Scapa Deep Water Quay
Technical Appendix 9.1, Noise Impact Assessment

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CONTROL SHEET

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EXECUTIVE SUMMARY

A construction and operational noise assessment has been carried out for the proposed Scapa Deep Water Quay (SDWQ)

Construction Noise

Worst case combined construction stages based on the proposed construction schedule have been modelled using CadnaA software. Details of construction activities have been provided by Arch Henderson.

The greatest weekday and weekend predicted noise levels are associated with construction Phases 1 & 2, in which activities including excavation, land reclamation and piling will be carried out.

There is the potential that dredging may be carried out over a 24 hour period, therefore evening and night-time noise levels have been predicted for this scenario.

The outcome of the assessment is that Neutral impacts are predicted during the day and night-time periods during all construction phases including dredging. There are no significant adverse impacts in EIA terms.

Operational Noise

The operational noise assessment considers the increase in potentially significant noise generating activities post development completion.

During the day and night-time periods noise levels are predicted to increase by up to 2.5dB at surrounding residential receptors as a result of the operational activities at SDWQ. The maximum significance of the changes in noise levels is Neutral / Slight, which is not significant in EIA terms.

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been appointed by Orkney Island Council Harbour Authority (OICHA) to undertake a Noise Impact Assessment (NIA) of the proposed Scapa Deep Water Quay (SDWQ)(Refer to Drawing No 674795-GIS143, Appendix A).

This report presents the results of the noise assessment for the proposed development. The noise assessment considers the airborne construction and operational noise impacts at existing sensitive receptors surrounding the site. The effects of construction noise on marine life is considered as part of the Underwater Noise Assessment presented in Chapter 5, Biodiversity and Technical Appendix 5.6, Volume 3 of the EIAR.

1.2 Site Description

The SDWQ will be situated circa 4km south from Scapa Pier – before Holm and close to Deepdale. It is currently untouched coastline comprising a gravelly beach and in places exposed rock bordered on the landside by a rock face circa 3m in height. The land above the rock face comprises rough grazing which slopes upwards to the east and the A961. The Burn of Deepdale is to the north with a rocky promontory forming a natural barrier to the south.

There are a number of existing noise sensitive receptors in the surrounding area with full or partial line of sight to the development site. Gaitnip Farm is located circa 2km to the north, and there are several private residences along the A961 to the north of the Burn of Button circa 1.0 - 1.3km from the development site. The Netherbutton cottages are the closest receptors, located circa 500m east of the development site and comprising one private residence and one holiday let. There are additional private residences located to the south east at West Bu at circa 700m from the development site.

1.3 Proposed Development

The main purpose of this facility would be to undertake multiple industrial activities that require both deep-water berthing and large laydown area. It is envisaged that the main activity will be the construction / assembly and maintenance of offshore wind turbines.

This proposal comprises approx. 597m long main quayside berth with general -15m CD water depth, incorporating a 135m quayside pocket with -20m CD water depth. Further north tug (3No.) and pilot boat (2No.) berth approx. 180m long with depths between -6 and -9m CD. Laydown area directly behind quay face approx. 22.85 Hectares. The proposal will also include an access road leading from the A961 to the laydown area.

1.4 Potential Impacts

Noise from the proposed development has the potential to impact surrounding existing residential receptors during the construction and operational phases.

1.4.1 Construction Phase

Significant noise generating construction activities associated with the construction of the quayside and laydown area, including piling and dredging have the potential to impact existing residents in the surrounding area.

Noise generating activities during the construction phase are understood to include;

- Construction of new access road;
- Excavation of current landform and reclamation of shore to form laydown area;
- Formation of bunds around eastern, and parts of the north and southern perimeters of proposed laydown area using reclaimed materials;
- Dredging of area around proposed quay;
- Piling of structure for quay wall;
- Infilling of material to form reclaimed land;
- Delivery and tipping of materials, predominantly by sea; and
- HGV and plant movements in and around the site

1.4.2 Operational Phase

During the operational phase, new proposed noise generating activities have the potential to increase the day and night-time existing baseline noise levels at surrounding noise sensitive receptors.

Noise generating activities which could be carried out during the operational phase include:

- Deep-water ship berthing and mooring;
- Ship loading / unloading activities including operation of cranes;
- Movement of materials between ships and laydown area;
- Construction / assembly and maintenance of offshore wind turbines;
- Plant and HGV movements within quay and laydown area; and
- Loading / unloading of HGVs.

1.5 Report Usage

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2 NOISE POLICY AND GUIDANCE

This section outlines policy and guidance relevant to this NIA.

2.1 National Planning Framework 4

The purpose of the National Planning Framework 4[1] is to set out national planning policies which reflect Scottish Ministers priorities for the operation of the planning system and the development and use of land.

Noise is highlighted as a key aspect of a development which should be considered. Methods of attenuating noise levels are encouraged.

2.2 PAN 1/2011 Planning and Noise

Advice on the role of the planning system in helping to prevent and limit the adverse effects of noise is provided in Planning Advice Note (PAN) 1/2011 – Planning and Noise[2]. PAN 1/2011 promotes the principles of good acoustic design and a sensitive approach to the location of both noise sensitive and noise generating developments. PAN 1/2011 promotes the avoidance of significant adverse noise impacts from new development while supporting sustainable economic growth. The input of environmental health officers and professional acousticians from an early stage is recommended to avoid unreasonable effects on quality of life. PAN 1/2011 promotes the application of reasonable criteria to assess noise impact but does not suggest specific target levels, allowing for consideration of contextual and non-acoustic factors.

The associated *Technical Advice Note (TAN) 'Assessment of Noise'*[3] provides guidance on NIA methods. The recommended assessment method includes an initial identification of noise sensitive receptors and their sensitivity, a quantitative assessment, a qualitative assessment, a determination on the level of significance and recommendations for the decision process.

2.3 Assessment of Noise: Technical Advice Note

Assessment of Noise: Technical Advice Note[4] (TAN) is supplementary guidance to PAN 1/2011 published by the Scottish Government. TAN recommends a five stage process to the assessment of noise, as detailed below

Stage 1: Initial Process

The development is categorised according to whether it has the potential to generate noise *i.e.* a Noise Generating Development (NGD) or be affected by the existing noise *i.e.* a Noise Sensitive Development (NSD). All Noise Sensitive Receptors (NSRs) that have the potential to be impacted by the proposed development are identified and prioritised according to their level of sensitivity. Residential NSRs are noted to be of high sensitivity.

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[1] The Scottish Government (2023), *National Planning Framework 4.*
[2] The Scottish Government (2011), *PAN 1/2011 Planning and Noise*.
[3] The Scottish Government (2011), *TAN 1/2011 Technical Advice Note*.
[4] The Scottish Government (2011), *Assessment of Noise: Technical Advice Note.*

Stage 2: Quantitative Assessment

The quantitative assessment method depends on the type of development proposed *i.e.* Noise Sensitive Development (NSD) or Noise Generating Development (NGD). Typically the assessment will compare absolute levels (predicted or measured) with an agreed target. The magnitude of the impact is then defined by assessing the amount the predicted noise level exceeds the agreed assessment target criteria for either day or night time periods. The agreed target and magnitude of impact scales used in this assessment are presented in Section 3.

Stage 3: Qualitative Assessment

The qualitative assessment allows the magnitude of the impact established in Stage 2 to be adjusted accordingly to account for additional factors not addressed in the quantitative assessment.

Stage 4: Level of Significance

The level of significance of the noise impact at the NSR is obtained through the relationship of the receptor's sensitivity to noise and the magnitude of the noise impact. The prescribed level of significance is used to determine whether or not noise is a key decision making issue for the NSR in question.

Stage 5: The Decision Process.

Stages 2 to 4 are repeated for all identified NSRs and a Summary Table of Significance is completed which provides an overview of the level of significance of the noise impact on all NSRs. The recommendation from the environmental health officer to the planning officer should be informed by the distribution of levels of significance.

2.4 World Health Organization Guidelines for Community Noise

In *Guidelines for Community Noise*[5], 55 dB $L_{Aeq,16h}$ is indicated as a criterion threshold below which few people are seriously annoyed for an outdoor living area, during daytime and evening hours. A lower guideline value of 50 dB $L_{Aeq,16h}$ is provided as a criterion below which few people are annoyed. In addition, the guidance identifies that negative sleep impacts are avoided at 30 dB $L_{Aeq,8h}$ for continuous noise sources. It is stated that "for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10 – 15 times per night".

It should be noted that these limits are typically understood to relate to the onset of adverse impact. This is clarified in TAN: *"The WHO guideline levels have been set at the threshold of detectable effects in the population. There is no evidence that anything other than a small minority of the population exposed at the WHO guideline noise levels finds them to be particularly onerous in the context of their daily lives."*

2.5 BS5228-1:2009+A1:2014; Code of Practice for Noise and Vibration Control on Construction and Open Sites.

Methods for calculating noise and vibration produced by construction and open sites are provided in BS5228-1:2009+A1:2014[6]. Annexes C and D of Part 1 provide generic source data for different types

[5] World Health Organization (1999), *Guidelines for Community Noise*.
[6] British Standards Institution (2014), *BS 5228-1:2009+A1:2014 – Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise.*

of noise source, as well as methods for calculating noise from stationary and mobile plant. Specific advice on noise from sources such as piling is provided.

2.6 BS 4142:2014+A1:2019, Methods for rating and assessing industrial and commercial sound

BS 4142:2014+A1:2019[7] provides methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

a) Sound from industrial and manufacturing processes;
b) Sound from fixed installations which comprise mechanical and electrical plant and equipment;
c) Sound from loading and unloading of goods and materials at industrial and/or commercial premises; and
d) Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements in or around an industrial and/or commercial site.

The methods described use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The measured specific sound source is corrected for acoustic features (if present) of intermittency, impulsivity and tonality to give the rated noise level. The assessment considers the impact of the specific sound by subtracting the measured background sound level from the rating level, and considering the following;

a) Typically, the greater this difference, the greater the magnitude of impact.
b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
c) A difference of around +5dB(A) is likely to be an indication of an adverse impact, depending on the context.
d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact, or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

[7] British Standards Institution (2019), *BS 4142:2014+A1:2019 – Methods for Rating and Assessing Industrial and Commercial Sound*.

3 CONSULTATION, METHODOLOGY AND TARGET CRITERIA

3.1 Consultation

A summary of the relevant responses to the Scoping Report submitted by EnviroCentre, and further email consultation with Orkney Island Council's (OIC) Environmental Health Department, is shown in Table 3-1.

Table 3-1: Summary of Consultation Responses

<table>
<tr><th>Organisation</th><th>Consultation Response</th><th>How and where addressed</th></tr>
<tr><td rowspan="2">Orkney Island Council (OIC)</td><td>With appropriate mitigation, including the provision of a Framework CEMP/ Dust Mitigation Strategy defined within the EIA, it should be possible to scope noise out during the construction phase of the proposed development for the reasons set out in the Scoping Report.</td><td rowspan="3">Assessment of construction and operational airborne noise have been included in the EIA report in order to address the responses from both OIC and Marine Scotland.

Both assessments assume worst case scenarios.</td></tr>
<tr><td>Operational noise should be scoped into the EIA</td></tr>
<tr><td>Marine Scotland</td><td>The Scottish Ministers advise that airborne noise is scoped in for both construction and operation phases and a construction noise impact assessment must be included in the EIA Report. If construction methodologies have not been confirmed then the worst case scenario must be assessed.</td></tr>
</table>

3.2 Methodology

The noise assessment was undertaken to establish the impact of construction and operational activities on noise sensitive receptors surrounding the Site. The assessment involved the following stages;

- Consultation with OIC Environmental Health Department to agree assessment methodology and noise criteria;
- Measurement of existing baseline noise environment at a sample of 2 areas representative of the most exposed noise sensitive receptors surrounding the proposed development; the monitoring locations are shown in Drawing No. 674795-GIS143 Appendix A;
- Review of construction activities, locations and noise data;
- Calculation and assessment of construction noise at the most exposed sensitive receptors, following guidance provided in BS5228-1:2009+A1:2-014; Code of Practice for Noise and Vibration on Construction and Open Sites. 3D computer noise modelling using CadnaA software has been used in the calculation of construction noise at sensitive receptors.
- Review of existing and proposed operational activities, locations and noise data;

- Prediction of operational noise using CadnaA software at location of most exposed sensitive receptors; and
- PAN 1/2011 assessment of operational noise, using principles defined in BS4142:2014.

3.3 Construction Noise Assessment Methodology and Target Criteria

3.3.1 BS5228-1:2009+A1: 2014 – Methodology (ABC Method)

The assessment of construction noise is carried out in accordance with guidance provided in BS 5228-1:2009+A1:2014[6] 'Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise'. The standard describes methods for evaluating the potential significant effects of construction noise, one of which is the 'ABC' method which is based on exceedance of fixed noise limits. The ABC method, as detailed within Annex E.3.2 has been used within this noise assessment, as it considers the pre-existing industrial noise climate at the receptors.

The ABC method considers that a potential significant effect occurs when the total noise level at a dwelling, including construction activity, exceeds the appropriate category values shown in Table 3-2. The table is used as follows;

- The ambient noise is determined and rounded to the nearest 5dB;
- The rounded ambient noise level is then compared with the total noise level, including construction. A significant effect at a noise sensitive receptor is considered to occur when the total noise, including construction activity exceeds the appropriate category values, shown in Table 3-2.
- The ABC method of BS5228-1:2009+A1:2014 does not provide specific guidance on determining the magnitude and significance of noise impacts above the threshold values shown in Table 3-2. In order to determine the level of significance, guidance provided in the Technical Advice Note (TAN) 1/2011 has been used. The significance criteria adopted within this noise assessment are shown in Table 3-3.

Table 3-2: Threshold of Significant Effect at Dwellings

Period	Threshold Value, in decibels (dB)		
	Category A	**Category B**	**Category C**
Night-time (23:00 to 07:00)	45	50	55
Evenings weekday (19:00-23:00), Saturdays (13:00-23:00) and Sundays (07:00-23:00)	55	60	65
Daytime weekday (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75
Note 1: A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level. Note 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total L_{Aeq}, T noise level for the period increases by more than 3 dB due to site noise. Note 3: Applied to residential receptors only.			
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			

Table 3-3: Significance Criteria for the Assessment of Construction Noise

Significance	Level Above Threshold Value dB(A)	Definition
Neutral	< 0	No effect, not significant, noise need not be considered as a determining factor in the decision making process.
Slight adverse	≤ 0 to < 3	These effects may be raised but are unlikely to be of importance in the decision making process.
Moderate adverse	≤ 3 to < 5	These effects, if adverse, while important, are not likely to be key decision making issues.
Large adverse	≤ 5.0 to < 10	The effects are likely to be important considerations but where mitigation may be effectively employed such that resultant adverse effects are likely to have a moderate or slight significance.
Very large adverse	≥ 10	These effects represent key factors in the decision making process. They are generally, but not exclusively, associated with impacts where mitigation is not practical or would be ineffective.

3.4 Operational Noise Assessment Target Criteria

Proposed activities from the operations within the site are assessed following guidance provided in PAN 1/2011 (as the associated document TAN 1/2011 ‘Technical Assessment of Noise’), using principles defined in BS4142:2014.

The noise criteria to be applied to operational industrial noise is summarised in Table 3-4. The table is used as follows;

- Calculate the difference between the rated operational noise level ($L_{Ar,T}$) and the background noise ($L_{A90,T}$) at each noise sensitive receptor, following principles defined in BS4142:2014. This difference in levels is used to define the Sensitivity of Receptor, as shown in Table 3-4.
- Calculate the total noise at each noise sensitive receptor, including operational activity ($L_{Aeq,T}$). The difference between the total noise including operational activity, and that before development at each sensitive receptor is used to define the Magnitude of Impact, as shown in Table 3-4.
- The Significance of Impact is then defined, as shown in Table 3-4.

Table 3-4: Significance of Effects; Operational Industrial Noise

Magnitude of Impact (After – Before) L_{AeqT} dB	Sensitivity of Receptor based on likelihood of complaint X = (Rating ($L_{Ar,Tr}$) – Background ($L_{A90,T}$)) dB		
	Low (x < 5)	Medium (5 ≤ x < 10)	High (x ≥ 10)
Major (≥ 5)	Slight / Moderate	Moderate / Large	Large / Very Large
Moderate (3 to 4.9)	Slight	Moderate	Moderate / Large
Minor (1 to 2.9)	Neutral / Slight	Slight	Slight / Moderate
Negligible (0.1 to 0.9)	Neutral / Slight	Neutral / Slight	Slight
No Change (0)	Neutral	Neutral	Neutral

4 BASELINE MONITORING

4.1 Introduction

A background noise survey was carried out in the area surrounding the proposed development site during day and night-time periods between 28th and 30th November 2022. The purpose of the survey was to establish day and night-time background noise levels at areas representative of the most exposed properties surrounding the development site. The noise monitoring locations and methodology were agreed with OIC Environmental Health Department through consultation.

Measurements were conducted using a Norsonic Nor140 (serial number 1403301) and a Norsonic Nor 118 (serial number 11831675), both calibrated using a Nor-1251 calibrator (serial number 312226), and a Norsonic Nor 145 (serial number 14529959) which was calibrated using a Nor-1255 calibrator (serial number 125526127) before and after measurements, with a maximum drift of 0.2 dB noted. Calibration certificates are available on request. Measurements were conducted 1.3 m above ground using a fast time weighting.

4.2 Noise Monitoring Locations

The noise monitoring locations are described in Table 4-1, and shown in Drawing No. 674795-GIS143, Appendix A.

Table 4-1: Noise Monitoring Locations

NML ID	Grid Reference	Location
01	345915 1004426	At the end of the farm track connected to the A961 which leads to Netherbutton Cottages with unobstructed views of Scapa Flow and the Bay of Deepdale.
02	345782 1005233	On the grass at Fernbank, adjacent to the A961. Chosen to be representative of the closest properties to the development located along the A961.

4.3 Meteorological Conditions and Observations

The weather conditions and observations noted during the monitoring period of 28/11/22 – 30/11/22 are summarised in Table 4-2 and Table 4-3.

Table 4-2: Baseline Noise Monitoring Weather Conditions

Date	Monitoring Period	Meteorological Conditions
28/11/22	Daytime – Afternoon	Mostly clear skies, 1 – 2 oktas. Generally negligible wind with some breezes from the west up to 2 or 3 m/s. Temperature 3 – 4°C.
28/11 to 29/11/22	Night-time	Clear skies, 0 – 1 oktas. Negligible wind. Temperature 1 – 2°C.
29/11/22	Daytime – Afternoon	Mostly clear skies, 1 – 2 oktas. Some light breezes from the south. Temperature 1 – 2°C.
29/11 to 30/11/22	Night-time	Clear skies, 0 – 1 oktas. Negligible wind. Temperature 0 – 2°C.

Table 4-3: Baseline Monitoring Observations

NML ID	Date	Period	Start Time	Observations
1	28/11/2022	Day	17:58	Background sound is a mix of offshore noise from barges and tankers visible in Scapa Flow as well as distant traffic, mostly from the south towards St. Mary's. Occasional passing traffic directly to the north east along the A961 is also clearly audible when present. Offshore noise includes some low frequency rumble and faint tonal components. Some bird calls and aircraft approaching Kirkwall Airport were also heard.
	29/11/2022		14:21	
	29/11/2022	Night	01:25	Background sound was predominantly from offshore noise in Scapa Flow during night time hours. As with daytime a mix of low frequency rumble and tonal components were heard. Road traffic noise from individual passing cars on A961 was clearly audible but there was no background traffic noise continuum as heard during the day.
	29/11/2022		23:45	
2	28/11/2022	Day	17:58	Road traffic passing on the A961 was dominant when present. During breaks in passing traffic, the noise environment was noted to be similar to that observed at Position 1 (Netherbutton). Some low frequency rumble and faint tonal components were heard from vessels in Scapa Flow. The contributions of distant traffic to the south were less prominent than at Position 1, causing shipping noise to stand out more. Some bird calls and aircraft approaching Kirkwall Airport were also heard.
	29/11/2022		14:21	
	29/11/2022	Night	00:41	As at Position 1 (Netherbutton), background sound is predominantly from offshore noise in Scapa Flow and made up of a mix of low frequency rumble and tonal components. Road traffic noise from individual passing cars on A961 was again dominant but very few cars were observed during night time hours. There was no background traffic noise continuum as heard during the day.
	29/11/2022		23:02	

4.4 Background Noise Data

A summary of the day and night-time results can be found in Table 4-4 and

Table 4-5.

Table 4-4: Daytime Background Sound Measured Results

NML ID	Date	Start time	Duration, T (hrs:mins)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
1	28/11/2022	16:37	01:00	36.0	30.6
	29/11/2022	14:21	01:00	35.7	30.6
2	28/11/2022	17:58	01:00	59.8	35.1
	29/11/2022	17:01	01:00	62.6	36.1

Table 4-5: Night-time Background Sound Measured Results

NML ID	Date	Start time	Duration, T (hrs:mins)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
1	29/11/2022	01:25	00:30	33.9	31.5
	29/11/2022	23:45	00:30	31.8	28.5
2	29/11/2022	00:41	00:30	48.3	28.9
	29/11/2022	23:02	00:30	49.9	31.9

5 CONSTRUCTION NOISE MODELLING AND ASSESSMENT

5.1 Noise Sensitive Receptors

A sample of four residential noise sensitive receptors have been identified following consultation with the EHO at OIC. They have been chosen as being representative of those most exposed to noise from construction and operational activities at the proposed development. These are described in Table 5-1, and shown in Drawing No. 674795-GIS144 Appendix A.

Table 5-1: Noise Sensitive Receptor Locations; Construction and Operational Noise

NSR ID	Location	Grid Reference
NSR 1	Gaitnip House and farm	344681 1006281
NSR 2	Midway, A961	345690 1005423
NSR 3	Netherbutton Cottages	345924 1004408
NSR 4	West Bu	346078 1003418

The background noise measured at Location 1 in Table 4-1 is considered representative of NSRs 1, 3 and 4. The background noise measured at Location 2 in Table 4-1 is considered representative of NSR 2. The noise measurement locations are shown in Drawing No.674795-GIS143, Appendix A.

Receptors have been modelled at 1.5m height at one-story properties, and 4m height at two-storeys.

5.2 Construction Noise Model Input Parameters

5.2.1 Construction Schedule

Details of the proposed construction schedule at the Site have been supplied by Arch Henderson. A summary of the proposed construction schedule is shown in Table 5-2.

Table 5-2: SDWQ, Proposed Construction Schedule

Phase	Description
Phase 1	Access road installed to main cut and fill site with graded hard core surface together with laying of all ducts and services to the site within road verge
	Excavation of current landform along with reclamation of shore to form laydown area bounded by overburden bunds on the north and eastern edges
	Creation of berthing by formation of a quay constructed of steel tubular piles with interlocking sheet piles with a further inner tied sheet pile anchor wall
	Dredging adjacent to the newly formed quay to provide -15m CD water depth
Phase 2	Excavation of current landform along with reclamation of shore to form an additional laydown area to the south of Phase 1 laydown area. The bund on the eastern edge will be extended along the length of the new laydown area and partially along the southern edge
	Extension of the Phase 1 quay area to the south

Phase	Description
	Dredging adjacent to the newly formed Phase 2 quay to provide -15 CD water depth
Phase 3	Dredging on the northern side of the newly formed quay extension to provide -20m CD water depth

The exemplar design is now well established for SDWQ and the anticipated timetable for works is expected to be:

- Main Works – Commencing September 2024 assuming planning and marine licences can be obtained.
- Phase 1 is anticipated to be completed by 2027; and
- Phase 2 is anticipated to commence September 2027 and completed in 2028.

Phase 3 dredging works are an aspiration to be completed at some point in the future.

5.2.2 Laydown Site

The primary intention behind the construction of the deep water quay site is to maximise and balance all excavated inert stone from the existing land to fill and form the reclaimed land and quay works, with all waste material not suitable for this purpose deposited and managed into material bunds on perimeter of the phased development site.

During Phase 1 material from excavation associated with access road construction will be temporarily stockpiled until the laydown areas are created.

For Phases 1 and 2, excavation would then progress using heavy tracked plant to excavate and rip material. For harder strata on land the excavation may require pre-treatment through drilling 100mm dia. holes and controlled delayed explosives (approximately 25kg per hole). Recovered material would be screened and suitable inert stone and glacial till (all free of organic and clay material) will be stockpiled. The stockpiled suitable material from these operations will then become the main inert material fill source for future reclamation and quay works. The unsuitable material would be used to form the northern and eastern perimeter bunds.

Other than the mobilisation of heavy vehicles and plant, the site is to be self-contained for Phases 1 and 2. Arch Henderson have indicated that as many 8 dump trucks, 10 excavators and 8 tracked drilling rigs may be required to service this. These have been assumed to be operational during each of the first two phases as required. Use of excavators and drilling equipment over 24 hours, including at weekends, has been confirmed.

5.2.3 Reclamation and Quay Works

The reclamation works would commence by forming the north perimeter reclamation bund leading from the access road to the rear of the quay works. Placement of secondary and primary rock armour will follow thereafter. Once this reclamation perimeter bund and armour slope is formed then this shall provide the main land route to access the quay works construction site.

Rock armour at the north of Phase 1 and the south of Phase 2 is to be predominantly imported by sea on barges, though some secondary rock armour may be won on site. For each phase, rock armour is expected to be placed by excavators mounted on barges which may be moored or tethered to tugboats. For a worst case scenario, each phase has assumed one vessel with two mounted excavators, two tug boats and additional dump truck movements and tipping on the shore.

The main quay berth face is proposed to be constructed of steel tubular piles with interlocking sheet piles forming a combi wall solution with a further inner tied sheet pile anchor wall. This combi quay wall will support a pre cast concrete cope and deck directly behind followed by a general hard core surfaced laydown reclamation area.

The tubular steel piles will be installed at specified locations using vibro hammering technique, which typically generates less noise than impact hammering techniques. Drilling will be undertaken using Bauer BG41 Drill rigs or similar, either from temporary piling platforms from the reclamation bund or a jack up barge with silt booms placed to seaward side. The sheet piles are also expected to be vibro hammered, with contingency for impact piling if vibro piling is ineffective. Tie rods are then installed and secured between front face and rear sheet pile wall and pre cast and in-situ concrete cope placed by crane.

As the quay works advance south the reclamation fill would advance behind. The concrete deck immediately behind the quay face will be placed with remaining reclamation and laydown area capped and compacted with graded hard core surface.

5.2.4 Terrestrial Rock Blasting

During creation of the laydown area, where hard rock strata is encountered pre-treatment involving drilling and controlled explosions will be necessary. The scope of BS5228-1:2009+A1:2014 does not cover the assessment of noise from rock blasting, however in relation to surface coal and mineral extraction sites, it states that good blasting practices will reduce the inherent and associated impulsive noise. Part 2 of the standard provides good practice guidelines in relation to controlling vibration emissions from surface coal and mineral extraction sites. The good practice guidance includes the following;

- Restriction of blasting as far as practicable to regular daytime periods, not on Sundays and away from public holidays;
- Good community relations; where relevant, informing nearby noise/vibration sensitive receptors ahead of periods of blasting;
- The choice of appropriate drilling rigs; and
- Designing blasts to maximize efficiency and reduce the transmission of noise/vibration.

Terrestrial rock blasting is therefore not included in this noise assessment.

5.2.5 Dredging

The assessment has assumed that a short dredging campaign will be carried out during each of the 2 construction phases as a worst case scenario to create the deepwater berths at the quayside. However, in reality there will only be one dredge campaign at the end of Phase 1. The assessment has assumed the dredging campaign will be carried out over a 24 hour period.

It has been assumed the dredging will be carried out using cutter suction to remove soft dredge and backhoe for ripping harder material. The dredge spoil will be removed into a split hopper barge for deposit within the reclamation behind the quay wall. Any unsuitable material would be transported to an offshore licensed dredge disposal site. Backhoe dredging generates higher airborne noise levels than the cutter suction method, therefore this NIA assumes use of the backhoe method as a worst-case scenario. Where cutter suction methods are employed the levels shall be less than those presented in this report.

5.2.6 Modelled Scenarios

The scenarios have been set up to model the worst-case combination of construction activities for the construction phases. The construction of the access road in Phase 1 has been considered as a separate modelling scenario as this work is required prior to mobilisation of plant for Phases 1 and 2, in addition to the proximity of the activities to NSRs 2 and 3.

As can be seen in Table 5-2, Phases 1 & 2 entail similar construction activities and there is anticipated to be overlap between these. In order to account for the worst case cumulative impact of concurrent activities, individual noise modelling scenarios have been set up for each of these phases assuming all proposed activities occurring simultaneously.

A summary of the combined construction activities and relevant assessment periods for each of the modelled scenarios is shown in Table 5-3. A full breakdown of the individual items of plant and activities for each set of construction activities and scenarios are shown in Appendix C. It should be noted that while the modelling has predicted all operations within a Phase/scenario to be concurrent, this is a conservative assumption, and some activities will in fact be contiguous.

Table 5-3: Modelled Scenarios; Construction Noise

Modelled Scenario	Modelled Combination of Construction Stages (Worst Case)	Relevant Assessment Periods
Access Road Construction	Excavation and drilling	Day, Evening, Night, Weekend
	HGV movement of material and tipping	
	Rolling/compaction	
Phase 1	Excavation and drilling, HGV movement of material and tipping	Day, Evening, Night, Weekend
	Rock armour revetment	
	Drainage, infill and compaction	
	Pile sea bed pre-treatment	
	Install sheet pile wall	
	Tie rod / anchor walls	
	Surfacing	
	Dredging	
Phase 2	Excavation and drilling, HGV movement of material and tipping	Day, Evening, Night, Weekend
	Rock armour revetment	
	Drainage, infill and compaction	
	Pile sea bed pre-treatment	
	Install sheet pile wall	
	Tie rod / anchor walls	
	Surfacing	
	Dredging	
Phase 3	Dredging	Day, Evening, Night, Weekend

5.2.7 Evening and Night-time Construction Noise

With reference to the assessment periods included in Table 5-3 only in the case of excavation and drilling of the existing landform, and dredging offshore are works scheduled to be carried out over a 24-hour period. All other activities are expected to have finished by 19:00 hours on a daily basis Monday to Saturday and by 14:00 hours on Sundays.

5.2.8 Weekend Construction Noise

The proposed construction schedule includes working during daytime hours during the week days and the weekends. The implication of this is that works associated with higher noise levels are likely to be continued during weekend hours (Saturday 07:00 – 19:00 and Sunday 08:00 – 14:00), which are subject to more stringent noise limits than during the weekdays (refer to Table 3-2).

5.2.9 Construction Noise Model Data

3D computer noise modelling of the various stages of construction activity at the site has been carried out using CadnaA software. Details on worst case construction activities, operating times, and associated items of noise generating plant for each stage of construction used within the noise models have been supplied by Arch Henderson.

Calculations were carried out using noise data and guidance provided in BS5228-1:2009+A1:2014, to derive predicted noise levels at noise sensitive receptors. Where data was not available within BS5228 it has been sourced from the Environmental Protection Department of Hong Kong's Technical Memorandum on Noise from Construction Work[8]. Noise data for backhoe dredging and impact wrenches was taken from published online sources[9],[10].

Full details of the items of modelled construction plant, noise data (including data source), operating times, durations and source heights for each of the considered scenarios is shown in Appendix C.

5.2.10 Construction Noise Model Assumptions

A number of assumptions have been established during the CadnaA modelling exercise, as detailed below:

- The ground model uses Lidar 1m resolution terrain height data for the existing site and the surrounding area;
- For completed sections of the laydown area and quayside the ground height has been set to 7m Above Chart Datum (ACD) per site sections provided by Arch Henderson;
- The heights of buildings have been estimated from photographs;
- Predicted noise levels are calculated in the free-field environment;
- Ground absorption has been set to 1 for areas of soft ground. Areas of hard ground and water have been set to 0 for reflective surfaces;
- Weekend daytime noise levels generated by construction activities have been assumed to be the same as those generated during weekday hours representing a worst case scenario;
- The noise model assumes locations of plant based on descriptions of construction activities provided by Arch Henderson;
- Worst case scenario combinations of construction activities likely to occur in any one day during the considered assessment periods have been assumed;

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[8] Environmental Protection Department of Hong Kong; *Technical Memorandum on Noise from Construction Work other than Percussive Piling,* 1989.
[9] Waterman. *Aberdeen Harbour Expansion Project, Environmental Statement, Volume 3, Appendix 20C.* Nov 2015.
[10] Markesino et al, *Study of Noise Transmission from an Electric Impact Wrench*, Noise-Con 2004, Baltimore

- Spud-leg barges on which piling equipment is intended to be located have been assumed to have a height of 1m above sea level. The height of equipment located on the barges (eg piling rigs) has been assumed as relative to the height of the barge.
- The following sources have been modelled as line sources within CadnaA;
    - Heavy goods vehicles (HGVs) and dump trucks;
    - Moving construction plant;
- All remaining sources (not outlined above) have been modelled within CadnaA as point sources.

5.2.11 ABC Category Thresholds

The appropriate ABC category thresholds above which there is considered to be a noise impact from construction noise have been calculated following guidance provided in BS5228-1:2009+A1:2014 (refer to Section 2.5). Details of the calculations are shown in Appendix B.

5.3 Construction Noise Model Results and Assessment

The noise model results for each modelled scenario of construction activity, along with the BS5228 assessment at each of the considered noise sensitive receptors are summarised in Table 5-4 to Table 5-7.

Table 5-4: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 1

NSR 01	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
ARC	65	36	Neutral	55	35	Neutral	55	35	Neutral	45	33	Neutral
1	65	36	Neutral	55	35	Neutral	55	34	Neutral	45	32	Neutral
2	65	36	Neutral	55	34	Neutral	55	34	Neutral	45	32	Neutral
3	65	36	Neutral	55	34	Neutral	55	34	Neutral	45	32	Neutral

Table 5-5: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 2

NSR 02	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
ARC	65	60	Neutral	60	57	Neutral	60	57	Neutral	55	49	Neutral
1	65	60	Neutral	60	57	Neutral	60	57	Neutral	55	49	Neutral
2	65	60	Neutral	60	57	Neutral	60	57	Neutral	55	49	Neutral
3	65	60	Neutral	60	57	Neutral	60	57	Neutral	55	48	Neutral

Table 5-6: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 3

NSR 03	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
ARC	65	36	Neutral	55	40	Neutral	55	38	Neutral	45	38	Neutral
1	65	44	Neutral	55	44	Neutral	55	42	Neutral	45	42	Neutral
2	65	42	Neutral	55	41	Neutral	55	39	Neutral	45	38	Neutral
3	65	40	Neutral	55	40	Neutral	55	39	Neutral	45	38	Neutral

Table 5-7: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 4

NSR 04	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
ARC	65	36	Neutral	55	36	Neutral	55	35	Neutral	45	34	Neutral
1	65	41	Neutral	55	40	Neutral	55	39	Neutral	45	38	Neutral
2	65	43	Neutral	55	43	Neutral	55	41	Neutral	45	40	Neutral
3	65	40	Neutral	55	40	Neutral	55	39	Neutral	45	39	Neutral

The greatest weekday and weekend noise levels are predicted during Phases 1 & 2 of construction. Evening and night-time levels relate to land drilling, and dredging activities only.

The outcome of the BS5228 assessment is that Neutral impacts are predicted at the surrounding residential receptors as a result of all construction phases during the day and night-time periods. There are no adverse effects predicted in EIA terms.

6 OPERATIONAL NOISE MODEL INPUT PARAMETERS

6.1 Proposed Operational Activities

During the operational stage, there is the potential for noise from ships berthing, loading / unloading activities, assembly of turbines and transfer of materials to / from to the laydown area to impact upon existing residents. In summary, the potentially significant noise generating operational activities as a result of the proposed quay and laydown area are anticipated to comprise of;

- Deep-water ship berthing (including on-board generators) and mooring;
- Movement, laydown, and storage of renewables components such as those for off shore wind farms. This is typically carried out using Self Propelled Modular Transporters (SMPTs);
- Movement of OIC tug and pilot boat vessels;
- Construction / assembly and maintenance of offshore wind turbines;
- Plant and HGV movements within quay and laydown area; and
- Loading / unloading of HGVs.

To account for the new berthing areas, two ship generators running over a 24 hour period have been modelled. As a worst case assumption a boat lift has been modelled as operating during both the day and night-time hours. This also applies to tug/pilot boat movements.

It is understood that it is proposed to use the laydown area predominantly for the assembly and storage of wind turbine components. These structures shall be loaded / unloaded directly from the ship using pairs of SPMTs. It is assumed that two pairs of SPMTs shall be driven onto the ship to load / unload each component, with approximately one movement within a daytime period.

For lifting operations, a 55T tracked mobile crane and a 400T wheeled telescopic crane has been modelled at each of the berths with additional heavy lifting provision from a 750T crane to service the laydown area.

Two additional 16 ton Fork Lift Trucks are likely to be present on the quay to service the vessels and move materials. Circa two additional HGV movements in and out of the quay and laydown area are likely to occur per 24 hour period. The noise model has assumed a worst case two movements per hour during the day and night-time period.

6.2 Operational Noise Model Input Parameters

6.2.1 Operational Noise Data

3D computer noise modelling of operational activity at the proposed development has been carried out using CadnaA software.

Calculations were carried out using plant manufacturer’s noise data, and published data in BS5228:2009+A1:2014, to derive predicted noise levels at noise sensitive receptors. Full details of the items of modelled operational plant, noise data (including data source), operating times, durations and source heights for the modelled operations are shown in Appendix D.

6.2.2 Operational Noise Model Assumptions

A number of assumptions have been established during the CadnaA modelling exercise, as detailed below.

- The ground model uses Lidar 1m resolution terrain height data for the surrounding area.
- The laydown area and quayside ground height has been set to 7m Above Chart Datum (ACD) per site sections provided by Arch Henderson;
- The heights of buildings have been estimated from photographs;
- Predicted noise levels are calculated in the free-field environment;
- Ground absorption has been set to 1 for areas of soft ground. Areas of hard ground and water have been set to 0.1 for reflective surfaces;
- Vehicle movements and mobile plant have been modelled as line sources within CadnaA;
- The ship generators and boat lift have been modelled as point sources.

6.3 BS4142:2014 Acoustic Feature Correction

CadnaA software has been used to model the specific sound level from operational activities at the location of the most exposed sensitive receptors. To calculate the rated sound level, the assessment considers the character of the sound being assessed at the receptor location. If present, corrections for impulsivity, intermittency and/or tonality are added to the specific sound level to calculate the rated sound level.

A sound source may exhibit acoustic characteristics at source, however, the prominence of these features may be masked at the location of the noise sensitive receptors by the residual (background) sound at these locations. The amount by which the residual sound masks these features varies as the residual sound changes in level and possible character. Similarly, the sources acoustic character may also vary with time.

In the case of ships loading / unloading, the movement of cargo and wind turbine components has the potential to create sound which is impulsive in nature. The modelled specific sound from these activities is predicted to be below, or close to the measured background noise at the most exposed sensitive receptors, which is an indication that the sound is predicted to be mostly inaudible. Despite this, due to the high transient peak levels that the movement of cargo and wind turbine components may create it is considered likely that some sound from these activities may be perceptible at the most exposed sensitive receptors. For this reason, a correction of 3dB(A), for impulsivity that is just perceptible, has been applied to the specific noise levels at NSR 1 (Gaitnip House and farm) and NSR 2 (Midway, A961) which are located over 1km from the laydown area. A correction of 6dB(A), for impulsivity that is clearly perceptible, has been applied to the specific noise levels at NSR 3 (Netherbutton Cottages) and NSR 4 (West Bu) as these receptors are located at distances of circa 500m and 700m from the laydown area with direct line of sight to the development.

The background noise measured at Location 1 in Table 4-1 is considered representative of NSR1 (Gaitnip House and farm), NSR3 (Netherbutton Cottages) and NSR4 (West Bu). The background noise measured at Location 2 in Table 4-1 is considered representative o fNSR2 (Midway, A961). The lowest measured background levels during daytime and night time have been used for assessment. The background noise monitoring locations and NSR locations are shown in Drawing Nos. 675795-GIS143 and GIS144 respectively.

6.4 Operational Noise Model Results and Assessment

The noise model results and TAN 2011 assessments for the day and night-time periods for operational activities are shown in Table 6-1 and Table 6-2.

Table 6-1: Noise Model Results and TAN 1/2011 Assessment; Daytime

Noise Sensitive Receptor ID	1	2	3	4
Modelled Specific Level $L_{S, (1\ hour)}$ dB	0.0	26.9	31.6	28.5
Acoustic Feature Correction dB(A)	3	3	6	6
Rated Noise $L_{Ar, (1\ hour)}$ dB	3.0	29.9	37.6	34.5
Background Noise $L_{A90, (1\ hour)}$ dB	30.6	35.1	30.6	30.6
Rated - Background Noise dB(A)	-27.6	-5.2	7.0	3.9
Sensitivity of Receptor	Low	Low	Medium	Low
Existing Level $L_{Aeq, (1\ hour)}$ dB	35.7	59.8	35.7	35.7
Specific Level + Existing Level $L_{Aeq, (1\ hour)}$ dB	35.7	59.8	37.1	36.5
Change in level	0.0	0.0	1.4	0.8
Magnitude of Impact (After – Before)	No Change	No Change	Minor	Negligible
Significance of Effects	Neutral	Neutral	Slight	Neutral / Slight

Table 6-2: Noise Model Results and TAN 1/2011 Assessment; Night-time

Noise Sensitive Receptor ID	1	2	3	4
Modelled Specific Level $L_{S, (1\ hour)}$ dB	0	24.1	27.4	25.2
Acoustic Feature Correction dB(A)	3	3	6	6
Rated Noise $L_{Ar, (1\ hour)}$ dB	3	27.1	33.4	31.2
Background Noise $L_{A90, (1\ hour)}$ dB	28.5	28.9	28.5	28.5
Rated - Background Noise dB(A)	-25.5	-1.8	4.9	2.7
Sensitivity of Receptor	Low	Low	Low	Low
Existing Level $L_{Aeq, (1\ hour)}$ dB	28.5	28.9	28.5	28.5

Noise Sensitive Receptor ID	**1**	**2**	**3**	**4**
Specific Level + Existing Level $L_{Aeq, (1 hour)}$ dB	28.5	30.1	31.0	30.2
Change in level	0.0	1.2	2.5	1.7
Magnitude of Impact (After – Before)	No Change	Minor	Minor	Minor
Significance of Effects	Neutral	Neutral / Slight	Neutral / Slight	Neutral / Slight

The results show that the daytime noise from proposed operations is predicted to result in an increase in noise levels at sensitive receptors of between 0.8dB(A) at NSR 4 to 1.4dB(A) at NSR 3. No increase in noise levels is predicted at NSR 1 or NSR 2. The significance of the increases in noise levels is Neutral / Slight at NSR 4 and Slight at NSR 3.

At night the noise from proposed operations is predicted to result in an increase in noise levels at sensitive receptors NSR 2, 3 and 4 between 1.2dB(A) and 2.5dB(A). The significance of the increases in noise levels are Neutral / Slight. The noise levels are predicted to be unchanged at NSR 1.

In terms of human perception of sound, an increase of 3dB(A) is considered to be barely perceptible, therefore the maximum predicted increase of 2.5 dB(A) at night is considered likely to be mostly imperceptible.

There are no significant adverse impacts in EIA terms during the day or night time periods.

7 CONCLUSIONS

A construction and operational noise assessment has been carried out for the proposed Scapa Deep Water Quay.

7.1 Construction Noise

Worst case combined construction stages based on the proposed construction schedule have been modelled using CadnaA software. Details of construction activities have been provided by Arch Henderson.

The greatest weekday and weekend predicted noise levels are associated with construction Phases 1 & 2, in which activities including excavation, land reclamation and piling will be carried out.

There is the potential that dredging may be carried out over a 24 hour period, therefore evening and night-time noise levels have been predicted for this scenario.

The outcome of the assessment is that Neutral impacts are predicted during the day and night-time periods during all construction phases including dredging. There are no significant adverse impacts in EIA terms.

7.2 Operational Noise

The operational noise assessment considers the increase in potentially significant noise generating activities post development completion.

During the day and night-time periods noise levels are predicted to increase by up to 2.5dB at surrounding residential receptors as a result of the operational activities at SDWQ. The maximum significance of the changes in noise levels is Neutral / Slight, which is not significant in EIA terms.

NOISE DEFINITIONS

The following definitions relating to noise are used in this report:-

Ambient Sound Level: As defined in BS4142:2014; equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, at the assessment location. The ambient sound level includes the contribution from the residual sound level and the specific sound level. Measured with $L_{Aeq,T}$.

Background Sound Level: The background sound level represents baseline conditions, filtering out intermittent noises, and can be thought of as a baseline over which a continuous noise would be heard. Defined in BS 4142 as the A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of any given time interval, T, $L_{A90,T}$.

Free-field: Sound can propagate from a source to a receiver through a direct path as well as reflected paths. The free-field represents a scenario where there are no contributions from reflections. In environmental assessments this largely refers to the scenario where the contribution from reflections is negligible.

Façade Effect: When sound is reflected back towards its source, off a surface, such a wall, the reflected and incident sound waves sum. One metre from the façade of a building this typically results in an increase in level, compared to that of the free-field, by approximately 3 dB, referred to as the façade effect.

$L_{Aeq,T}$: Equivalent continuous A-weighted sound pressure level. This is the single number that represents the average sound energy over a given time period, T. It is the sound level of a notionally steady sound that has the same energy as a sound that fluctuates over the specified measurement period.

$L_{A10,T}$: The noise level exceeded for 10% of the measurement period, T.

$L_{A10,18h}$: The average noise level exceeded for 10% of the time in each of the eighteen one hour periods between 06:00 to 24:00 hours. This takes into account the fluctuation in traffic volumes over time to provide a single figure for assessment purposes and is typically used in road traffic assessments.

$L_{A90,T}$: The noise level exceeded for 90% of the measurement period.

L_{Amax}: The maximum A-weighted sound pressure level over the specified period.

Octave: A range of frequencies whose upper frequency limit is twice that of its lower frequency limit.

Octave Band: Sound pressure level is often measured in octave bands, the centre frequencies of the bands are defined by ISO – 31.5Hz, 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz, 16kHz to divide the audio spectrum into 10 equal parts. The sound pressure level of sound that has been passed through an octave band pass filter is termed the octave band sound pressure level. Additionally, sound is often represented by one-third octave bands, which divides each octave band into three.

Rating Level: The specific sound level with the addition of any character correction penalties.

Residual Sound Level: The continuous A-weighted sound pressure level at a given location in the absence of the specific sound level. This, unlike the background sound level, includes the contribution from fluctuating sounds.

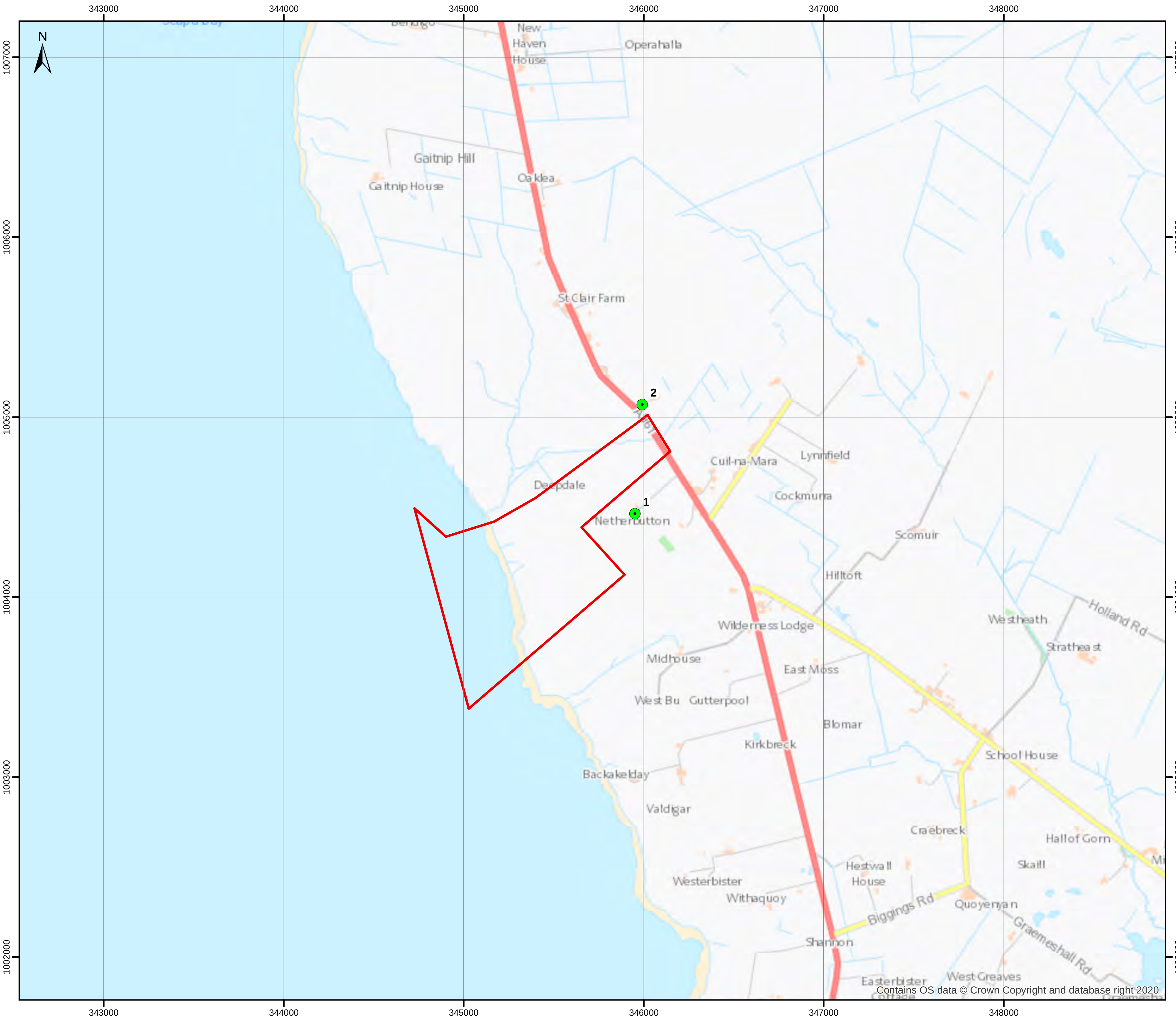
Specific Sound Level: The continuous A-weighted sound pressure level at a given location of the isolated industrial noise source.

Character Penalty: A penalty applied to a specific sound source to account for inherent character of a source as perceived at the position of the noise sensitive receptor. For example a tonal penalty can be derived subjectively (2 dB for a tone which is just perceptible at the receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible). The tonal penalty can be derived objectively through two procedures. The first is to assess the one-third octave band spectrum, where if certain criteria are met a 6 dB penalty is applicable. If a tone is not identified using the one-third octave band spectrum the penalty should be derived using the reference method, a more in depth narrow-band method based on a psychoacoustic model for tonal audibility.

Weighting: Human hearing is most sensitive to frequencies between about 500Hz and 6kHz and less sensitive to frequencies above and below these. In order to measure noise levels representative of human hearing a filter is applied termed a Frequency Weighting which is a prescribed frequency filter provided in a sound level meter. An A-weighted sound pressure level in decibels (denoted as dB(A)) is designed to reflect the sharpness of the human ear, which does not respond equally to all frequencies

APPENDICES

A DRAWINGS



Legend

- Scapa Deep Water Quay Boundary
- Noise Monitoring Locations

Do not scale this map

Client
Orkney Island Council Harbour Authority

Project
Scapa Deep Water Quay

Title
Noise Monitoring Locations

Status
Final

Drawing No.	Revision	Date
674795-GIS143	-	27 April 2023
Drawn	**Checked**	**Approved**
AH	EC	EC

Scale
1:20,000 @A3
0 100 200 400 600 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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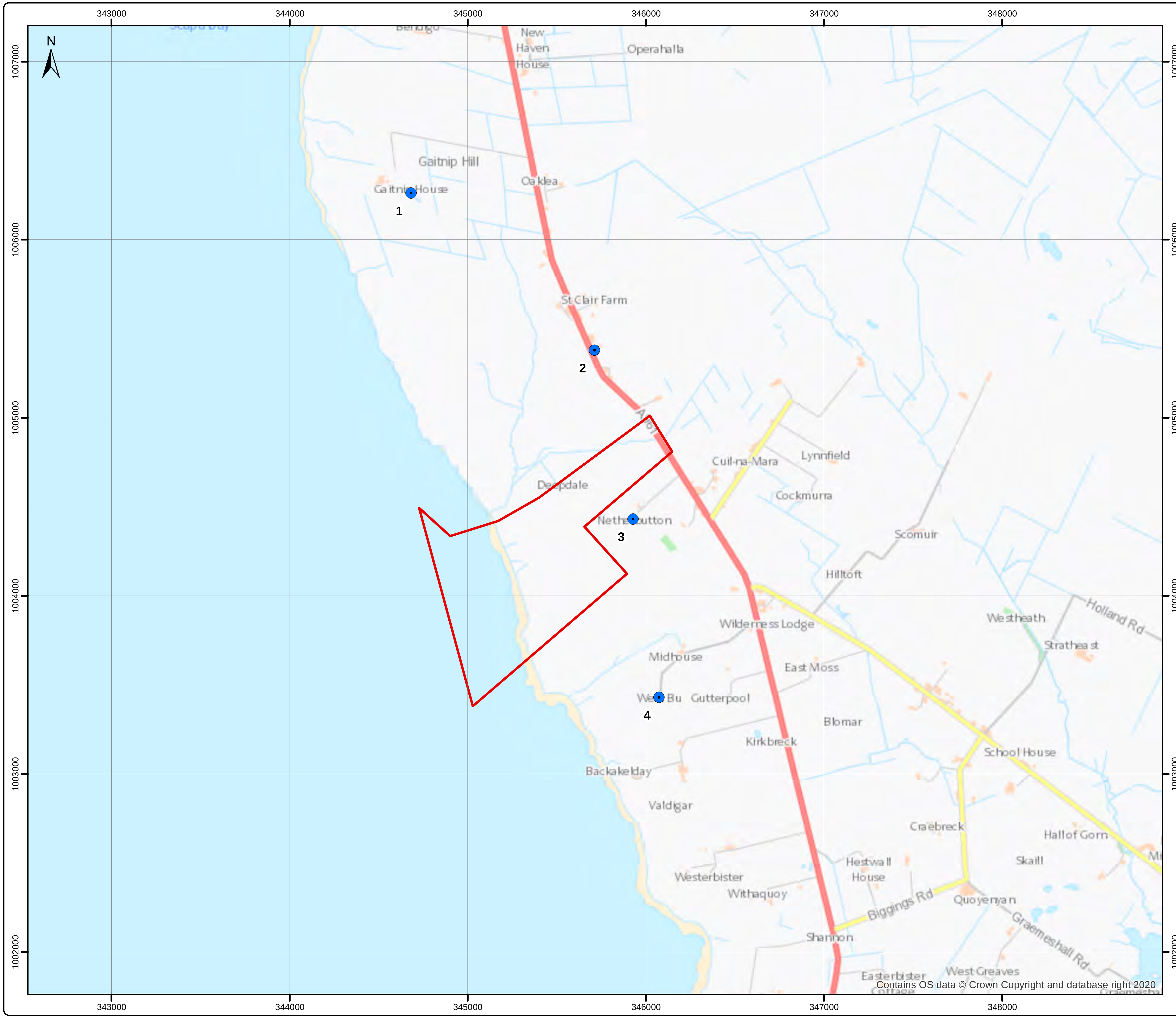

Legend

- Scapa Deep Water Quay Boundary
- Noise Sensitive Receptors

Do not scale this map

Client		
Orkney Island Council Harbour Authority		
Project		
Scapa Deep Water Quay		
Title		
Noise Sensitive Receptors		
Status		
Final		
Drawing No.	**Revision**	**Date**
674795-GIS144	-	27 April 2023
Drawn	**Checked**	**Approved**
AH	EC	EC

Scale
1:20,000 @A3
0 100 200 400 600 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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B ABC CATEGORY THRESHOLDS

The appropriate ABC category thresholds for each of the noise sensitive receptors has been calculated following guidance provided in Annex E of the standard (refer to Section 3.3.1 for assessment criteria).

Calculations for each of the noise sensitive receptors, based on measured day and night-time ambient noise levels in the absence of construction noise is shown in Table B-1 and Table B-2. Evening and Weekend ambient noise levels have been assumed to be Category A to ensure a conservative assessment.

Table B-1: ABC Category Thresholds, NSR 1, NSR 3 & NSR 4

NSR 01	Measured Daytime dB(A)	Measured Night-time dB(A)	Weekend dB(A)	Evening dB(A)
Ambient Levels	35.7	31.8	34.2	34.2
Ambient Levels Rounded	35	30	35	35
BS5228 ABC Category	**A**	**A**	**A**	**A**
Threshold Value	65	45	55	55

Table B-2: ABC Category Thresholds, NSR 2

NSR 02	Measured Daytime dB(A)	Measured Night-time dB(A)	Weekend dB(A)	Evening dB(A)
Ambient Levels	59.8	48.3	57.1	57.1
Ambient Levels Rounded	60	50	55	55
BS5228 ABC Category	**A**	**C**	**B**	**B**
Threshold Value	65	55	60	60

C CONSTRUCTION NOISE MODEL DATA

Construction Activities	Modelling Scenarios	Individual Plant / Activities	No. of Units	Lp at 10m dB(A)	Data Source	Source Height (m)	Operating Times	% On-time of Operating Hours	Operating Periods			
									D	W	E	N
Access Road Construction	ARC	Dump truck movements	2 p/h	90	BS5228 C.9 ref 21	0.5	07:00 – 19:00	80	X	X		
		Dump truck tipping fill	2 p/h	80	BS5228 C.1 ref 11	0.5		25	X	X		
		16T Twin Drum Rollers	2	73	BS 5228 C.2 ref 38	0.5		80	X	X		
		Tracked Hydraulic Drilling Rig	4	86	BS5228 C.6 ref 35	1	24 Hours	80	X	X	X	X
		40T Excavators	4	79	BS 5228 C.2 ref 14	1		80	X	X	X	X
HGV Deliveries	Phase 1 Phase 2	HGV delivery full	2 p/h	80	BS5228 C.6 Ref 21	0.5	07:00 – 19:00	7 p/h	X	X		
		HGV delivery empty	2 p/h	83	BS5228 C.6 Ref 22	0.5		7 p/h	X	X		
		Dump truck tipping fill	2 p/h	80	BS5228 C.1 Ref 11	0.5		7 p/h	X	X		
Drainage, Infill and Compaction	Phase 1 Phase 2	D6 Dozers - 18T	8	81	BS 5228 C.2 ref 12	1	07:00 – 19:00	80	X	X		
		Dump truck movements	8	90	BS5228 C.9 ref 21	0.5		80	X	X		
		Dump truck tipping fill	8	80	BS5228 C.1 ref 11	0.5		25	X	X		
		Tracked Hydraulic Drilling Rig	4	86	BS5228 C.6 Ref35	1	24 Hours	80	X	X	X	X
		40T Excavators	10	79	BS 5228 C.2 ref 14	1		80	X	X	X	X
		16T Twin Drum Rollers	2	73	BS 5228 C.2 ref 38	0.5	07:00 – 19:00	80	X	X		
		26T High Energy Impact Compaction Roller	1	80	BS5228 C.5 ref 19	0.5		80	X	X		
		9T Rapid Impact Compaction (compactor rammer)	1	91	BS5228 D.3 ref 121	0.5		80	X	X		
		Diesel water pump	1	91	BS5228 D.11 ref 1	0.5		80	X	X		
Surfacing	Phase 1 Phase 2	Asphalt spreader	1	82	BS5228 D.8 Ref 22	0.5	07:00 – 19:00	80	X	X		
		Batching Plant	1	78	BS5228 D.6 Ref 10	1		100	X	X		
		Truck mixer	1	81	BS5228 D.5 Ref 15	1		80	X	X		
		Lorry mounted Concrete pump	1	81	BS5228 D.5 Ref 16	1		80	X	X		
Rock Armour Revetment	Phase 1 Phase 2	40T Excavators on import vessel	2	79	BS 5228 C.2 ref 14	1	07:00 – 19:00	80	X	X		
		Jack up barge	1	76	CNP 061	1		100	X	X		
		Tug boat/Mooring vessels	2	82	CNP 221	1		80	X	X		
		Dump truck movements	1	90	BS5228 C.9 ref 21	0.5		80	X	X		
		Dump truck tipping	1	80	BS5228 C1 Ref. 11	1		25	X	X		
Install Sheet Pile Wall	Phase 1 Phase 2	100t crawler crane	2	67	BS5228 C.3 Ref 28	1	07:00 – 19:00	80	X	X		
		Large capacity vibrating hammer	3	88	BS5228 D.4 Ref 43	0.5		80	X	X		
		Vibrating hammer generator	3	74	BS5228 C.4 Ref 84	0.5		80	X	X		
Tie Rod, Anchor Walls	Phase 1 Phase 2	Impact wrenches	3	70	Markesino et al. Study of noise transmission from impact wrench.	1	07:00 – 19:00	80	X	X		

Construction Activities	Modelling Scenarios	Individual Plant / Activities	No. of Units	Lp at 10m dB(A)	Data Source	Source Height (m)	Operating Times	% On-time of Operating Hours	Operating Periods			
									D	W	E	N
		Hammer	3	79	BS5228 D.7 Ref 80	0.5		20	X	X		
Rotary Percussive Drilling (Sea bed Prep for Piling)	Phase 1 Phase 2 Phase 3	Small boat to transfer personnel between the barge and shore	1	82	CNP 221	1	07:00 – 19:00	5	X	X		
		Hopper barge	1	76	CNP 061	1		100	X	X		
		Tracked mobile drilling rig (23t / 110mm dia)	1	87	BS5228 C.9 Ref 3	0.5		80	X	X		
Dredging	Phase 1 Phase 2 Phase 3	Backhoe dredge	1	88	Aberdeen Harbour Expansion Project, Vol 3, Appendix 20C. Waterman, Nov 2015.	1	24 hours	100	X	X	X	X
		Vessel engine	1	72	Internoise 2010, Noise From Moored Ships, Rob Witte	0.1		100	X	X	X	X
		Hopper barge	1	76	CNP 061	1		100	X	X	X	X

D OPERATIONAL NOISE MODEL DATA

Description of Operations	Individual Plant / Activities	No. of Units	Lw	Data Source	Source Height (m)	Operating Periods	% On-time of Operating Hours	Mins per 16 Hour Daytime	Mins per 8 Hour Night-time	Assumptions
Proposed Scapa Deep Water Quay Operations	750t Liebher LR1750 Crane	1	111	EnviroCentre database	1.5	24 hours	50	480	240	Placed in laydown area to facilitate largest components and lifting operations
	400t Wheeled Mobile Telescopic Crane	2	106	BS5228, Table C4, Ref 38	2		50	480	240	Assume one per berth for loading/unloading ships
	Mobile crane	2	98	BS5228, Table C3, Ref 29	2		50	480	240	Assume one per berth for loading/unloading ships, in support of larger cranes and SPMTs
	OICHA Pilot boats/transfer vessels	2	100	Internoise 2010, Noise From Moored Ships, Rob Witte	1		25	240	120	Assume two pilot boats or transfer vessels may be required in a given day or night time period at north end of quay.
	Boat Lift (tracked crane)	1	99	BS5228 C4 Ref. 50	10		5	48	24	Assume may operate both day and night-time as worst case scenario.
	SPMT	2 pairs	111	EnviroCentre database	0.5		80	960	0	4 x SPMTs per renewables component typically move to yard and then back once in a 10 hour period, going at 2km/h. They go onto the ship to unload the components, then are jacked down in the yard. As worst case assume 1 movement per hour max and 2km/h.
	16 ton Fork Lift Trucks	2	107	EnviroCentre database	0.5		80	768	384	Assume 10 movements per hour during the day and night-time. 15km/h.
	HGV delivery or pick up	2 per hour max	108	BS5228, Table C6, Ref 21	0.5		2 per hour max	N/A	N/A	Assume 2 movements per hour during the day and night-time. 20km/h.
	Ship generator noise	2	100	EnviroCentre database	6		100	960	480	2 additional generators over existing operations.