50 RMP Est. 1969
acoustics energy vibration

Unit 1, 7Hills Business Park
37 Bankhead Crossway South
Edinburgh
EH11 4EP

T: 0345 062 0000
E: rmp@napier.ac.uk
www.rmp.biz

BRIEF FOR CONSULTANCY:

To undertake a systematic noise assessment of the Shell NGL Mossmorran Plant as required by their PPC Permit.

PPC Noise Assessment
Shell NGL Mossmorran
Mossmorran
KY4 8EP

Technical Report No. R-8883-RRM-RGM
16 December 2020

PREPARED FOR:

[redacted]
Shell U.K. Limited
1 Altens Farm Road
Nigg
Aberdeen
AB12 3FY

Edinburgh Napier UNIVERSITY

RMP is a consulting division of Edinburgh Napier University.

Contents

1.0 Introduction

1.1 Robin Mackenzie Partnership (RMP) was instructed by [redacted] on behalf of Shell U.K. Limited to undertake a Systematic Noise Assessment of their existing industrial operations at Shell NGL Mossmorran, KY4 8EP, as required under their Pollution Prevention and Control (PPC) permit Ref: PPC/A/1013495 Condition 3.1.1.

1.2 The condition states; *3.1.1 Subject to Condition 3.1.2, at least every 4 years, the Operator shall carry out a systematic assessment of noise and vibration emissions associated with the Permitted Activities, the purpose of which shall be to identify methods of reducing noise and vibration emissions. Each assessment shall be recorded and reported to SEPA.*

1.3 The site is a large Natural Gas Liquids (NGL) processing plant, providing feedstock into ethane, commercial grade propane, butane and gasoline. The site includes; storage tanks, fractionation modules, two ground flares and an elevated flare. Ethane feedstock is supplied to the adjacent ExxonMobil site to the west, who also use the ground flares and supply steam.

1.4 The area surrounding the Shell site is predominantly farmland. The nearest noise sensitive receiver is Dorloch Cottage located approximately 610m to the South East. Other Noise Sensitive Receivers (NSRs) include a dwelling within Little Raith Farm 1470m to the North East and Watters Crescent, Lochgelly 2400m to the North. Also discussed are NSR's at Watson Street, Cowdenbeath to the North East, a Poultry Farm house to the West and the village of Auchtertool to the East.

1.5 A site location plan is given in Appendix A.

1.6 The principal noise sources associated with the premises are the numerous stacks and high pressure steam pipes and vents located externally around the site. The facility operates 24 hours per day and 7 days per week.

1.7 Flaring (elevated and ground) is a major noise event associated with the site. However this occurs as an emergency response to a process upset event within the facility, and is not part of the normal operation of the plant. Shell are able to reprocess feeds and therefore usage is limited to rare events (i.e. elevated flare usage perhaps once per year). These are not included within our assessment.

1.8 The systematic noise impact assessment is required to consider the effects of normal industrial operations on the nearest surrounding noise sensitive receivers, whilst providing a benchmark for continual improvement. The previous systematic noise impact assessment undertaken by ESG (Report Ref: 16_11_EN045892_DW_02 Rev 1 dated 10/11/16) found "the normal operation at Shell Morrmorran site, has no influence on the noise levels determined at any of the nearest NSR's". A comparison is not provided given the different prediction methodologies and uncertainty of monitoring locations.

1.9 The approach to this type of investigation is to measure the existing background noise levels at a time when the maximum impact is likely to occur, and compare the measured noise emission levels with the relevant guidelines, given in Section 2.0 of this report. The measurements are described in Section 3.0 with results presented in in Section 4.0, the impact assessment and comparison with SEPA guidelines in Section 5.0. Section 6.0 concludes the report.

1.10 The report has been produced under the restrictions imposed by the Covid 19 pandemic, the implications of which are discussed.

1.11 Reference will be made to RMPs previous work around this site in establishing background noise levels at the noise sensitive receivers (NSR's).

2.0 Relevant Guidelines

2.1 Directive 2010/75/EU, on industrial emissions (integrated pollution prevention and control) is implemented by the Pollution Prevention and Control (Scotland) Regulations 2012. The aim of the Regulations is to establish a regime for the control of industrial (and other) installations that have a considerable impact on the environment. They develop an integrated approach to controlling pollution from industrial sources and aim to achieve a high level of protection by regulating emissions. This is done through a permit system, based on the principal of best available techniques (BAT).

2.2 The PPC Regulations require that the installations be operated in such a way that all appropriate preventative measures are taken against pollution, including noise, in line with the Best Available Techniques (BAT). BAT is discussed later in this section.

2.3 **Noise Impact Assessment**

2.4 Guidance relevant to this report include Scottish Environment Protection Agency (SEPA) document, entitled 'Guidance on the control of noise at PPC installations'. This guidance document states that the principal objective of setting noise control conditions in PPC permits is:

'To prevent or minimise environmental pollution or harm to human health and preserve local amenity"

2.5 The SEPA guidance promotes the use of BS 4142 as the base for setting noise conditions. The most up to date version of which is BS 4142 (2014) +A1:2019: *'Methods for rating and assessing industrial and commercial sound'*, and we understand the intention is to utilise this where appropriate, although not in isolation.

2.6 Conducting an assessment in accordance with BS 4142 involves measuring the existing background noise level at a position representative of the nearest

noise-sensitive receptors during the normal times of operation of the industrial premises. This value is then compared with the rating level; which is the specific noise level generated by the source, corrected if appropriate to allow for the character of the noise. The difference between the two is calculated to give an assessment level, which is used to indicate the likelihood of adverse impact, depending on the context.

2.7 BS 4142 suggests that, in general, a difference of around + 5 dB is likely to be an indication of an adverse impact, depending on the context. A difference of around + 10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

2.8 Where the initial estimate of the impact needs to be modified due to the context, consideration should be given to the following factors:

- *The absolute level of sound, with consideration to background level, rating level and the residual sound level in the acoustic environment;*
- *The character and level of the residual sound compared to the character and level of the specific sound;*
- *The sensitivity of the receptor and whether dwellings will already incorporate design measures that provide good internal and/or outdoor acoustic conditions, such as façade insulation, ventilation and/or cooling that will reduce the need to have windows open for rapid ventilation, and acoustic screening.*

2.9 Context is further defined within BS 12913 – 1 (2014): Acoustics – Soundscape, provides a framework for considering context (see Figure 1 below). Factors include;

- Sensation; meteorological conditions, hearing impairments.
- Interpretation; attitudes to source and producer, experience and expectations, visual and odour.

- Responses to environment; time of day, lighting, weather; emotional state, ability to deal with the situation and exposure.

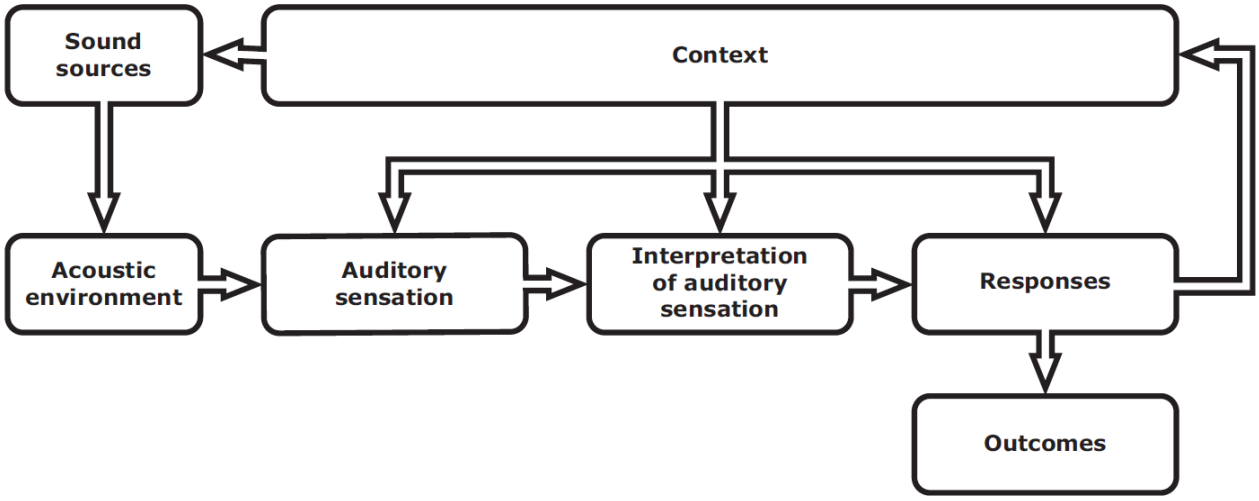


Figure 1: BS12913-1 *"Elements in the perceptual construct of soundscape"*

2.10 Noise Control using Best Available Techniques (BAT)

2.11 The Pollution Prevention and Control (PPC) (Scotland) Regulations 2012 provides the following advice regarding the definition of BAT (Best Available Techniques):

2.12 "Best available techniques", or "BATs", mean the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, reduce emissions and the impact on the environment as a whole.

2.13 *It therefore follows that what is "best available techniques" for a particular process will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.*

2.14 *"Techniques" include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.*

2.15 BAT for noise is further detailed within The Environment Agency document *"Horizontal Guidance for Noise Part 2 – Noise Assessment and Control"* (V3 June 2004).

2.16 *In deciding what level of control constitutes BAT for a given installation, a number of factors need to be considered and balanced. These include;*

- *costs and benefits*
- *the technical characteristics of the installation concerned*
- *geographical location*
- *local environmental conditions.*

2.17 **General**

2.18 The noise assessment is produced in accordance with BS 7445-2: 1991 *'Description and measurement of environmental noise. Part 2. Guide to the acquisition of data pertinent to land use'*.

3.0 Noise measurement methodology

3.1 The report has been produced under the restrictions imposed by the Covid 19 pandemic. Reductions in road and air traffic movements during this period supress ambient noise levels and may be unrepresentative of the prevailing noise climate. Care is required when undertaking impact assessments in such conditions as there is a risk of drawing unrepresentative conclusions.

3.2 RMP have extensive measurement data from previous work undertaken in association to the site. This report takes extracts from such work.

3.3 The noise measurement positions out-with the site were visited on 09.11.20, and subjectively we would maintain the prevailing noise sources appear consistent.

3.4 The on-site noise survey of noise generating sources was unaffected, and the results are contained herein.

3.5 **Identification of Noise Sensitive Receivers**

3.6 Table 1 below provides a summary of the surrounding residential properties with consideration as to their noise climate and exposure to industrial noise. Selection of the Noise Sensitive Receivers (NSR's) for assessment within this report is based on these considerations.

3.7 At some of the NRS measurement locations, industrial noise is audible so proxy locations have been selected.

3.8 The measurement locations are indicated in the site plan within Appendix A and discussed below.

Table 1. Summary of the surrounding Noise Sensitive Receivers			
Noise Sensitive Receiver	**Description of Noise Climate and Exposure to Industrial Noise**	**Comment on Measurement Suitability**	**Measurement Position Adopted / Excluded**
Watson Street, Cowdenbeath	@ 2400m, Local road traffic and diurnal A92 traffic noise. Intervening wind turbines to Mossmorran.	Residual noise level measurable.	Previously excluded from assessment. Consider in-line with outcomes of BG2 - Watters Crescent, Lochgelly.
Watters Crescent, Lochgelly	@ 2500m, Local road traffic and diurnal A92 traffic noise. Intervening wind turbines to Mossmorran.	Residual noise level measurable.	BG2 - Watters Crescent, Lochgelly
Little Raith Farm	@ 1470m, Rural setting, distant road traffic, agricultural noise sources including tractors, grain dryer, livestock, constant industrial noise.	Ambient noise level inclusive of industrial noise and agricultural noise. Shielded location from petrochemical sites identified nearby dwelling.	BG3.2 - Little Raith Farm Shielded
Auchtertool	@1850m, rural village situated on B925 road as per Dorloch Cottage.	General operations are not audible.	Not included in assessment.
Dorloch Cottage	@ 610m, isolated dwelling adjacent B925 road, constant industrial noise.	Ambient noise level inclusive of low level industrial noise.	BG4.2 – Proxy Location for Dorloch Cottage
Poultry Farm	@ 2000m, dwelling connected to agricultural facility, adjacent B925 road Intervening wind turbines to Mossmorran.	General operations are not audible.	Not included in assessment.

3.9 Measurement Details

3.10 The noise measurements were carried out insofar as was practicable in accordance with BS 7445 *'Description and measurement of environmental noise'*. Weather during all measurement samples was within acceptable parameters in that there was no rain and low wind. This is confirmed by MET data in the case of unmanned survey, with all adverse weather (including any period of rain and wind above 5m/s) excluded from the results.

3.11 The acoustical instrumentation used for the measurements conformed to a Class 1 integrating sound level meter specification in accordance with BS EN

61672-1: 2003. The microphone was fitted with a single or double windshield at all times and positioned at a minimum height of 1.5m.

3.12 Immediately prior to and following the surveys, the sensitivity of the sound level meter was checked using an acoustic calibrator. No significant deviations (above 0.1dB) from the calibration level of 94 dB re 2 x 10^{-5} Pa at 1000 Hz was detected.

3.13 A-weighted L_{eq}, L_{90}, L_{10} noise levels were measured along with other standard acoustical parameters such as L_{max}, and the un-weighted third octave band results.

3.14 The equipment used during the surveys is listed in Appendix B.

3.15 **Ambient Noise Measurement Details**

3.16 Table 2 provides a summary of the noise measurements undertaken at the aforementioned locations. Appendix A provides the measurement locations.

Table 2. Summary of measurements at surrounding Noise Sensitive Receivers

Measurement Location	Measurement Details and Application	Period	Date	Cumulative Duration (hh:mm:ss)
BG2 - Watters Crescent, Lochgelly	Background measurement results for BS 4142 assessment. Data from March 2020 - pre COVID19 lockdown where flares were inactive.*	Day (07:00 – 19:00)	04/03/20 – 06/03/20	19:00:00
		Evening (19:00 – 23:00)	04/03/20 – 05/03/20	08:00:00
		Night (23:00 – 07:00)	04/03/20 – 06/03/20	16:00:00
BG3.2 - Little Raith Farm Shielded	Background Location for BS 4142 assessment calculated from data from November 2020 where flares were inactive. Measurement location is shielded from the plant and is located adjacent to the farmhouse.*	Day	21/11/20 – 30/11/20	88:00:00
		Evening	21/11/20 – 30/11/20	30:00:00
		Night	21/11/20 – 30/11/20	51:45:00
BG4.2 - Proxy Location for Dorloch Cottage	Surrogate background Location for BS 4142 assessment Calculated from data from November 2020 where flares were inactive.*	Day	25/11/20 – 29/11/20	58:00:00
		Evening	25/11/20 – 29/11/20	19:00:00
		Night	25/11/20 – 30/11/20	41:45:00

* Calculated using data from long term measurements using methodology in Section 8 of BS 4142:2014+A1:2019. Winds over 5m/s and periods of precipitation have been excluded.

3.17 Sample Industrial Noise Measurements

3.18 Source noise measurements were undertaken within the confines of the site on the 09/11/20. Details of the sources measured are provided in Table 3 below.

3.19 The facility operates 24 hours per day and 7 days per week, and cumulative noise from the plant is relatively consistent. Two out of the three fractionation modules were operation during the survey, and this was considered normal for the operation of the site.

3.20 The measurement locations are indicated in the site plan within Appendix C.

Table3. Industrial Noise Source Details

Plant Name & Reference	Description of Noise	Description of Screening to Nearest Residential
Measurement Date - 11.09.20		
1 – Butane Cooks	Broadband hiss	Large bund to rear.
2 – Propane Boiler	Broadband hiss	Large bund to rear.
3 – Ground flare @ L1 burn	Roar and steam hiss	Hill to North.
4 – Elevated flare	Not flaring, steam release only – hiss	None from source height.
5 –Module 3	Whine	Hill to North. Buildings around Raith.
6 - Module 3	Whine	Hill to North. Buildings around Raith.
7 - Module 3	Whine	Buildings around Raith.
8 - Module 3	Whine	Large cutting/hill to Dorloch.
9 - Module 3	Whine	Large cutting/hill to Dorloch.
10 - Module 3	Whine	Large cutting/hill to Dorloch.
11 - Module 3	Whine	Buildings around Raith.
12 - Module 3 Compressor	Whine	Large cutting/hill to Dorloch.
13 – Module 1 Compressor	Broadband	Large cutting/hill to Dorloch.

4.0 Measurement Results

4.1 Ambient Environmental Noise Measurements

4.2 Table 4 below provides the noise measurement results from the measurement program detailed within Table 2.

Table 4. Residual noise measurements results at surrounding Noise Sensitive Receivers, dB re 20 µPa

Measurement Location	Period	L_{Aeq} (dB)	L_{A90} (dB)	L_{AFmax} (dB)	Description of Measured Noise Sources
BG2 - Watters Crescent, Lochgelly	Day	53	50	73	Road traffic noise from the A92 dominant. Local traffic and general residential noise sources. (i.e. children playing). Plant noise not audible.
	Evening	55	51	68	
	Night	49	47	67	Road traffic noise From the A92 dominant. Plant noise not audible.
BG3.2 - Little Raith Farm Shielded	Day	52	46	79	Distant road traffic noise from the A92. Local traffic on B roads. Farm noise including heavy machinery and animals.
	Evening	44	42	55	
	Night	40	38	50	Distant road traffic noise from the A92. Local traffic on B roads. Some animal noise.
BG4.2 - Proxy Location for Dorloch Cottage	Day	59	43	80	Intermittent road traffic noise on B925 dominant.
	Evening	52	34	77	
	Night	59	38	42	Intermittent road traffic noise on B925 dominant.

4.3 Given results of the measurements and locations/samples obtained, it is not expected that noise levels have been significantly affected by supressed road traffic levels as a result of the COVID 19 restrictions.

4.4 Table 5 below provides the industrial noise measurement results from the measurement program detailed within Table 3.

4.5 On-site a short duration measurement of 2 minutes was selected as the noise was constant and did not change.

4.6 Confirmation was sought that the plant was operating under normal conditions (loading/output etc.).

4.7 Where appropriate, measurements have been corrected to 10m using equation 1 below to provide the sound power of the plant.

$$\text{Distance attenuation} = 20\log (d_1 / d_2) \quad (1)$$

4.8 Where d_1 is the distance from source to measurement location, and
d_2 is the distance from source to receiver location.

Table 5. Industrial Noise Source Measurement Results, dB re 20 µPa

Plant Name & Reference	Distance From Source (m)	L_{Aeq} (dB)	L_{wA} @10m (dB)
1 – Butane Cooks	25	69	78
2 – Propane Boiler	25	68	76
3 – Ground flare @ L1 (low) burn	15m	67	71
4 – Elevated flare steam discharge	40m	69	-
5 –Module 3	120m	55	77
6 - Module 3	60m	65	81
7 - Module 3	55m	68	82
8 - Module 3	70m	65	82
9 - Module 3	120m	60	82
10 - Module 3	190m	47	-
11 - Module 3	60m	66	82
12 - Module 3 Compressor	25m	71	79
13 – Module 1 Compressor	25m	60	68

5.0 Noise impact assessment

5.1 BS4142 provides a noise impact assessment at a receiver location considering cumulative industrial noise.

5.2 In carrying out a BS 4142 assessment a number of corrections need to be applied to the source measurements. These are described below.

5.3 Distance correction:

5.4 Distance and ground effects are accounted for by application of equation 2 and 3 below;

$$Lp = Lw - 10 \log r - 11 \quad (2)$$

5.5 Where Lp is the receiver sound pressure level,
Lw is the source sound power level, and
r is the distance to the source (m)

5.6 Formula 2 provides a worst case scenario where the source behaves as a line source resulting in reduced attenuation.

5.7 Barrier Correction

5.8 Topography provides a barrier or partial barrier for a number of the site noise sources. Partial barrier attenuation has been applied at -5dB where there is only a partial line of sight from source to receiver. Partial barrier attenuation has been applied in all instances except to Dorloch Cottage where a full barrier is assumed providing -10dB attenuation.

5.9 Noise Source Character Corrections

5.10 BS 4142 requires noise source character corrections to be applied if deemed audible at a receiver location. Noise character penalties can be applied to the

source if it is deemed impulsive, intermittent or has another subjective feature which makes it noticeable.

5.11 A +3dB character correction has been requested by SEPA. This has not been applied where the industrial noise and is predicted to be inaudible at the receiver NSR (i.e. 10dB below background), or is subjectively inaudible.

5.12 Assessment Outcomes

5.13 BS4142 provides the following assessment outcomes based upon a difference between the background noise climate and the rating level;

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB 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.

5.14 Table 6 below provides the BS 4142 assessment considering the rating predicted cumulative noise from site. The assessments are provided on a worst case with regards to distance attenuation.

Table 6. Calculation of Assessment Outcomes, dB re 20 µPa				
Period	**Background Noise L_{A90} (dB)**	**Worst Case Rating Level at Receiver $L_{Ar,Tr}$ (dB)**	**Assessment Level**	**Assessment Outcome**
BG2 - Watters Crescent, Lochgelly				
Day	50	31	-19	No impact
Evening	51	31	-20	No impact
Night	47	31	-16	No impact
BG3 - Little Raith Farm				
Day	46	36	-10	No impact
Evening	42	36	-6	Low impact
Night	38	36	-2	Low impact
BG4 - Dorloch Cottage				
Day	43	36	-7	Low impact
Evening	34	36	2	Low impact
Night	38	36	-2	Low impact

5.15 The results within Table 6 predict either no impact (rating level is below background by $\geq$ 10dB) or *"low impact"* (assessment outcome (d) as provided above) from normal operation of the facility at all NSR's.

5.16 These results should be considered within the context of each receiver;

- BG2 - Watters Crescent, Lochgelly: location exposed to consistent road traffic noise from A92, industrial noise is predicted to be inaudible, masking noise provided by road traffic noise.

- BG3 - Little Raith Farm: at shielded locations around the farmhouse, industrial noise cannot be heard. Conversely, there are areas around the farmhouse and farm where industrial noise is present, however this is set within an agricultural setting where other sources of noise are also present. These sources mask the more distant site specific sound in locations with local shielding.

- BG4 - Dorloch Cottage: the noise climate includes a consistent level of industrial noise and frequent nearby passing traffic. This generally mask the more distant site specific sound.

5.17 Further context is provided by a comparison to the levels contained within BS 8233 (2014): “Guidance on sound insulation and noise reduction for buildings” for “anonymous noise”. Industrial noise is predicted to be below the external amenity level of $L_{Aeq,T}$ 50 dB and would be below the internal night-time amenity level of $L_{Aeq,T}$ 30 dB with windows open for ventilation.

5.18 We expect given these noise predictions, including a worst case distance attenuation correction, demonstrate that, there is no need for mitigation relative to the noise sensitive receiver locations included within this assessment.

6.0 Conclusions

6.1 Robin Mackenzie Partnership (RMP) was instructed to undertake a Systematic Noise Assessment of their existing industrial operations at Shell NGL Mossmorran, KY4 8EP, as required under their Pollution Prevention and Control (PPC) permit Ref: PPC/A/1013495 Condition 3.1.1.

6.2 The assessment is undertaken in line with the requirements of BS 4142 (2014): *'Methods for rating and assessing industrial and commercial sound'*, and is based on measurement of background noise at noise sensitive receiver locations and nearfield measurement the normal operations of the subject site.

6.3 The report has been produced under the restrictions imposed by the COVID 19 pandemic, the effect of which are considered negligible to this assessment.

6.4 The report presented provides scenarios for the assessment of noise impact with context to weight these conclusions. Scenarios include a worst case noise propagation model and source noise character correction.

6.5 It is predicted that industrial noise has a low, or no, impact at all NSR's for all periods of consideration. Given these results, there would be no need for mitigation.

Prepared by:	Approved by:
[redacted]	[redacted]

Appendix A. Site Location Plan

Legend

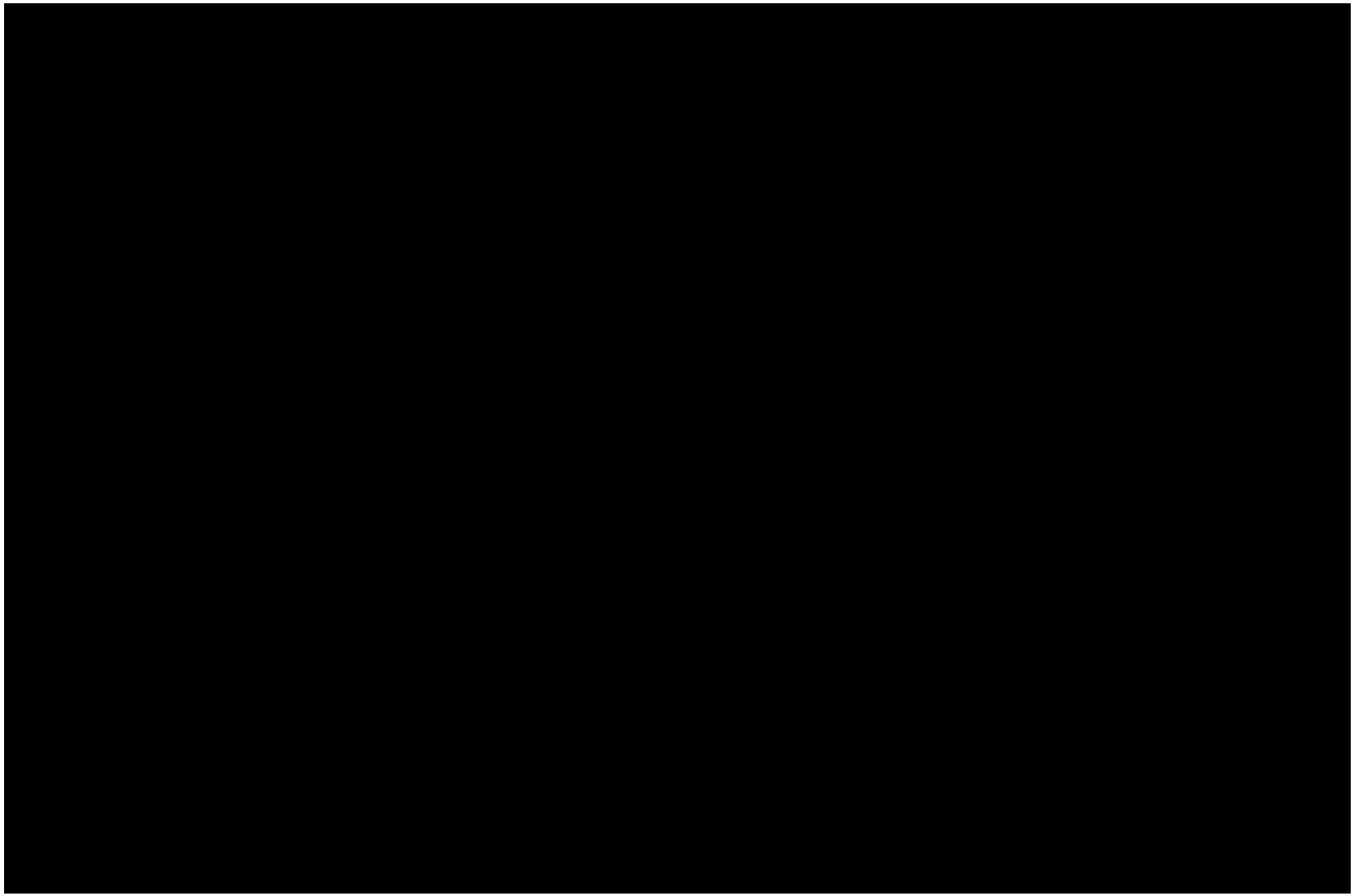
Extent of Exxon operations

Extent of Shell operations

Appendix B. Equipment Details

Equipment	Serial No.	Calibration expiry date	Calibration Certificate
Site Industrial Noise Survey - 09.11.20			
RION Sound Level Meter Type NL52 Modular Precision Sound Analyzer running Rion's programs NX-42EX Version 1.3, NX-42WR Version 1.2 and NX-42RT Version 1.2	00420769	06/03/21	TCRT19/1167
RION Pre-amplifier Type NH-25	20818	06/03/21	TCRT19/1167
RION Condenser Microphone Type UC-59	13127	06/03/21	TCRT19/1167
Brüel & Kjær Calibrator type 4230	1685303	23/10/22	36115
BG2 - Watters Crescent, Lochgelly			
RION NL52 Modular Precision Sound Analyzer running Rion's programs NX-42EX	00142575	14/09/2022	TCRT20/1537
RION Pre-amplifier Type NH-25	32603	14/09/2022	TCRT20/1537
RION Condenser Microphone Type UC-59	05994	14/09/2022	TCRT20/1537
Brüel & Kjær Calibrator type 4231	2326986	14/05/20	28549
BG3.2 - Little Raith Farm			
RION Sound Level Meter Type NL52 Modular Precision Sound Analyzer running Rion's programs NX-42EX Version 1.3, NX-42WR Version 1.2 and NX-42RT Version 1.2	00620898	2/11/22	TCRT20/1650
RION Pre-amplifier Type NH-25	10681	2/11/22	TCRT20/1650
RION Condenser Microphone Type UC-59	03974	2/11/22	TCRT20/1650
Brüel & Kjær Calibrator type 4230	1685303	23/10/22	36115
BG4.2 - Dorloch Cottage			
RION Sound Level Meter Type NL52 Modular Precision Sound Analyzer running Rion's programs NX-42EX Version 1.3, NX-42WR Version 1.2 and NX-42RT Version 1.2	00620897	2/11/22	TCRT20/1649
RION Pre-amplifier Type NH-25	10680	2/11/22	TCRT20/1649
RION Condenser Microphone Type UC-59	03791	2/11/22	TCRT20/1649
Brüel & Kjær Calibrator type 4230	1685303	23/10/22	36115
Weather Kits			
Lufft WS600 weather station	155.0220.0701.231	-	-
Lufft WS600 weather station	277.0220.0701.231	-	-

Appendix C. Industrial Measurement Locations



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OFFICES

Head Office Edinburgh
Unit 1, 7Hills Business Park
37 Bankhead Crossway South
Edinburgh
EH11 4EP
0345 062 0000

South West
17 Bishops Close
Torquay
Devon
TQ1 2PL
07908 144954

South East
The Officer's Mess
Royston Road
Duxford
Cambridge
CB22 4QH
07592 104564

rmp@napier.ac.uk

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