the exception of harbour porpoises where the risk of TTS is 100 m. With no soft start, the PTS risks to marine mammals are <10 m and $\leq$ 200 m, with the exception of harbour porpoises with risks of 100 PTS and 1800 TTS.

With respect to impact piling for mooring dolphin construction PTS risk ranges for minimal starting range for a fleeing animal with no soft start for the very high frequency cetaceans (VHF) hearing group are up to 5.4 km meaning that a VHF group animal (harbour porpoise) would likely need to be >5.4 km away before the activity commences to avoid exceeding the PTS threshold. For the low frequency cetaceans (LF) hearing group (minke whale) the PTS ranges for the impact piling are up to 1.9 km.

The high frequency cetaceans (HF) hearing group (bottlenose dolphin and white-beaked dolphin) has PTS ranges up to 200 m for impact piling. TTS ranges from 1800-7600 during this time. Where a 50 minute -25 dB soft start paired with a 1000 m exclusion zone is implemented PTS is $\leq$ 60 and TTS is $\leq$ 80 or less for LF, HF and VHF groups.

The development will result in increases in vessel movement in and out of the dock during and post-construction. 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.

The proposed developments to be considered for cumulative impacts are all on land, or for the three identified marine/coastal projects are of a scale and distance from the development site these projects would likely have no cumulative impacts to the Hunterston project in relation to marine mammals.

It has been assessed that the works will incur **temporary disturbance** from underwater noise associated with the **dredging**. The noise is not predicted to cause long term negative effects on the local populations of the aforementioned species due to its short duration and adherence to a detailed Marine Mammal Mitigation Plan (MMMP).

A Marine Mammal Observer (MMO) protocol for dredging and piling, which a mitigation exclusion zone of 1000m should be adopted. In addition impact piling should adopt a soft start protocol.

If the mitigation in section 4 and 5 is employed effectively, it is predicted that there will be no risk of injury, The risk of disturbance is greater than that of injury, with TTS (disturbance) occurring over a much wider area than PTS (injury). **Therefore an EPS licence will be required for potential disturbance from dredging and piling.**

Contents

Appendices

1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Limited was commissioned by Arch Henderson on behalf of Clydeport Operations Ltd., to undertake a Marine Mammal Risk Assessment (MMRA) to inform a European Protected Species (EPS) License Application in relation to the upgrade of the existing Hunterston Construction Yard (HCY) into a harbour facility with a large working platform suitable for renewable industries.

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 Scotland 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

Clydeport Operations Ltd. are currently considering the options for developing Hunterston PARC including the HCY to support the long-term sustainable development of various industrial users and specifically future use will be targeted towards providing a facility that supports the offshore wind industry for activities potentially including gravity-based structure construction, jacket construction, turbine assembly, and associated activities including the storage of components.

As part of this optioneering the Company has identified that the modification of the HCY through demolition and infilling of the existing dry dock and provision of a new quay on the western side of the site would provide a facility suited primarily for the renewables sector and specifically the offshore wind industry. Please note: the development description may evolve as the engineering design progresses.

In general, the new works will entail:

- Demolition of existing structures including removal of the base of the former dry dock
- Infilling of the dry dock to form a working platform;
- Formation of 570m quay wall 500mm back from MHWS i.e. in the terrestrial environment;
- Erection of port infrastructure including lighting columns, substations, drainage, security fencing, access gates and CCTV; and
- Erection of temporary site offices and staff welfare buildings to accommodate site workforce
- Formation of a temporary working platform overwater;
- Removal of the existing rock armour on the western boundary;
  Removal of the existing bund on the western boundary;
- Installation of sub-surface revetments for the new quay wall;
- Capital Dredging to a depth of -12m CD;

- Disposal of dredging spoil to a licensed marine spoil disposal site;
- Construction of mooring dolphins,
- Installation of grounding pad;
- Installation of fenders and other quay wall infrastructure i.e. drainage outfalls; and
- Installation of navigational aids.

The area of the construction works is approximately 40 hectares which includes the dry dock working area, access road and contractor compound.

1.4 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.

Whilst the Client has a right to use the information as appropriate, EnviroCentre Limited retains ownership of the copyright and intellectual content of this report. Any distribution of this report should be managed to avoid compromising the validity of the information or legal responsibilities held by both the Client and EnviroCentre Limited (including those of third party copyright). EnviroCentre Limited does not accept liability to any third party for the contents of this report unless written agreement is secured in advance, stating the intended use of the information.

EnviroCentre Limited accepts no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre Limited has confirmed it is appropriate for the new context.

2 MARINE MAMMAL BASELINE

2.1 Desk Study

In order to anticipate the potential marine mammal ecological sensitivities at the site, a desk study was conducted. The following sources were checked:

- The Joint Nature Conservation Committee (JNCC)[1] to determine distributions of marine mammals;
- NBN Atlas[2] for commercially available records of marine mammals within 20km from the site;
- Sea Watch Foundation (SWF)[3 & 4] for sightings of marine mammals;
- Hebridean Whale and Dolphin Trust (HWDT)[5] for records of marine mammals up to 20km from the site;
- Scottish Marine Animal Stranding Scheme (SMASS)[6] for records of marine strandings up to 20km from the site;
- Whale and Dolphin Conservation (WDC)[7] for diet information of marine mammals;
- Records from South West Scotland Environmental Information Centre (SWSEIC)[8]; and
- Marine Scotland (MS) Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters [9] and appendices[10].

2.1.1 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] Reid, J B, Evans, P G H, and Northridge, S P. JNCC Atlas of Cetacean Distribution in north-west European waters (2003) available at: http://jncc.defra.gov.uk/page-2713#download last accessed 19/10/2023
[2] NBN Atlas for records of marine mammals and fish, available at: https://scotland-records.nbnatlas.org/explore/your-area#55.7368|-4.8886|13|ALL_SPECIES last accessed 23/10/2023
[3] Sea Watch Foundation Cetaceans of Western Scotland available at: https://seawatchfoundation.org.uk/wp-content/uploads/2012/07/WesternScotland.pdf last accessed 19/10/2023
[4] Sea Watch Foundation Recent Sightings South West Scotland and Inner Hebrides available at: https://www.seawatchfoundation.org.uk/recentsightings/ last accessed 19/10/2023
[5] HWDT whale and dolphin sightings map, available at: https://whaletrack.hwdt.org/sightings-map/ last accessed 31/10/2023
[6] Species reported within a 10km (sea route) to Scottish Marine Animal Stranding Scheme (SMASS) available at: https://strandings.org/map/ last accessed 19/10/2023
[7] WDC species guides available at: https://uk.whales.org/whales-dolphins/species-guide/ last accessed 19/10/2023
[8] South West Scotland Environmental Information Centre available at: https://swseic.org.uk/
[9] 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
[10] Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters: Appendix 3 - SCANS surveys 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%20-%20Appendix%203%20SCANS%20surveys%20%281%29.pdf

2.2 Designated Sites

A search for designated sites was undertaken via the NatureScot (NS) Sitelink[11] website. The Hunterston site does not lie within any statutory designated sites relating to marine EPS (Marine Protected Areas (MPA), Special Areas of Conservations (SAC) or Sites of Special Scientific Interest (SSSI)).

Please see Appendix B: Designated Sites Boundaries.

2.3 Cetaceans

The cetacean fauna (whales, dolphins and porpoises) of western Scotland (including the Western Isles, West Highlands and South-west Scotland) is considered the richest in the UK and one of the most important areas in northwest Europe for cetaceans. Twenty one species of cetacean have been recorded, since 1980, within 60 km of the west coast of Scotland. Eleven of the twenty one species are thought to be either present throughout the year or at least recorded annually as seasonal visitors, which include fin whale (*Balaenoptera physalus*), minke whale (*Balaenoptera acutorostrata*), sperm whale (*Physeter macrocephalus*), long-fined pilot whale (*Globicephala melas*), killer whale (*Orcinus orca*), Risso's dolphin (*Grampus griseus*), white-beaked dolphin (*Lagenorhynchus albirostris*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), short-beaked common dolphin (*Delphinus delphis*), bottlenose and harbour porpoise (*Phocoena phocoena*). However, sighting hotspots tend to be from Calliach Point (approximately 250km north of the site (via the shortest path avoiding land masses)) spanning northwards, or from Corsewall Point (approximately 80km south of the site (via the shortest path avoiding land masses)) spanning southwards.

Harbour Porpoise
The harbour porpoise is widely distributed throughout the western region and is common in nearshore waters, especially along the West Highland coast. They are a Priority marine feature (PMF)[12] and European Protected Species (EPS). Harbour porpoise are predominantly confined to shelf waters, although sightings have occurred in deep water and locally high densities of porpoises off the west coast of Scotland have been recorded. Peak numbers and frequency of harbour porpoise sightings generally occur between July and October, when singles or family groups of 2-3 may form aggregations numbering 10- 100 individuals.

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*)[13].

No live sightings of harbour porpoise have been recorded within the development area. 34 records of harbour porpoise have been submitted to SWF in 2023 from south west Scotland and Inner Hebrides consisting of 66 individuals, the closest of which being approximately 20km north west of the development site, offshore of Rothesay Bay in Argyll and Bute May. HWDT have recorded 458 sightings of harbour porpoise within a 20km radius (shortest distance via water) between 2017-2023, with the nearest recorded 2km north west of the site. SMASS have recorded 99 records of harbour porpoise strandings between 1994-2022, with two records associated with the Hunterston site.

[11] NatureScot Site Link available at: https://sitelink.nature.scot/map last accessed 10/01/2024
[12] NatureScot Priority Marine Features in Scotland's Sea's List, available at: https://www.nature.scot/doc/priority-marine-features-scotlands-seas-habitats, last accessed 09/01/2023
[13] SWF, harbour Porpoise fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Harbour-Porpoise.pdf

SWSEIC have recorded 23 records of harbour porpoise between 2004-2020 within a 2km radius of the site. Figure 2-1 shows UK harbour porpoise sightings during the SCANS-III surveys.

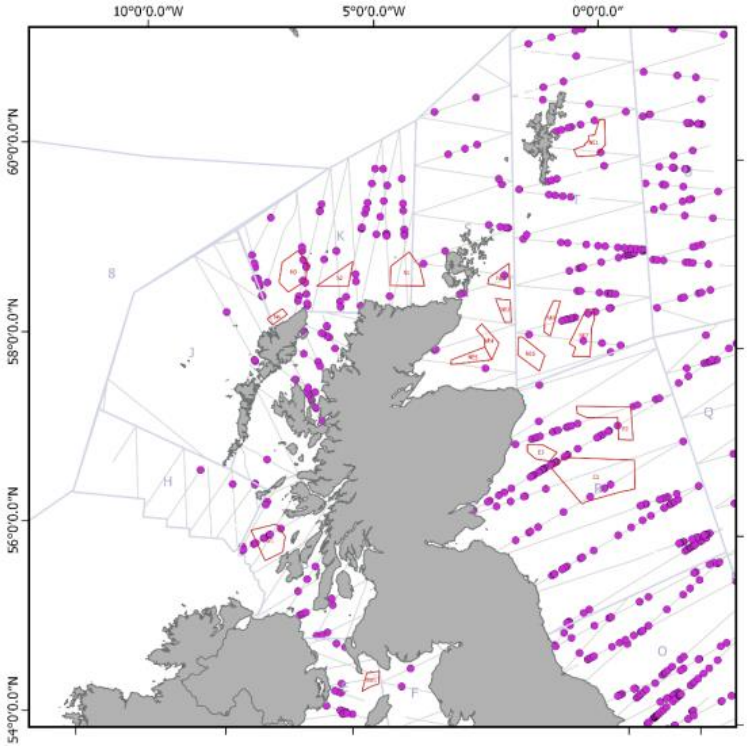


Figure 2-1: Sightings of harbour porpoise seen during the SCANS-III surveys (1994-2016)

Risso's Dolphin

Risso's dolphin are PMFs and EPS and 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. Most sightings of Risso's dolphins are from western Scotland (with the Outer Hebrides being the dominant area). Sightings on the west coast of Scotland occur generally between April and September, with numbers peaking in August and September.

Risso's dolphin predominantly eat cephalopods, specifically octopus (*Octopoda*), cuttlefish (*Sepiida*) and various small squid (*Decapodiformes)*, but will occasionally eat small fish, including cod[14].

No sightings of Risso's dolphin have been recorded within the development area. No records of Risso's dolphin have been submitted to SWF in 2023, HWDT between 2017 – 2023 and SMASS, within 20km of the site. Figure 2-2 shows UK Risso' dolphin sightings during the SCANS-III surveys, with the Hunterston site and surrounding are lacking sightings.

[14] SWF, Risso's dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/10/Rissos-Dolphin.pdf

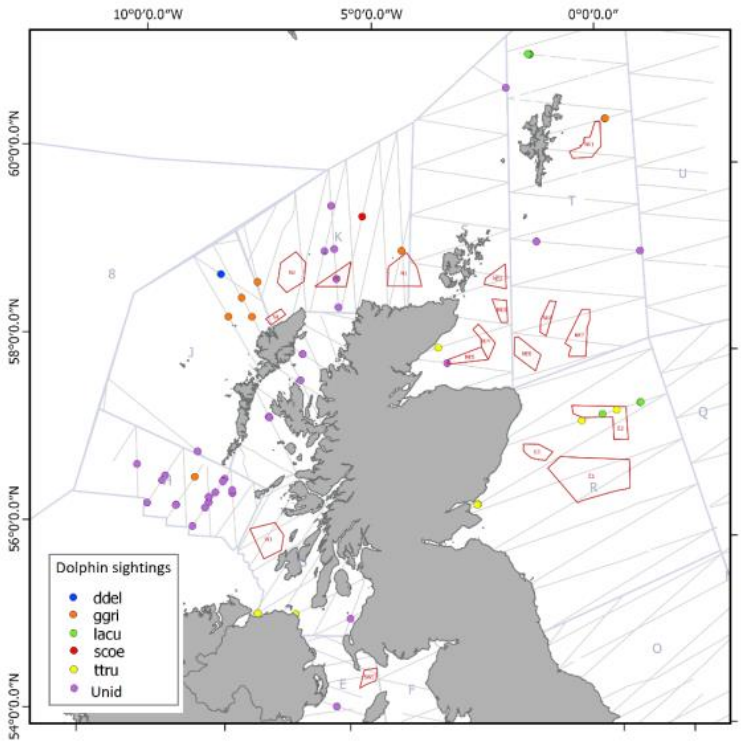


Figure 2-2: Sightings of Risso's dolphin (ggri) seen during the SCANS-III surveys (1994-2016)

Minke Whale

Minke whale are widely distributed in relatively small numbers, usually observed singly or in pairs. They are PMFs and EPS. Minke whale 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. Although minke whale occur year-round, peak numbers and frequency of sightings occur between July 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 villosus*), cod, whiting, haddock (*Melanogrammus aeglefinus*), but will also take euphausiids and copepods, especially at higher latitudes[15].

No sightings of minke whale have been recorded within the development area. 22 records of minke whale have been submitted to SWF in 2023 from south west Scotland and Inner Hebrides consisting of 20 individuals, the closest of which being approximately 21km south west of the development site, offshore of Brodick bay, Arran. HWDT have recorded 20 sightings of minke whale within a 20km radius (shortest distance via water) between 2017-2023, with the nearest recorded 1.4km north of the site. SMASS have recorded 6 records of minke whale strandings between 1993-2016, with the nearest recorded 6km north west of the Hunterston site. Figure 2-3 shows UK minke whale sightings during the SCANS-III surveys.

[15] SWF, minke whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Minke-Whale.pdf

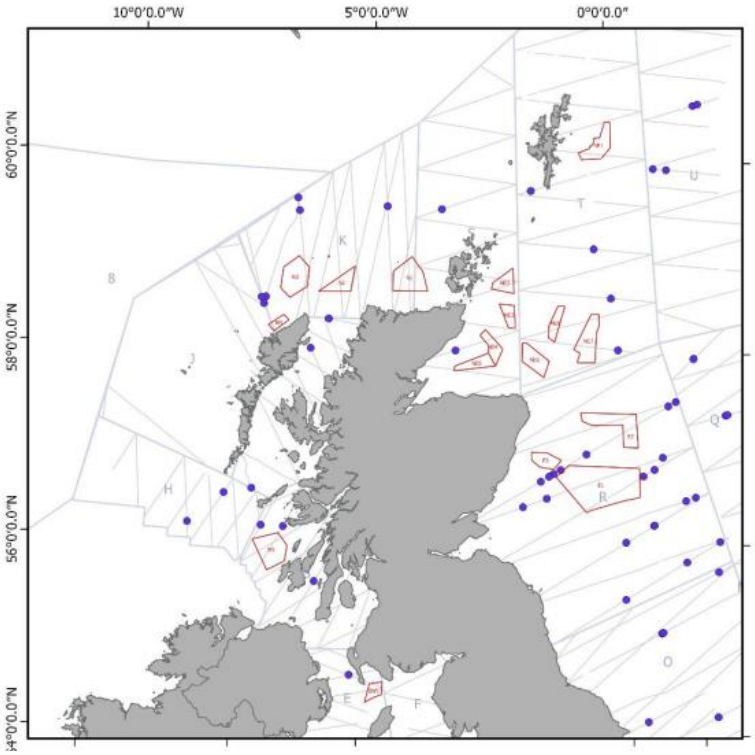


Figure 2-3: Sightings of minke whale seen during the SCANS-III surveys (1994-2016)

Fin Whale

Fin whale are distributed predominantly along or beyond 500m and are PMFs and EPS. Fin whales tend to favour areas with high topographic variation such as underwater sills or ledges with high zooplankton concentrations. Fin whale can be sighted occasionally off South-west Scotland, predominantly of single individuals or small groups of 2-3 animals, as they are a non-social species. Most sightings associated with the West of Scotland occur May to August.

The 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[16].

No sightings of fin whale have been recorded within the development area. Three records of fin whale have been submitted to SWF in 2023 from south west Scotland and Inner Hebrides consisting of four individuals, the closest of which being approximately 240km north west of the development site, offshore of Mull. No records of fin whale were reported to HWDT within a 20km radius (shortest distance via water) between 2017-2023 and no records of fin whale strandings have been reported to SMASS within a 20km radius of the development site. Figure 2-4 shows UK fin whale sightings during the SCANS-III surveys.

[16] SWF, humpback whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Fin-Whale.pdf

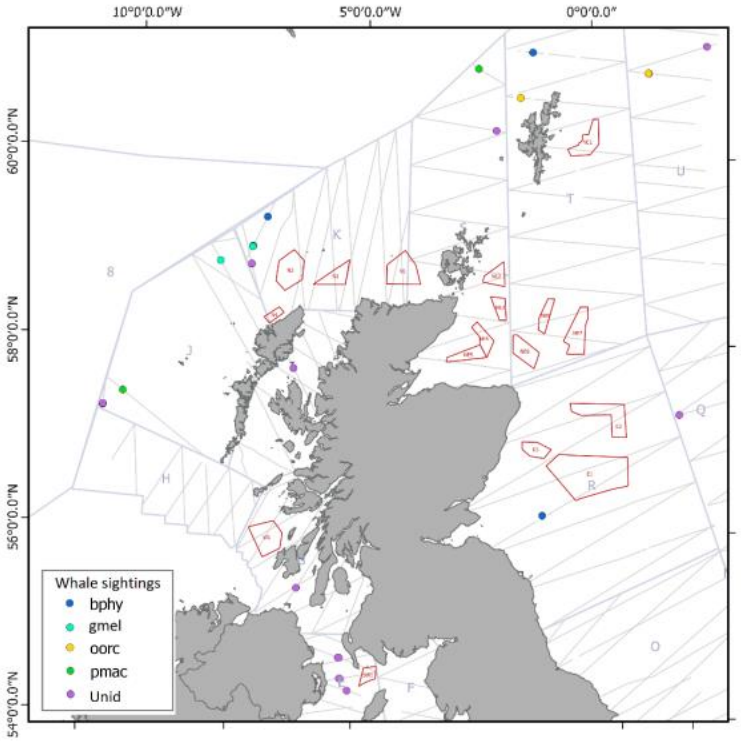


Figure 2-4: Sightings of fin whale (bphy) seen during the SCANS-III surveys (1994-2016)

Long-finned Pilot Whale

Long-finned pilot whale are PMFs and EPS and 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. Sightings of 10-50 individuals are sometimes seen nearshore, where occasional mass strandings have occurred, with larger pods (tens to hundreds) being seen in deeper waters. Sighting in the west of Scotland generally peak between April and September.

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 [17].

No sightings of fin whale have been recorded within the development area. No records of long-finned pilot whale have been submitted to SWF in 2023 from south west Scotland and Inner Hebrides or HWDT within a 20km radius (shortest distance via water) between 2017-2023. One long-finned pilot whale stranding was reported to SMASS within a 20km radius of the development site in 2021, located approximately 18km south offshore of Saltcoats. Figure 2-5 shows UK long-finned pilot whale sightings during the SCANS-III surveys.

[17] 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

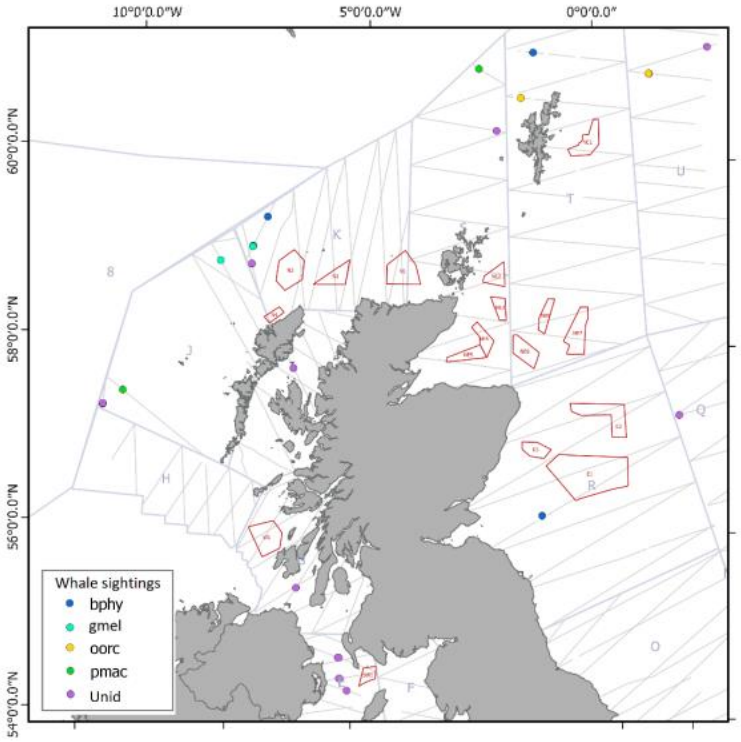


Figure 2-5: Sightings of pilot whale (gmel) seen during the SCANS-III surveys (1994-2016)

Sperm Whale

Sperm whale are uncommon throughout the west coast of Scotland but have been sighted in deep waters west of the continental shelf edge. Male sperm whales occur mainly in waters deeper than 200m, such as beyond the shelf break west of Scotland, but they have also been observed in near-shore waters mainly off the Northern Isles of Scotland. The species can sometimes be seen in nearshore waters where mass strandings have occasionally occurred. There is no apparent seasonal pattern of occurrence, however sperm whale have been recorded mainly 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[18].

No sightings of sperm whale have been recorded within the development area. No records of sperm whale have been submitted to SWF, HWDT or SMASS within a 20km radius (shortest distance via water) of the development site. Figure 2-6 shows UK sperm whale sightings during the SCANS-III surveys.

[18] SWF, Atlantic white-sided dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Sperm-Whale.pdf

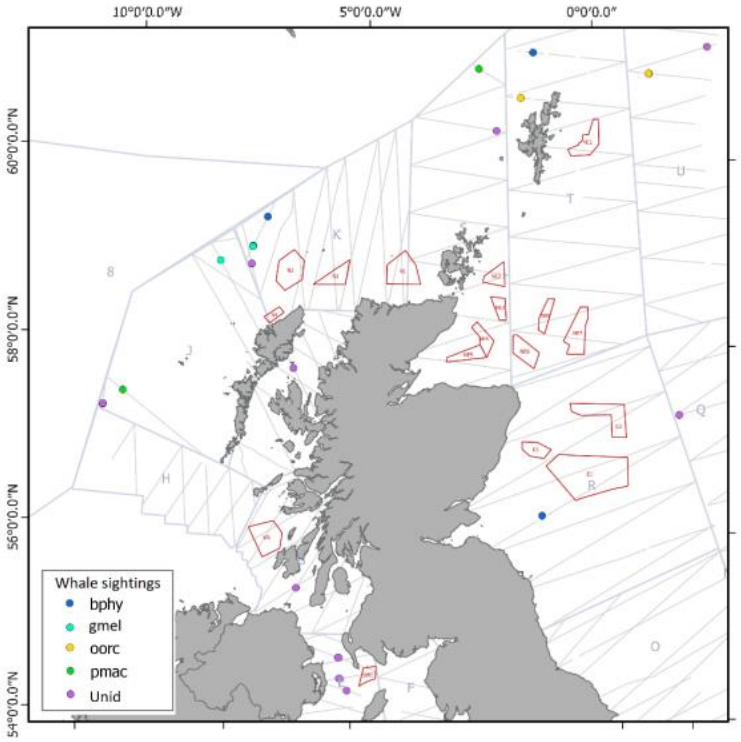


Figure 2-6: Sightings of sperm whale (pmac) seen during the SCANS-III surveys (1994-2016)

Killer Whale

Although killer whales are uncommon, they are widely distributed in the west of Scotland and are PMFs and EPS. In UK waters, killer whales occur in all months of the year, however records have mainly been recorded in coastal waters between April and October singly or in groups numbering up to 14 individuals, with peak number of records occurring between June and October.

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[19].

No sightings of killer whale have been recorded within the development area. One record of killer whale have been submitted to SWF in 2023 from south west Scotland and Inner Hebrides consisting of two individuals, being approximately 23km south of the development site, offshore of Irvine. Two records of killer whale were reported to HWDT within a 20km radius (shortest distance via water) between 2017-2023. No records of killer whale strandings were reported to SMASS within a 20km radius of the development. Figure 2-7 shows UK long-finned pilot whale sightings during the SCANS-III surveys.

[19] SWF, killer whale fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2021/03/Killer-Whale.pdf

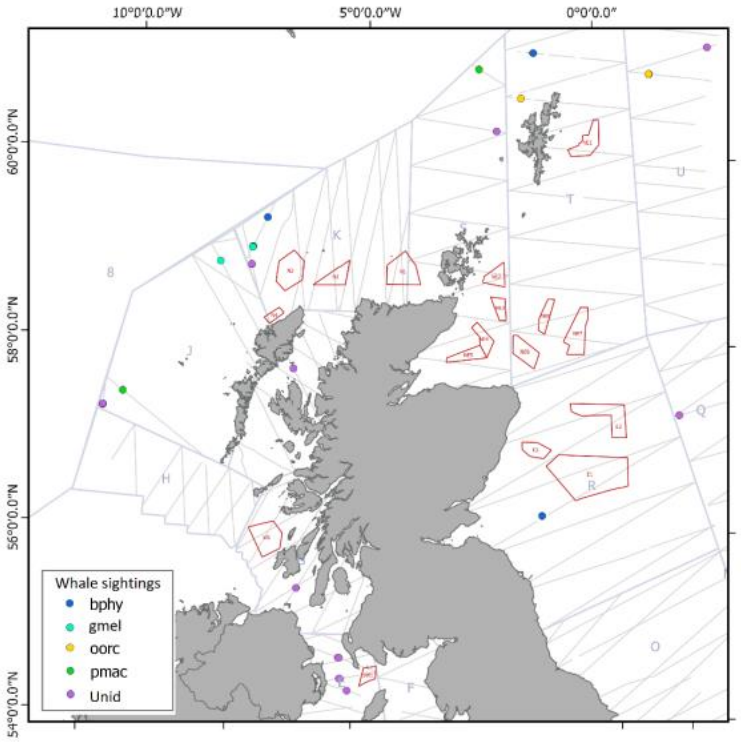


Figure 2-7: Sightings of killer whale (oorc) seen during the SCANS-III surveys (1994-2016)

White-beaked Dolphin

White-beaked dolphin are widely distributed but most frequently observed around the Outer Hebrides west to St. Kilda, east to the North Minch, in the Little Minch, and the southern and western ends of the Sea of the Hebrides. White-beaked dolphin and are PMFs and EPS. Group size varies between 10-100 individuals. Peak numbers are recorded between July and September, with most sightings occurring nearshore.

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[20].

No sightings of white-beaked dolphin have been recorded within the development area. No records of white-beaked dolphin have been submitted to SWF, HWDT or SMASS within a 20km radius (shortest distance via water) of the development site. Figure 2-8 shows UK white-beaked dolphin sightings during the SCANS-III surveys.

[20] SWF, white-beaked dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/White-beaked-Dolphin.pdf

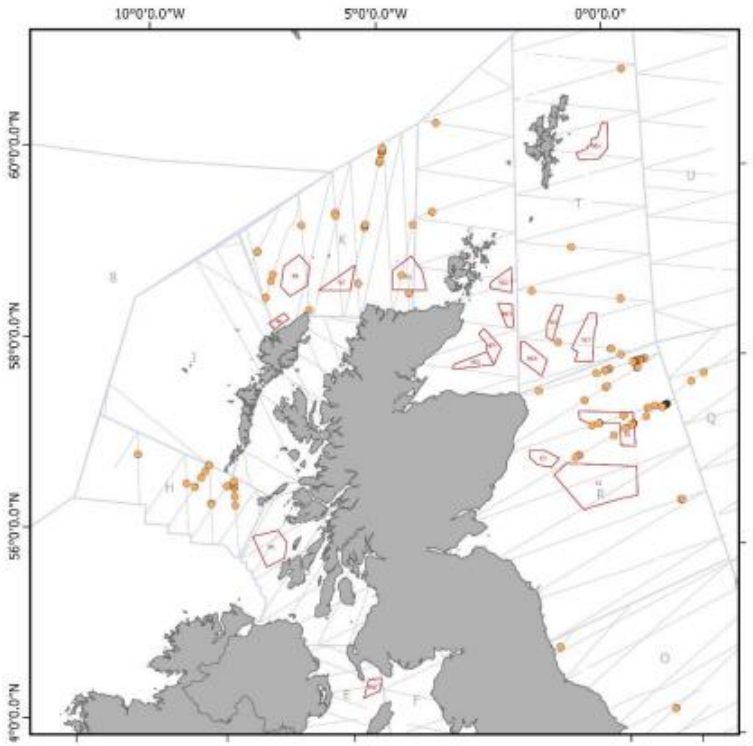


Figure 2-8: Sightings of white-beaked dolphin seen during the SCANS-III surveys (1994-2016)

Atlantic White-sided Dolphin

Atlantic white-sided dolphin are predominantly distributed north west of Britain and found in deep waters mainly along the northern end of the North Minch, the southern end of the Sea of the Hebrides, and along the shelf edge north and west of the Outer Hebrides. Atlantic white-sided dolphin are PMFs and EPS. Group sizes are often large (100-1,000 individuals), with peak numbers and frequency of sightings in the west of Scotland occurring between July and 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*)[21].

No sightings of Atlantic white-sided dolphin have been recorded within the development area. Three records of Atlantic white-sided dolphin have been submitted to SWF in 2023 from south west Scotland and Inner Hebrides consisting of 21 individuals, the closest of which being approximately 240km north west of the development site, offshore of Mull. No records of Atlantic white-sided dolphin were reported to HWDT between 2017-2023 or SMASS within a 20km radius (shortest distance via water). of the development. Figure 2-9 shows UK white-beaked dolphin sightings during the SCANS-III surveys.

[21] 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

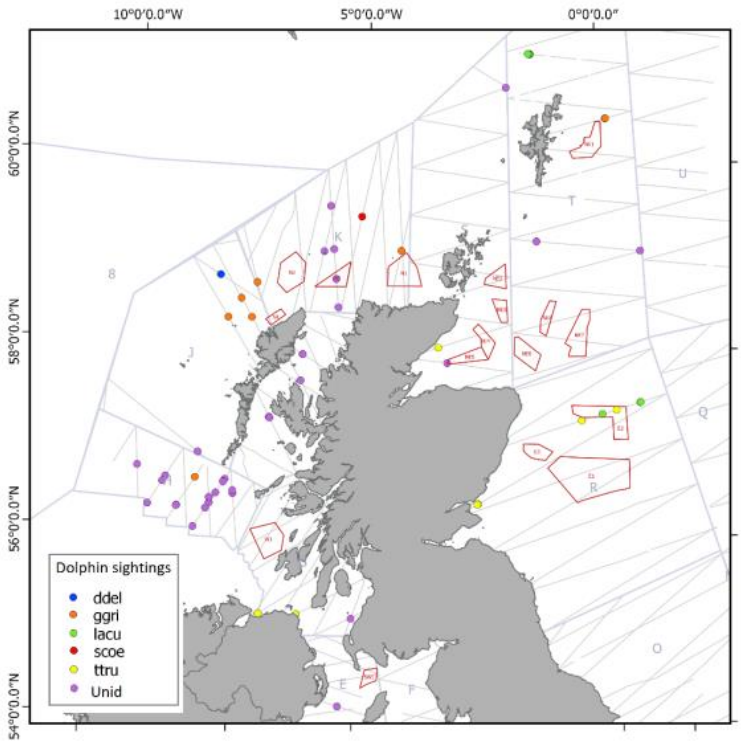


Figure 2-9: Sightings of Atlantic white-sided dolphin (lacu) seen during the SCANS-III surveys (1994-2016)

Short-beaked Common Dolphin

Short-beaked common dolphin are not strongly associated with nearshore waters, instead being considered an offshore species, however, sightings off southwest Scotland north to the Isle of Skye are common year round. Peak number of sightings occur between May and early July, declining sharply from August onwards, with groups of 5-20 individuals usually observed (larger groups of up to 500 individuals have been recorded). Short-beaked common dolphin are PMFs.

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[22].

No sightings of short-beaked common dolphin have been recorded within the development area. 22 records of short-beaked common dolphin have been submitted to SWF in 2023 from south west Scotland and Inner Hebrides consisting of 437 individuals, with the nearest record located within in the Firth of Clyde (no exact location provided) which the site extends into. 31 records of short-beaked common dolphin were reported to HWDT within a 20km radius (shortest distance via water) between 2017-2023. Two short-beaked common dolphin strandings were reported to SMASS within a 20km radius of the development site in 2001 and 2013, with the nearest located approximately 16km south offshore of Saltcoats. SWSEIC returned 11 records of short-beaked common dolphin between 2010-2019 within a 2km radius of the site. Figure 2-10 shows UK short-beaked common dolphin sightings during the SCANS-III surveys.

[22] SWF, short-beaked common dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Common-Dolphin.pdf

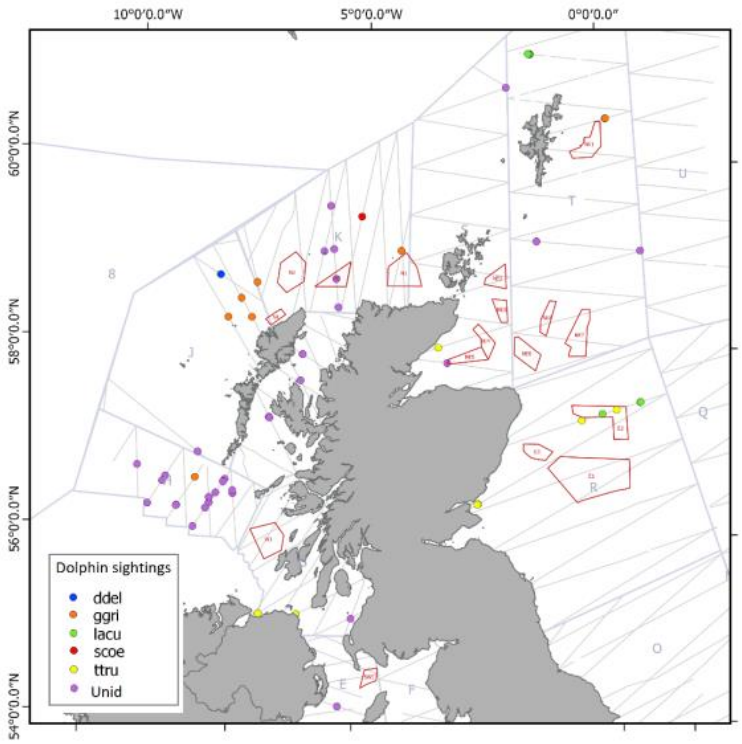


Figure 2-10: Sightings of short-beaked common dolphin (Ddel) seen during the SCANS-III surveys (1994-2016)

Bottlenose Dolphin

Bottlenose dolphin are uncommon throughout the year along the west coast of Scotland, although small resident or semi-resident communities numbering 5-20 individuals occur in a few scattered localities (e.g. Barra, Islay, Mull, and the Sound of Sleat). Bottlenose dolphin are observed in the greatest numbers in coastal waters between April and September.

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[23].

No sightings of bottlenose dolphin have been recorded within the development area. 11 records of bottlenose dolphin have been submitted to SWF in 2023 from southwest Scotland and Inner Hebrides consisting of 74 individuals, with the nearest located approximately 218km northwest offshore of Ardalanish, Isle of Mull. 86 records of bottlenose dolphin were reported to HWDT within a 20km radius (shortest distance via water) between 2017-2023. No bottlenose dolphin strandings were reported to SMASS within a 20km radius of the development site. SWSEIC have recorded two records of bottlenose dolphin between 201-2022 within a 2km radius of the site. Figure 2-11 shows UK bottlenose dolphin sightings during the SCANS-III surveys.

[23] SWF, bottlenose dolphin fact sheet (2020), available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Bottlenose-Dolphin.pdf

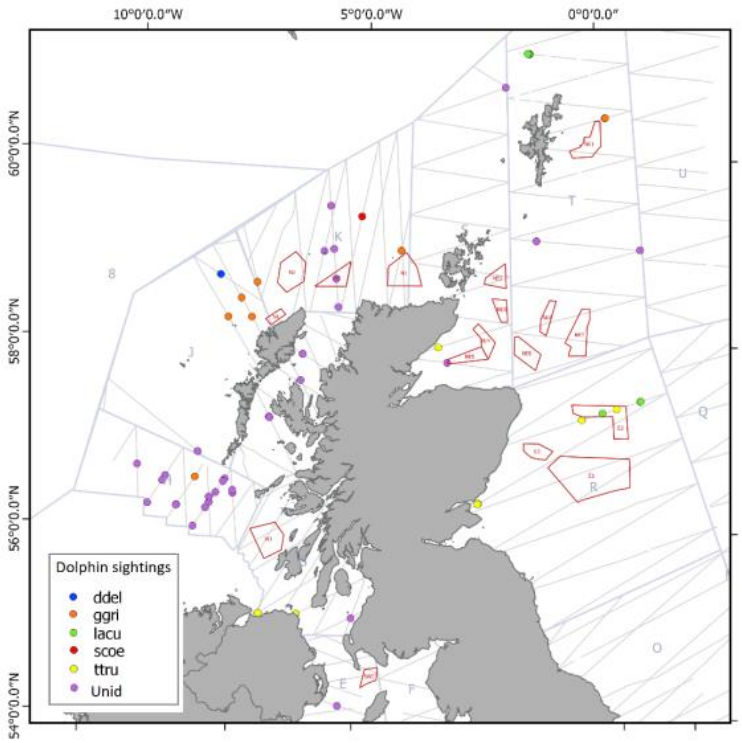


Figure 2-11: Sightings of bottlenose dolphin (ttru) seen during the SCANS-III surveys (1994-2016)

Other Cetaceans

Other rare cetacean species recorded around the west coast of Scotland since 1980 include blue whale, sei whale, humpback whale, Northern right whale (*Eubalaena glacialis*), Sowerby's beaked whale (PMF), Cuvier's beaked whale, Northern bottlenose whale (PMF), Beluga, striped dolphin and Fraser's dolphin. In general, the conditions off Hunterston do not tend to suit the requirements of the majority of these species and no recent records of these species within a 20km radius (shortest distance via water) were returned from SWF or HWDC. The nearest record for these rare species was of an individual humpback whale approximately 21km north west offshore of Ardmaleish point in Bute reported to SWF in 2023, with other species recorded at greater distances from the site (>100km).

2.4 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 Hunterston expansion development are:

- Harbour porpoise
- Bottlenose dolphin
- Minke whale
- Killer whale

The other species are less frequently observed within the waters of the West of Scotland 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.

3 MARINE MAMMAL RISK ASSESSMENT

3.1 Activities Affecting Marine Mammals

The Marine Scotland 'Guidance for Scottish Inshore Waters: The Protection of Marine European Protected Species from Injury and Disturbance'[24] 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.

3.1.1 Underwater Noise Producing Activities

The main risk to marine EPS from the proposed development is considered to be the generation of underwater noise which can cause injury, disturbance or, in extreme circumstances, death to individuals. Activities which will introduce underwater noise into the marine environment include dredging.

Underwater noise modelling was commissioned as part of this assessment and was appraised to inform this document. Please refer Appendix C for the RPS: 'Hunterston Construction Yard, Subsea Noise Technical Report' which details the methods and findings of the underwater noise modelling.

It is noted that as the project design progressed the piling design for the site has been altered. The proposed piling schedule now does not include piling for the quay wall in or directly adjacent to the water environment with all piling being carried out within the terrestrial land. Material would then be excavated away from in front of the new piled wall on completion.

Mooring dolphins will be installed as part of the development, therefore the only piling in the marine environment relates to the construction of the dolphins.

It has been assumed that a trailing suction hopper dredger vessel will be used. For the purposes of the model assessment, the broadband level for the dredger is 192 dB SPL with the dredging operation noise dominating at all but the lowest frequencies (<31.5 Hz). Dredging will be undertaken for up to

[24] 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

130 days. In addition, a dredger coming to site to pump ashore using Clyde Arisings into the dry dock will also be present at the site on an assumed frequency of up to four times within a 24 hour period for 2 hours each visit. This additional dredger would likely occur over a separate period of up to 130 days.

3.1.2 Increased vessel movement

During construction, there will likely be an increase in vessel movement in and out of the area as the Hunterston Construction Yard principally related to the dredging activities and import of materials to the site. It is not currently known what the predicted increase in vessel movements will be as a result of the development, but they will be increased from their current amount.

The increase in the number of vessels travelling through to Hunterston, both during construction and operation, would increase the risk of collision with marine mammals, potentially resulting in death or injury to individuals.

3.1.3 Turbidity

Seabed disturbance through dredging can result in increased turbidity and creation of sediment plumes, this has been assessed as part of Chapter 10 of the EIAR.

Marine mammals are known to inhabit turbid environments, and many use echolocation utilise to sense the environment around them[25]

3.2 Cumulative Impacts

Three proposed developments to be considered include:

- Fastrig Wing Sail Test Facility Yard - Temporary consent for the establishment of a Fastrig Wing Sail Test Facility Yard to include all temporary buildings (including workshop, storage, office, canteen and WC), access, parking and other required infrastructure.
- Bakkafrost smolt facility - build a recirculating aquaculture system (RAS) smolt facility on industrial land at Hunterston in North Ayrshire as part of a strategy to produce 18 million large post-smolts annually to improve fish health and performance.
- XLCC submarine cable factory - erection of a high voltage cable manufacturing facility, including detailed planning permission for the construction of a 185m high extrusion tower with associated factories, research and testing laboratories, offices with associated stores, transport, access, parking and landscaping with on-site generation and electrical infrastructure and cable delivery system.
- Construction of new slipway for Largs lifeboat.
- Construction of new slipway for Cumbrae ferry.
- Construction of new coastal path in Fairlie.

The three on land projects would likely have no cumulative impacts to the Hunterston project in relation to marine mammals.

[25] Au et al, Springer Handbook of Auditory Research (2000)

The three projects that are marine/coastal are noted to be of a small scale and are not in close proximity to the site. As such there is no potential impact for cumulative impact associated with these developments.

3.3 Noise Modelling Results: Impacts of Underwater Noise on Marine Mammals

Full details of the Underwater noise modelling conducted to inform the assessment can be found in Appendix C.

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'*[26]. 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[27].

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.

Dolphins

With respect to impact piling for mooring dolphin construction PTS risk ranges for minimal starting range for a fleeing animal with no soft start for the very high frequency cetaceans (VHF) hearing group are up to 5.4 km meaning that a VHF group animal (harbour porpoise) would likely need to be >5.4 km away before the activity commences to avoid exceeding the PTS threshold.

For the low frequency cetaceans (LF) hearing group (minke whale) the PTS ranges for the impact piling are up to 1.9 km. The high frequency cetaceans (HF) hearing group (bottlenose dolphin and white-beaked dolphin) has PTS ranges up to 200 m for impact piling. TTS ranges from 1800-7600 during this time.

While these ranges are expected where the animal remains in a straight line-of-sight from the activity, they are exceedingly conservative where an animal swims around an acoustic obstacle. For this site, given the land geometry and presence of several islands this effect may be significant in reducing the needed fleeing durations for a proportion of the animals.

Where a 50 minute -25 dB soft start paired with a 1000 m exclusion zone is implemented PTS is $\leq$ 60 and TTS is $\leq$ 80 or less for LF, HF and VHF groups.

[26] NOAA guidance available at: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm last accessed 13/12/22
[27] JNCC UK Marine Noise Registry: Information Document available at: http://jncc.defra.gov.uk/pdf/MNR__Draft_InfoDoc_V1_20160808.pdf last accessed 10/01/2024

Dredging

Dredging has a low impact on all marine mammals, with risks of <10 m for TTS and PTS for 1 second exposure (instantaneous risk) of continuous noise, with the exception of harbour porpoises where the risk of TTS is 100 m. With no soft start, the PTS risks to marine mammals are <10 m and ≤ 200 m, with the exception of harbour porpoises with risks of 100 PTS and 1800 TTS.

3.4 Effects of Increased Vessel Movement on Marine Mammals

Based on Automatic Identification System (AIS) for shipping traffic, the average annual density average for all vessels associated with the waters surrounding Hunterston is 142 vessels annually[28]. Therefore, it is considered that the vessel movement will increases as a result of the construction and operation at the site,

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[29]. HWDC[30] 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.

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[31]. They are also less able to manoeuvre away from vessels to avoid vessel strike as are fin whale.

Killer whales are generally inquisitive and are observed approaching vessels, however, like other smaller cetaceans (Atlantic white-sided dolphin, bottlenose dolphin, short-beaked common dolphin and long-finned pilot whale) they are fast, agile and manoeuvrable in water.

3.5 Conclusion

It has been assessed that the primary risk from the works is to harbour porpoises; with consideration to be made for other cetaceans (Atlantic white-sided dolphin, white-sided dolphin, bottlenose dolphin, short-beaked common dolphin, long-finned pilot whale, fin whale and killer whales).

Dredging and vibratory piling is considered to have the potential to cause TTS injury to individual cetaceans, but very unlikely to cause PTS or death. 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 injury and death this will be decreased. It is not possible to rule out some level of disturbance to individuals which might be present within the area.

Impact Piling is considered to have a more significant potential to cause TTS injury with a wide range of impact (up to 5.4km) to cause PTS, as such the risks associated with the piling for the mooring

[28] AIS Shipping Traffic –Vessel Density Average Annuals – All Types data, available at: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=1332 last accessed 15/04/2024
[29] Sea Watch Foundation: The Harbour Porpoise in UK Waters available at: http://seawatchfoundation.org.uk/wp-content/uploads/2012/07/Harbour_Porpoise.pdf last accessed 13/12/2022
[30] HWDC Harbour Porpoise information available at: https://hwdt.org/harbour-porpoise last accessed 12/12/2022
[31] 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).

dolphins are considered to be high. The following section details the proposed mitigation measures to be employed to address the identified risks.

4 PILING METHODOLOGY

To reduce risk ranges, soft start is necessary incorporating the following requirements.

To achieve an exclusion zone of 1000 m:

- Introduce either a 60-minute soft start with a -15 dB reduction in source level or
- A 50-minute soft start with a -25 dB reduction in source level

These exclusion zones should be verified as absent of marine mammals in accordance with JNCC guidance in relation to pile driving (JNCC, 2010) prior to the commencement of the soft starts. This is detailed in the following sections.

5 MARINE MAMMAL MITIGATION PLAN

The marine mammal mitigation will comprise a standard Marine Mammal Observation Protocol (MMOP) protocol as per JNCC guidance which will be implemented during piling and dredging operations in optimal sea states and during times of optimal visibility, and avoidance of works commencing during low hours of visibility and when sea state exceeds 2.

5.1 Marine Mammal Observations Protocol

The MMOP will be implemented so that the piling 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) [32] [33].

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 piling and dredging. The MMO will undertake observation for marine mammals within the mitigation zone before and during piling and 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 land based and will be trained. The identity and credentials of the MMO will be agreed with Marine Scotland.

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.

[32] https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf

[33] 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.

Although these forms were developed for seismic surveys, they can be used for piling and 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 piling and dredging. A formal chain of communication from the MMO to the contractor, who will start/stop piling, 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 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 the length of activity, the water depth, the nature of the activities (for the effect of the substrate on noise transmission. From underwater noise modelling, minimum recommended mitigation zone of 500 metres from the piling (on the basis of the proposed soft start methodology) and 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).

5.2 Piling and 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. Piling and dredging will not commence during poor visibility (such as fog) or during periods when the sea state is not conducive to visual searches (above sea state 4 is considered not conducive[34]) as there is a greater risk of failing to detect the presence of marine mammals. Harbour porpoise have small dorsal fins, therefore the MMO shall take additional precautions if the sea state exceeds 2. An elevated platform for the MMO to monitor from would be beneficial when the sea state is 2 or above, the piling and dredging works could also be scheduled on a day where the sea is expected to be calm.

2. The MMO(s) should be situated in location that provides the best viewing platform and is likely to be closest to the piling and 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

[34] Detection of marine mammals, particularly porpoises, decreases as sea state increases. According to the JNCC guidance ideally sea states of 2 or less are required for optimal visual detection.

MMO viewing platform (and therefore more than one vessel) may be required to ensure that the entire mitigation zone can be observed).

3. The mitigation zone will be monitored visually by the MMO for an agreed period prior to the commencement of piling and dredging. This will be a minimum of 30 minutes.

4. At least 30 minutes before any dredging works/piling 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 piling/dredging works can start.

5. 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.

6. Dredging/piling should not be undertaken within 30 minutes of a marine mammal being detected within the mitigation zone.

7. If a marine mammal 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 marine mammal is not detected again within 30 minutes, it can be assumed that it has left the area and the works may commence.

8. If a MMO is uncertain whether marine mammals are present within the mitigation zone, they should advise that the activity should be delayed as a precaution until they are certain that no animals are present.

9. A soft-start will be employed, with the gradual ramping up of piling. The soft-start duration will be a period of not less than 50 minutes. This will allow for any marine mammals to move away from the noise source.

10. 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.

11. When piling or dredging at full power this will continue if a marine mammal is detected in the mitigation zone (as it is deemed to have entered voluntarily[35]).

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 Scotland at the conclusion of dredging activity. Reports will include:

- Completed MMRFs;
- Date and location of the dredging activities;

[35] The guidance states that there is no scientific evidence for this voluntary hypothesis; instead it is based on a common sense approach. Factors such as food availability may result in marine mammals approaching operations; in particular, the availability of prey species stunned by loud underwater noise may attract marine mammals into the vicinity.

- 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 marine mammals;
- Details of watches made for marine mammals, including details of any sightings, and details of the dredging/piling activity during the watches;
- Details of any problems encountered during the dredging/piling activities including instances of non-compliance with the agreed dredging protocols; and
- Any recommendations for amendment of the protocols.

5.4 Vessel Movement Mitigation Protocol

Peelports implement speed restrictions on vessels within the entire Firth of Clyde (north of Brodick) waters, additionally, leaflets can be created to provide additional advice to port users to avoid disturbance to and/or collision with marine mammal which should include, but is not limited to the following:

- Keep a safe distance. Never get closer than 100m (200m if another boat is present) 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
- Avoid sudden changes in speed.
- Vessels should be limited to 4 knots and a vessel management plan including agreed routes and speed limits should be devised.

Wildlife code of conduct methods have been created by NatureScot and are available on their website.

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.

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 European Protected Species. 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 European Protected Species 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 Scotland (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:

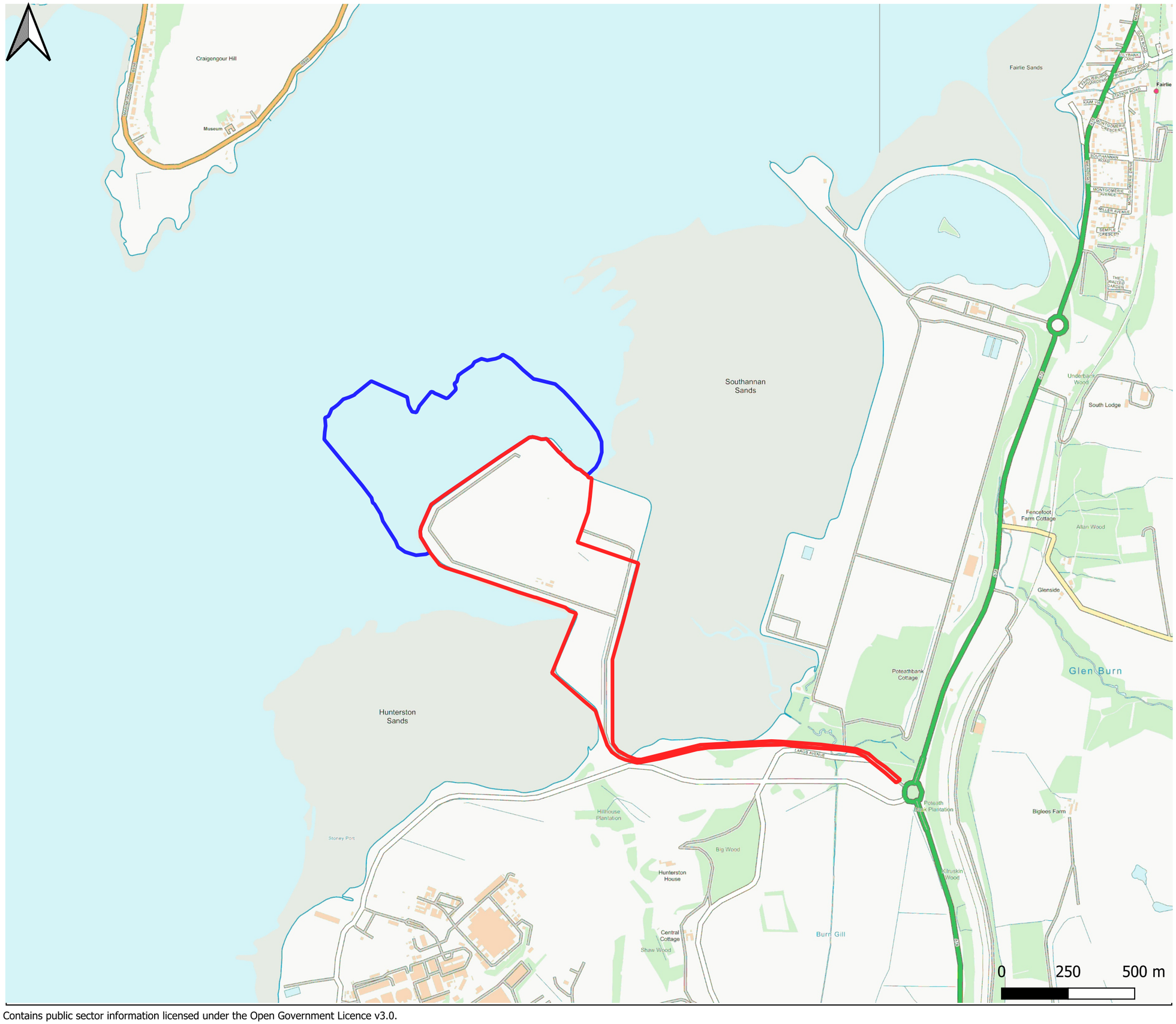
- There is a licensable purpose.
- There are no satisfactory alternatives.
- The actions authorised will not be detrimental to the maintenance of the population of the species concerned at favourable conservation status[36] in their natural range.

As highlighted in section 3.4, the risk of disturbance cannot be ruled out completely and so a derogation licence for disturbance will be required.

[36] 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 SITE LOCATION AND LAYOUT



Legend

Terrestrial Boundary

Marine Boundary

Do not scale this map

Client
Clydeport Operations Ltd

Project
Hunterston Construction Yard

Title
Location Map

Status
FINAL

Drawing No.	Revision	Date
176482-QGIS004	-	10 May 2024
Drawn	**Checked**	**Approved**
JSH	GD	GD

Scale
1:13,812 @ A3

Rev	Date	Amendment	Initials
-	-	-	-

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W: www.envirocentre.co.uk

B LOCATION OF DESIGNATED SITES

212000 216000 220000 224000

656000 652000 648000

Imagery Source: OS maps. Image courtesy of Ordnance Survey © 2023 TomTom

Legend

- terrestrial site boundary
- Designated Sites 5km Buffer
- Ballochmartin Bay SSSI
- Kames Bay SSSI
- Portencross Woods SSSI
- Southannan Sands SSSI

Do not scale this map

Client
Peel Ports

Project
Hunterston Construction Yard

Title
Designated Sites Plan

Status
FINAL

Drawing No.	Revision	Date
176482-GIS011	-	14 Dec 2023
Drawn	**Checked**	**Approved**
LC	JEP	MM

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1:45,000 @ A3

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-	-	-	-

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C UNDERWATER NOISE ASSESSMENT

HUNTERSTON CONSTRUCTION YARD

SUBSEA NOISE TECHNICAL REPORT

IE001010
A01
11 April 2024

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Glossary

Term	Meaning
Decibel (dB)	A relative scale most commonly used for reporting levels of sound. The actual sound measurement is compared to a fixed reference level and the "decibel" value is defined to be $10 \cdot \log_{10}$(“actual”/”reference”), where (“actual”/”reference”) is a power ratio. The standard reference for underwater sound pressure is 1 micro-Pascal (µPa), while 20 micro-Pascals is the standard for airborne sound. The dB symbol is often followed by a second symbol identifying the specific reference value (i.e. re 1 µPa).
Grazing angle	A glancing angle of incidence (the angle between a ray incident on a surface and the line perpendicular to the surface).
Permanent Threshold Shift (PTS)	A total or partial permanent loss of hearing caused by some kind of acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear, and thus a permanent reduction of hearing acuity.
Temporary Threshold Shift (TTS)	Temporary loss of hearing as a result of exposure to sound over time. Exposure to high levels of sound over relatively short time periods will cause the same amount of TTS as exposure to lower levels of sound over longer time periods. The mechanisms underlying TTS are not well understood, but there may be some temporary damage to the sensory cells. The duration of TTS varies depending on the nature of the stimulus, but there is generally recovery of full hearing over time.
Sound Exposure Level (SEL)	The cumulative sound energy in an event, formally: “ten times the base-ten logarithm of the integral of the squared pressures divided by the reference pressure squared”. Equal to the often seen “L_E” or “dB SEL” quantity. Defined in: ISO 18405:2017, 3.2.1.5
Sound Pressure level (SPL)	The average sound energy over a specified period of time, formally: “ten times the base-ten logarithm of the arithmetic mean of the squared pressures divided by the squared reference pressure”. Equal to the deprecated “RMS level”, “dB_{rms}” and to Leq if the period is equal to the whole duration of an event. Defined in ISO 18405:2017, 3.2.1.1
Peak Level, Peak Pressure Level (L_P)	The maximal sound pressure level of an event, formally: “ten times the base-ten logarithm of the maximal squared pressure divided by the reference pressure squared” or “twenty time the base-ten logarithm of the peak sound pressure divided by the reference pressure, where the peak sound pressure is the maximal deviation from ambient pressure”. Defined in ISO 18405:2017, 3.2.2.1
Source Level (SL)	Here taken to mean the level (SEL/SPL/L_P) at 1 meter range. If not otherwise stated it’s assumed the source is omnidirectional (equal level in all directions). For sources larger than 1 m in radius the Source Level is back-calculated to 1 m.
decidecade	Used to refer to a step in frequency, similar to “one-third-octave”, defined as a ratio of $10^{0.1} \approx 1.259$ (one third octave is $21/3 \approx 1.260$). Used interchangeably with “3rd octave”.
noise	Sound that is irrelevant, unwanted or harmful to the organism(s) in question. Noise is often detrimental, but not necessarily so.

Acronyms

Term	Meaning
ADD	Acoustic Deterrent Device
LF	Low Frequency (Cetaceans)
HF	High Frequency (Cetaceans)
VHF	Very High Frequency (Cetaceans)
MF	Mid Frequency (Cetaceans) – **DEPRECATED** only for reference to NOAA/NMFS 2018 groups
OW/OCW	Otariid pinnipeds/Other Carnivores in water (refers to the same weighting and animal groups)
PW/PCW	Phocid pinnipeds
NMFS	National Marine Fisheries Service
RMS	Root Mean Square
SEL	Sound Exposure Level, [dB]
SPL	Sound Pressure Level, [dB]
L_P	Peak Pressure Level, [dB]
SL	Source Level [dB]
TTS	Temporary Threshold Shift
PTS	Permanent Threshold Shift
SSS	Side scan sonar – Towed sonar device typically positioned 10-15 m above the sediment, main purpose is to characterise the sediment surface texture.
MBES	Multi beam echosounder – Uses multiple narrow beams to measure the depth across a swath below the vessel.
SBP	Sub Bottom Profiler – Any device/system that uses acoustics to record echoes from within the sediment, examples include seismic arrays, sparkers, boomers, chirpers, pingers and associated recorder array.
USBL	Ultra Short Baseline Array – Small array of at least 4 hydrophones and a pinger to measure positions of equipment under water.
UHRS	Ultra High-Resolution Seismic survey – Usually a sparker driven sub bottom characterisation system.
c.	Circa, i.e., approximately

Units

Unit	Description
dB	Decibel (Sound)
Hz	Hertz (Frequency)
kHz	Kilohertz (Frequency)
kJ	Kilojoule (Energy)
km	Kilometre (Distance)
km^2	Kilometre squared (Area)
m	Metre
ms	Millisecond (10^{-3} seconds) (Time)
ms^{-1} or m/s	Metres per second (Velocity or speed)
kn	Knots (speed), 1 kn = 0.514 m/s, 1 m/s = 1.944 kn
µPa	Micro Pascal
Pa	Pascal (Pressure: newton/m^2)
psu	Practical Salinity Units (parts per thousand of equivalent salt in seawater, weight-based)

Unit	Description
kg/m³	Specific density (of water, sediment or air)
Z	Acoustic impedance [kg/(m²·s) or (Pa·s)/m³]

Units will generally be enclosed in square brackets e.g.: “[m/s]”

1 INTRODUCTION

This Subsea Noise Technical Report presents the results of a desktop study considering the potential short-term effects of underwater noise on the marine environment from the proposed development of Hunterston Construction Yard (hereafter referred to as “the Project”). This development would see the upgrade of the existing Hunterston Construction Yard (HCY) into a harbour facility to support both the long-term sustainable development of various industrial users and future offshore wind industry activities.

HCY is located between the Hunterston Coal Terminal and Hunterston B Nuclear Power Station, to the south of the village of Fairlie and extends into the Firth of Clyde. The proposed construction works will cover an area of approx. 40 hectares, which includes the dry dock working area, access road and contractor compound. In general, the works relevant to this assessment will entail the construction of a new quay and associated quayside infrastructure on the western edge of the site and dredging to enable marine vessel access to quay area.

Sound is readily transmitted into the underwater environment and there is potential for the sound emissions from anthropogenic sources to adversely affect marine mammals and fish. At close ranges from a noise source with high noise levels, permanent or temporary hearing damage may occur to marine species, while at a very close range gross physical trauma is possible. At long ranges (several kms) the introduction of any additional noise could, for the duration of the activity, potentially cause behavioural changes, for example to the ability of species to communicate and to determine the presence of predators, food, underwater features, and obstructions.

This report provides an overview of the potential effects due to underwater noise from the Project on the surrounding marine environment based on the Southall et al. 2019 and Popper et al. 2014 frameworks for assessing impact from noise on marine mammals and fishes.

Consequently, the primary purpose of the underwater noise assessment is to predict the likely range of onset for potential physiological and behavioural effects due to increased anthropogenic noise as a result of the Project.

2 ASSESSMENT CRITERIA

2.1 General

To determine the potential spatial range of injury and disturbance, assessment criteria have been developed based on a review of available evidence including national and international guidance and scientific literature. The following sections summarise the relevant assessment criteria and describe the evidence base used to derive them.

Underwater noise has the potential to affect marine life in different ways depending on its noise level and characteristics. Assessment criteria generally separate sound into two distinct types, as follows:

- **Impulsive sounds** which are typically transient, momentary (less than one second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI, 2005; ANSI, 1986; NIOSH, 1998). This category includes sound sources such as seismic surveys, impact piling and underwater explosions. Additionally included here are sounds under 1 second in duration with a weighted kurtosis over 40 (see note below*).
- **Non-impulsive** (and continuous) sounds which can be broadband, narrowband or tonal, momentary, brief or prolonged, continuous or intermittent and typically do not have a high peak sound pressure with rapid rise/decay time that impulsive sounds do (ANSI, 1995; NIOSH, 1998).This category includes sound sources such as continuous vibro-piling, running machinery, some sonar equipment and vessels. Additionally included here are sounds over 1 second in duration with a weighted kurtosis under 40 (see note below*).

* Note that the European Guidance: “Monitoring Guidance for Underwater Noise in European Seas, Part II: Monitoring Guidance Specifications” (MSFD Technical Subgroup on Underwater Noise, 2014) includes sonar as impulsive sources (see Section 2.2). However, the guidance suggests that *“all loud sounds of duration less than 10 seconds should be included”* as impulsive.
This contradicts research on impact from impulsive sounds suggesting that a limit for “impulsiveness” can be set at a kurtosis[1] of 40 (Martin, et al., 2020).
This latter criterion has been used for classification of impulsive versus non-impulsive for sonars and similar sources. The justification for departing from the MSFD criterion is that the Southall et al. 2019 and the Popper et al. 2014 framework limits are based on the narrower definition of impulsive as given in “Impulsive sounds” above.

The acoustic assessment criteria for marine mammals and fish in this report has followed the latest international guidance (based on the best available scientific information), that are widely accepted for assessments in the UK, Europe and worldwide (Southall, et al., 2019; Popper, et al., 2014).

2.2 Effects on Marine Animals

Underwater noise has the potential to affect marine life in different ways depending on its noise level and characteristics. Richardson *et al.* (1995) defined four zones of noise influence which vary with distance from the source and level, to which an additional zone has been added “zone of temporary hearing loss”.
These are:

- **The zone of audibility**: This is defined as the area within which the animal can detect the sound. Audibility itself does not implicitly mean that the sound will affect the animal.
- **The zone of masking**: This is defined as the area within which sound can interfere with the detection of other sounds such as communication or echolocation clicks. This zone is very hard to estimate due to a paucity of data relating to how animals detect sound in relation to masking levels (for example, humans can hear tones well below the numeric value of the overall sound level). Continuous sounds will generally have a greater masking potential than intermittent sound due to the latter providing some

[1] Statistical measure of the asymmetry of a probability distribution.

relative quiet between sounds. Masking only occurs of there is near-overlap in sound and signal, such that a loud sound at e.g., 1000 Hz will not be able to mask a signal at 10,000 Hz[2].

- **The zone of responsiveness**: This is defined as the area within which the animal responds either behaviourally or physiologically. The zone of responsiveness is usually smaller than the zone of audibility because, as stated previously, audibility does not necessarily evoke a reaction. For most species there is very little data on response, but for species like harbour porpoise there exists several studies showing a relationship between received level and probability of response (Graham IM, 2019; Sarnoci´nska J, 2020; BOOTH, 2017; Benhemma-Le Gall A, 2021).
- **The zone of temporary hearing loss**: The area where the sound level is sufficient to cause the auditory system to lose sensitivity temporarily, causing loss of "acoustic habitat": the volume of water that can be sensed acoustically by the animal. This hearing loss is typically classified as Temporary Threshold Shift (TTS).
- **The zone of injury / permanent hearing loss**: This is the area where the sound level is sufficient to cause permanent hearing loss in an animal. This hearing loss is typically classified as Permanent Threshold Shift (PTS). At even closer ranges, and for very high intensity sound sources (e.g., underwater explosions), physical trauma or acute mortal injuries are possible.

For this study, it is the zones of injury (PTS) that are of primary interest, along with estimates of behavioural impact ranges. To determine the potential spatial range of injury and behavioural change, a review has been undertaken of available evidence, including international guidance and scientific literature. The following sections summarise the relevant thresholds for onset of effects and describe the evidence base used to derive them.

2.3 Thresholds for Marine mammals

The zone of injury in this study is classified as the distance over which a fleeing marine mammal can suffer PTS leading to non-reversible auditory injury. Injury thresholds are based on a dual criteria approach using both un-weighted L_P (maximal instantaneous SPL) and marine mammal hearing weighted SEL. The hearing weighting function is designed to represent the sensitivity for each group within which acoustic exposures can have auditory effects. The categories include:

- **Low Frequency (LF) cetaceans**: Marine mammal species such as baleen whales (e.g. minke whale *Balaenoptera acutorostrata*).
- **High Frequency (HF) cetaceans**: Marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales (e.g., bottlenose dolphin *Tursiops truncatus* and white-beaked dolphin *Lagenorhynchus albirostris*).
- **Very High Frequency (VHF) cetaceans**: Marine mammal species such as true porpoises, river dolphins and pygmy/dwarf sperm whales and some oceanic dolphins, generally with auditory centre frequencies above 100 kHz) (e.g., harbour porpoise *Phocoena phocoena*).
- **Phocid Carnivores in Water (PCW)**: True seals, earless seals (e.g., harbour seal *Phoca vitulina* and grey seal *Halichoreus grypus*); hearing in air is considered separately in the group PCA.
- **Other Marine Carnivores in Water (OCW)**: Including otariid pinnipeds (e.g., sea lions and fur seals), sea otters and polar bears; in-air hearing is considered separately in the group Other Marine Carnivores in Air (OCA).
- **Sirenians (SI)**: Manatees and dugongs. This group is only represented in the NOAA guidelines.

[2] The exact limit of how near a noise can get to the signal in frequency before causing masking will depend on the receivers auditory frequency resolution ability, but for most practical applications noise and signal frequencies will need to be within 1/3rd octave to start to have a masking effect.

These weightings are used in this study and are shown in Figure 2-1. It should be noted that not all of the above hearing groups of marine mammal will be present in the Project area, but all hearing groups are presented in this report for completeness.

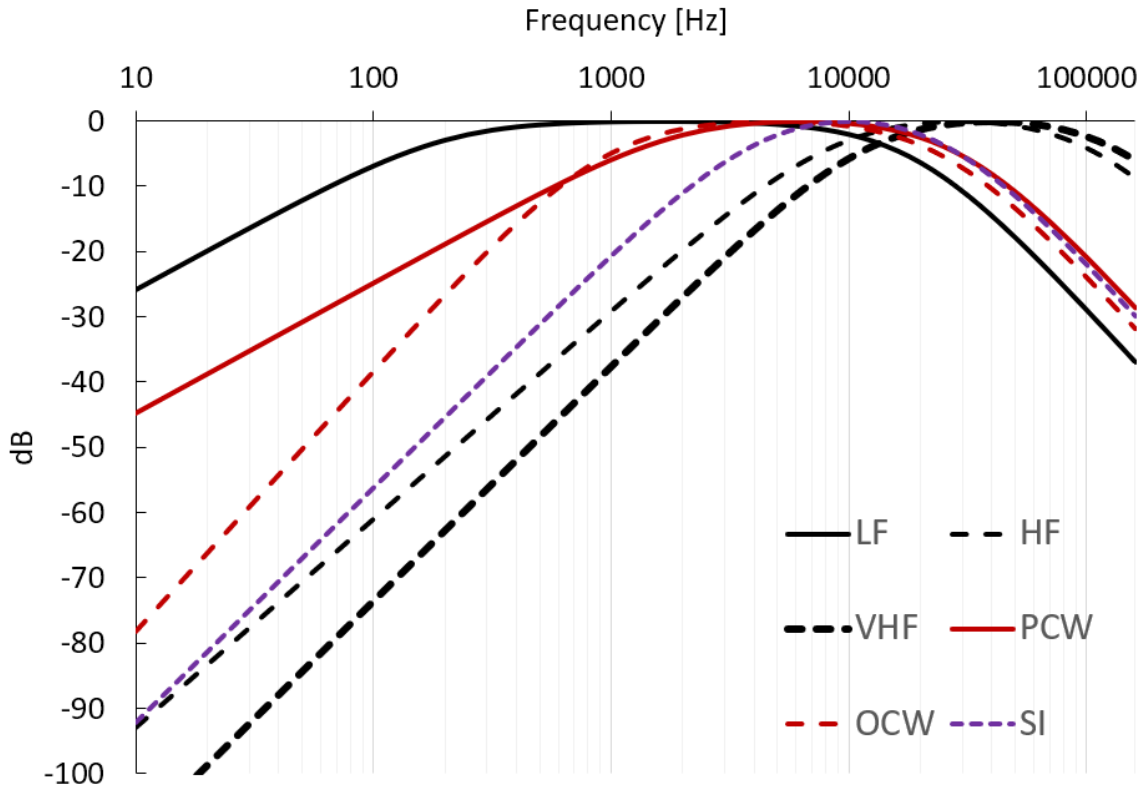

Figure 2-1: Hearing weighting functions for pinnipeds, cetaceans and sirenians (NMFS, 2018; Southall et al. 2019)

Both the criteria for impulsive and non-impulsive sound are relevant for this study given the nature of the sound sources used during the Project. The relevant PTS and TTS criteria proposed by Southall *et al*. (2019) are summarised in Table 2-1.

Table 2-1: PTS and TTS onset acoustic thresholds (Southall *et al., 2019*; Tables 6 and 7)

Hearing Group	Parameter	Impulsive [dB]		Non-impulsive [dB]	
		PTS	TTS	PTS	TTS
Low frequency (LF) cetaceans	L_P, (unweighted)	219	213	-	-
	SEL, (LF weighted)	183	168	199	179
High frequency (HF) cetaceans	L_P, (unweighted)	230	224	-	-
	SEL, (MF weighted)	185	170	198	178
Very high frequency (VHF) cetaceans	L_P, (unweighted)	202	196	-	-
	SEL, (HF weighted)	155	140	173	153
Phocid carnivores in water (PCW)	L_P, (unweighted)	218	212	-	-
	SEL, (PW weighted)	185	170	201	181
Other marine carnivores in water (OCW)	L_P, (unweighted)	232	226	-	-
	SEL, (OW weighted)	203	188	219	199
Sirenians (SI) (NOAA only)	L_P, (unweighted)	226	220	-	-
	SEL, (OW weighted)	190	175	206	186

These updated marine mammal injury criteria were published in March 2019 (Southall, et al., 2019). The paper utilised the same hearing weighting curves and thresholds as presented in the preceding regulations document NMFS (2018) with the main difference being the naming of the hearing groups and introduction of additional thresholds for animals not covered by NMFS (2018). A comparison between the two naming conventions is shown in Table 2-2.

The naming convention used in this report is based upon those set out in Southall *et al*. (2019). Consequently, this assessment utilises criteria which are applicable to both NMFS (2018) and Southall *et al*. (2019).

Table 2-2: Comparison of Hearing Group Names between NMFS (2018) and Southall *et al.* (2019)

NMFS (2018) hearing group name	Southall *et al*. (2019) hearing group name
Low-frequency cetaceans (LF)	LF
Mid-frequency cetaceans (MF)	HF
High-frequency cetaceans (HF)	VHF
Phocid pinnipeds in water (PW)	PCW
Otariid pinnipeds in water (OW)	OCW
Sirenians (SI)	Not included

2.4 Disturbance to Marine Mammals

Disturbance thresholds for marine mammals are summarised in Table 2-3. Note that the non-impulsive threshold can often be lower than ambient noise for coastal waters with some human activity, meaning that ranges determined using this limit will tend to be higher than actual ranges. However, the levels are unweighted and ranges to threshold will be dominated by low-frequency sound, which for most hearing groups is outside their hearing range. For hearing groups with low thresholds this can mean that their range to TTS/PTS is *larger* than the range to the behavioural threshold, e.g., the PTS threshold for impulsive sound for the VHS group is 155 dB SEL, while the behavioural threshold is 160 dB SPL. For a typical scenario, for 1 second's exposure (SEL equals SPL for 1-second durations) that means the range to the behavioural threshold will be approximately twice the range to the PTS threshold (a difference of 5 dB). This is just one of the reasons why this behavioural threshold should be interpreted with caution.

Table 2-3: Disturbance Criteria for Marine Mammals Used in this Study based on Level B harassment of NMFS (National Marine Fisheries Service, 2005)

Effect	Non-Impulsive Threshold	Impulsive Threshold
Disturbance (all marine mammals)	120 dB SPL	160 dB $SEL_{single\ impulse}$ or 1-second SEL

2.5 Injury and Disturbance to Fish and Sea Turtles

The injury criteria used in this noise assessment are given in Table 2-4 and Table 2-5 for impulsive noises and continuous noise respectively. L_P and SEL criteria presented in the tables are unweighted. Physiological effects relating to injury criteria are described below (Popper, et al., 2014):

- **Mortality and potential mortal injury**: either immediate mortality or tissue and/or physiological damage that is sufficiently severe (e.g., a barotrauma) that death occurs sometime later due to decreased fitness. Mortality has a direct effect upon animal populations, especially if it affects individuals close to maturity.

- **Recoverable injury ("PTS" in tables and figures)**: Tissue damage and other physical damage or physiological effects, that are recoverable, but which may place animals at lower levels of fitness, may render them more open to predation, impaired feeding and growth, or lack of breeding success, until recovery takes place.

The PTS term is used here to describe this, more serious impact, even though it is not strictly permanent for fish. This is to better reflect the fact that this level of impact is perceived as serious and detrimental to the fish.

- **Temporary Threshold Shift (TTS)**: Short term changes (minutes to few hours) in hearing sensitivity may, or may not, reduce fitness and survival. Impairment of hearing may affect the ability of animals to capture prey and avoid predators, and also cause deterioration in communication between individuals, affecting growth, survival, and reproductive success. After termination of a sound that causes TTS, normal hearing ability returns over a period that is variable, depending on many factors, including the intensity and duration of sound exposure.

Popper et al. 2014 does not set out specific TTS limits for L_P and for disturbance limits for impulsive noise for fishes. Therefore publications: "Washington State Department of Transport Biological Assessment Preparation for Transport Projects Advanced Training Manual" (WSDOT, 2011) and "Canadian Department of Fisheries and Ocean Effects of Seismic energy on Fish: A Literature review" (Worcester, 2006) on effects of seismic noise on fish are used to determine limits for these:

- The criteria presented in the Washington State Department of Transport Biological Assessment Preparation for Transport Projects Advanced Training Manual (WSDOT, 2011). The manual suggests an un-weighted sound pressure level of 150 dB SPL (assumed to be duration of 95 % of energy) as the criterion for onset of behavioural effects, based on work by (Hastings, 2002). Sound pressure levels in excess of 150 dB SPL are expected to cause temporary behavioural changes, such as elicitation of a startle response, disruption of feeding, or avoidance of an area. The document notes that levels exceeding this threshold are not expected to cause direct permanent injury but may indirectly affect the individual fish (such as by impairing predator detection). It is important to note that this threshold is for onset of potential effects, and not necessarily an 'adverse effect' threshold. The threshold is implemented here as either single impulse SEL or 1 second SEL, whichever is greater.

- The report from the Canadian Department of Fisheries and Ocean "Effects of Seismic energy on Fish: A Literature review on fish" (Worcester, 2006) found large differences in response between experiments. Onset of behavioural response varied from 107-246 dB L_P, the 10th percentile level for behavioural response was 158 dB L_P.

Given the large variations in the data from the two sources above, we have rounded the value to 160 dB L_P as the behavioural threshold for fishes for impulsive sound, and 150 dB SPL for non-impulsive sound.

Table 2-4: Criteria for onset of injury to fish and sea turtles due to impulsive noise

Type of animal	Unit	Mortality and potential mortal injury [dB]	Recoverable injury (PTS) [dB]	TTS [dB]	Behavioural [dB]
Fish: no swim bladder (particle motion detection)	SEL	219[1]	216[1]	186[1]	150[3]
	L_P	213[1]	213[1]	193[2]	160[2]
Fish: where swim bladder is not involved in hearing (particle motion detection)	SEL	210[1]	203[1]	186[1]	150[3]
	L_P	207[1]	207[1]	193[2]	160[2]
Fish: where swim bladder is involved in hearing (primarily pressure detection)	SEL	207[1]	203[1]	186	150[3]
	L_P	207[1]	207[1]	193[2]	160[2]
Sea turtles	SEL	210[1]	(*Near*) High (*Intermediate*) Low (*Far*) Low	-	-
	L_P	207[1]		-	-
Eggs and larvae	SEL	210[1]	(*Near*) Moderate (*Intermediate*) Low (*Far*) Low	-	-
	L_P	207[1]		-	-

[1] (Popper et al. 2014) [2] (Worcester, 2006) [3] (WSDOT, 2011)

Where Popper et al. 2014 present limits as “>” 207 or “>>” 186, we have ignored the “greater than” and used the threshold level as given.

Relevant thresholds for non-impulsive noise for fishes relating to PTS, TTS, and behaviour are given in the table below. Note that for the behaviour threshold we have used the impulsive threshold as basis for the continuous noise threshold, in absence of better evidence.

Table 2-5: Criteria for fish due to non-impulsive noise from Popper et al. 2014.

Type of animal	Unit	Mortality and potential mortal injury	Recoverable injury (PTS) [dB]	TTS [dB]	Behavioural [dB]
All fishes	SEL	-	222	210	150 [SPL]*

*This is based on the impulsive criteria.

3 METHOD, ENVIRONMENT AND SITE

The following sections are based on the information given in the documents:

- Hunterston Construction Yard Scoping Report dated September 2023.
- Hunterston Construction Yard Scoping Report Appendix 1 and 2 drawings.
- Written communication with the client or client's representative.

3.1 Site

The Project site and nearby surroundings is characterised by shallow water (<60 m), narrow straits and islands, silty to fine sandy sediment, but tidal flows keeping the water well mixed with the Irish sea (Figure 3-1).

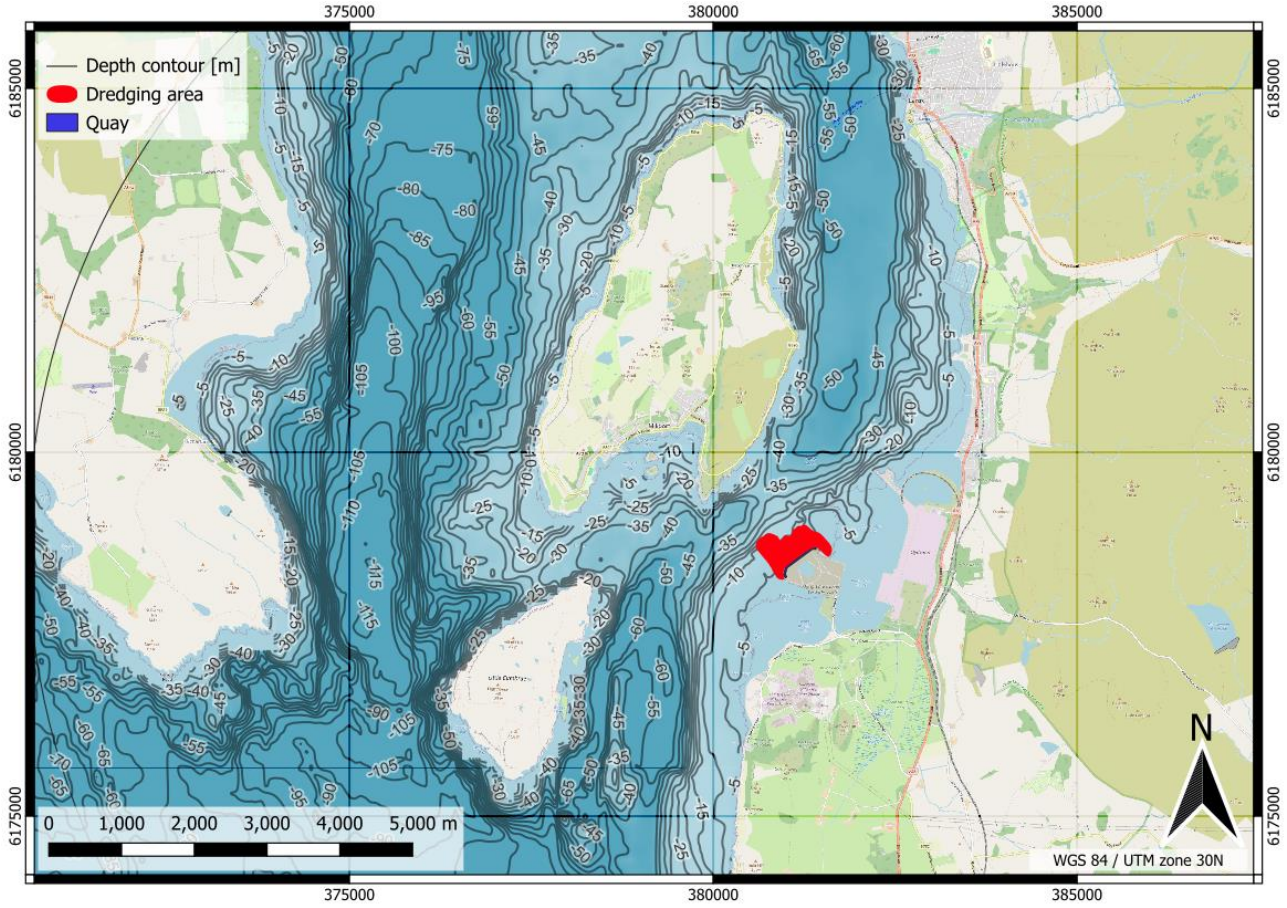

Figure 3-1: Site location in Firth of Clyde. Background map: OpenStreetMap

3.2 Development Description

Specific to the underwater environment, the following works are proposed as part of this project:

- The construction of a new quay.
- Dredging (including future maintenance) to enable marine vessel access to quay areas.
- Possible additional associated quayside infrastructure (dolphins) on the western edge of the site to berth vessels or barges. These are assessed here for completeness but might not be realised in the final project layout.

3.2.1 Quay Wall

Generally, the structure will take the form of a tied wall consisting of a combined wall to the front and rear, made up of large diameter steel tubular piles with sheet piles between. The front wall will be connected to the rear wall using steel tie rods. The tubular piles that will form the wall will be approximately 35 m long, driven to refusal/into rock in order to create sufficient deep water berthing options to support future operations – subject to final design load requirements. Additional tubular piles may be installed within the structure in order to allow increased loads in specific areas.

Design options are being considered in relation the quay wall design. All options include the demolition and infilling of the dry dock. However, there are three options in relation to the quay configuration:

- Option 1 sees the creation of a 450 m long quay wall on the north-western edge of the site with an additional 150 m long quay wall at the east.
- Option 2 sees the creation of a 450 m long quay wall on the western edge of the site with a 150 m long angled quay wall to the south-west.
- Option 3 sees the creation of a 250 m long quay on the western edge of the site.

All three options are covered in this report as a single assessment of the longer western quay wall.

3.2.2 Dolphins

Adjacent to the main quay wall three dolphins might be installed (to be confirmed) at c. 50, 100, 150 m in a north-western direction (Figure 3-2). These are based on tubular steel piles, vibrated or impacted into position.

3.2.3 Additional Works – Not Assessed Here

Additional works that are currently being considered to be installed on the seafloor adjacent to the new quay following dredging are:

- A Roll-on Roll-off (RO-RO) facility; and/or
- A grounding pad (not exceeding 250 m x 250 m, exact location to be confirmed) as a temporary fixed gravel platform for grounding two barges.
- A catwalk for access to the berthed barges.

These activities will be assessed as required in a subsequent document.

3.3 Construction Description

Specific to the marine environment, it is envisaged that construction works for all three quay wall options will involve the following:

- Tubular piles being vibrated/driven into deep strata which may need to be anchored by using a concrete pile toe bored into competent material through the tubular pile section.
- Sheet piles installed between the steel tubular piles which are to be vibrated to shallower depths than the tubular piles.
- Installation of a reinforced concrete capping beam to complete the quay wall.
- Potential tie-in and extension of existing quay wall and new quay wall.
- Dredging in front of the new quay wall to -12 m CD and further maintenance dredging.

3.4 Source Locations

Modelling was based on representative locations within the project area, prioritising either proposed locations (dolphins) or worst-case/most conservative locations (quay) (Figure 3-2).

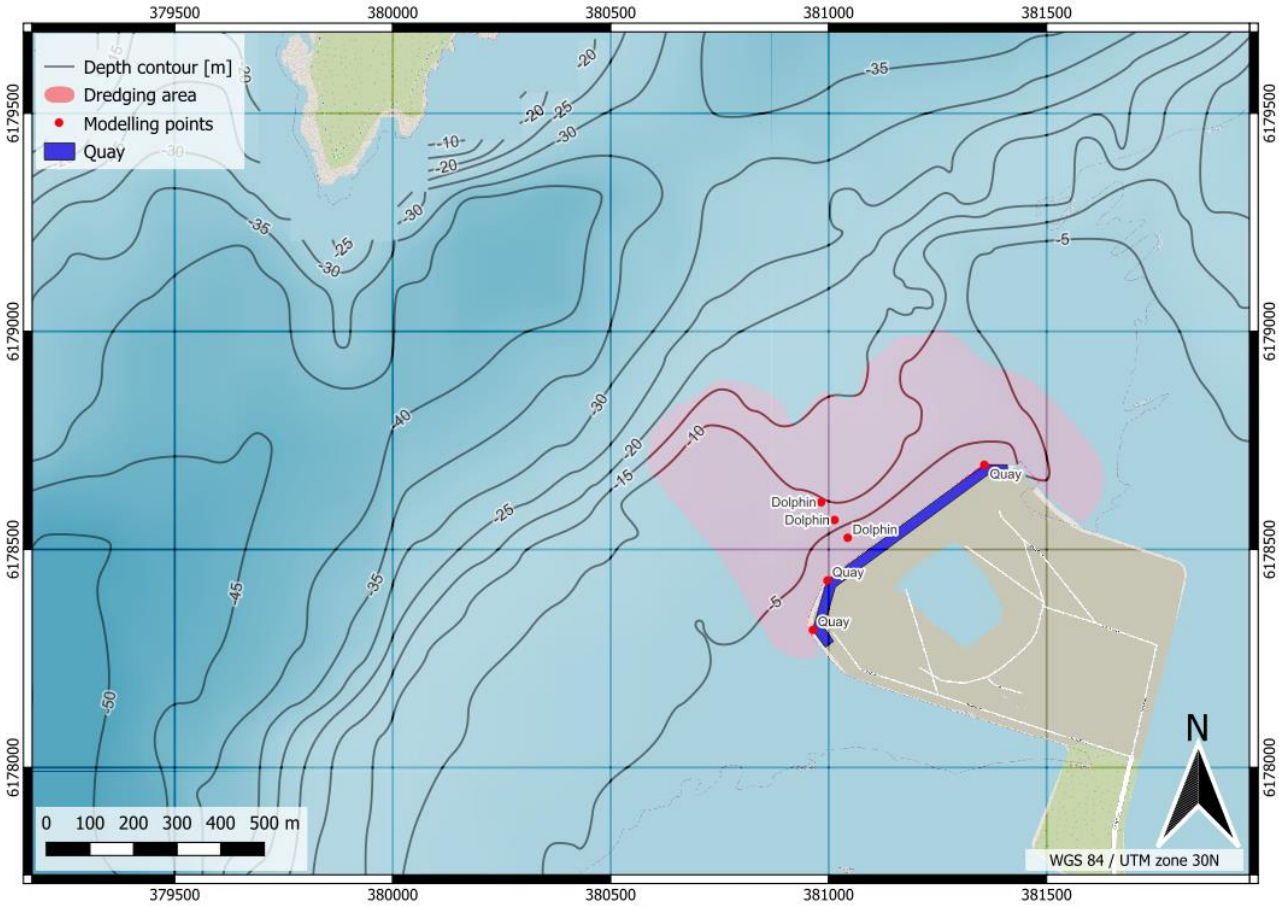

Figure 3-2. Overview of the site and nearby area, modelled piling locations and dredged area. Background map: OpenStreetMap

3.5 Water Properties

Water properties were determined from historical data for the area. Where a range of values are expected, the value leading to less transmission loss was chosen for a more conservative assessment. This thus covers seasonal variation.

- Temperature: 13°C – maximal temperature (during August) given by the Scottish Government for the Clyde Sea[3].
- Salinity: 30 psu – minimal salinity given by the Scottish Government for the Clyde Sea[3].
- Soundspeed profile: Assumed uniform given high mixing as a result of tidal flows. A uniform soundspeed profile is conservative compared to the likely downward refracting soundspeed profiles seen during summer months, causing increased loss to the sediment (higher temperature in the surface leads to higher soundspeeds).

3.6 Sediment Properties

Sediment properties are taken from the sediment sampling campaign detailed in the document “171500 Hunterston Sediment Sampling – Final.pdf” dated 16 July 2019. The campaign sampled locations (Figure 3-3).

[3] 3. THE ENVIRONMENT OF THE CLYDE SEA - Scottish Marine and Freshwater Science Volume 3 Number 3: Clyde Ecosystem Review - gov.scot (www.gov.scot)

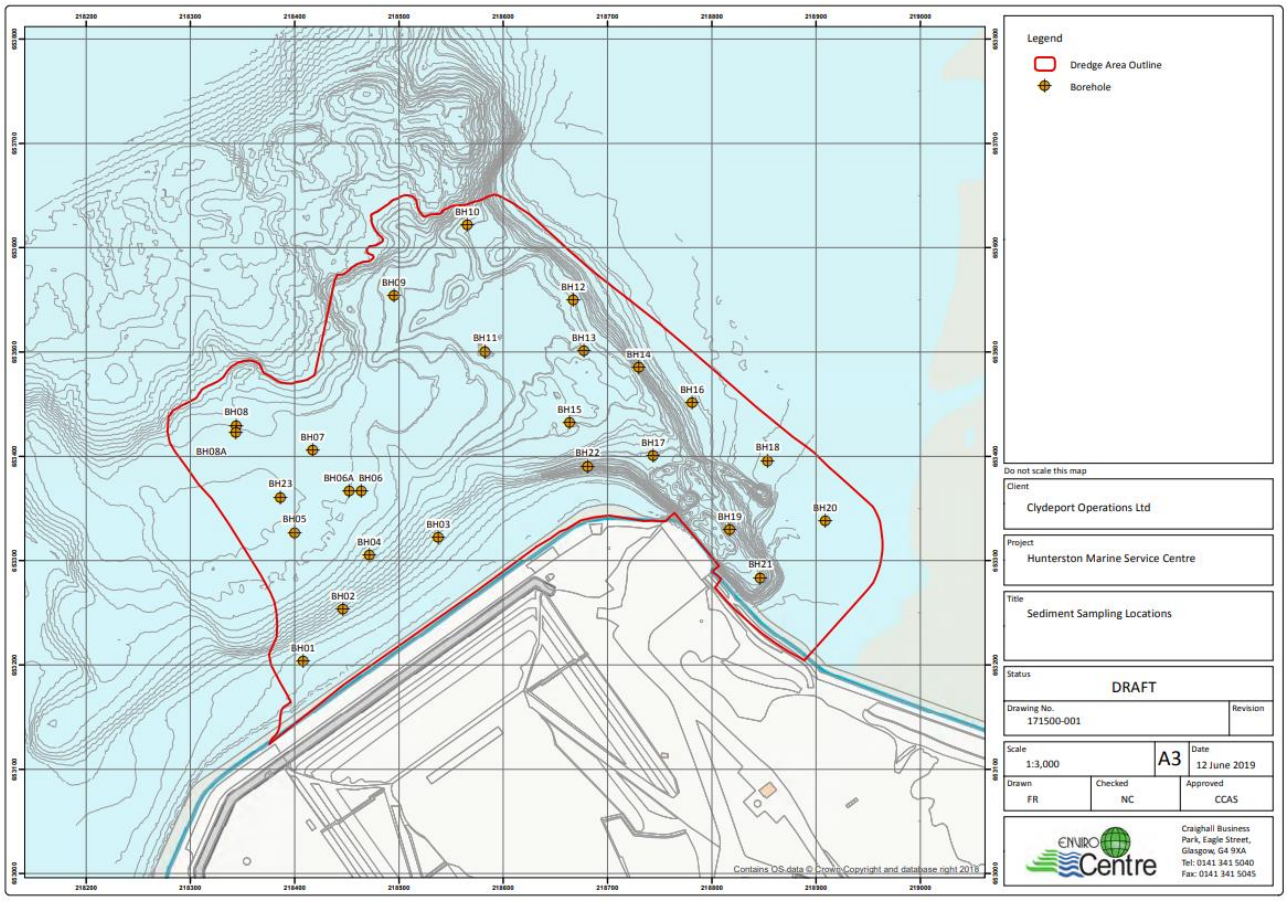

Figure 3-3. Borehole locations from Sediment sampling campaign (p. 18 of document).

The upper sediment layer from each location was used as basis for the surface sediment. A sediment model (Ainslie, 2010) was used to derive the acoustic properties of the sediment from the grain size. To simplify the modelling a single type of sediment is used throughout, defined as the 90th percentile value for both sediment soundspeed and density (Table 3-1).

Table 3-1: Sediment Properties. 90th percentile sediment properties used throughout (in bold font).

Sediment type*	Count	Density [kg/m^3]	Soundspeed [m/s]	Grain size [mm] (nominal)
90th percentile		**1778**	**1642**	**0.064**
fine Sand	2	1806	1653	0.063
fine to coarse Sand	2	1884	1689	0.100
fine to medium Sand	1	1787	1644	0.056
sandy Silt	3	1531	1536	0.009
Silt	3	1484	1518	0.006
silt and fine Sand	1	1538	1539	0.010
silty fine Sand	9	1531	1536	0.009
silty gravelly fine to coarse Sand	1	1712	1611	0.035

*The capitalised word indicates the main sediment type, e.g.,"*silty gravelly fine to coarse **S**and*".

4 SOURCE NOISE LEVELS

Underwater noise sources are usually quantified in dB scale with values generally referenced to 1 µPa pressure amplitude as if measured at a hypothetical distance of 1 m from the source (called the Source Level). In practice, it is not usually possible to measure at 1 m from a source, but the metric allows comparison and reporting of different source levels on a like-for-like basis. In reality, for a large sound source, this imagined point at 1 m from the acoustic centre does not exist. Furthermore, the energy is distributed across the source and does not all emanate from an imagined acoustic centre point. Therefore, the stated sound pressure level at 1 m does not occur for large sources. In the acoustic near-field (i.e. close to the source), the sound pressure level will be significantly lower than the value predicted by the back-calculated source level (SL).

4.1 Source Models

The noise sources and activities investigated during this assessment are summarised in Table 4-1. Source locations are given in Figure 3-2.

Note that:

1. Modelling for impact piling was done with two concurrent impact drivers, meaning that:
    a. Modelling for the dolphin locations had one active rig at the dolphin *and* one active rig at the quay.
    b. Modelling for the quay locations had two concurrent rigs impact piling.
2. The source level changes during a pile installation (here c. 20 dB), the impact piling model accounts for this and the loudest blows are used as representative for the installation and used as basis for further modelling as a conservative measure.

Table 4-1: Summary of Sound Sources and Activities Included in the Subsea Noise Assessment

Equipment	Source level [SPL] (as used in model)	Primary decidecade bands (-20 dB width)	Source model details	Impulsive/non-impulsive
Dredging vessel	192 dB SPL	10-125,000 Hz	Based on trailing suction hopper dredger	Non-impulsive
Dolphin impact piling (round piles)	Single blow: 218 dB SEL 251 dB L_P Accounting for blow rate, 0.57 Hz: 215 dB SPL	16-20,000 Hz	"Taranis" (Appendix B) Tubular steel pile, length 55 m, diameter 2 m, wall thickness 0.024 m. Hammer: CG300 (300 kJ rating)	Impulsive
Quay impact piling (round piles)	Single blow: 216 dB SEL 250 dB L_P Accounting for blow rate, 0.57 Hz: 213 dB SPL	16-20,000 Hz	"Taranis" (Appendix B) Tubular steel pile, length 40 m, diameter 2.032 m, wall thickness 0.024 m. Hammer: CG300 (300 kJ rating)	Impulsive
Quay vibratory piling (sheet piles)	183 dB SPL	16-20,000 Hz	90th percentile decidecade bands from previous installations.	Non-impulsive

4.2 Quay Wall Construction

The piling associated with the quay wall will be driving of round piles (vibratory and impact piling) and vibratory piling for sheet piles between the round piles.

4.2.1 Impact Piling

During the loudest part of the impact piling of round piles at the quay single blow levels of 216 dB SEL / 250 dB L_P are expected. Accounting for the blow rate of the hammer this equates 213 dB SPL. Peak pressure level of a single blow was modelled as up to 250 dB L_P. These levels are based on the pile dimensions, hammer rating and the sediment profile (Appendix B for details on source model).

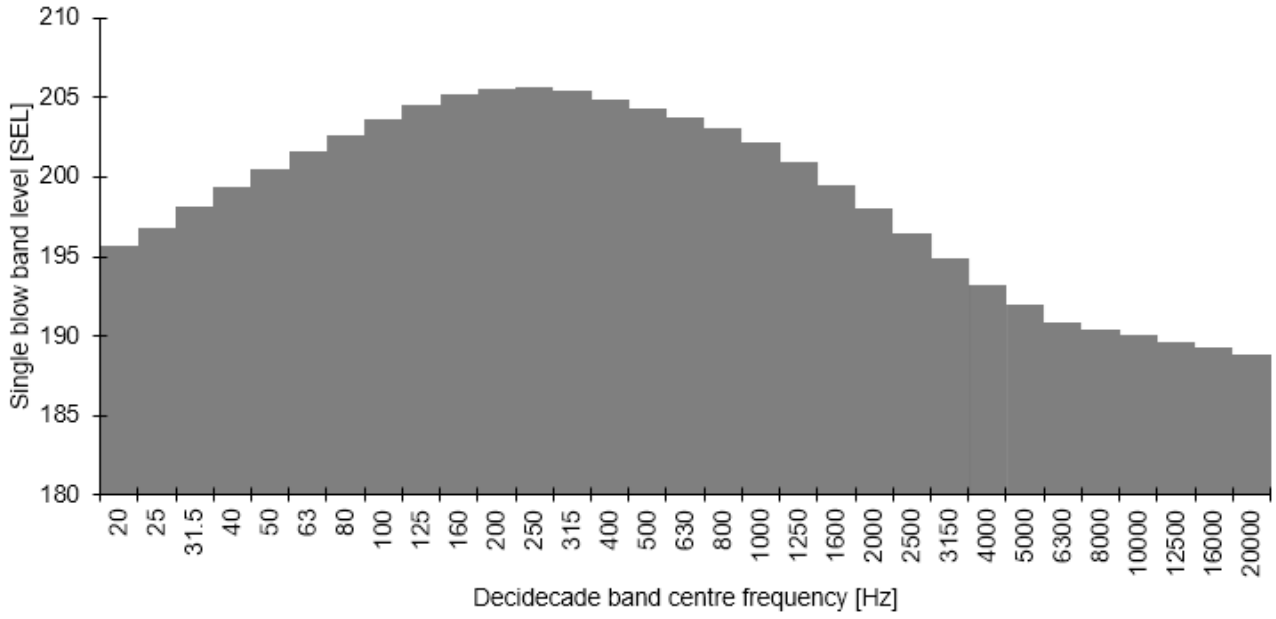

Figure 4-1: Decidecade band levels [SEL] for a single blow for impact piling of quay round piles.

4.2.2 Vibratory Piling

Sheet piles are vibrated in place between the round piles to form the quay wall. They are shorter (here assumed to be 10 m [4]), made of bent sheets rather than being round and are not “set” by impacting. Dimensions of sheet piles expected to be installed are described in Figure 4-2. The exact dimensions are not critical to the noise emissions and the final design might deviate from the stated dimension with no effect on this assessment’s outcome.

[4] The exact length is not critical for this assessment.

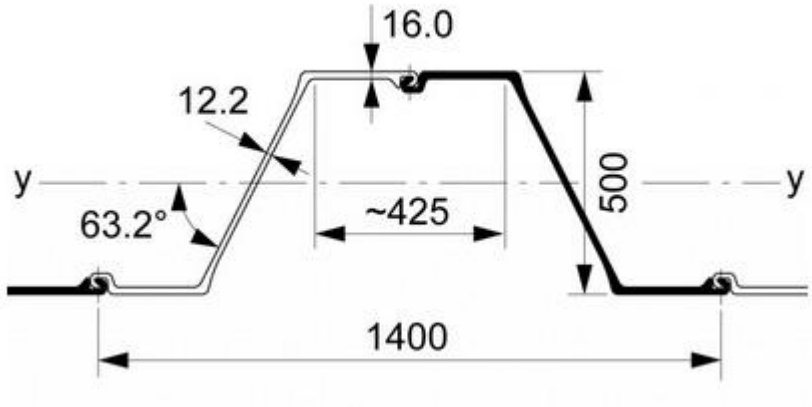

Figure 4-2: Nominal dimensions [mm] of a section of "AZ38/700" sheet pile viewed end-on.

The band levels for the vibratory piling (Figure 4-3) are based on available data from 80 measurements. As there was no clear trend in emitted sound in relation to driver energy, sheet pile dimensions or sediment, the 90th percentile band levels form the basis for the band levels used in this assessment.

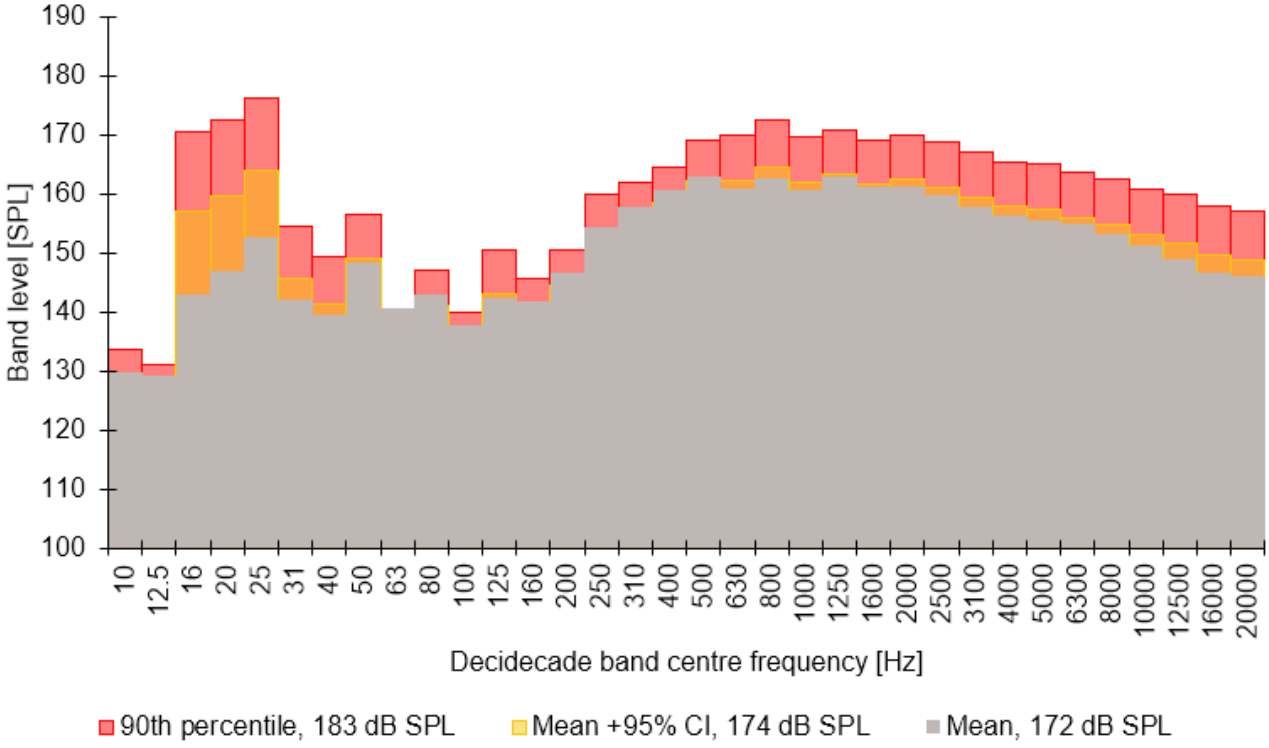

Figure 4-3: Decidecade band levels [SPL] for vibrated sheet piles. 90th percentile band levels used in the assessment.

4.3 Dolphins

During the loudest part of the impact piling of round piles at the quay single blow levels of 216 dB SEL / 250 dB L_P are expected. Accounting for the blow rate of the hammer this equates 213 dB SPL. Peak pressure level of a single blow was modelled as up to 251 dB L_P. These levels are based on the pile dimensions, hammer rating and the sediment profile (Appendix B for details on source model).

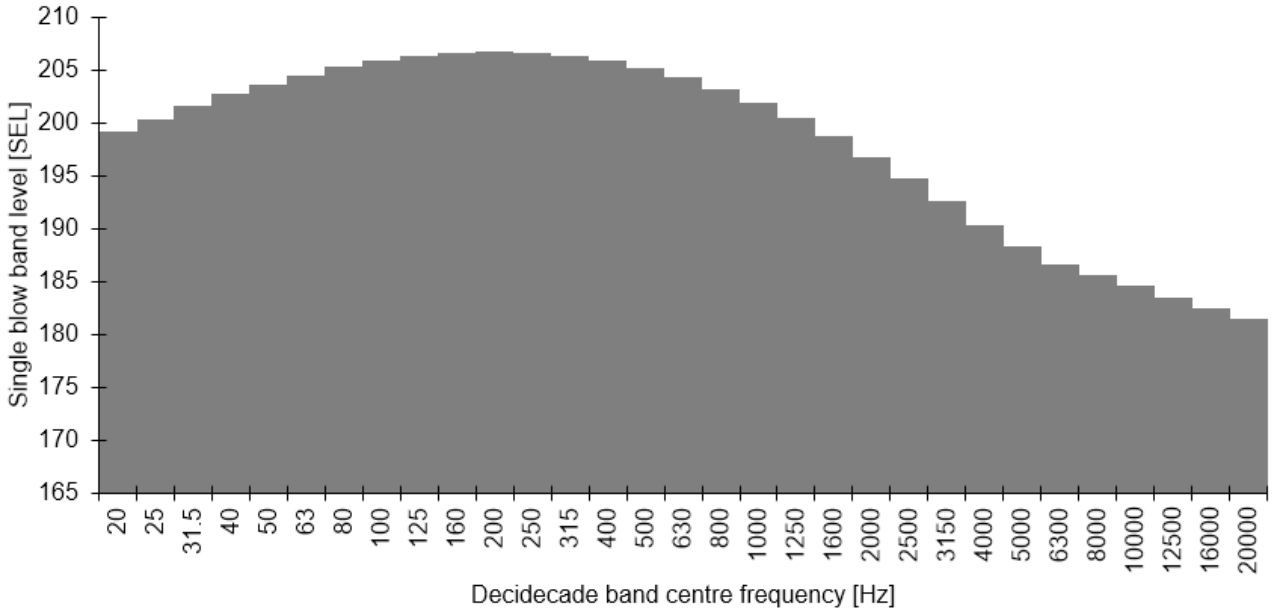

Figure 4-4: Decidecade band levels [SEL] for a single blow for impact piling of dolphin round piles.

4.4 Dredging

The dredging noise levels were based on active dredging band levels from published sources (Jong, et al., 2010; Reine, et al., 2021; Robinson, et al., 2011) as well as vessel models (Heitmeyer, 2001; Wittekind, 2014; Simard, et al., 2016). The broadband level for the dredger is 192 dB SPL with the dredging operation noise dominates at all but the lowest frequencies (<31.5 Hz).

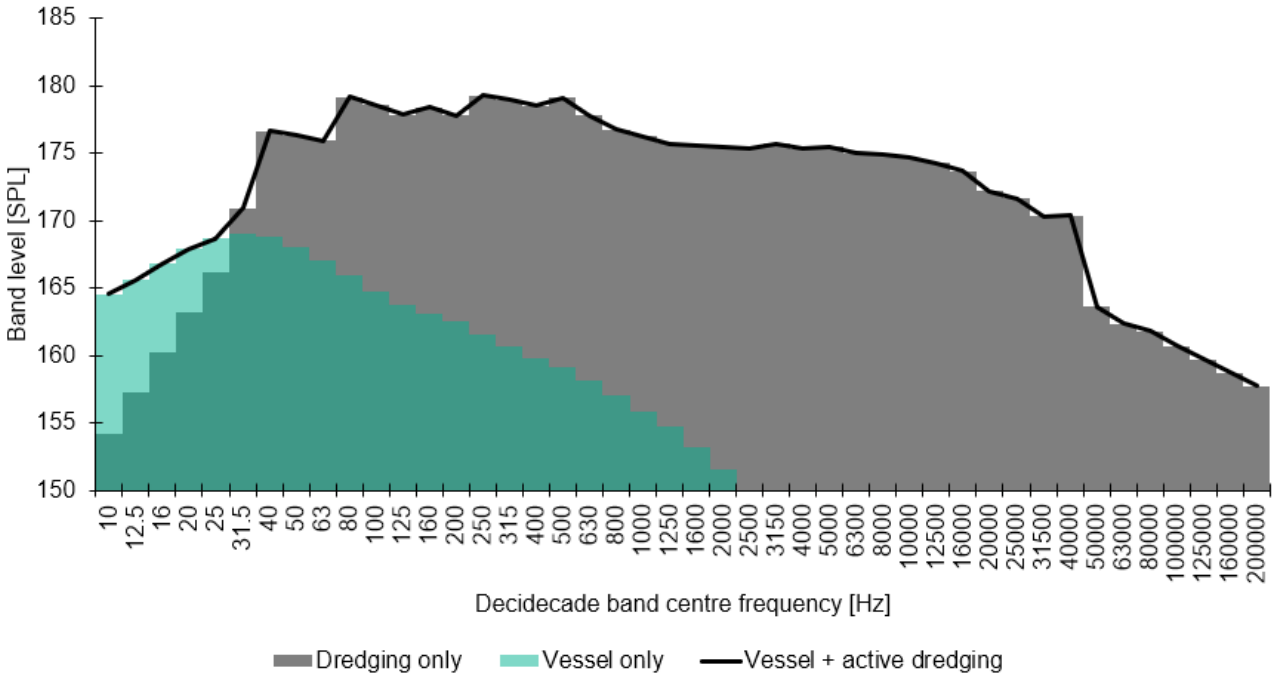

Figure 4-5: Decidecade band levels [SPL] for the active dredging noise as well as vessel noise only and dredging noise only.

5 SOUND PROPAGATION MODELLING METHODOLOGY

There are several methods available for modelling the propagation of sound between a source and receiver ranging from very simple models which simply assume spreading according to a $10 \cdot \log_{10}$(range) or $20 \cdot \log_{10}$(range) relationship to full acoustic models (e.g., ray tracing, normal mode, parabolic equation, wavenumber integration and energy flux models). In addition, semi-empirical models are available which lie somewhere in between these two extremes in terms of complexity (e.g., (Rogers, 1981; Weston, 1971)).

5.1 Semi-empirical Models

For simpler scenarios where the sediment is relatively uniform and mostly flat or where great detail in modelling is not warranted, due to uncertainty in model input or where the source level is relatively low compared to the receiver sensitivity, the speed of these simpler models is preferred over the higher accuracy of numerical models and are routinely used for these types of assessments. For this assessment we have used the “Roger’s” model (Rogers, 1981). This model is compared to measurements in the paper describing it and is capable of accurate modelling in acoustically simpler scenarios[5].

These semi-empirical models will tend to underestimate the transmission losses (leading to estimated greater than actual impact) due primarily to the omission of surface roughness, wind effects and shear waves in the sediment.

5.2 Analytical models

For the impulsive sources we have used the dBSea software’s ray tracing solver dBSeaRay, as this accounts for the full waveform propagation of an impulse. This means including surface and bottom reflections as well as time-of-arrival in the calculations. These are important to include to correctly estimate the effects of constructive and destructive interference. dBSea solvers are validated against a range of opensource solvers for so-called “standard scenarios” that have agreed solutions[6].

5.3 Exposure Calculations (dB SEL)

To compare modelled levels with the two impact assessment frameworks (Southall et al. 2019 & Popper et al. 2014) it’s necessary to calculate received levels as exposure levels, SEL, weighted for marine mammals, and unweighted for fishes. For ease of implementation sources have generally been converted to an SPL source level, meaning converting to SEL from SPL or from a number of events.
The conversion is relatively easy:

To convert from SPL to SEL the following relation can be used:

$$SEL = \mathrm{SPL} + 10 \cdot Log_{10}(t_2 - t_1) \quad (1)$$

Or where it’s inappropriate to convert SEL from one event to SEL cumulative by relating to the number of events as:

$$SEL_{,n\ events} = SEL_{\ single\ event} + 10 \cdot Log_{10}(n) \quad (2)$$

And SPL from SEL:

$$SPL = SEL_{\ single\ event} + 10 \cdot Log_{10}\left(\frac{n}{t_2 - t_1}\right) \quad (3)$$

As an animal swims away from the sound source, the noise it experiences will become progressively more attenuated; the cumulative, fleeing SEL is derived by logarithmically adding the SEL to which the mammal is exposed as it travels away from the source. This calculation is used to estimate the approximate minimum start distance for an animal in order for it to be exposed to sufficient sound energy to result in the

[5] Simpler meaning shallow in relation to the wavelengths and with no significant sound speed gradient in the water column.

[6] https://www.dbsea.co.uk/validation/

exceedance of a threshold, or to check if a set exclusion zone is sufficient for an activity (e.g. will an exclusion zone of 500 m be sufficient to prevent exceeding a PTS threshold). It should be noted that the sound exposure calculations are based on the simplistic assumption that the animal will continue to swim away at a constant speed. The real-world situation is more complex, and the animal is likely to move in a more varied manner. Reported swim speeds are summarised in Table 5-1 along with the source papers for the assumptions.

For this assessment, we used a swim speed of 1.5 m/s for marine mammals, and 0.5 m/s for fishes including sharks.

For very long fleeing durations the ambient sound itself can exceed the thresholds, e.g., an ambient sound level of 117.5 dB, weighted for the VHF group, will exceed the non-impulsive TTS threshold of 153 dB SEL after 2 hour's exposure[7]. We here consider fleeing durations of 2 hours (7200 seconds, allowing 10800 m of fleeing), meaning that weighted levels of 117.5 dB SPL will exceed the VHF group's non-impulsive TTS threshold in the fleeing model.

Table 5-1: Swim speed examples from literature

Species	Hearing Group	Swim Speed (m/s)	Source Reference
Harbour porpoise	VHF	1.5	Otani *et al.,* 2000
Harbour seal	PCW	1.8	Thompson, 2015
Grey seal	PCW	1.8	Thompson, 2015
Minke whale	LF	2.3	Boisseau *et al.,* 2021
Bottlenose dolphin	HF	1.52	Bailey and Thompson, 2010
White-beaked dolphin	HF	1.52	Bailey and Thompson, 2010
Basking shark	Group 1 fish	1.0	Sims, 2000
All other fish groups	All fish groups	0.5	Popper *et al.,* 2014

[7] 117.5 dB SPL + $10*\log_{10}$(3600 seconds) = 153.1 dB SEL, TTS non-impulsive threshold for the VHF group is 153 dB SEL.

6 RESULTS AND ASSESSMENT

Results are presented here as the geographical “risk range” to an auditory threshold (TTS/PTS/Behavioural) as given in section 2.3 & 2.5. A given risk range specifies the expected range, within which, a receiver would exceed the relevant threshold. Risk ranges are given for the estimated 90th percentile value. This value is based on the calculated 90th percentile, given mean and standard deviation of the modelled results.

The main assumptions for the validity of the results are:

1. At least one of the following two methods of soft start for impact piling can be realised:
    a. “Blow-energy reduction only” – For the duration of the soft start the impact driver is running at minimal energy, nominally 30 kJ per blow, yielding a 15 dB reduction in source levels during soft start.
    b. “Blow-energy & blow-rate reduction” – For the duration of the soft start the impact driver is running at minimal energy, nominally 30 kJ per blow and with a 10x reduction in blow rate to 1 blow per 28 seconds, yielding a 25 dB reduction in source levels during soft start.
2. Animals fleeing the area will not return within a 24-hour period.
3. Animals flee for up to 2 hours after which they will be up to 10.8 km & 3.6 km away, for marine mammals and fish respectively.
4. There will be concurrent impact piling either as “quay & quay” simultaneously or as “dolphin & quay” simultaneously.
5. Only outermost dolphin modelled as this will be the worst-case scenario for the row of dolphins.
6. Modelling assumes high tide; this is a worst-case assumption.

Result types

Several result types are presented for each activity to inform this assessment and to provide flexibility in mitigation:

1. **“1 second exposure risk range”:**
   This is the range of acute risk of impact from the activity (a one second exposure) and is presented to indicate instantaneous risk and for comparison with other studies.
   This assumes a stationary animal (during the 1-seond exposure) with all equipment operating at full power and does not include a soft start.

2. **“Minimal starting range for a fleeing animal with no soft start”:**
   The minimal range a fleeing animal needs to start fleeing from to avoid being exposed to noise exceeding its TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s.

3. **“Minimal starting range for a fleeing animal with a 30 min, -15 dB soft start”:**
   The minimal range a fleeing animal needs to start fleeing from to avoid being exposed to noise exceeding its TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s. Assuming soft start of 30 minutes with 15 dB reduction in source levels.

4. **“Minimal starting range for a fleeing animal with a 60 min, -15 dB soft start”:**
   The minimal range a fleeing animal needs to start fleeing from to avoid being exposed to noise exceeding its TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s. Assuming soft start of 60 minutes with 15 dB reduction in source levels.

5. **“Minimal starting range for a fleeing animal with a 30 min, -25 dB soft start”:**
   The minimal range a fleeing animal needs to start fleeing from to avoid being exposed to noise exceeding its TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s. Assuming soft start of 30 minutes with 25 dB reduction in source levels.

6. **“Minimal starting range for a fleeing animal with a 60 min, -25 dB soft start”:**
   The minimal range a fleeing animal needs to start fleeing from to avoid being exposed to noise

exceeding its TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s. Assuming soft start of 60 minutes with 25 dB reduction in source levels.

The next four result types (points “7” to “10”) are an effort to simplify mitigation choice by estimating the required soft start duration to avoid TTS/PTS while having specified an either 500 m or 1000 m exclusion zone.
These are based on modelling 20, 30, 40, 50 & 60-minute soft starts and deriving soft start duration from that set of results.

7. **“Estimated soft start duration for a 500 m exclusion range with a -15 dB soft start”:**
   The estimate soft start duration required for animals to avoid being exposed to noise exceeding their TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s. Assuming soft start with 15 dB reduction in source levels.

8. **“Estimated soft start duration for a 1000 m exclusion range with a -15 dB soft start”:**
   The estimate soft start duration required for animals to avoid being exposed to noise exceeding their TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s. Assuming soft start with 15 dB reduction in source levels.

9. **“Estimated soft start duration for a 500 m exclusion range with a -25 dB soft start”:**
   The estimate soft start duration required for animals to avoid being exposed to noise exceeding their TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s. Assuming soft start with 25 dB reduction in source levels.

10. **“Estimated soft start duration for a 1000 m exclusion range with a -25 dB soft start”:**
    The estimate soft start duration required for animals to avoid being exposed to noise exceeding their TTS/PTS threshold. Animals are moving in a straight line away from the source at a constant speed of 1.5 m/s. Assuming soft start with 25 dB reduction in source levels.

11. **“Peak level risk range”:**
    The range of acute risk of impact from peak pressure levels associated with the impulsive sources. *This measure is not included in tables as the range to the lowest TTS limit (fish 186 dB L_P) was ~50 m (all other groups are shorter).*

12. **“Behavioural response range”:**
    The range at which the behavioural limit for the marine mammals (160 dB SPL) or the fishes (150 dB SPL) behavioural limits for impulsive noise is exceeded.

6.1 Results

6.1.1 1-second exposure risk range

Risk ranges for a single second of exposure. For impact piling these are representative for the loudest part of the installation.

“<10” indicates the lower bound of model resolution.

PTS risk ranges are up to 400 for the VHF group for impact piling. With remaining hearing groups below 200 m.

For continuous noise (vibratory piling and dredging) all risk ranges (TTS and PTS) are below 10 m.

Table 6-1: Risk ranges for TTS and PTS for all hearing groups and locations for 1-second exposure.

Location	LF (TTS / PTS) [m]	HF (TTS / PTS) [m]	VHF (TTS / PTS) [m]	PCW (TTS / PTS) [m]	OCW (TTS / PTS) [m]	Fish (TTS / PTS) [m]
Dolphin, north-west	1200 / 200	100 / <10	1500 / 300	200 / 100	<10 / <10	200 / <10
Quay, north-east	200 / 100	100 / <10	1700 / 400	200 / 100	<10 / <10	100 / <10
Quay, mid	300 / 100	100 / <10	1700 / 400	200 / 100	<10 / <10	100 / <10
Quay, south	300 / 100	100 / <10	1700 / 400	200 / 100	<10 / <10	100 / <10
Vibratory, north-west	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, mid	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, south	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Dredging	<10 / <10	<10 / <10	100 / <10	<10 / <10	<10 / <10	<10 / <10

6.1.2 Minimal starting range for a fleeing animal with no soft start

Minimal starting ranges for animals fleeing to avoid TTS and PTS, assuming no soft start and piling at full power/during noisiest part of installation.

PTS risk ranges for the VHF hearing group are up to 5.4 km (Dolphin impact piling), meaning that a VHF group animal (harbour porpoise) would likely need to be >5.4 km away before the activity commences to avoid exceeding the PTS threshold.

For the LF hearing group the PTS ranges for the impact piling are up to 1.9 km (Dolphin impact piling), with quay impact piling ranges up to 600 m.

The PCW hearing group has PTS ranges up to 1.2 km (Dolphin impact piling), with remaining locations having risk ranges up to 400 m.

The Fish hearing group has PTS ranges up to 600 m (Dolphin impact piling), with remaining locations having risk ranges up to 100 m.

The HF hearing group has PTS ranges up to 200 m for impact piling.

For all hearing groups vibratory piling and Dredging lead to risk ranges below 10 m.

Table 6-2: Risk ranges for TTS and PTS for all hearing groups and locations when fleeing, but with no soft start.

Location	LF (TTS / PTS) [m]	HF (TTS / PTS) [m]	VHF (TTS / PTS) [m]	PCW (TTS / PTS) [m]	OCW (TTS / PTS) [m]	Fish (TTS / PTS) [m]
Dolphin, north-west	7600 / 1900	1800 / 100	7600 / 5400	6200 / 1200	800 / <10	1900 / 600
Quay, north-east	1800 / 300	1500 / 100	5400 / 3600	1800 / 200	200 / <10	500 / 100
Quay, mid	2100 / 300	1600 / 200	6400 / 4400	2000 / 300	200 / <10	500 / 100
Quay, south	2700 / 600	1700 / 200	6800 / 4600	2500 / 400	300 / <10	800 / 100
Vibratory, north-west	<10 / <10	<10 / <10	100 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, mid	<10 / <10	<10 / <10	100 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, south	<10 / <10	<10 / <10	100 / <10	<10 / <10	<10 / <10	<10 / <10
Dredging	200 / <10	<10 / <10	1800 / 100	100 / <10	<10 / <10	<10 / <10

6.1.3 Minimal starting range for a fleeing animal with a 30 min, -15 dB soft start

For the VHF group a 30-minute soft start at minimal blow energy for the impact piling the start ranges for fleeing animals are up 2.7 km to avoid exceeding the PTS threshold.

The LF hearing group has risk ranges up to 600 m for impact piling at the outermost dolphin.

Remaining hearing groups all have risk range at or below 100 m for all locations and activities.

Table 6-3: Risk ranges for TTS and PTS for all hearing groups and locations when fleeing, with a 30-minute, -15 dB source level soft start.

Location	LF (TTS / PTS) [m]	HF (TTS / PTS) [m]	VHF (TTS / PTS) [m]	PCW (TTS / PTS) [m]	OCW (TTS / PTS) [m]	Fish (TTS / PTS) [m]
Dolphin, north-west	5000 / 600	200 / <10	4900 / 2700	3600 / 100	<10 / <10	1100 / 100
Quay, north-east	300 / 100	200 / <10	2700 / 1400	300 / 100	<10 / <10	100 / <10
Quay, mid	400 / 100	200 / <10	3700 / 1900	300 / 100	<10 / <10	200 / <10
Quay, south	700 / 100	200 / <10	4100 / 2100	600 / 100	<10 / <10	200 / <10
Vibratory, north-west	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, mid	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, south	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Dredging	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10

6.1.4 Minimal starting range for a fleeing animal with a 60 min, -15 dB soft start

For the VHF group a 60-minute soft start at minimal blow energy for the impact piling the start ranges for fleeing animals are up 1.2 km to avoid exceeding the PTS threshold.

The LF hearing group has risk ranges up to 600 m for impact piling at the outermost dolphin.

Remaining hearing groups all have risk range at or below 100 m for all locations and activities.

Table 6-4: Risk ranges for TTS and PTS for all hearing groups and locations when fleeing, with a 60-minute, -15 dB source level soft start.

Location	LF (TTS / PTS) [m]	HF (TTS / PTS) [m]	VHF (TTS / PTS) [m]	PCW (TTS / PTS) [m]	OCW (TTS / PTS) [m]	Fish (TTS / PTS) [m]
Dolphin, north-west	2900 / 600*	100 / <10	2300 / 1100	1600 / 100	<10 / <10	900 / <10
Quay, north-east	300 / 100	100 / <10	2300 / 1000	200 / 100	<10 / <10	100 / <10
Quay, mid	300 / 100	200 / <10	2400 / 1100	300 / 100	<10 / <10	200 / <10
Quay, south	600 / 100	200 / <10	2500 / 1200	500 / 100	<10 / <10	200 / <10
Vibratory, north-west	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, mid	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, south	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Dredging	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10

*The rounding of the results make it seem that there is no reduction from 30-minute soft start (Table 6-3) to a 60-minute soft start, but there is an actual c. 50 m difference.

6.1.5 Minimal starting range for a fleeing animal with a 30 min, -25 dB soft start

For the VHF group a 30-minute soft start at minimal blow energy and longer inter-blow-interval for the impact piling the start ranges for fleeing animals are up 2.7 km to avoid exceeding the PTS threshold.

The LF hearing group has risk ranges up to 600 m for impact piling at the outermost dolphin.

Remaining hearing groups all have risk range at or below 100 m for all locations and activities.

Table 6-5: Risk ranges for TTS and PTS for all hearing groups and locations when fleeing, with a 30-minute, -25 dB source level soft start.

Location	LF (TTS / PTS) [m]	HF (TTS / PTS) [m]	VHF (TTS / PTS) [m]	PCW (TTS / PTS) [m]	OCW (TTS / PTS) [m]	Fish (TTS / PTS) [m]
Dolphin, north-west	4900 / 100	<10 / <10	4900 / 2700*	3500 / <10	<10 / <10	1000 / <10
Quay, north-east	100 / 100	<10 / <10	2700 / 900	100 / <10	<10 / <10	100 / <10
Quay, mid	200 / 100	<10 / <10	3700 / 1700	100 / <10	<10 / <10	100 / <10
Quay, south	400 / 100	<10 / <10	4100 / 1900	200 / <10	<10 / <10	100 / <10
Vibratory, north-west	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, mid	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, south	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Dredging	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10

*The rounding of the results make it seem that there is no reduction from 30-minute soft start (Table 6-3).

6.1.6 Minimal starting range for a fleeing animal with a 60 min, -25 dB soft start

For the VHF group a 60-minute soft start at minimal blow energy and longer inter-blow-interval for the impact piling the start ranges for fleeing animals are up 400 m to avoid exceeding the PTS threshold.

Remaining hearing groups all have risk range at or below 100 m for all locations and activities.

Table 6-6: Risk ranges for TTS and PTS for all hearing groups and locations when fleeing, with a 60-minute, -25 dB source level soft start.

Location	LF (TTS / PTS) [m]	HF (TTS / PTS) [m]	VHF (TTS / PTS) [m]	PCW (TTS / PTS) [m]	OCW (TTS / PTS) [m]	Fish (TTS / PTS) [m]
Dolphin, north-west	2200 / 100	<10 / <10	2200 / 400	900 / <10	<10 / <10	400 / <10
Quay, north-east	100 / 100	<10 / <10	1000 / 300	100 / <10	<10 / <10	100 / <10
Quay, mid	200 / 100	<10 / <10	1100 / 300	100 / <10	<10 / <10	100 / <10
Quay, south	200 / 100	<10 / <10	1400 / 300	100 / <10	<10 / <10	100 / <10
Vibratory, north-west	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, mid	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Vibratory, south	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10
Dredging	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / <10

6.1.7 Estimated soft start duration for a 500 m exclusion range with a -15 dB soft start.

A 500 m exclusion zone paired with a 60-minute, -15 dB soft start for impact piling will prevent exceedance of the PTS threshold by fleeing receivers of the VHF hearing group.

All other groups have lower requirement for soft start duration.

Table 6-7: Required soft start duration with -15 dB source level soft start to achieve a 500 m exclusion zone.

Location	LF (TTS / PTS) [minutes]	HF (TTS / PTS) [minutes]	VHF (TTS / PTS) [minutes]	PCW (TTS / PTS) [minutes]	OCW (TTS / PTS) [minutes]	Fish (TTS / PTS) [minutes]
Dolphin, north-west	90 / 40	30 / 0	80 / 70	80 / 30	20 / 0	70 / 0
Quay, north-east	40 / 0	30 / 0	80 / 60	40 / 0	0 / 0	0 / 0
Quay, mid	40 / 0	30 / 0	80 / 60	40 / 0	0 / 0	0 / 0
Quay, south	50 / 0	30 / 0	80 / 60	40 / 0	0 / 0	20 / 0
Vibratory, north-west	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Vibratory, mid	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Vibratory, south	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Dredging	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

6.1.8 Estimated soft start duration for a 1000 m exclusion range with a -15 dB soft start.

A 1000 m exclusion zone paired with a 60-minute, -15 dB soft start for impact piling will prevent exceedance of the PTS threshold by fleeing receivers of the VHF hearing group.

All other groups have lower requirement for soft start duration.

Table 6-8: Required soft start duration with -15 dB source level soft start to achieve a 1000 m exclusion zone.

Location	LF (TTS / PTS) [minutes]	HF (TTS / PTS) [minutes]	VHF (TTS / PTS) [minutes]	PCW (TTS / PTS) [minutes]	OCW (TTS / PTS) [minutes]	Fish (TTS / PTS) [minutes]
Dolphin, north-west	80 / 30	20 / 0	80 / 60	70 / 0	0 / 0	50 / 0
Quay, north-east	20 / 0	20 / 0	70 / 50	20 / 0	0 / 0	0 / 0
Quay, mid	30 / 0	20 / 0	70 / 60	30 / 0	0 / 0	0 / 0
Quay, south	40 / 0	20 / 0	80 / 60	30 / 0	0 / 0	0 / 0
Vibratory, north-west	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Vibratory, mid	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Vibratory, south	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Dredging	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

6.1.9 Estimated soft start duration for a 500 m exclusion range with a -25 dB soft start.

A 500 m exclusion zone paired with a 60-minute, -25 dB soft start for impact piling will prevent exceedance of the PTS threshold by fleeing receivers of the VHF hearing group.

All other groups have lower requirement for soft start duration.

Table 6-9: Required soft start duration with -25 dB source level soft start to achieve a 500 m exclusion zone.

Location	LF (TTS / PTS) [minutes]	HF (TTS / PTS) [minutes]	VHF (TTS / PTS) [minutes]	PCW (TTS / PTS) [minutes]	OCW (TTS / PTS) [minutes]	Fish (TTS / PTS) [minutes]
Dolphin, north-west	80 / 30	30 / 0	80 / 60	70 / 30	20 / 0	60 / 0
Quay, north-east	30 / 0	30 / 0	70 / 50	30 / 0	0 / 0	0 / 0
Quay, mid	40 / 0	30 / 0	70 / 50	30 / 0	0 / 0	0 / 0
Quay, south	40 / 0	30 / 0	70 / 60	40 / 0	0 / 0	20 / 0
Vibratory, north-west	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Vibratory, mid	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Vibratory, south	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Dredging	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

6.1.10 Estimated soft start duration for a 1000 m exclusion range with a -25 dB soft start.

A 1000 m exclusion zone paired with a 50-minute, -25 dB soft start for impact piling will prevent exceedance of the PTS threshold by fleeing receivers of the VHF hearing group.

All other groups have lower requirement for soft start duration.

Table 6-10: Required soft start duration with -25 dB source level soft start to achieve a 1000 m exclusion zone.

Location	LF (TTS / PTS) [minutes]	HF (TTS / PTS) [minutes]	VHF (TTS / PTS) [minutes]	PCW (TTS / PTS) [minutes]	OCW (TTS / PTS) [minutes]	Fish (TTS / PTS) [minutes]
Dolphin, north-west	80 / 20	20 / 0	80 / 60	60 / 0	0 / 0	40 / 0
Quay, north-east	20 / 0	20 / 0	60 / 40	20 / 0	0 / 0	0 / 0
Quay, mid	30 / 0	20 / 0	70 / 50	20 / 0	0 / 0	0 / 0
Quay, south	30 / 0	20 / 0	70 / 50	30 / 0	0 / 0	0 / 0
Vibratory, north-west	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Vibratory, mid	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Vibratory, south	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Dredging	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

6.1.11 Peak level risk range

Table 6-11: Risk ranges for TTS and PTS for all hearing groups and locations for peak pressure [dB L_P].

Location	LF (TTS / PTS) [m]	HF (TTS / PTS) [m]	VHF (TTS / PTS) [m]	PCW (TTS / PTS) [m]	OCW (TTS / PTS) [m]	Fish (TTS / PTS) [m]
Dolphin, north-west	200 / 100	100 / 100	1400 / 600	300 / 100	100 / 100	1500 / 400
Quay, mid	200 / 100	100 / 100	1000 / 700	300 / 100	100 / 100	1500 / 400

6.1.12 Behavioural response range

Behavioural response ranges for all activities.

Marine mammal threshold for impulsive noise is 160 dB SPL, and 120 dB SPL for non-impulsive.

Fish limits are assumed to be 150 dB SPL or 150 dB $SEL_{1\text{-second}}$, whichever is exceeded first, for both noise types (section 2.5).

As noted in section 2.4 and 2.5 these behavioural limits are often problematic given that they are not backed by the same rigorous scientific work as the TTS/PTS thresholds and being unweighted ignores frequency-dependent propagation effects and variations in hearing capability between hearing groups.

Behavioural disturbance ranges for impulsive noises (impact piling) are below 1.7 km for marine mammals, and up to 2.8 km for fish. For non-impulsive noise (dredging and vibratory piling) these ranges are 1.3-7.7 km for marine mammals and 80-530 m for fish.

Table 6-12: Behavioural response ranges. Note that all marine mammals have the same threshold for behavioural response.

Location	Marine mammals [m]	Fish [m]
Dolphin, north-west	1680	2800
Quay, north-east	370	1010
Quay, mid	400	1070
Quay, south	640	1238
Vibratory, north-west	1300	80
Vibratory, mid	1500	120
Vibratory, south	1700	110
Dredging	7700	530

6.2 Results Summary

6.2.1 Impact piling

All impact piling modelled resulted in large risk ranges. While these ranges are expected where the animal remains in a straight line-of-sight from the activity, they are exceedingly conservative where an animal swims around an acoustic obstacle. For this site, given the land geometry and presence of several islands (Figure 3-1), this effect may be significant in reducing the needed fleeing durations for a proportion of the animals.

6.2.1.1 Dolphin

For the unmitigated impact piling the risk ranges for PTS are up to 5.4 km for the VHF hearing group, meaning a fleeing path starting 5.4 km from the impact piling location can avoid exceeding the PTS Threshold (Table 6-2).

The VHF hearing group is the group requiring largest ranges/longest softs starts and is the focus here, but the LF and PCW groups have significant risk ranges too.

6.2.1.2 Quay

For the unmitigated impact piling the risk ranges for PTS are up to 4.6 km for the VHF hearing group, meaning a fleeing path starting 4.6 km from the impact piling location can avoid exceeding the PTS Threshold (Table 6-2).

The VHF hearing group is the group requiring largest ranges/longest soft starts and is the focus here, but the LF and PCW groups have significant risk ranges too.

6.2.2 Vibratory Piling

All hearing groups have risk ranges shorter than 10 m for vibratory piling.

6.2.3 Dredging

The VHF hearing group has a PTS risk range to 100 m, while the remaining groups have risk ranges shorter than 10 m for the dredging activity.

6.2.4 Mitigation

No mitigation is required for vibratory piling or dredging, the two impact piling location are addressed separately below.

6.2.4.1 Dolphin

To reduce risk ranges, soft starts (or other mitigation) is necessary with two examples outlined below.

To achieve an exclusion zone of 500 m:

- Introduce either a 70-minute soft start with a -15 dB reduction in source level (1.a, section 6) or
- A 60-minute soft start with a 25 dB reduction in source level (1.b, section 6)

To achieve a 1000 m exclusion zone:

- Introduce either a 60-minute soft start with a -15 dB reduction in source level (1.a, section 6) or
- A 60-minute soft start with a 25 dB reduction in source level (1.b, section 6)[8].

These exclusion zones should be verified as absent of marine mammals in accordance with JNCC guidance in relation to pile driving (JNCC, 2010) prior to the commencement of the soft starts.

Alternative mitigation (not modelled as part of this assessment) can be pursued, such as:

- Only piling during low tide, given the shallow water, there is a significant difference in sound propagation between tidal states, and it's likely that acoustic impact could be significantly lessened. E.g., assuming low tide (MSL-1.68 m) the risk range for the VHF group is reduced to 1.6 km (from 2.6 km) for a 30 min soft start, and from 5.4 km to 4.0 km with no soft start.
- Adding an attenuator, e.g., a cofferdam or a bubble net around the piling operation – this is costly, but effective and practical given the shallow depths.

6.2.4.2 Quay

To reduce risk ranges soft starts (or other mitigation) is necessary with two examples outlined below.

To achieve an exclusion zone of 500 m:

- Introduce either a 60-minute soft start with a -15 dB reduction in source level (1.a, section 6)

To achieve a 1000 m exclusion zone:

- Introduce either a 60-minute soft start with a -15 dB reduction in source level (1.a, section 6) or
- A 50-minute soft start with a 25 dB reduction in source level (1.b, section 6).

These exclusion zones should be verified as absent of marine mammals in accordance with JNCC guidance in relation to pile driving (JNCC, 2010) prior to the commencement of the soft starts.

Alternative mitigation (not modelled as part of this assessment) can be pursued, such as:

- Only piling during low tide, given the shallow water, there is a significant difference in sound propagation between tidal states, and it's likely that acoustic impact could be significantly lessened (see example in section 6.2.4.1).
- Adding an attenuator, e.g., a cofferdam or a bubble net around the piling operation – this is costly, but effective and practical given the shallow depths.

[8] Due to the logarithmic nature of transmission losses and rounding of results values (to nearest 10 m or two significant digits), this figure is not meaningfully different from a 500 m exclusion zone for the VHF hearing group.

7 CONCLUSIONS

This assessment concludes that the vibratory piling and dredging associated the Project pose little to no risk of causing auditory injury to marine mammals or fish.

For the impact piling adherence to soft-start procedures as described in section 6.2.4 are required to mitigate the risk of auditory injury to marine mammals.

Given the large risk ranges or long soft start periods required, we suggest additional modelling be carried out to establish the effects of introducing other mitigation measures such as limited impact piling during high tide or the use of sound barriers (cofferdams or bubble nets) to shorten both risk ranges and soft start durations.

The large risk ranges can be cause for concern in terms of dispersing animals a significant distance, this is further cause for seeking alternative or additional mitigation measures.

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Appendix A – Acoustic Concepts and Terminology

Sound travels through water as vibrations of the fluid particles in a series of pressure waves. The waves comprise a series of alternating compressions (positive pressure variations) and rarefactions (negative pressure fluctuations). Because sound consists of variations in pressure, the unit for measuring sound is usually referenced to a unit of pressure, the Pascal (Pa). The unit usually used to describe sound is the decibel (dB) and, in the case of underwater sound, the reference unit is taken as 1 µPa, one micro-pascal, whereas airborne sound is usually referenced to a pressure of 20 µPa. To convert from a sound pressure level referenced to 20 µPa to one referenced to 1 µPa, a factor of 20 log (20/1) i.e. 26 dB has to be added to the former quantity. Thus, a sound pressure of 60 dB re 20 µPa is the same as 86 dB re 1 µPa, although care also needs to be taken when converting from in air sound to in water sound levels due to the different sound speeds and densities of the two mediums resulting in a conversion factor of approximately 62 dB for comparing intensities (watt/m²), see Table 8-1 , below.

Table 8-1: Comparing sound quantities between air and water.

	Constant intensity		Constant pressure	
Properties	**Air**	**Water**	**Air**	**Water**
Soundspeed (C) [m/s]	340	1500	340	1500
Density (ρ) [kg/m³]	1.293	1026	1.293	1026
Acoustic impedance (Z=C·ρ) [kg/(m²·s) or (Pa·s)/m³]	440	1539000	440	1539000
Sound intensity (I=p²/Z) [Watt/m²]	1	1	22.7469	0.0065
Sound pressure (p=(I*Z)^{½}) [Pa]	21	1241	100	100
Particle velocity (I/p) [m/s]	0.04769	0.00081	0.22747	0.00006
dB re 1 µPa²	146.4	**181.9**	160.0	**160.0**
dB re 20 µPa²	**120.4**	155.9	**134.0**	134.0
Difference dB re 1 µPa² & dB re 20 µPa²	**61.5**		**26.0**	

All underwater sound pressure levels in this report are described in dB re 1 µPa². In water, the sound source strength is defined by its sound pressure level in dB re 1 µPa², referenced back to a representative distance of 1m from an assumed (infinitesimally small) point source. This allows calculation of sound levels in the far-field. For large, distributed sources, the actual sound pressure level in the near-field will be lower than predicted.

There are several descriptors used to characterise a sound wave. The difference between the lowest pressure deviation (rarefaction) and the highest pressure deviation (compression) from ambient is the peak to peak (or pk-pk) sound pressure (L_{P-P} for the level in dB), Note that L_{P-P} can be hard to measure consistently, as the maximal duration between the lowest and highest pressure deviation is not standardised. The difference between the highest deviation (either positive or negative) and the ambient pressure is called the peak pressure (L_P for the level in dB). Lastly, the average sound pressure is used as a description of the average amplitude of the variations in pressure over a specific time window (SPL for the level in dB). SPL is equal to the L_{eq} when the time window for the SPL is equal to the time window for the total duration of an event. The cumulative sound energy from pressure is the integrated squared pressure over a given period (SEL for the level in dB). These descriptions are shown graphically in Figure 8-1 and reflect the units as given in ISO 18405:2017, “Underwater Acoustics – Terminology”.

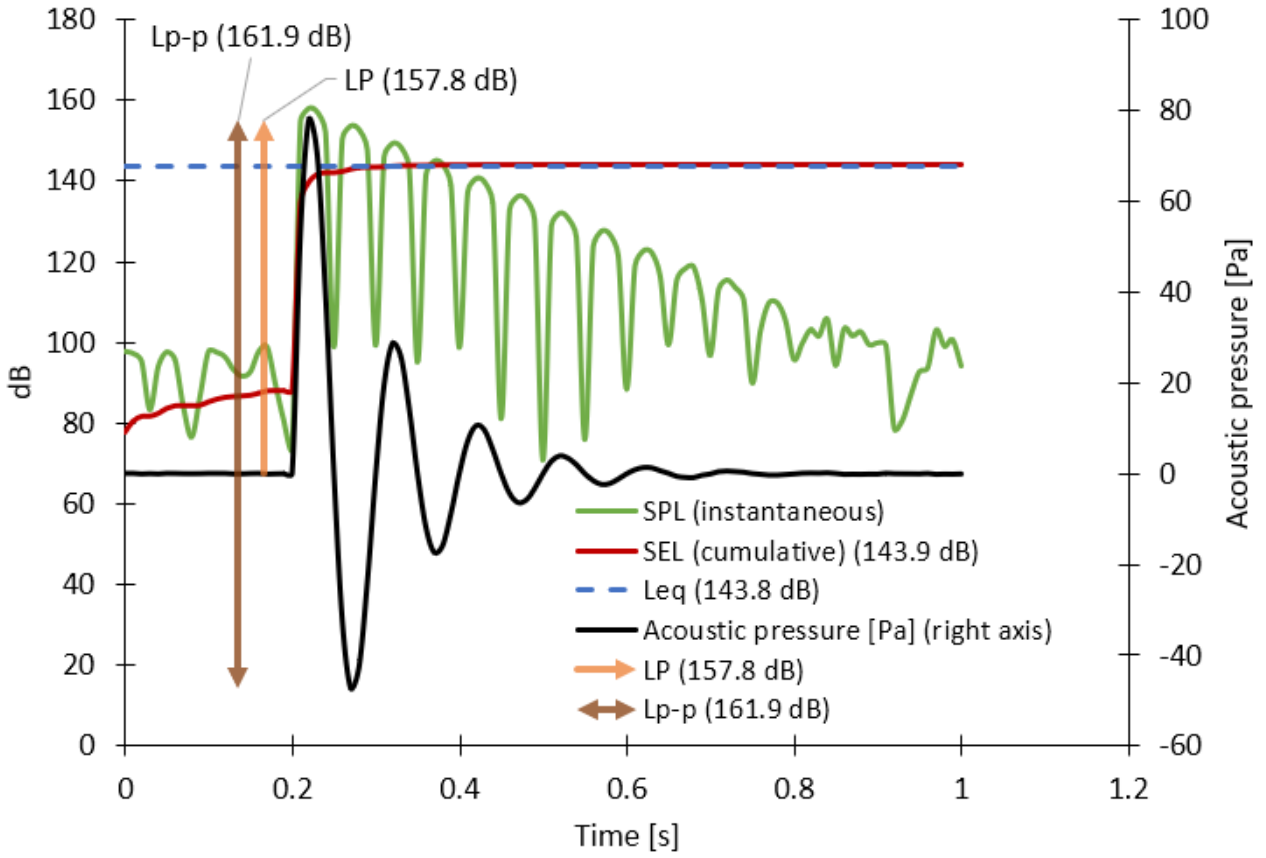

Figure 8-1: Graphical representation of acoustic wave descriptors ("LE" = SEL).

The sound pressure level (SPL[9]) is defined as follows (ISO 18405:2017, 3.2.1.1):

$$SPL = 10 \cdot Log_{10}\left(\frac{\overline{p^2}}{1 \cdot 10^{-12} Pa}\right) \quad (1)$$

Here $\overline{p^2}$ is the arithmetic mean of the squared pressure values. Note that L_P is simply the instantaneous SPL (ISO 18405:2017, 3.2.2.1).

The peak sound pressure level, L_P, is the instantaneous decibel level of the maximal deviation from ambient pressure and is defined in (ISO 18405:2017, 3.2.2.1) and can be calculated as:

$$L_P = 10 \cdot Log_{10}\left(\frac{max(p^2)}{1 \cdot 10^{-12} Pa}\right)$$

Another useful measure of sound used in underwater acoustics is the Exposure Level, or SEL. This descriptor is used as a measure of the total sound energy of a single event or a number of events (e.g. over the course of a day). This allows the total acoustic energy contained in events lasting a different amount of time to be compared on a like for like basis. Historically, use was primarily made of SPL and L_P metrics for assessing the potential effects of sound on marine life. However, the SEL is increasingly being used as it allows exposure duration and the effect of exposure to multiple events over e.g. a 24-hour period to be taken into account. The SEL is defined as follows (ISO 18405:2017, 3.2.1.5):

$$SEL = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right) \quad (2)$$

To convert from SEL to SPL the following relation can be used:

$$SEL = \mathrm{SPL} + 10 \cdot Log_{10}(t_2 - t_1) \quad (3)$$

[9] Equivalent to the commonly seen "RMS-level".

Converting from a single event to multiple events for SEL:

$$SEL_{n\ events} = SEL_{single\ event} + 10 \cdot Log_{10}(n) \quad (4)$$

The frequency, or pitch, of the sound is the rate at which these oscillations occur and is measured in cycles per second, or Hertz (Hz). When sound is measured in a way which approximates to how a human would perceive it using an A-weighting filter on a sound level meter, the resulting level is described in values of dB(A). However, the hearing faculties of marine mammals and fish are not the same as humans, with marine mammals hearing over a wider range of frequencies, fish over a typically smaller range of frequencies and both with different sensitivities. It is therefore important to understand how an animal's hearing varies over the entire frequency range to assess the effects of sound on marine life. Consequently, use can be made of frequency weighting scales to determine the level of the sound in comparison with the auditory response of the animal concerned. A comparison between the typical hearing response curves for fish, humans and marine mammals is shown in Figure 8-2. Note that hearing thresholds are sometimes shown as audiograms with sound level on the y axis rather than sensitivity, resulting in the graph shape being the inverse of the graph shown. It is also worth noting that some fish are sensitive to particle velocity rather than pressure, although paucity of data relating to particle velocity levels for anthropogenic sound sources means that it is often not possible to quantify this effect.

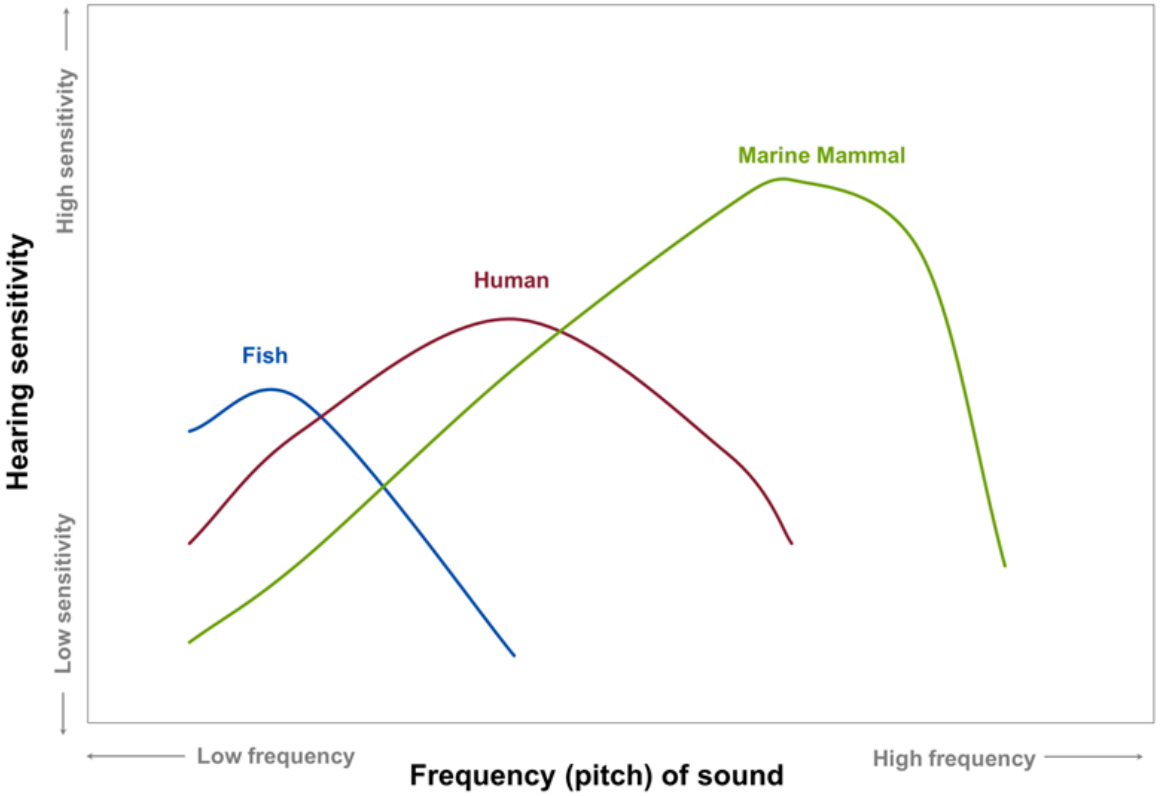

Figure 8-2: Comparison between hearing thresholds of different marine animals and humans.

Review of Sound Propagation Concepts

Increasing the distance from the sound source usually results in the level of sound getting lower, due primarily to the spreading of the sound energy with distance, analogous to the way in which the ripples in a pond spread after a stone has been thrown in.

The way that the sound spreads will depend upon several factors such as water column depth, pressure, temperature gradients, salinity, as well as water surface and seabed conditions. Thus, even for a given locality, there are temporal variations to the way that sound will propagate. However, in simple terms, the sound energy may spread out in a spherical pattern (close to the source, with no boundaries) or a cylindrical pattern (much further from the source, bounded by the surface and the sediment), although other factors mean that decay in sound energy may be somewhere between these two simplistic cases.

In acoustically shallow waters[10] in particular, the propagation mechanism is coloured by multiple interactions with the seabed and the water surface (Lurton, 2002; Etter, 2013; Urick, 1983; Brekhovskikh and Lysanov 2003, Kinsler et al., 1999). Whereas in deeper waters, the sound will propagate further without encountering the surface or bottom of the sea, in shallower waters the sound is reflected many times by the surface and sediment.

At the sea surface, the majority of sound is reflected back into the water due to the difference in acoustic impedance (i.e. sound speed and density) between air and water. However, scattering of sound at the surface of the sea is an important factor with respect to the propagation of sound from a source. In an ideal case (i.e. for a perfectly smooth sea surface), the majority of sound wave energy will be reflected back into the sea. However, for rough waters, much of the sound energy is scattered (Eckart, 1953; Fortuin, 1970; Marsh, Schulkin, and Kneale, 1961; Urick and Hoover, 1956). Scattering can also occur due to bubbles near the surface such as those generated by wind or fish or due to suspended solids in the water such as particulates and marine life. Scattering is more pronounced for higher frequencies than for low frequencies and is dependent on the sea state (i.e. wave height). However, the various factors affecting this mechanism are complex. Generally, the scattering effect at a particular frequency depends on the physical size of the roughness in relation to the wavelength of the frequency of interest.

As surface scattering results in differences in reflected sound, its effect will be more important at longer ranges from the source sound and in acoustically shallow water (i.e. where there are multiple reflections between the source and receiver). The degree of scattering will depend upon the water surface smoothness/wind speed, water depth, frequency of the sound, temperature gradient, grazing angle and range from source. Depending upon variations in the aforementioned factors, significant scattering could occur at sea state 3 or more for higher frequencies (e.g. 15 kHz or more). It should be noted that variations in propagation due to scattering will vary temporally (primarily due to different sea-states/wind speeds at different times) and that more sheltered areas (which are more likely to experience calmer waters) could experience surface scattering to a lesser extent, and less frequently, than less sheltered areas which are likely to encounter rougher waters. However, over shorter ranges (e.g. within 10-20 times the water depth) the sound will experience fewer reflections and so the effect of scattering should not be significant. Consequently, over the likely distances over which injury will occur, this effect is unlikely to significantly affect the injury ranges presented in this report, and not including this effect will overestimate the impact.

When sound waves encounter the seabed, the amount of sound reflected will depend on the geoacoustic properties of the seabed (e.g. grain size, porosity, density, sound speed, absorption coefficient and roughness) as well as the grazing angle (see Figure 8-3[11]) and frequency of the sound (Cole, 1965; Hamilton, 1970; Mackenzie, 1960; McKinney and Anderson, 1964; Etter, 2013; Lurton, 2002; Urick, 1983). Thus, seabeds comprising primarily of mud or other acoustically soft sediment will reflect less sound than acoustically harder seabeds such as rock or sand. This effect also depends on the profile of the seabed (e.g. the depth of the sediment layers and how the geoacoustic properties vary with depth below the sea floor). The sediment interaction is less pronounced at higher frequencies (a few kHz and above) where interaction is primarily with the top few cm of the sediment (related to the wavelength). A scattering effect (similar to that which occurs at the surface) also occurs at the seabed (Essen, 1994; Greaves and Stephen, 2003; McKinney and Anderson, 1964; Kuo, 1992), particularly on rough substrates (e.g. pebbles and larger).

[10] Acoustically, shallow water conditions exist whenever the propagation is characterised by multiple reflections with both the sea surface and seabed (Etter, 2013). Consequently, the depth at which water can be classified as acoustically deep or shallow depends upon numerous factors including the sound speed gradient, water depth, sediment type, frequency of the sound and distance between the source and receiver.

[11] The density of “rays” indicate difference in effective propagation angle from the source, with acoustically harder sediments (gravel) having better reflection at steeper angles leading to more “rays” being effectively propagated (no significant bottom attenuation) in the waveguide. Beam shape indicated in left chart, with the black line showing the same received level.

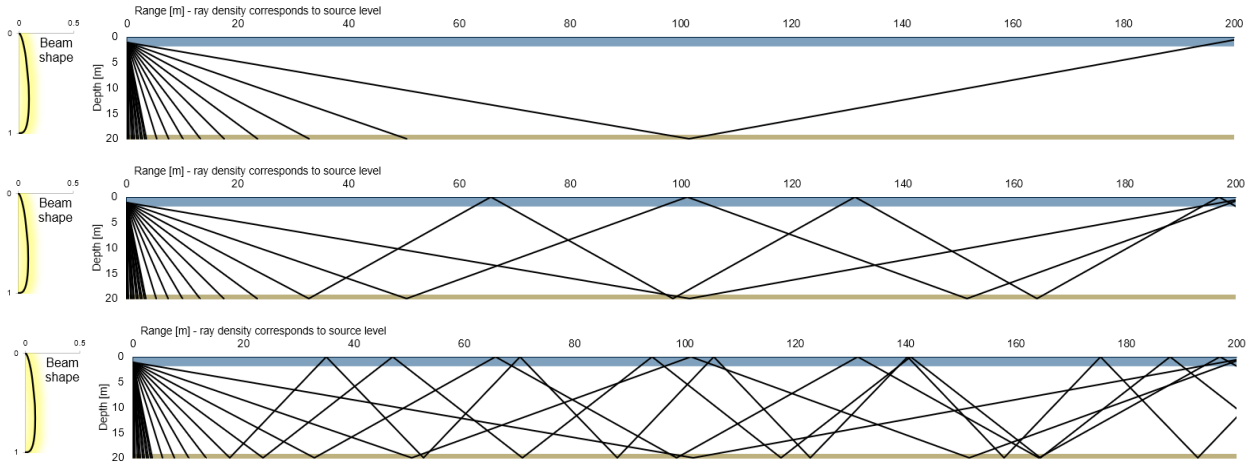

Figure 8-3: Schematic of the effect of sediment on sources with narrow beams. Sediments range from fine silt (top panel), sand (middle panel), and gravel (lower panel).

Another phenomenon is the waveguide effect which means that shallow water columns do not allow the propagation of low frequency sound (Urick, 1983; Etter, 2013). The cut-off frequency of the lowest mode in a channel can be calculated based on the water depth and knowledge of the sediment geoacoustic properties. Any sound below this frequency will not propagate far due to energy losses through multiple reflections. The cut-off frequency as a function of water depth is shown in Figure 8-4 for a range of seabed types. Thus, for a water depth of 10m (i.e. shallow waters typical of coastal areas and estuaries) the cut-off frequency would be approximately 70Hz for sand, 115Hz for silt, 155Hz for clay and 10Hz for bedrock.

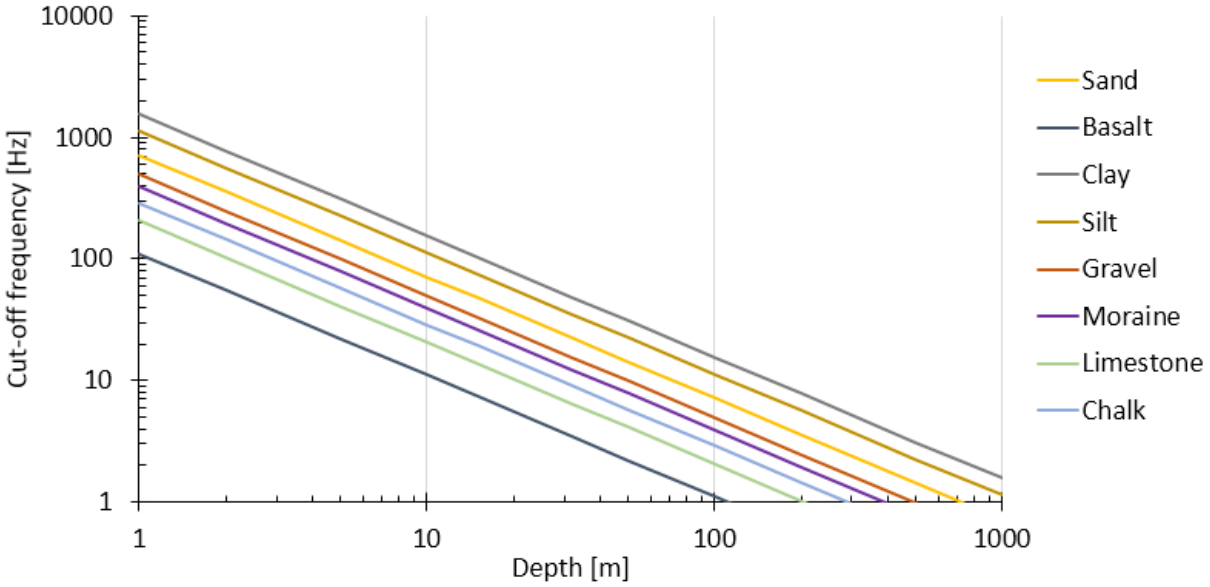

Figure 8-4: Lower cut-off frequency as a function of depth for a range of seabed types.

Changes in the water temperature and the hydrostatic pressure with depth mean that the speed of sound varies throughout the water column. This can lead to significant variations in sound propagation and can also lead to sound channels, particularly for high-frequency sound. Sound can propagate in a duct-like manner within these channels, effectively focussing the sound, and conversely, they can also lead to shadow zones. The frequency at which this occurs depends on the characteristics of the sound channel but, for example, a 25m thick layer would not act as a duct for frequencies below 1.5kHz. The temperature gradient can vary throughout the year and thus there will be potential variation in sound propagation depending on the season.

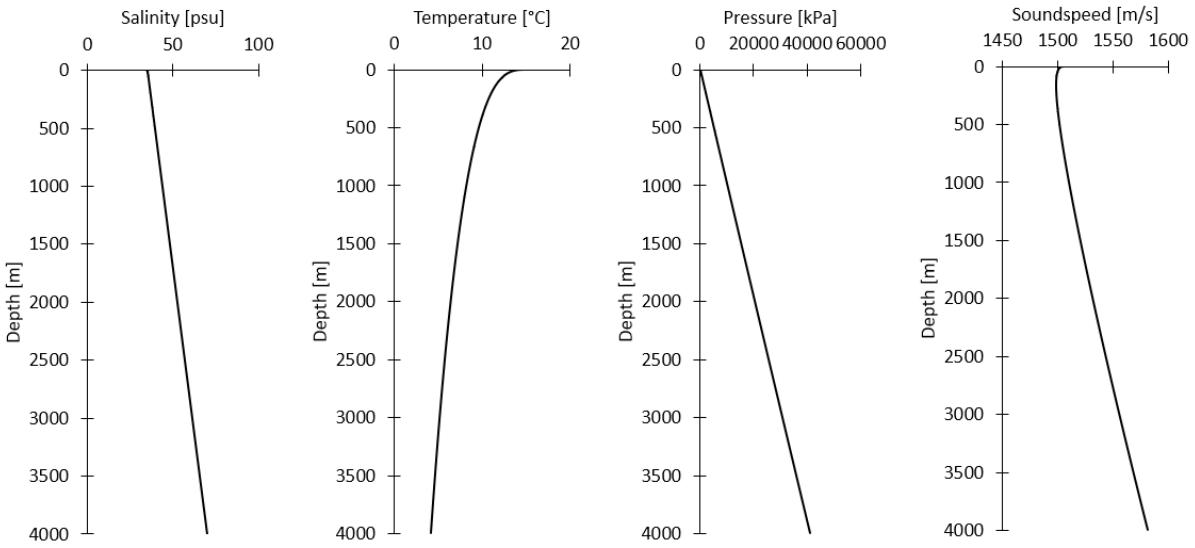

Figure 8-5: Soundspeed profile as a function of salinity, temperature and pressure.

Wind can make a significant difference to the soundspeed in the uppermost layers as the introductions of bubbles decreases the soundspeed and refracts (bends) the sound towards the surface, where the increased roughness and bubbles from the wind will cause increased transmission loss.

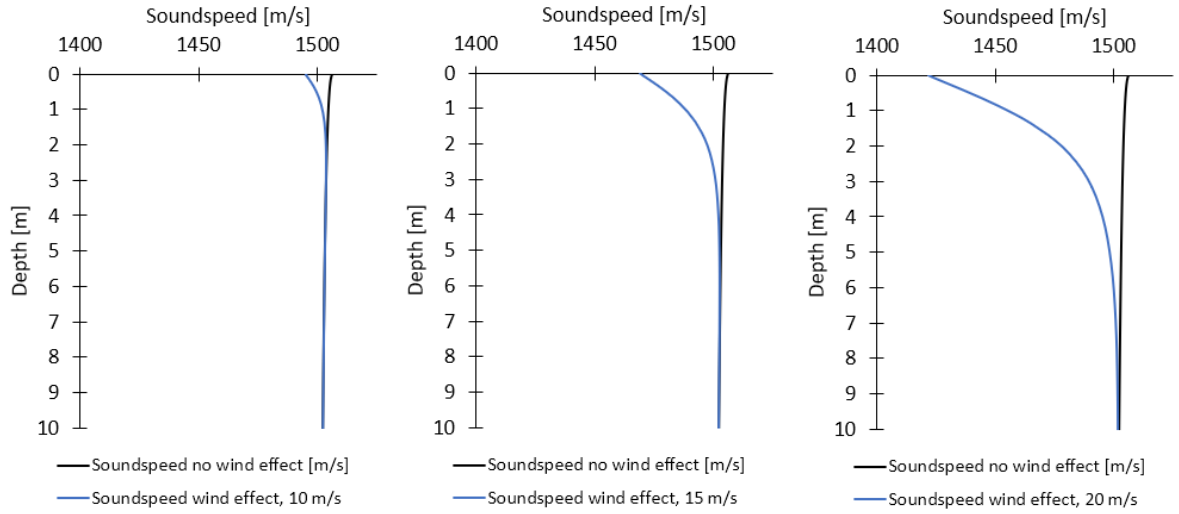

Figure 8-6: Effect of wind (at 10 m height) on upper portion of soundspeed profile.

Sound energy can also be absorbed due to interactions at the molecular level converting the acoustic energy into heat. This is another frequency dependent effect with higher frequencies experiencing much higher losses than lower frequencies. This is shown in Figure 8-7 where the variation of the absorption (sometimes called volume attenuation) is shown for various salinities and temperatures. As the effect is proportional to the wavelength, colder water, with slower soundspeed/period and being slightly more viscous, will have more absorption. Higher salinity slightly decreases absorption at low frequencies (mostly due to increase in soundspeed and wavelength/period), but much higher absorption at higher frequencies where interaction with pressure sensitive molecules of magnesium sulphite and boric acid increase the conversion acoustic energy to heat.

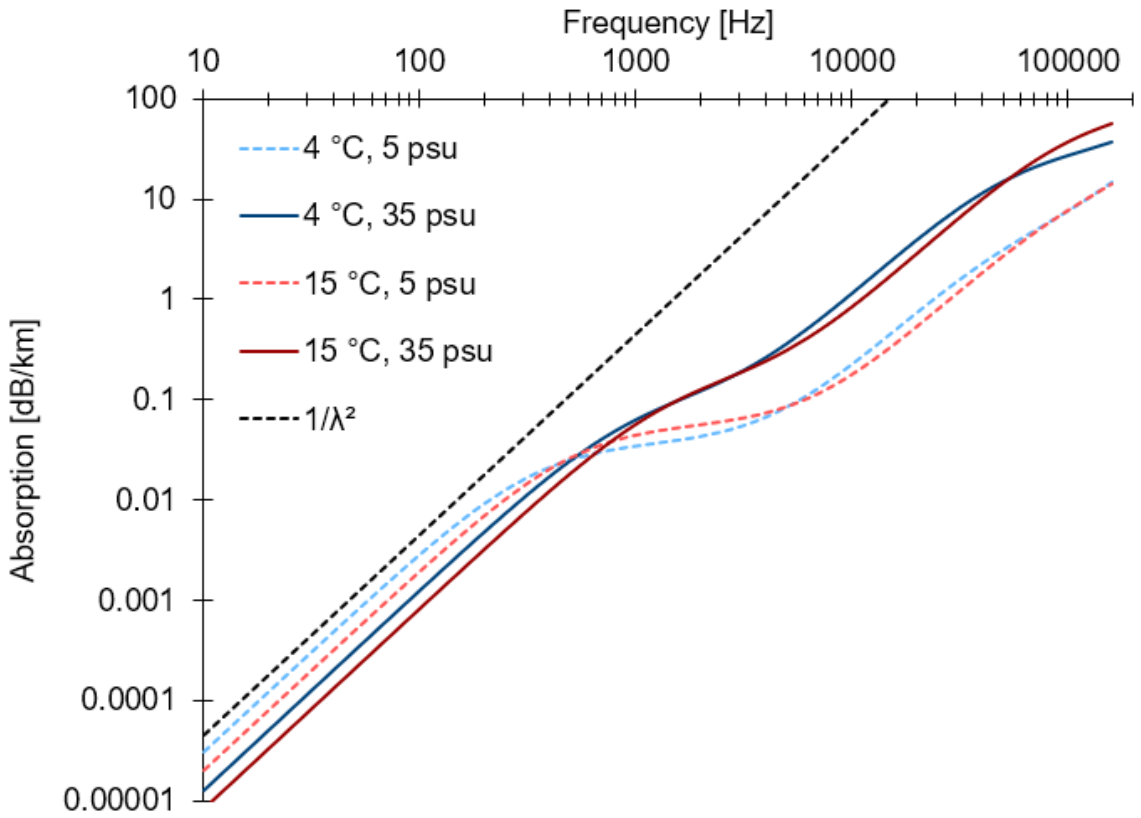

Figure 8-7: Absorption loss coefficient (dB/km) for various salinities and temperature.

Appendix B – Taranis impact piling model

RPS has developed a hybrid model for prediction of source levels from impact piling – “Taranis”. The model is part numerical and part empirical, taking the best of both worlds in that it is fast like an empirical model, but also able to predict source levels from sites where no data exists, like a numerical model. The model has been validated against a large dataset of measured data from installation of piles from 0.5 - 9 m diameter in both nearshore and offshore settings for varying sediment conditions and hammer sizes and types. By outputting both per-blow band levels & time-series impulses it is an excellent tool for prediction of impact piling source levels. Additionally, because the model has a large validation dataset it reports the statistical uncertainty for the generated output, to give the user a full understanding of the confidence they can have in any given set-up.

The model was compared and calibrated against a range of real-world recordings that were back-calculated, using a combination of simple spreading relations, Rogers model (Rogers, 1981) and dBSea[12] propagation modelling software, accounting for the specific environment of the recording location. This means that the model has greater validity when used within the range of conditions of the measurements, and within those bounds we further know the statistical uncertainty of the model. Outside those bounds the model is essentially extrapolating, but care has been taken to ensure the model is “stable” and results outside the bounds change in a predictable manner.

Below is a graphical representation of the model coverage.

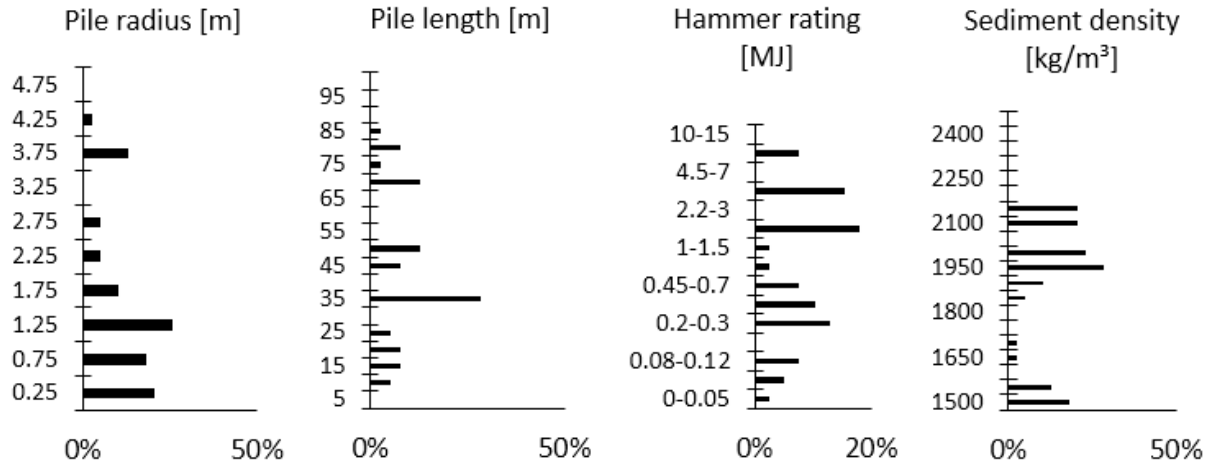

Figure 8-8. Overview of equipment and environmental parameters covered in the validation.

These cover a multidimensional space, and even if within all parameter limits, that particular combination of parameters might not have been tested, but given that the model has shown no “run-away” predictions we are confident that such combinations will still give representative results.

Table 8-2. Overview of the Taranis model’s inputs.

Model part	Parameter [unit] (default value)
Sediment	Density [kg/m³] as list (2100) Soundspeed [m/s] as list (2000) Grain size (diameter) [m] as list (0.35)
Water	Depth at piling site [m] Salinity [psu] (35) Temperature [degrees C] (15)
Hammer	Minimal blow energy [kJ] Maximal planned blow energy [kJ] Maximal rated blow energy [kJ]

[12] www.dBSea.co.uk

Model part	Parameter [unit] (default value)
Pile	Length [m] Radius [m] Penetration at desired installation depth [m] Density [kg/m³] (8050) Young's modulus [Pa] (2e11) Soundspeed [m/s] (5900) Wall thickness [m] (radius/50) Raking angle [degrees] (0.0)

Generally (>50 % of cases) the model predicts band levels within 6 dB of recorded levels with broad band levels being within 4 dB and peak levels within 7.5 dB (Figure 8-9, p. 39). There seems to be a bias in the band-wise errors showing a tendency for Taranis to underpredict levels at higher frequencies. This tendency is driven by a single validation case where Taranis' predictions for higher frequencies were >20 dB below the recorded. This case is included in the data, but remind the reader that something was likely different about this case making it a non-representative case. It is likely that the piling was done with the piles somewhat restricted and not free to move as assumed by the model (piles are assumed to be fixed at one end only).

The approach for model validation was to collate available data for recordings of impact piling where information on the hammer, the pile dimensions, the sediment and the water conditions where available. Recorded levels were back-calculated to an "equivalent monopoint source[13]". The back-calculation was mostly done using "Roger's model" (Rogers, 1981) when bathymetry was flat, dBSeaPE for longer ranges in range-dependent scenarios, and spherical spreading if the range to the source from the receiver was shorter than the depth. Roger's model and dBSea take into account the additional loss at low frequencies often not accounted for in simpler transmission loss calculations.

The main metrics used for accuracy estimation are:

- Band-wise error: The per decidecade band error for single blow SEL in dB
- Broadband error: The broadband error for single blow SEL in dB
- Peak error: The error in predicted L_P in dB

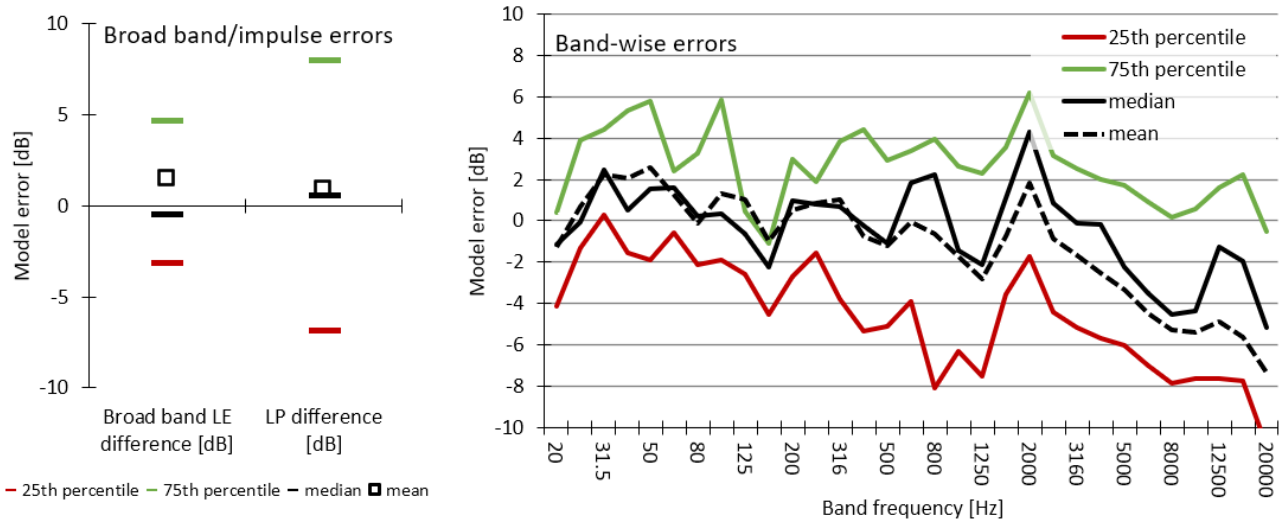

Figure 8-9. An overview of the broadband, peak and band-wise performance of the Taranis model.

Comparisons against other models (here a FE model) are favourable to this model for the 3 cases we have data for, where the FE model used in the case report has 50 % of is predictions within 14.6 dB, Taranis is

[13] Non-exiting quantity used to compare source levels at 1 meter from a point. In reality pile act like line or moving sources that have a "mach cone" (supersonic pressure front).

within 3.3 dB. This serves only as an example that in at least this case the simpler approach from Taranis was not inferior to an FE model that's being used commercially by other actors.

B BIOSECURITY PLAN

Hunterston Construction Yard
Biosecurity Plan

April 2024

CONTROL SHEET

Client: Clydeport Operations Limited
Project Title: Hunterston Construction Yard
Report Title: Biosecurity Plan
Document number: 14184
Project number: 176482

Issue Record

Issue	Status	Author	Reviewer	Approver	Issue Date
1	Final	GD	VM	GD	26/4/24
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Contents

1 INTRODUCTION

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of Clydeport Operations Ltd., to undertake an Environmental Impact Assessment (EIA) in relation to the upgrade of the existing Hunterston Construction Yard (HCY) into a harbour facility with a large working platform suitable for renewable industries. This Environmental Impact Assessment Report (EIAR) comprises the written findings of the EIA process undertaken under both the Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 ('the EIA Regulations') and the Marine Works (Environmental Impact Assessment (Scotland) Regulations 2017 ('the Marine EIA Regulations').

To inform the EIAR EnviroCentre produced a Scoping Report in 2023. Scoping responses were received from North Ayrshire Council and the Marine Directorate. The scoping responses included the following comments in relation to Marine Invasive Non Native Species (mINNS).

Table 1 Scoping Responses

Consultee	Response
NatureScot	Given this maritime movement we recommend that an assessment of management actions and/ or mitigation required to address issues relating to invasive species such as, but not limited to, wireweed (Sargassum muticum) and carpet sea squirt (Didemnum vexillum) are carried out. We advise that a site-based biosecurity plan for marine non-native species and terrestrial non-native species affecting seabirds should be developed in line with best practice Marine Biosecurity Planning guidance (SNH and Firth of Clyde Forum 2014)
Marine Directorate – Marine Invasive Species Team	I don't have many comments but I do have some reservations about the statement made by Clydeports that Sargassum muticum is the only marine invasive non-native species of concern at the site; I would certainly include Didemnum vexillum in this as it is a high impact species which we know to be present in nearby Fairlie, and also Styela clava as the NatureScot response highlights. The only other thing I would like to flag in addition to the comments by NatureScot is a couple of Biosecurity Plans specific to Didemnum vexillum (carpet sea squirt) for Loch Fyne and Loch Creran which have industry-specific actions that may be useful in drafting their Biosecurity Plan.

In support of the application and EIAR this document is a Draft Marine Biosecurity Management Plan which covers the proposed development and the operation of the Hunterston Construction Yard.

The document is a live document and will be subject to update following commission of a contractor to undertake the site construction works and subject to changes in operational practices at the site or changes in guidance.

The plan has been informed by the following documents:

- Marine Biosecurity Planning – Scottish Natural Heritage (now NatureScot) and Firth of Clyde Forum, February 2014;
- Marine biosecurity planning – Identification of best practice: A review – Scottish Natural Heritage (now NatureScot), 2014
- Firth of Clyde Biosecurity Plan – Clyde Marine Planning Partnership, 2012-2016
- Loch Creran - Community led marine biosecurity plan to support an 'active loch' – April 2017
- Loch Fyne Community Biosecurity Action Plan, 2020
- A Brighter Future for Seabirds – Biosecurity for Life

1.1 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 SITE INFORMATION

2.1 Construction Phase

The proposed development relates to the upgrade of the existing Hunterston Construction Yard (HCY) into a harbour facility with a large working platform suitable for renewable industries. The development works will incorporate construction works in the Marine Environment which will require to be licensed by the Marine Directorate, these will include:

- Formation of a temporary working platform;
- Removal of the existing rock armour on the western boundary;
- Removal of the existing bund on the western boundary;
- Installation of sub-surface revetments for the new quay wall;
- Capital Dredging to a depth of -12m CD;
- Disposal of dredging spoil to a licensed marine spoil disposal site;
- Installation of fenders and other quay wall infrastructure i.e. drainage outfalls; and
- Installation of navigational aids.

2.2 Operational Phase

Following the proposed construction works the site will remain in use as an active port facility which will incorporate movement and berthing of commercial vessels. In addition there may be the requirement for maintenance dredging to facilitate ongoing access for vessels.

2.3 Potential Existing mINNS

The Firth of Clyde Biosecurity Plan identifies that the following mINNS are known to be present within the wider Firth of Clyde:

- A bryozoan (no common name) (*Tricelleria inopinata*)
- A hydroid (no common name) (*Cordylophora caspia)*
- Acorn barnacle (*Elminius modestus*)
- An orange sheath tunicate (no common name) (*Botrylloides violaceus)*
- Carpet sea squirt (*Didemnum vexillum*)
- Common cord-grass (*Spartina anglica*)
- Green sea fingers (*Codium fragile*)
- Japanese skeleton shrimp (*Caprella mutica*)
- Leathery sea squirt (*Styela clava)*
- Orange tipped sea squirt (*Corella eumyota)*
- Wireweed (*Sargassum muticum)*

As detailed in the EnviroCentre Scoping Report Japanese wireweed (*Sargassum muticum*), was previously identified as a known issue in the development area as detailed in a previous Environmental Statement associated with a proposed power station development at Hunterston (Ayrshire Power Limited, 2010).

The Scoping consultation responses from NatureScot have also identified carpet sea squirt (*Didemnum vexillum)* and Leathery sea squirt *(Styela clava)* as being identified in the wider Fairlie area.

Whilst these are named known mINNS that may be present in the vicinity of the site it is considered that the proposed Biosecurity Measures will also be beneficial in relation to other mINNS.

The following information with respect to the named mINNS has been obtained from the Firth of Clyde Biosecurity Plan – Clyde Marine Planning Partnership, 2012-2016

Wireweed

Wireweed is a highly distinctive large olive-brown seaweed, often over 1m long. Its lateral branches hang like washing from a line when held out of the water. Wireweed competes with native seaweeds and sea grasses through rapid-growth, shading and abrasion. It is a nuisance in harbours and shallow waters where it is a hazard to boating due to entanglement of propellers. It can dominate in rock pools, altering the habitat. It is distributed widely along the coasts of south and west England, Wales and West Scotland. It was first recorded in Scotland in Loch Ryan in 2004 and has since populated various areas in the Firth of Clyde and also now moved further north up the west coast. There is some concern over potential fouling of aquaculture installations. Whilst physical removal may be possible, care must be taken to prevent further spread of the species and re colonisation from surrounding populations following clearance is likely.

Carpet Sea Squirt

First recorded in 2008 in the Plymouth and Holyhead estuaries, carpet sea squirt has now been recorded in a number of locations in Great Britain including a couple on the Clyde. It forms pale orange, cream or off-white colonies of extensive thin (2-5 mm) sheets and can form long pendulous outgrowths. Colonies can overgrow other fauna and occupy a substantial proportion of available space. On offshore banks in the USA it has shown very extensive coverage of the seabed, potentially smothering species living in gravel and affecting aquaculture. There have been decreases in brittle stars and sea urchins noted in The Netherlands. It is suggested that carpet sea squirt degrades in cold weather and that this influences its ability to regenerate and reproduce sexually35. Wrapping affected surfaces in polythene sheets secured with cable ties has been effective in New Zealand and N Wales, whilst a costly exercise, causes the encased sea squirt to suffocate and decay within days, and can be enhanced by adding a biocide such as bleach within the plastic wrapping. Repopulation from an unknown source has occurred in N Wales. Funding will soon be sought at a UK level to consider further options to tackle this invasive species.

In addition the following detail is obtained from the Loch Fyne Community Biosecurity Action Plan, 2020:

- *D. vexillum prefers to grow on manmade structures.*
- *D. vexillum can spread by larval dispersal but also by fragmentation of colonies which can dislodge and settle elsewhere.*
- *Local conditions such as wave action, UV exposure and freshwater events such as surface water can all influence where it flourishes.*
- *D. vexillum is killed by natural methods such as desiccation (drying out) and prolonged exposure to freshwater. Any other treatments may require a licence and advice should be sought before taking action.*
- *Maintaining antifouling coatings and reducing biofouling on vessels is a useful step towards lowering risk.*

Leathery Sea Squirt

The leathery sea squirt is a brown solitary sea squirt up to 20 cm tall, attached by a small flat holdfast at the base of a narrow stalk. It attaches to solid surfaces in shallow water, especially in harbours and marinas but also on wrecks and natural rock bottoms. It is a large organism that can achieve high

densities and did prove to be a severe nuisance to long-line mussel farming in eastern Canada until replaced by other invasive species, however, this species has not been noted as a problem to aquaculture in the UK to date. It is distributed from the Clyde around the south coast of England and to the Humber. Mechanical clearance by individual 'picking' appears possible; however, small unstalked individuals would be very inconspicuous, suggesting that total clearance of surfaces would be necessary to achieve eradication.

2.4 Site Condition

The site is located in a saline environment with minimal input of freshwater, as such the site is considered to represent a higher risk environment for presence and establishment of mINNS.

The proposed development will have a new quay wall with associated fenders and marine infrastructure. It is known that mINNS generally prefer to settle on man-made structures rather than natural surfaces, as such these are likely potential areas where mINNS may be established.

The site itself forms a man made island connected to the mainland via Oil Rig Road. As such there is potential for migration of terrestrial invasive species to the site from the wider mainland. Regardless of this potential it is recommended that measures are considered to address the potential for spread of terrestrial invasive species to the site (in this case considered to be focussed on rodents). This is principally considered to be associated with any vessel bringing in cargo or equipment directly to the site as part of the construction or operation.

3 PATHWAYS

On the basis of the proposed construction and operational activity at the site the following potential pathways in relation to spread of mINNS (both existing and potentially imported to site) are identified:

- Use of construction barges and slow moving vessels
- Using vessels from locations outside local water body
- Importation of materials
- Removal of old structures/ equipment
- Biofouling
- Hull cleaning
- Operating dockside berths for visiting vessels
- Maintaining pilings and ladders
- Ballast water transfer
- Plant and equipment
- Navigational aid cleaning
- Dredge material
- Marine litter
- Contractors
- Import of materials and cargo to the site.

4 BIOSECURITY MEASURES

With respect to the proposed construction works these will require to undertaken under a Peel Ports Works Licence. When assessing works licences Peel Ports request that a biosecurity risk assessment is included in higher risk submissions. The contractor identified to carry out the construction phase of the works will require to produce their own updated Biosecurity Plan to reflect their operations.

The Peel Ports Marine Team has held biosecurity workshops across their port facilities with external stakeholders to help understand the practical measures to control the spread of INNS within marine environments.

The following table details proposed biosecurity measures to be adopted at the site as part of the construction and operation, as noted previously this requires to be updated to reflect specific working elements.

Table 2 Biosecurity Measures

Activity	Biosecurity Measure
Construction Works Including Dredging and Vessel Movements	Gather biosecurity information on all vessels and equipment proposed to be used in marine environment. Request anti-fouling maintenance history, sites/ regions visited since last anti-fouling applied. Where review indicates high risk request contractor to address risk prior to mobilising plant to site Rodenticide poison and/or kill traps should be in place on all vessels which pose a significant risk of transporting rodents. Ships should use line guards on ship-to-shore lines to stop rodents using mooring lines to get on and off the ship. Make contractor aware of existing potential for mINNS at site and confirm biosecurity measures to be carried out during works/at completion of works to ensure no potential for spread from site to other areas
Prevention of biofouling on infrastructure	Apply anti fouling coating to relevant infrastructure at site and carry out routine maintenance and reapplication in line with manufacturers instructions
Removing Biofouling	Avoid biofouling scrapings entering the water by appropriate collection (i.e. using tarpaulin) and collect any materials generated during washdown
Operation of facility for berthing commercial vessels	Gather biosecurity information from visiting vessels at the earliest opportunity; including port of origin and when anti-fouling was last applied to hull. Carry out visual inspection of vessels deemed high risk

	Rodenticide poison and/or kill traps should be in place on all vessels which pose a significant risk of transporting rodents. Ships should use line guards on ship-to-shore lines to stop rodents using mooring lines to get on and off the ship. Vessel operators should not dispose of any water contained on the vessel (e.g., ballast tanks, bilge water, anchor lockers) into the water at your site
Port Operation	All staff and visiting contractors and vessel operators to be made aware of biosecurity plans Staff to be trained on biosecurity Develop a monitoring strategy to allow for routine assessment of areas where potential biofouling could occur Promote a culture of reporting mINNS if observed Ask contractors carrying out maintenance to specifically review for evidence of mINNS presence Store waste securely in rodent proof bins and dispose of regularly