TECHNICAL APPENDIX 9.2

Orkney Logistics Base (Hatston)
Technical Appendix 9.2, Noise Impact Assessment v2

June 2023

CONTROL SHEET

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1	06/09/2023	Removed reference to sea disposal in Table 5-3 and Section 5.3.6.
2		

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EXECUTIVE SUMMARY

A construction and operational noise assessment has been carried out for the proposed development at Hatston.

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 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.

The change in road traffic noise levels along routes which HGVs carrying infill material to / from the local quarries which will supply the site has been predicted. The maximum change in noise level as a result of construction HGVs is predicted to be less than 1dB along the routes. The maximum significance of effects as a result of the construction traffic is Slight, which is not significant 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 1dB at surrounding residential receptors as a result of the increased operational activities at Hatston. 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) for the proposed expansion of the existing Hatston Ferry Terminal to create a Logistics Base.

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 Technical Appendix 5.6, and Chapter 5, Biodiversity of the EIAR.

1.2 Site Description

Hatston Pier and Harbour is located on the coast to the northwest of Kirkwall. The proposed development site boundary and surrounds are shown in Drawing No. 674795-GIS083, Appendix A.

There are a number of existing noise sensitive receptors in the surrounding area with full or partial line of sight to the site. Saverock Farm is located circa 1km to the south-west, a small hamlet at Hatston Park is located circa 950m to the south-east. Housing at Grainbank on the outskirts of Kirkwall is located circa 1.3km to the south east. Directly across the water to the east is housing on Carness Road on the northern outskirts of Kirkwall.

1.3 Existing Use

Hatston Pier and Harbour is Orkney's primary commercial terminal and link south to Aberdeen and north to Shetland. It is also Scotland's longest deep-water commercial berth with a total of 884 metres of quay side available for multi-purpose use. This infrastructure accommodates a range of operational activities including large cruise ships, renewable energy, ferries, oil and gas and cargo/ livestock.

The site also comprises an area of land used for short/long term parking, freight, marshalling area and storage. There are a number of commercial / industrial buildings situated adjacent to the access road. A causeway edged with rock armour extends out towards a 'T'-shaped pier formed from piles topped by a concrete slab. On the eastern arm of the pier is the passenger reception facility and associated infrastructure.

1.4 Proposed Development

The proposed development comprises an extension to the existing pier facilities which will increase quay length. An area of land will be reclaimed to create a new laydown and storage area adjacent to the quay. The pier extension, laydown area and associated infrastructure has been designed to be future proofed so as to accommodate a range of potential future uses.

It is intended that the site will be used to enable offshore wind activities such as maintenance and operations, complementing activities at the future proposed Scapa Deep Water Quay. The new laydown area is likely to be used for storage of renewable energy devices, such as wind turbine components.

The development includes provision of a new boat lift capable of handling vessels of up to 800 tonnes. A small scale boatyard with undercover facilities for storage and maintenance of boats including smaller leisure, fishing and aquaculture may be developed at a future unspecified date. There are no developed plans for undercover storage and maintenance facilities at the time of writing.

The site could potentially be used for the storage of alternative fuels. There are no developed plans for alternative fuel storage at the time of writing.

1.5 Potential Impacts

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

1.5.1 Construction Phase

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

Noise from HGV movements associated with import of infill material has the potential to impact existing noise sensitive receptors located along the routes to and from the site from Heddle and Cursiter quarries.

1.5.2 Operational Phase

The operational phase will see an extension of existing activities at Hatston. The following activities have been identified as having the potential to increase noise levels in the surrounding area;

- Increased ship berthing and mooring, including use of onboard ship generators;
- Ship loading / unloading activities;
- Movement of materials, including renewables components between ships and laydown area;
- HGV movements associated with increased activities;
- Boat lifting and transport between pier and storage areas.

1.6 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre Limited.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre Limited for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

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2 NOISE POLICY AND GUIDANCE

This section outlines policy and guidance relevant to this NIA.

2.1.1 Scottish Planning Policy

The purpose of the Scottish Planning Policy[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.

2.1.2 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.

2.1.3 Assessment of Noise: Technical Advice Note

Assessment of Noise: Technical Advice Note[3] (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.

Stage 2: Quantitative Assessment

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[1] The Scottish Government (June 2014), *Scottish Planning Policy.*
[2] The Scottish Government (2011), *PAN 1/2011 Planning and Noise*.
[3] The Scottish Government (2011), *TAN 1/2011 Technical Advice Note*.

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.

2.1.4 Calculation of Road Traffic Noise

CRTN[4] is the standard UK procedure which defines measurement and calculation methods for assessing road traffic noise.

The standard contains a shortened measurement procedure by which daytime $L_{A10,18h}$ noise level can be calculated from the arithmetic average of three consecutive hourly $L_{A10,1h}$ measurements.

2.1.5 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."*

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[4] The Department for Transport (1988), *The Calculation of Road Traffic Noise*.
[5] World Health Organization (1999), *Guidelines for Community Noise*.

2.1.6 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 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.

2.1.7 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.

[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.*
[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, is shown below and overleaf in Table 3-1.

Table 3-1: Summary of Consultation Responses

Organisation	Consultation Response	How and where addressed
Orkney Island Council (OIC)	The EIA should define the source of infill material and if this is not known at the time of submission, should outline the potential options ensuring assessment of the potential impacts associated with the worst case scenario through providing information of likely HGV movements associated with that option and appropriate mitigation, including a Framework CEMP/Dust Mitigation Strategy. With appropriate mitigation of the worst case scenario outlined in the introductory sections of the EIA, noise and air quality during the construction phase of the proposed development can be scoped out of the EIA.	The source of infill material and associated worst case assumptions adopted in this NIA are described in Section 5.3.4.
	It is agreed that operational noise can be scoped out of the assessment for the reasons set out in the Scoping Report.	Assessment of operational noise has been included in the EIA to address Marine Scotland requirements.
Marine Scotland	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.	Assessment of construction and operational airborne noise have been included in the EIA report. Both assessments assume worst case scenarios.

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 3 areas representative of the most exposed noise sensitive receptors surrounding the proposed development; the monitoring locations are shown in Drawing No. 674795-GIS081 Appendix A;
- Measurement of existing baseline road traffic noise at two locations along routes to / from Heddle and Cursiter Quarries. The monitoring locations are shown in Drawing No. 674795-GIS082, 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.

3.3.2 PAN 1/2011 Methodology and Target Criteria - Change in Road Traffic Noise

The change in road traffic noise as a result of development generated road traffic during the construction phase (specifically HGVs associated with infill activities) is assessed in accordance with methodology provided in PAN 1/2011, and associated TAN 2011.

The magnitude of impact is defined by assessing the change in road traffic as a result of development generated traffic during the day and night-time periods at existing noise sensitive receptors. The classification of the magnitude of impacts used in this assessment is shown in Table 3-4.

Table 3-4: Classification of Magnitude of Noise Impacts; Construction Road Traffic Noise

Change in Noise Level, x $L_{Aeq,T}$ dB	Magnitude of Impact
x ≥ 5	Major adverse
3 ≤ x < 5	Moderate adverse
1 ≤ x < 3	Minor adverse
0 < x < 1	Negligible adverse
x = 0	No change

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 3-5. 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 3-5.
- 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 3-5.
- The Significance of Impact is then defined, as shown in Table 3-5.

Table 3-5: 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 Baseline Background Noise

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) calibrated using a Nor-1251 calibrator (serial number 30796), and Norsonic Nor 145 (serial number 14529959) and 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.

4.1.1 Background Noise Monitoring Locations

The noise monitoring locations are described in Table 4-1, and shown in Drawing No. 674795-GIS081, Appendix A.

Table 4-1: Noise Monitoring Locations

ID	Grid Reference	Location
01	342756 1012636	On the grounds of Saverock farmhouse. The monitoring position was located adjacent to the access road which runs north east from Saverock farmhouse in order to represent the closest property on this track to Hatston Pier.
02	343425 1012133	At the end of the farm track accessed via Hatston Park. The monitoring position was located to the north east of the barn with direct line of sight to Hatston Pier.
03	345718 1012302	Located approximately 15 metres west of Carness Road with a direct view across the Bay of Weyland to Hatston Pier.

4.1.2 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. Negligible wind. 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.

Date	Monitoring Period	Meteorological Conditions
30/11/22	Daytime - Afternoon	Some scattered clouds, 2 – 3 oktas. Wind from west around 3 – 4 m/s, some gusts of 5 m/s and above. Temperature 5 - 7°C.

Table 4-3: Baseline Monitoring Observations

NML ID	Date	Period	Start Time	Observations
1	29/11/2022 30/11/2022	Day	17:25 12:33	Road traffic noise is dominant at this location, with the background noted to be comprised mostly of distant traffic noise to the south east (Kirkwall). Some faint industrial noise was also heard from the Hatston Retail and Business Park, with greater contributions from this noted on the second day of measurement. Some occasional clattering and banging was also heard from towards Hatston Pier.
	28/11/2022 29/11/2022	Night	23:26 00:17	Road traffic noise was dominant when present, however passing vehicles were infrequent during night time hours. The background noise at this location comprised of a mix of low level intermittent traffic and industrial noise /low level hum from the east. On the second night of measurement there was noted to be increased activity at Hatston Pier, with metallic bangs and clattering noted on several occasions to be clearly audible against the quiet background.
2	30/11/2022 30/11/2022	Day	12:07 13:28	Both daytime measurements were captured on the same afternoon. The noise environment was noted to be similar to Position 1. Road traffic on the A965 dominated levels when present. Traffic was noted to be regular and it was rare for individual vehicles to not be audible. The background was comprised of a mix of constant distant traffic to the south east (Kirkwall) and a mix of industrial sources to the east from various industrial sources within Hatston Retail and Business Park. During the first hour a large earth moving vehicle seen moving back and forth on the western boundary of the retail and was clearly audible throughout. Other noted sources from the park were intermittent reverse alarms and a low frequency generator hum with an accompanying rattling sound which would be active for up to 20 minutes at a time.
	28/11/2022 29/11/2022	Night	00:04 23:41	As with the daytime measurements, the noise environment was noted to be similar to Position 1. Noise from passing cars on the A965 was dominant when present. The background comprised of a mix of low level distant traffic and night time operations at Hatston Retail and Business Park to the east. On the second night there was noted to be increased activity at Hatston Pier, including some metallic banging and low frequency hum.

NML ID	Date	Period	Start Time	Observations
3	29/11/2022	Day	15:31	Road traffic on Carness Road was dominant when present. The background was noted to be comprised of a mix of distant road traffic from Kirkwall and low frequency hum from various vessels at Hatston Pier and possibly industrial sources across the bay. The increase in wind speeds on the second day of measurement introduced some low level waves and interactions with the water but this did not raise levels.
	30/11/2022		13:52	
	28/11/2022	Night	00:45	Road traffic on Carness Road was dominant when present, with two or three passing vehicles during each measurement. An unidentified source of mid frequency broadband noise directly south of the measurement position was clearly audible on both nights. The background was otherwise noted to be comprised of low frequency hum/rumble from across the water, assumed to be idling vessels, and some distant traffic noise.
	29/11/2022		23:01	

4.1.3 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

ID	Date	Start time	Duration, T (hrs:mins)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
1	29/11/2022	17:25	01:00	49.4	41.7
	30/11/2022	12:33	01:00	48.2	42.2
2	30/11/2022	12:07	01:00	48.5	44.1
	30/11/2022	13:28	01:00	45.8	42.2
3	29/11/2022	15:31	01:00	52.5	42.5
	30/11/2022	13:52	01:00	51.9	41.9

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

ID	Date	Start time	Duration, T (hrs:mins)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
1	28/11/2022	23:26	00:30	36.5	23.3
	29/11/2022	00:17	00:30	37.8	26.6
2	28/11/2022	00:04	00:30	32.2	25.8
	29/11/2022	23:41	00:30	35.2	28.5
3	28/11/2022	00:45	00:30	34.6	32.6
	29/11/2022	23:01	00:30	42.6	33.0

4.2 Baseline Road Traffic Noise

Noise from Heddle Road and the A965 was measured at two positions for three consecutive one hour intervals in accordance with the shortened measurement procedure detailed in CRTN. The positions are along routes which HGVs will travel with infill material from Heddle and Cursiter Quarries to the development site.

4.2.1 Road Traffic Noise Monitoring Locations

The baseline CRTN measurement positions are described in Table 4-6 and shown in Drawing No. 674795-GIS082, Appendix A.

Table 4-6: Baseline CRTN Noise Monitoring Location

ID	Grid Reference	Location
CRTN 1	335822 1013392	Adjacent to Heddle Road in the front garden of a residential property
CRTN 2	338891 1012493	Adjacent to A965, on drive of Ingashowe House

The road traffic noise measurement on Heddle Road was conducted using a Norsonic Nor 145 (serial number 14529959) and calibrated using a Nor-1255 calibrator (serial number 125526127) before and after measurements, with a maximum drift of 0.1 dB noted. The measurement on the A965 was conducted using a Norsonic Nor118 sound level meter (serial number 131675), calibrated using a Nor-1251 calibrator (serial number 30796) before and after measurements, with a drift of 0.1 noted. Calibration certificates are available on request. Measurements were conducted at approximately 1.3 m above ground using a fast time weighting

The weather conditions and observations noted during the monitoring are summarised in Table 4-2.

4.2.2 Results

A summary of the hourly results can be found in Table 4-7.

Table 4-7: CRTN Hourly Measured Results

ID	Start time	Duration (hh:mm)	$L_{Aeq,1h}$ (dB)	$L_{A10,1h}$ (dB)
CRTN 1	29/11/2022 10:09	01:00	58.6	51.9
	29/11/2022 11:09	01:00	59.6	54.6
	29/11/2022 12:09	01:00	58.3	48.5
CRTN 2	29/11/2022 10:18	01:00	67.7	72.3
	29/11/2022 11:19	01:00	68.3	73.0
	29/11/2022 12:20	01:00	68.2	72.7

5 NOISE MODELLING

5.1 Noise Sensitive Receptors

A sample of five residential noise sensitive receptors 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-GIS083 Appendix A.

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

NSR ID	Location	Grid Reference
NSR 1	Saverock Farm	342746 1012647
NSR 2	Hatston Park	343254 1012117
NSR 3	Grainbank	343640 1011602
NSR 4	Boray Drive Housing Estate	345799 1011976
NSR 5	Carness Road	345708 1012386

During consultation with the EHO at OIC, it was requested that background noise monitoring at NSR 2 be conducted at a location representative of the farm to the south of the housing estate at Hatston Park. This was carried out as indicated by Monitoring Location No. 2 in Drawing No. 674795-GIS081, Appendix A. It was noted on site, however, that the residential properties at the farm do not have line of sight to Hatston Pier, as there are intervening farm buildings. Noise modelling has determined that the most exposed property is at the northern corner of Hatston Park, which has greater line of sight to Hatston Pier. For this reason, NSR 2 is a property at Hatston Park as this is more exposed than the farmhouse.

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

5.2 Change in Road Traffic Noise Level Noise Sensitive Receptors

The sections of road considered within the change in road traffic noise assessment as a result of the construction phase are described in Table 5-2 and shown in Drawing No. 674795-GIS084, Appendix A. The sections have been chosen to represent the routes that the HGVs from Heddle and Cursiter Quarries will take. The HGV routes from both quarries are shown in Drawing No. 202043/FS-04 titled *Hatston Pier, Kirkwall, Feasibility Study, Existing Commercial Quarries Location Plan* by Arch Henderson, Appendix A. It should be noted that these locations represent assessment locations rather than individual NSRs along each road. As the assessment carried out relates to a change in road traffic noise level, any propagation corrections would cancel out in calculating the change in level, and so are not included in the calculations.

Table 5-2: Change in Road Traffic Noise Level NSRs

ID	Assessed Road Section
CiR-1	Heddle Road
CiR-2	A965 between Heddle Road and Old Finstown Road
CiR-3	Old Finstown Road
CiR-4	A965 east of Old Finstown Road

5.3 Construction Noise Model Input Parameters

5.3.1 Construction Schedule and Modelled Scenarios

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 5-3.

Table 5-3: East Quay, Proposed Construction Schedule

Phase	Stage	Description
1	1	Formation of reclamation bund. Existing armour stone uplifted and used as outer slope protection to Stage 2.
	2	Continuation of reclamation bund, with section of sheet pile retaining wall installed using vibro hammer.
	3 & 4	Drainage and infill behind reclamation bund progressed to create reclaimed area.
2	5	Forming works access approach parallel to existing causeway.
	6	Forming reclamation access to commence steel sheet piling using vibro hammer adjacent existing suspended deck pier.
	7	Sheet piling at commencement of new 300m quay. Rotary drill located on spud leg barge to pre-treat sea bed. Crane on further barge used for lifting and progressing piling using vibro piling methods.
	8	Pre-treatment of hard strata and then vibro piling to form quay wall. Infill and install of tie rods. Install of main concrete cope and deck works.
3	9	Dredging of outside berth and north west navigational approach to -10m Cd. Either cutter suction of backhoe dredging technique used to removed dredge spoil into split hopper barge.

At this stage exact construction timings for the Phases in Table 5-2 are not know, however, it is understood that Phase 1 reclamation, armour and drainage works are programmed to be carried out circa 6 months ahead of Phase 2 and 3 works commencing.

As can be seen in Table 5-3, in many cases more than one type of construction activity will occur during the same months. Noise modelling scenarios have been set up to account for the cumulative impact of the concurrent activities. The scenarios have been set up to model the worst-case potential combination of construction activities for the construction phases. A summary of the combined construction activities and relevant assessment periods for each of the modelled scenarios is shown in Table 5-4. 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 scenario to be concurrent, this is a conservative assumption and some activities will in fact be contiguous.

Table 5-4: Modelled Scenarios; Construction Noise

Modelled Scenario	Phases	Modelled Combination of Construction Stages (Worst Case)	Relevant Assessment Periods
1	1 & 2	HGV deliveries and tipping	Day, Weekend
		Rock armour revetment	
		Drainage, infill and compaction	
		Pile sea bed pre-treatment	
		Install sheet pile wall	
2	3	HGV deliveries and tipping	Day, Weekend

Modelled Scenario	Phases	Modelled Combination of Construction Stages (Worst Case)	Relevant Assessment Periods
		Rock armour revetment	
		Drainage, infill and compaction	
		Install sheet pile wall	
		Pile sea bed pre-treatment	
		Tie rod / anchor walls	
		Surfacing	
3	4	Dredging	Day, Evening, Night, Weekend

5.3.2 Evening and Night-time Construction Noise

With reference to the assessment periods included in Table 5-4, only in the case of dredging are works scheduled to be carried out over a 24-hour period. All other activities are expected to have finished by 7 pm on a daily basis.

5.3.3 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 carried out during weekend hours (Saturday 07:00 – 19:00 and Sunday 09:00 – 13:00), which are subject to more stringent noise limits than during the weekdays (refer to Table 3-2).

5.3.4 Infill and Associated HGV movements

Import of the fill material will be carried out over a circa 10 month period using up to 6 to 7 trucks per hour. The material will come from the existing Cursiter and Heddle quarries 7.5km to 9km away from the site. The HGV routes between both quarries and Hatston Pier are shown in Drawing No. 202043/FS-04 titled *Hatston Pier, Kirkwall, Feasibility Study, Existing Commercial Quarries Location Plan* by Arch Henderson, Appendix A. The split of materials coming from each quarry is anticipated to be circa 50 / 50.

Arch Henderson have confirmed that up to 6 to 7 HGVs are expected per hour during the infill stages. HGV movements have been modelled using a worst case of 8 HGVs per hour, with a 50% split of HGVs travelling from Heddle and Cursiter Quarries respectively.

5.3.5 Sea Bed Pre-Treatment and Piling

Piling will be carried out between the hours of 08:00 and 19:00 M to F, and Saturday 08:00 – 19:00 and Sunday 09:00 – 13:00.

Steel sheets will be installed at specified locations using vibro hammering technique, which typically generates less noise than impact hammering techniques. The installation of sheet piling for construction of the new 300m quay will involve pre-treatment of the seabed. Drilling will be undertaken using a rotary percussive DTH hammer with a Symmetrix N131 casing or equivalent. Hole size will generally be 110mm diameter. Drilling patterns will be reviewed following trial pile installation to ensure the required depth is being achieved. Underwater blasting will be carried out in the drilled spaces to prepare the seabed for sheet piling. The impact of blasting on underwater noise is assessed in Technical Appendix 5.6, and Chapter 5, Biodiversity of the EIAR.

Water to airborne sound transmission from underwater blasting for piling preparation will not be significant. The prediction of underwater to airborne sound transmission form blasting is beyond the scope of BS5228, and has not been included in this NIA as any potential impacts would be on the marine ecological environment only.

5.3.6 Dredging

A short dredging campaign of 10300m^2 area and 6650m^3 volume will commence following completion of all quay works. The dredging will be carried out by either cutter suction or back hoe dredging technique. The dredge spoil will be removed into a split hopper barge. 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. Should cutter suction method be employed the levels shall be less than those presented in this report.

The dredging has the potential to be carried out over a 24 hour period and is anticipated to run for up to a 2 week period.

5.3.7 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.

5.3.8 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 Hatston site and the surrounding area.
- The heights of buildings have been estimated from photographs;
- Predicted levels are calculated in the free-field environment;

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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

- 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;
- 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;
- 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.

5.3.9 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 3.3.1). Details of the calculations are shown in Appendix B.

5.3.10 Change in Road Traffic during Construction Phase

For each NSR the aspects of road traffic noise subject to change has been calculated. A full 3D propagation model has not been conducted, as the only aspects of interest are those that change due to development generated traffic. Those aspects subject to change in accordance with CRTN are the total number of vehicles in an 18-hour period, Q, the velocity, v, and the percentage of HGVs, p. The formulas associated with these variables are provided below:

$$Basic\ L_{A10,18h} = 29.1 + 10\log_{10} Q$$

$$Correction = 33\log_{10}\left(V + 40 + \frac{500}{V}\right) + 10\log_{10}\left(1 + \frac{5p}{V}\right) - 68.8$$

The $L_{Aeq,16h}$ is determined from the $L_{A10,18h}$ by subtracting 2 dB, in line with recommendations in BS 8233, resulting in the following formula:

$$L_{Aeq,16h} = Basic\ L_{A10,18h} + Correction - 2\ dB$$

Baseline traffic data for Old Finstown Road and the A965 between Heddle Road and Old Finstown Road was taken from the Finstown Traffic Management Study conducted by Systra in April 2022[11]. Baseline traffic count data was not available for Heddle Road and the A865 east of Old Finstown Road. Traffic count data collected by EnviroCentre as part of the baseline CRTN measurements described in Section 4.2 has been used for these sections.

HGV movements have been modelled using a worst case of eight HGVs per hour, with a fifty percent split of HGVs travelling from Heddle and Cursiter Quarries respectively. Four HGVs per hour are assumed to travel along the routes from each Quarry. The HGV routes from both quarries are shown

[11] Systra, *Finstown Traffic Management Study*. Report Ref: GB01T21F18 dated 29/04/2022.

in Drawing No. 202043/FS-04 titled *Hatston Pier, Kirkwall, Feasibility Study, Existing Commercial Quarries Location Plan* by Arch Henderson, Appendix A.

- Do-Minimum. Contains baseline traffic data without construction HGV movements.
- Do-Something. Contains baseline traffic with construction HGV movements.

The traffic data for the NSR locations relevant for the change in road traffic noise level are shown in Table 5-5.

Table 5-5: Baseline Road Traffic Noise Data and Predicted Levels

ID	Baseline			With Development		
	18 Hour AAWT	P (%)	v (km/h)	18 Hour AAWT	P (%)	v (km/h)
CiR-1	390	45.3	82.1	394	49.0	48.3
CiR-2	4046	1.0	86.4	4050	1.1	48.3
CiR-3	988	0.7	96.5	992	1.1	96.5
CiR-4	5355	4.3	96.5	5363	4.3	96.5

5.3.11 Operational Noise Model Input Parameters

5.3.12 Increased Vessel Movements

During the operational phase, there will be an increase in vessel movements and associated harbour activity over that of the existing baseline which was established in 2016. Current baseline vessel movements comprise circa 2292 total movements per year, which comprise predominantly ferries (42%), cruise ships (11%), pilot boats (31%) and cargo vessels (8%). There are also a smaller percentage of oil supply (2%), renewables (3%), tugs (2%) and other vessels (2%).

The proposed development shall increase the number of oil supply vessels by circa 120 movements per year initially, rising to 400 per year (circa 1 extra vessel per week, rising to 3 to 4). It is estimated that there would be 4 additional HGV movements associated with each extra supply vessel, which equates to circa 2 extra HGVs arriving/departing per week, rising to 6 to 8.

The use of Hatston as a base for operations and maintenance activities associated with offshore wind farm development is anticipated to commence from 2028 onwards. There shall be an increase of circa 24 vessel movements initially, rising to 48 by 2032. There is not anticipated to be a significant increase in HGV movements associated with operations and maintenance of offshore wind farms, with the majority of supplies arriving to / from the harbour via vessels.

There shall also be an increase in other types of vessel, such as boat repair, renewables and cargo, the numbers of which will increase based on demand, with exact numbers not known at this stage. The number of associated HGVs will depend on the type of vessel, however, it is anticipated that most materials will arrive to / from the port via vessels so significant increases are unlikely.

5.3.13 Proposed Operational Activities

During the operational stage, there is the potential for noise from ships berthing, loading / unloading activities, and transfer to / from materials 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 extension and laydown are anticipated to comprise of;

- Ship berthing (including on-board generators) and cargo loading / unloading activities;
- Use of boat lift and movement of boats within site for storage or maintenance;
- 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 cargo to / from laydown area; and
- HGV loading / unloading and movements.

To account for the new berthing areas, two additional ship generators running over a 24 hour period have been modelled. As a worst case it has been the boat lift has been modelled as operating during both the day and night-time hours.

It is understood that it is proposed to use the laydown area predominantly for the 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. The noise model has assumed a worst case one movement per hour during the day.

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 extended 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.

5.3.14 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.

5.3.15 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 existing Hatston site and the surrounding area.
- The heights of buildings have been estimated from photographs;
- Predicted 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 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 6-1 to Table 6-5.

Table 6-1: 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
1	65	51	Neutral	55	50	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
2	65	50	Neutral	55	49	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
3	65	48	Neutral	55	46	Neutral	55	46	Neutral	45	37	Neutral

Table 6-2: 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
1	65	49	Neutral	55	48	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
2	65	49	Neutral	55	48	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
3	65	46	Neutral	55	44	Neutral	55	44	Neutral	45	38	Neutral

Table 6-3: 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
1	65	48	Neutral	55	47	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
2	65	48	Neutral	55	46	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
3	65	46	Neutral	55	44	Neutral	55	44	Neutral	45	37	Neutral

Table 6-4: 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
1	65	52	Neutral	55	49	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
2	65	52	Neutral	55	49	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
3	65	52	Neutral	55	49	Neutral	55	49	Neutral	45	35	Neutral

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

NSR 05	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
1	65	52	Neutral	55	49	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
2	65	52	Neutral	55	49	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
3	65	52	Neutral	55	49	Neutral	55	49	Neutral	45	35	Neutral

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

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 in EIA terms.

6.1 Construction Road Traffic Noise Levels

Table 6-6 presents a comparison of the current baseline and future road traffic noise levels at a reference distance of 10m from the road edge on the routes along which HGVs carrying infill from Heddle and Cursiter Quarries will travel. The road sections are shown in Drawing No. 674795-GIS084, Appendix A.

Table 6-6: Comparison of Baseline and Construction Road Traffic Noise Levels.

ID	Existing Noise Level (dB $L_{Aeq,16h}$)	Future Noise Level (dB $L_{Aeq,16h}$)	Difference (dB $L_{Aeq,16h}$)	Magnitude of Impact	Significance of Impact
CiR-1	57.6	57.9	0.3	Negligible	Slight
CiR-2	60.6	60.6	0	No Change	Neutral
CiR-3	59.4	59.5	0.1	Negligible	Slight
CiR-4	67.5	67.5	0	No Change	Neutral

The increase in road traffic noise levels as a result of increased construction HGV movements is predicted to be less than 1dB at CiR-1 (Heddle Road) and CiR 3 (Old Finstown Road). No change in level is predicted at CiR-2 (A965 between Heddle Road and Old Finstown Road) and CiR-4 (A965 east of Old Finstown Road). The maximum level of significance of the change in road is Slight. There are no significance adverse effects in EIA terms.

7 OPERATIONAL NOISE MODEL RESULTS AND ASSESSMENT

7.1 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 characters 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 just 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 all receptor locations.

7.2 East Quay Operational Activities

The noise model results and TAN 2011 assessments for the day and night-time periods for operational activities are shown in Table 7-1 and Table 7-2.

Table 7-1: Noise Model Results and TAN 1/2011 Assessment; Daytime

Noise Sensitive Receptor ID	1	2	3	4	5
Modelled Specific Level $L_{S, (1\ hour)}$ dB	32.5	29.3	27.3	0.0	20.9
Acoustic Feature Correction dB(A)	3	3	3	3	3
Rated Noise $L_{Ar, (1\ hour)}$ dB	35.5	32.3	30.3	3.0	23.9
Background Noise $L_{A90, (1\ hour)}$ dB	41.7	42.2	42.2	41.9	41.9
Rated - Background Noise dB(A)	-6.2	-9.9	-11.9	-38.9	-18
Sensitivity of Receptor	Low	Low	Low	Low	Low
Existing Level $L_{Aeq, (1\ hour)}$ dB	48.2	45.8	45.8	51.9	51.9
Specific Level + Existing Level $L_{Aeq, (1\ hour)}$ dB	48.3	45.9	45.9	51.9	51.9

Noise Sensitive Receptor ID	1	2	3	4	5
Change in level	0.1	0.1	0.1	0.0	0.0
Magnitude of Impact (After – Before)	Negligible	Negligible	Negligible	No change	No change
Significance of Effects	Neutral / Slight	Neutral / Slight	Neutral / Slight	Neutral	Neutral

Table 7-2: Noise Model Results and TAN 1/2011 Assessment; Night-time

Noise Sensitive Receptor ID	1	2	3	4	5
Modelled Specific Level $L_{S, (1\ hour)}$ dB	29.9	26.3	24.3	0.0	16.5
Acoustic Feature Correction dB(A)	3	3	3	3	3
Rated Noise $L_{Ar, (1\ hour)}$ dB	32.9	29.3	27.3	3	19.5
Background Noise $L_{A90, (1\ hour)}$ dB	23.3	25.8	25.8	32.6	32.6
Rated - Background Noise dB(A)	9.6	3.5	1.5	-29.6	-13.1
Sensitivity of Receptor	Medium	Low	Low	Low	Low
Existing Level $L_{Aeq, (1\ hour)}$ dB	36.5	32.2	32.2	34.6	34.6
Specific Level + Existing Level $L_{Aeq, (1\ hour)}$ dB	37.4	33.2	32.9	34.6	34.7
Change in level	0.9	1.0	0.7	0.0	0.1
Magnitude of Impact (After – Before)	Negligible	Minor	Negligible	No change	Negligible
Significance of Effects	Neutral / Slight	Neutral / Slight	Neutral / Slight	Neutral	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 up to 0.1dB(A) at NSR 1 to 3 (Saverock Farm, Hatston Park & Grainbank). The significance of the increases in noise levels is Neutral / Slight.

At night the noise from proposed operations is predicted to result in an increase in noise levels at sensitive receptors of between 0.1dB(A) at NSR 5 (Carness Road) and 1.0dB(A) at NSR 2 (Hatston Park). The significance of the increases in noise levels is Neutral / Slight. The noise levels are predicted to be unchanged at NSR 4 (Boray Drive Housing Estate).

In terms of human perception of sound, an increase of 3dB(A) is considered to be barely perceptible, therefore the maximum predicted increase of 1 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.

8 CONCLUSIONS

A construction and operational noise assessment has been carried out for the proposed development at Hatston.

8.1 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 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.

The change in road traffic noise levels along routes which HGVs carrying infill material to / from the local quarries which will supply the site has been predicted. The maximum change in noise level as a result of construction HGVs is predicted to be less than 1dB along the routes. The maximum significance of effects as a result of the construction traffic is Slight, which is not significant in EIA terms.

8.2 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 1dB at surrounding residential receptors as a result of the increased operational activities at Hatston. 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.

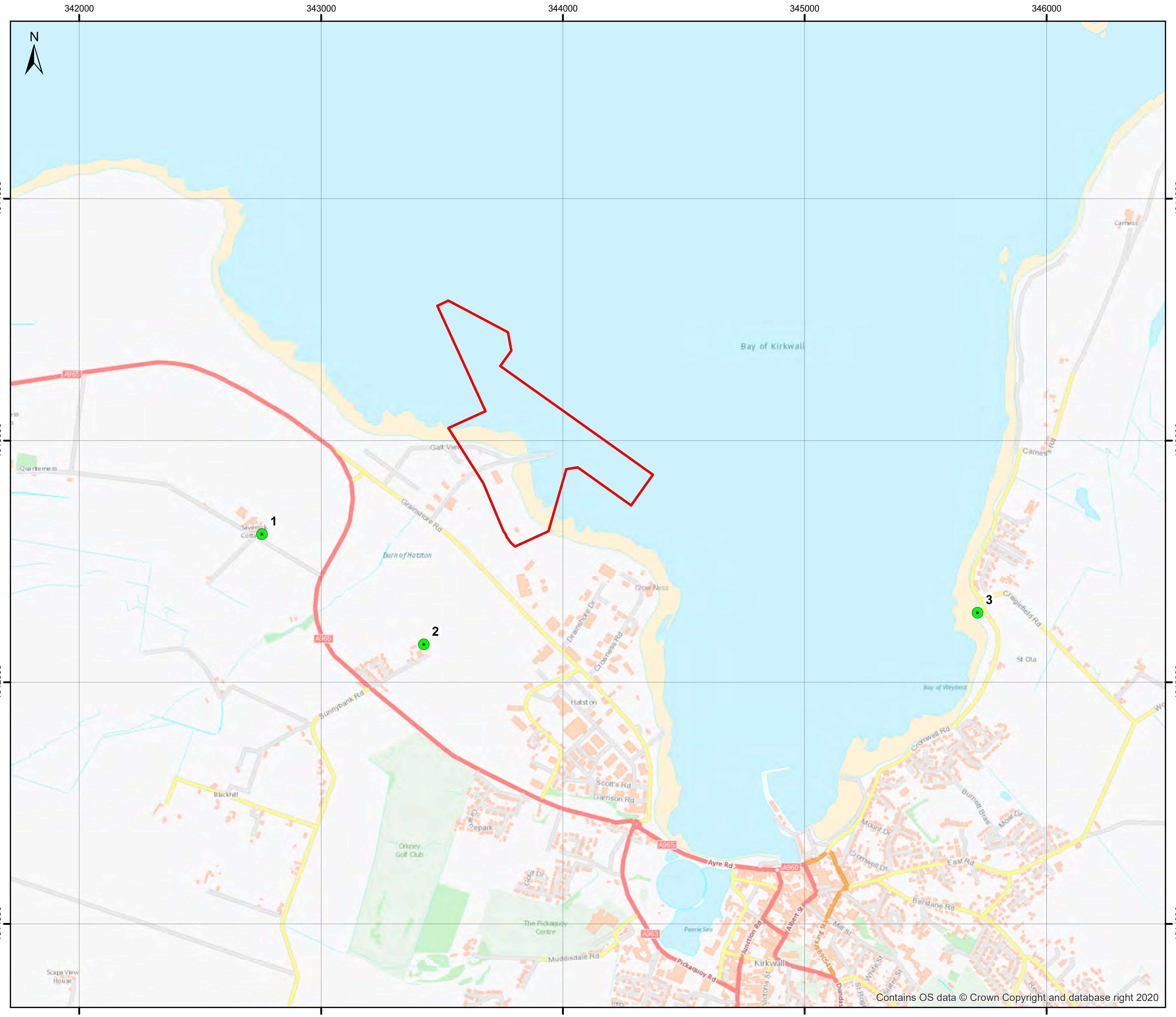
Specific Sound Level: The continuous A-weighted sound pressure level at a given location of the isolated industrial noise source.

Tonal Penalty: A penalty applied to a specific sound source to account for inherent tonality of a source as perceived at the position of the noise sensitive receptor. 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

- Hatston Site Boundary
- Noise Monitoring Locations

Do not scale this map

Client	Orkney Island Council Harbour Authority	
Project	Hatston Pier	
Title	Background Noise Monitoring Locations	
Status	Final	
Drawing No. 674795-GIS081	**Revision** -	**Date** 21 Jan 2023
Drawn CC	**Checked** AH	**Approved** AH

Scale 1:15,000 @A3 (0 75 150 300 450 Metres)

Rev	Date	Amendment	Initials
-	-	-	-

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Legend

- Hatston Site Boundary
- Road Traffic Monitoring Location

Do not scale this map

Client
Orkney Island Council Harbour Authority

Project
Hatston Pier

Title
Road Traffic Noise Monitoring Locations

Status
Final

Drawing No.	Revision	Date
674795-GIS082	-	21 Jan 2023

Drawn	Checked	Approved
CC	AH	AH

Scale
1:35,000 @A3

0 175 350 700 1,050 Metres

Rev	Date	Amendment	Initials
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Legend

- Hatston Site Boundary
- Noise Sensitive Receptors

Do not scale this map

Client
Orkney Island Council Harbour Authority

Project
Hatston Pier

Title
Noise Sensitive Receptors

Status
Final

Drawing No.	Revision	Date
674795-GIS083	-	21 Jan 2023
Drawn	**Checked**	**Approved**
CC	AH	AH

Scale
1:15,000 @A3

0 75 150 300 450 Metres

Rev	Date	Amendment	Initials
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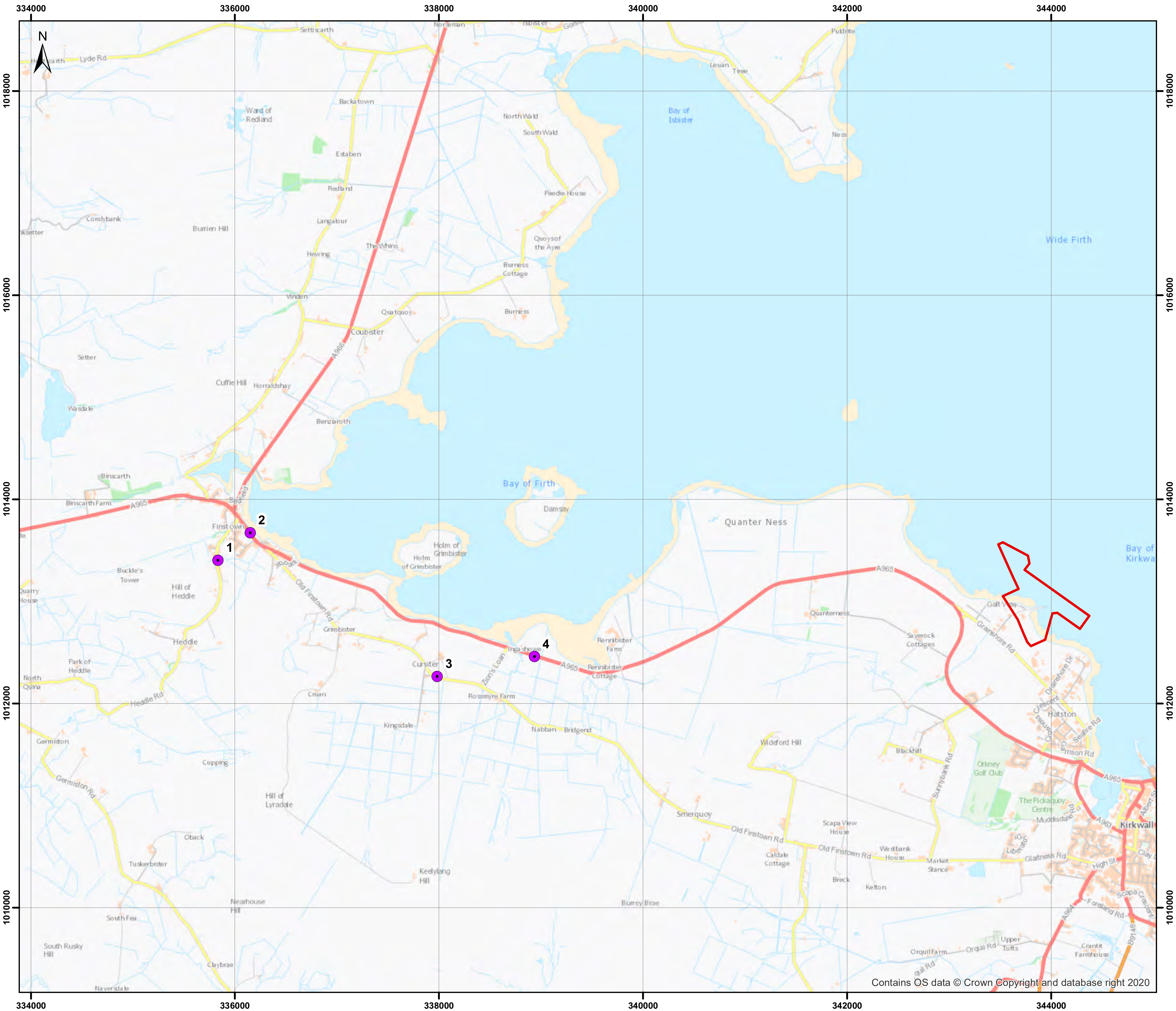

Legend

- Hatston Site Boundary
- CiRTN Assessment Road Sections

Do not scale this map

Client
Orkney Island Council Harbour Authority

Project
Hatston Pier

Title
Change in Road Traffic Noise, Construction Phase Road Section Assessment Locations

Status
Final

Drawing No.	Revision	Date
674795-GIS084	-	21 Jan 2023
Drawn	**Checked**	**Approved**
CC	AH	AH

Scale
1:35,000 @A3

0 175 350 700 1,050 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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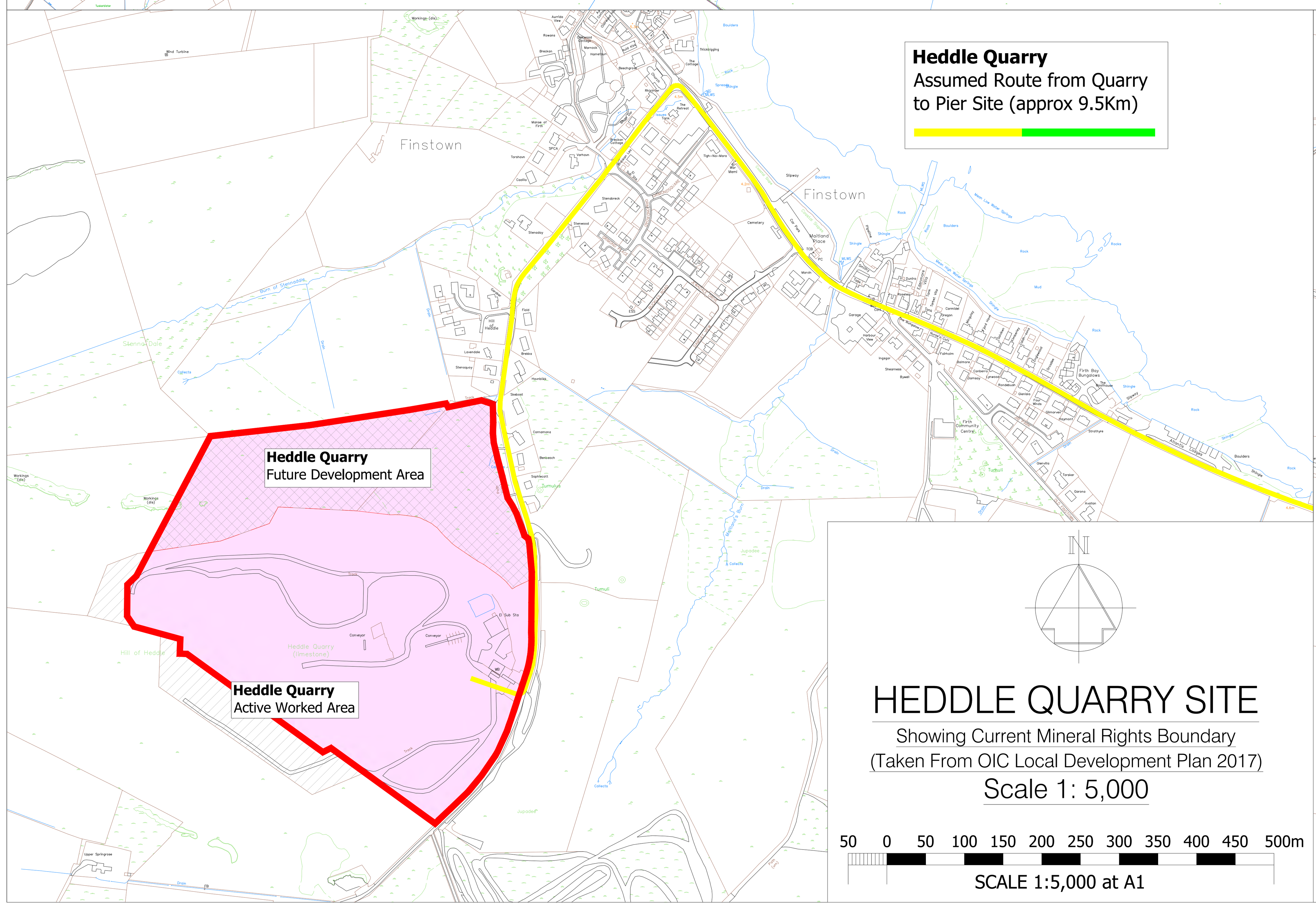

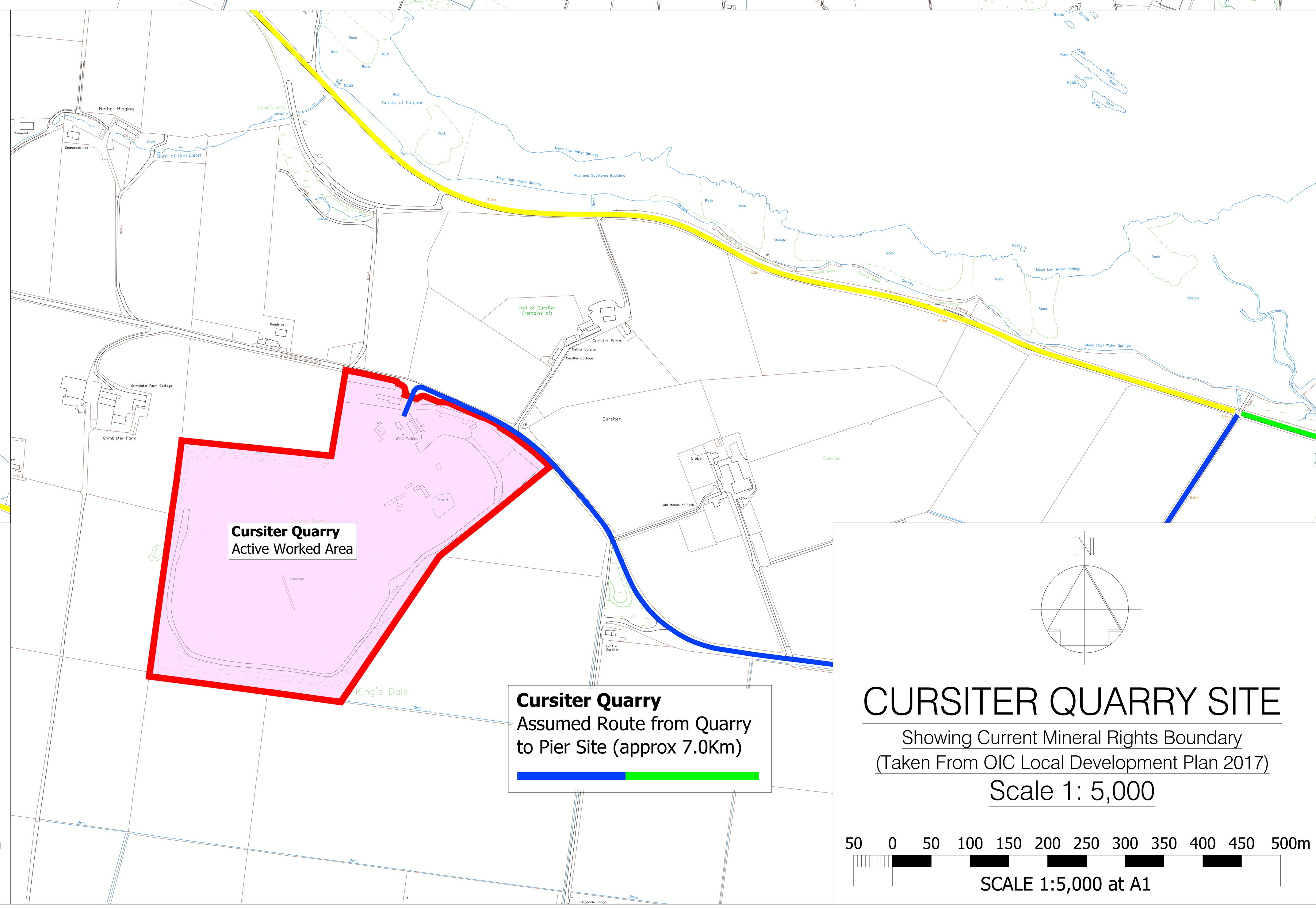

REV	DATE	REVISION	DRN	CHK
-	28:04:2021	Final Feasibility Study Issue	JJM	
P2	26:03:2021	Draft Feasibility Study Issue	JJM	
P1	26:02:2021	Preliminary Feasibility Study Issue	JJM	

ORKNEY ISLANDS COUNCIL
Harbour Authority

Hatston Pier, Kirkwall - Proposed Extension

Feasibility Study
Existing Commercial Quarries Location Plan

Arch Henderson 1919
Civil Engineers
Structural Engineers
Architects
CDM Co-ordinators
Geotechnical services
Environmental services
Stewart Building, Lerwick, Shetland. ZE1 0LL.
Tel : 01595 695512
www.arch-henderson.co.uk - email : lerwick@arch-henderson.co.uk
Aberdeen; Dundee; Glasgow; Lerwick; Inverness; Thurso; Stromness; Southampton; Falkland Islands

DRAWN :	DATE :	CHECKED :	APPROVED :
JJM	February 2021	APS	APS

SCALE : (A1)	DRAWING STATUS :
As Shown	Feasibility Study

DRAWING No :	REV :
202043/FS- 04	-

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 to Table B-3. Evening and Weekend ambient noise levels have been assumed to be the average of daytime and night-time measured noise levels.

Table B-1: ABC Category Thresholds, NSR 01

NSR 01	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	48.2	36.5	45.5	45.5
Ambient Levels Rounded	50	35	45	45
BS5228 ABC Category	**A**	**A**	**A**	**A**
Threshold Value	65	45	55	55

Table B-2: ABC Category Thresholds, NSRs 02 & 03

NSR 02	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	45.8	32.2	42.9	42.9
Ambient Levels Rounded	45	30	45	45
BS5228 ABC Category	**A**	**A**	**A**	**A**
Threshold Value	65	45	55	55

Table B-3: ABC Category Thresholds, NSRs 04 & 05

NSR 03	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	51.9	34.6	49	49
Ambient Levels Rounded	50	35	50	50
BS5228 ABC Category	**A**	**A**	**A**	**A**
Threshold Value	65	45	55	55

C CONSTRUCTION NOISE MODEL DATA

Construction Activities	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
HGV Deliveries	HGV delivery full	7 p/h	80	BS5228 C.6 Ref 21	0.5	07:00 – 19:00	7 p/h	x	x		
	HGV delivery empty	7 p/h	83	BS5228 C.6 Ref 22	0.5		7 p/h	x	x		
	Dump truck tipping fill	7 p/h	80	BS5228 C.1 Ref 11	0.5		7 p/h	x	x		
Drainage, Infill and Compaction	D6 Dozers - 18T	2	81	BS5228 C.2 Ref 12	1	07:00 – 19:00	80	X	X		
	Dump truck movements	2	90	BS5228 C.9 Ref 21	0.5		80	X	X		
	Dump truck tipping fill	2	80	BS5228 C.1 Ref 11	0.5		25	X	X		
	50T Excavators	2	79	BS 5228 C.2 Ref 14	1		80	X	X		
	16T Twin Drum Rollers	2	73	BS 5228 C.2 Ref 38	0.5		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		
	D6 Dozers - 18T	2	81	BS5228 C.2 Ref 12	1		80	X	X		
Surfacing	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	50T Excavators	2	79	BS5228 C.2 Ref 14	1	07:00 – 19:00	80	x	x		
	Dump truck movements	2	90	BS5228 C.9 Ref 21	0.5		80				
	Dump truck tipping	2	80	BS5228 C.1 Ref. 11	1		25	x	x		
Install Sheet Pile Wall	100t crawler crane	1	67	BS5228 C.3 Ref 28	1	07:00 – 19:00	80	x	x		
	Large capacity vibrating hammer	1	88	BS5228 D.4 Ref 43	0.5		80	x	x		
	Vibrating hammer generator	1	74	BS5228 C.4 Ref 84	0.5		80	x	x		
Tie Rod, Anchor Walls	Impact wrenches	4	70	Markesino et al. Study of noise transmission from impact wrench.	1	07:00 – 19:00	80	X	80		
	Hammer	4	79	BS5228 D.7 Ref 80	0.5		20	X	20		
Rotary Percussive Drilling (Sea bed Prep for Piling)	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		

Construction Activities	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
	Tracked mobile drilling rig (23t / 110mm dia)	1	87	BS5228 C.9 Ref 3	0.5		80	X	X		
Dredging	Backhoe dredge	1	88	Aberdeen Harbour Expansion Project, Vol 3, Appendix 20C. Waterman, Nov 2015.	1	24 hours	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 Operations	Boat Lift (tracked crane)	1	99	BS5228 C4 Ref. 50	10	24 hours	5	48	24	Assume may operate both day and night-time as worst case scenario.
	SPMT	2 pairs	111 per pair	EnviroCentre database	0.5		80	768	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	1.5		100	960	480	2 additional generators over existing operations.