The Creamery, Aber-Arad

Dairy Partners Limited

BAT Noise Audit

1st December 2021

First Issue

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Revision History

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Executive Summary

This document, a BAT Noise Audit, has been written to evaluate the noise contributions from each individual process, plant and machinery (that generates a significant amount of noise) at the nearby residential properties, in order to determine which are the main contributors, and therefore which will require further noise mitigation to reduce the level of impact.

The document also evaluates the existing mitigation measures (including those recently installed) and determines whether more action could feasibly be taken, i.e. are Best Available Techniques already being implemented and if not, how could they (and should they).

PJA attended site on the 17th and 18th of November 2021 to conduct noise measurements and audit noise generating equipment/processes. PJA took measurements both close to the source of noise, and at the site boundary/outside residential properties. This information was then used in conjunction with noise mapping/modelling to determine specific noise contributions from each source at the closest/most affected residents and effectively rank the sources in order of disturbance. See Section 3.2.

Subsequently a review of the noise mitigation measures already applied and whether further BAT measures should be installed has been made. It is recognised that a number of measures have been implemented in the years/months prior to this report and that significant reductions in noise emissions have been made.

A review of possble mitigating actions is therefore given in Section 3.3, for the operator to consider further and present a plan to put forward to NRW.

Section 3.4 reviews the background noise levels measured at the site boundaries over the most recent survey in comparison to surveys conducted over the past 2 years. It is seen that significant reductions have been made over the 2 years, including a reduction of around 4 dB since the most recent survey (prior to this one) in July 2021.

Contents

1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed by Dairy Partners Limited (DP) to undertake a Best Available Techniques (BAT) Noise Audit, as requested by Natural Resources Wales (NRW) in regulating the existing Environmental Permit for the facility at The Creamery, Aber-Arad, Newcastle Emlyn, SA38 9DQ ('the site').

This document, a BAT Noise Audit, has been written to evaluate the noise contributions from each individual process, plant and machinery (that generates a significant amount of noise) at the nearby residential properties, in order to determine which are the main contributors, and therefore which will require further noise mitigation to reduce the level of impact.

The document also evaluates the existing mitigation measures (including those recently installed) and determines whether more action could feasibly be taken, i.e. are Best Available Techniques already being implemented and if not, how could they (and should they).

The report follows on from similar documents produced by PJA in September 2020 and July 2021.

Note that whilst every attempt has been made to ensure that this report communicates effectively to a reader who might not have much knowledge of acoustics, some parts are necessarily technical. A glossary of acoustic terminology and concepts is provided in Appendix A.

2.0 Background Information

2.1 Site Description

The site is located at grid reference SN 31672 40106 (SN316401) in Aber-Arad, Newcastle Emlyn, with the main entrance to the site off the B4333 along the south boundary. The facility is on the outskirts of the town with residential receptors along the south and west boundaries, with some slightly further to the north.

The development is a dairy processing facility, operating for 24 hours a day, 365 days a year, with many items of plant running continuously throughout this. This includes heavy goods vehicles coming in and out of site around the clock, and an average batch cycle of approximately 35 hours (28 hours production, 7 hours cleaning).

2.2 Changes since the last BAT Noise Audit

2.2.1 Mitigating Actions

Since the last visit/report in July 2021, the following mitigating actions have been taken:

- Acoustic jackets/insulating lining has been applied to the oil separators in the chiller compound.
- A door has been added to the Pump House.
- A pump on the edge of the new ETP area has been fixed to eliminate a high frequency tonal quality that was audible at the site boundary.
- DP conducted a scheme of maintenance checks as recommended.
- All of the old ETP plant has now stopped operating.

PJA also note that the previous report in July 2021 missed the addition of acoustic jackets/insulating lining around parts of the glycol pumps, a measure which was not present for the 1st audit in September 2020 but was present in July and subsequently November 2021.

Investigations were made by a specialist vibration isolation supplier/expert in response to recommendations in the previous report that anti-vibration fixings could be added to much of the plant around site. The further specialist investigations concluded that taking this course of action would have a negligible benefit on noise levels, thus the cost benefit analysis concluded this was not worthwhile. PJA do note however that DP conducted a scheme of maintenance checks as recommended.

2.3 Noise Generating Plant/Processes

Whilst on-site, PJA spent several hours observing the various noise generating processes, plant and equipment. The main noise emitters (locations shown in Figure 2.1 overleaf) considered in this report are:

- ETP Tankers – tankers entering the site via the south-east entrance and collecting effluent from the tankers to take away from site and dispose of. Previously with the existing ETP, around 8 to 9 of these tankers were at site each day. During this site visit, only 1 tanker visited over a 24 hour period. The pumping process is the noisiest aspect, also requiring the tanker engine to idle, occurring for around 10 - 20 minutes at a time.
- Milk Tankers – delivering milk to the front of the site, there can be roughly 24 to 30 tankers per day with up to 6 at any one time.
- Chiller compound, including:
    - Chillers (x 3)– running continuously but varying in noise as the load changes (depending on how much the temperature needs to be chilled, and whether all chillers are operational). Acoustic lagging jackets have been added to the blue oil compressors which have reduced noise emissions from these significant, and prior to the last visit in July 2021 jackets had been added to the larger parts of the chillers and a partial angled roof/barrier had been added on the east side of the compound.
    - Glycol Pumps – also within the chiller compound, running continuously at a steady load.
- Cooling Tower – two towers with a large set of acoustic attenuators on either side (which were added in 2019).
- Cooling Tower Pumps – in a small enclosure at the corner of the Boiler House and behind the Cooling Tower – running continuously at a steady load. The enclosure was recently extended before the audit in July 2021.
- Borehouse Pump Room – several pumps inside a small lightweight building beside the chiller compound – running continuously. The door was previously open, it has now been closed and the ventilation fan in the east façade is now back in operation.
- Borehole Water Tank – next to the pump room, running continuously.
- Vat Room Exhausts (east elevation) – two high level vents on the east elevation of the main production building above rooms appearing to contain milk/cream VATs – running continuously. Previously referred to as 'Milk Silo Exhausts' in the 1st report.
- Vat Room Exhaust (south elevation) – an exhaust added in early 2021, on the south elevation of the Vat Room, sitting in the external wall (not ducted).
- Production Hall Exhausts – two high level vents on the west side of the production hall near to the dock levellers – running continuously.
- Boiler House Louvres – high level ventilation louvres on the south elevation – previously observed to be generating noise continuously but on this visit were observed to intermittently emit noise.
- Boiler House Pressure Valve Release – high level dog leg shaped exhaust flue on the north elevation – operating occasionally for a few minutes at a time.
- Whey Dispatch Pump – unloading tankers in through the main entrance 4 to 5 times a day per 30 minutes at a time – though only 1 tanker was observed in the recent audit.
- Pump House – set of 5 to 6 pumps on the north side of site which operate intermittently for a few minutes - an external door has recently been added to reduce noise emissions.
- LNG – refuelling of liquified natural gas tankers for approximately 5 hours per visit, once a week.

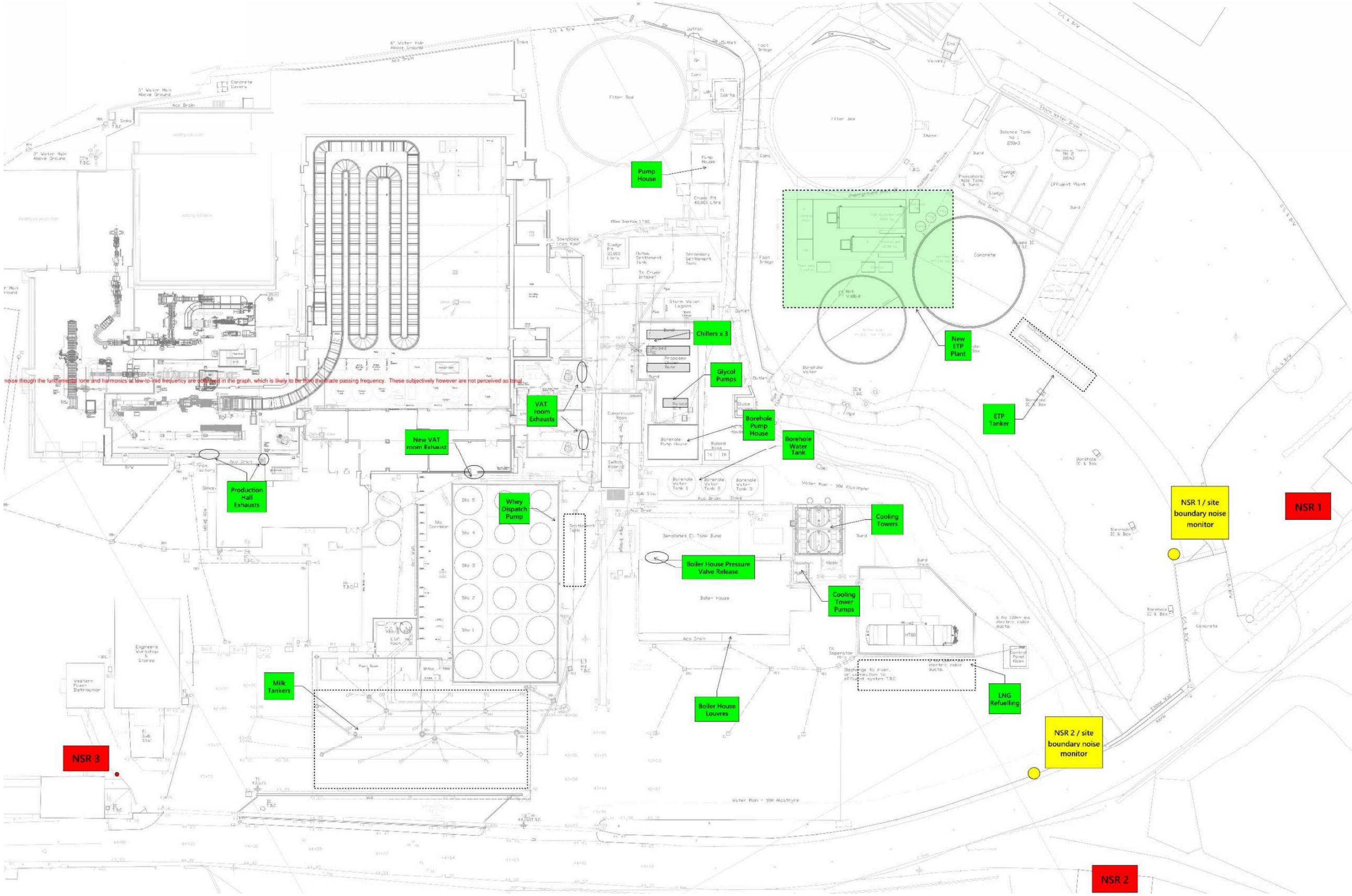
- New ETP Plant – area which has become recently operational in the 12 – 18 months, with an array of noise generating plant pumps, blowers, and flotation units. Replaces the old ETP plant to the north-east which has now ceased operating entirely. Previous assessment identified two pumps between the aeration and buffer tanks with a clear line of sight to NSR 1 and an audible tonal quality at the site boundary (the tonal quality is now no longer audible).

2.4 Noise Sensitive Receptors

For the purpose of this assessment, three noise-sensitive receptors (NSRs) have been defined overleaf in Figure 2.1. The locations represent positions close to the boundaries of residential properties PJA were able to access and measure at during the survey.

Fixed noise monitoring positions were employed as identified in the figure, as has been done on previous audits. The results are discussed in Section 3.4.

Figure 2.1 – Site plan showing locations of main noise generating processes/equipment (green), long term measurement positions (yellow) and nearby noise sensitive receptors (red)



3.0 Assessment

3.1 Methodology

PJA attended site on the Wednesday 17th and Thursday 18th of November 2021 to conduct noise measurements and audit noise generating equipment/processes. Measurements were taken both close to the source of noise, and at the site boundary/outside residential properties (in between vehicle passing's along the main road to the south), at the locations shown in Figure 2.1.

The site appeared to be in full/normal operation throughout. PJA took measurements of most processes on at least 2 days in case noise levels varied from day to day.

For a handful of the plant, it was possible to determine individual noise contributions at nearby residential properties through measurement in isolation. However, noise emissions from the majority of processes were either well below or close to the residual baseline noise level (from noise sources other than the site) when attempting to measure at the receptors. Therefore, the assessment has also utilised noise map modelling (based upon measurements taken close to source) to predict the individual noise contributions from each process at the receptors where they could not be conclusively determined through measurement alone. In many cases, the noise source was subjectively audible but required this additional modelling to determine the specific noise level.

Where noise sources were not operational during the survey (some noise sources are intermittent every few days), measurements conducted successfully in the previous two noise audits have been presented.

The tonality of the dominant sources has been assessed using narrow-band frequency analysis, in accordance with Annex D of BS 4142:2014+A1:2019.

Baseline levels in fixed positions at the site boundary near to NSR 1 and NSR 2, monitoring over approximately 24 hours. More information regarding the survey and modelling process is given in Appendix B.

3.2 Operational Measurements/Observations

Table 3.1 overleaf presents the estimated noise contributions from each noise source at each of the three NSRs based upon the measurements, modelling, and subjective observations. Photographs from the site and screenshots of the noise model are shown in Appendix B.3.

Table 3.1 – Noise contributions and subjective observations from each source at nearby residential receptors

Source	Noise Contribution dB $L_{Aeq,T}$			Subjective Notes / Dominant Noise Generating Component	Regularity
	NSR 1	NSR 2	NSR 3		
ETP Tankers (pumping)	62 - 65	52 – 55	29 – 32	Very loud and dominant at receptors close to the ETP site entrance. Fairly tonal noise. However, 7 – 10 dB quieter than the survey in Sept 2020, but pump noise may be different on each lorry. <u>Noisiest component(s)</u>: Vacuum Pump	20 minutes typically once every other day.
ETP Tankers (idling)	55	43	22	Low frequency hum, clearly audible though not as noticeable when pumping. <u>Noisiest component(s)</u>: Tanker engine	20 minutes typically once every other day.
Chillers	38	38	22	Tonal qualities audible at NSR 1 though less so than in Sept 2020. Overall noise far less than in July 2021 due to noise mitigation measures on the oil separators. <u>Noisiest component(s)</u>: Screw compressor tonal quality dependent upon speed of the internal fan.	Continuous - 24 hours a day. Tonal quality varies depending upon the load – previously observed, though not observed during the latest site visit.
Cooling Tower Pumps	38	40	22	Slight tonal element though not particularly noticeable outside of the recently constructed enclosure. <u>Noisiest component(s)</u>: Rotary component in pump.	Continuous - 24 hours a day
Milk Tankers (pumping and idling)	40	48	65	Pumps relatively quiet, the main noise is the tanker engines idling whilst pumping. <u>Noisiest component(s)</u>: Engine	30 minutes for up to 30 times a day – can accommodate 4 – 6 tankers at the same time

Source	Noise Contribution dB $L_{Aeq,T}$			Subjective Notes / Dominant Noise Generating Component	Regularity
	NSR 1	NSR 2	NSR 3		
Vat Room Exhausts (east elevation)	41	40	20	Low-frequency/broadband hum with no tonal qualities – clearly heard but not as distinguishable from other noise sources at a similar level because of the lack of tonal characteristic. Noisiest component(s): Extract fan within the ventilation system. Possible flow-generated noise.	Continuous - 24 hours a day
Vat Room Exhaust (new) (south elevation)	33	24	26	Low-frequency/broadband hum, blade passing frequency noticeable at source objectively but subjectively not particularly tonal, and not perceived as tonal at the receptors. Noisiest component(s): Extract fan	Continuous - 24 hours a day
New ETP (all plant)	36	35	15	High pitched tonal element can be heard at around 8 kHz at the site boundary with NSR 2 on occasion. Intermittent noise every minute or so from a 'knife gate valve' also faintly audible. Noisiest component(s): Pumps, knife gate valve, fluid rushing through pipes	Continuous - 24 hours a day
Borehole Pump Room	29	20	7	Constant low-mid frequency broadband noise – improved since the door has been shut. Noisiest component(s): Several pumps.	Continuous - 24 hours a day
Boiler House Pressure Valve Release	54	50	47	Clearly noticeable but relatively broadband noise without particularly annoying characteristics. Noisiest component(s): Flow regenerated noise from pressured steam through small pipework.	Once per day for a few minutes. Can occur overnight

Source	Noise Contribution dB $L_{Aeq,T}$			Subjective Notes / Dominant Noise Generating Component	Regularity
	NSR 1	NSR 2	NSR 3		
LNG (alarm)*	21 – 45	43 – 67	21 - 45	Tonal alarm, very audible at the receptor across the road with the door open but muffled with the door closed. Noisiest component(s): Tonal alarm	5 hours – once a week – intermittent every 3 minutes for a few seconds
Cooling Towers	31	33	11	Slight mid-high frequency broadband noise but relatively quiet compared to other sources due to the addition of silencers. Noisiest component(s): Airflow noise	Continuous - 24 hours a day
Glycol Pumps (Chiller Base)	37	31	23	Clear harmonic tones when measuring close to source but not particularly noticeable outside of the chiller compound. Noisiest component(s): Rotary component inside pump, tonal quality seen close to internal fans assumed RPM + 1st harmonic.	Continuous - 24 hours a day
Whey Dispatch Pump	38	33	30	High frequency tonal quality – but not that perceptible at the receptors. Noisiest component(s): Rotary component inside pump, tonal quality seen close to internal fans assumed RPM.	30 minutes for up to 4 or 5 times a day
Boiler House Louvres	20	35	25	Low-frequency hum, not particularly noticeable or disturbing. Noisiest component(s): Ventilation system inside – airflow type noise.	Continuous - 24 hours a day

Source	Noise Contribution dB $L_{Aeq,T}$			Subjective Notes / Dominant Noise Generating Component	Regularity
	NSR 1	NSR 2	NSR 3		
Pump House	19	18	3	Constantly running but very intermittent, pumps run for a minute or so then turn off completely for another minute. Not noticeable at receptors. Noisiest component(s): Pumps on the left hand side of the door.	Continuous/intermittent - 24 hours a day
Production Hall Exhausts	13	13	34	Low-frequency hum, not particularly noticeable or disturbing. Noisiest component(s): Extract fan	Continuous - 24 hours a day
LNG (pressure fill)	<17	<26	Negligible	Very quiet even close to source, wasn't immediately clear that the process was even running (it was, but no obvious noise from it). Noisiest component(s): Not clear, very quiet.	5 hours – once a week
Borehole Water Tank	21	17	18	Broadband noise but not distinguishable from other sources when more than 5 – 10m away. Noisiest component(s): Water flow.	Continuous - 24 hours a day
*range depending on whether door to the case containing the alarm is closed or open.					

3.3 BAT Audit and Recommended Mitigation

Table 3.2 overleaf presents a review of the noise mitigation measures already installed to existing noise sources, determines where best available techniques (BAT) are already being applied, and if not, what BAT techniques could be applied, and lastly, where it is necessary to implement further mitigation on the basis of whether the noise is particular disturbing/requires reduction.

These techniques also take into account the guidance of the Food, Drink and Milk BREF note which is applicable to the site, which was recently reviewed in December 2019.

However, at this stage, PJA believes that the level of mitigation that DP can reasonably install is near exhaustion. DP has taken significant strides over recent years in reducing noise levels at the boundary, as discussed in Section 3.4.

It is understood that a cost benefit analysis has been submitted separate from this report, with inputs regarding the likely level of noise reduction provided by PJA.

The likely reductions at the receptor are based upon applying the reduction at source in the noise modelling and recalculating the noise levels at receptors (the overall levels from all continuous noise sources operating simultaneously, as normal). Hence whilst a large reduction can be achieved at source in some cases, this does not necessarily translate to a large reduction at the receptor, given the summation of all noise sources and that there is no one, single dominant noise source. The chillers were previously considered to be the most significant contributor to background sound levels for 24 hours a day, however, the latest mitigation appears to have reduced the noise contributions from these.

For example, if an acoustic enclosure were installed around the chiller compound (which houses the chillers and the glycol pumps), a reduction of up to 25 dB could feasibly be achieved when measured outside of the enclosure. However, this may only result in an improvement in overall noise levels of 2 dB at the boundary, because of the balance of noise contributions between several noise sources. The cost outlay of installing such an enclosure is expected to be exceptionally high in comparison to the small return that it would achieve, reducing noise levels by only a couple of decibels.

Ultimately, DP will need to consider a cost benefit analysis and input on which measures are feasible and could be taken forward, as well as providing a timetable for doing so to NRW (and agreeing the measures to be taken with NRW). It is not up to PJA to decide timescales/deadlines by which mitigating actions should be taken. PJA understand that DP has actively made enquiries to contractors in the past but in many cases have been turned down when previously installing mitigation due to the small size of the proposed contracts and the location relative to the manufacturers.

Table 3.2 – Assessment of current noise control measurements and potential future BAT mitigation

<table>
<tr><th>Source</th><th>Noise generating parts (in order of dominance)</th><th>Current Noise Control Measures</th><th>Already employing BAT?</th><th>Potential BAT Measures</th><th>Recommended for Improvement?</th></tr>
<tr><td>ETP Tankers (pumping)</td><td rowspan="2">Vacuum pump
Tanker engine idling</td><td rowspan="2">The number of ETP tankers visiting the site has decreases substantially as a result of the new ETP being commissioned.
ETP tankering does not occur at night.</td><td rowspan="2">Yes</td><td rowspan="2">Erect a portable screen/barrier at the side of the tanker. The barrier can be lifted into place around the vacuum pump and hydraulic cooler. Alternatively a more permanent structure could be constructed to form a bay for the tanker to reverse in to. The barrier should break the line of sight from the side of HGV to the residential properties. Likely a 5 - 10 dB reduction.
Position tanker vehicles so that the side where the vacuum pump and hydraulic cooler are facing north-westwards, with the tanker itself acting a noise barrier, out of sight from residents to the south-east.
Install silencers on to vacuum pumps if possible or replace with quieter alternatives.</td><td rowspan="2">No

Substantial improvements have already been recently made</td></tr>
<tr><td>ETP Tankers (idling)</td></tr>
</table>

Source	Noise generating parts (in order of dominance)	Current Noise Control Measures	Already employing BAT?	Potential BAT Measures	Recommended for Improvement?
Chillers	• Chiller screw compressors Tonal noise is created by the rotary components running at high speed (cooled water rotary screwed chiller), and ringing of metal-on-metal contact from lack of anti-vibration fixings.	• A third chiller was recently installed to reduce the load on the existing two, which appears to have improved the situation. • Installed in an open top enclosure with acoustic absorption installed to the walls. A small section of angled roof has been added. • Acoustic insulation/lagging has now been installed on all of the screw compressors, as well as the oil separators, the latter in particular has made a significant difference.	No	• Construct a full enclosure including roof to replace the chiller compound. Likely a 10 – 15 dB reduction at source/1m outside the compound. <u>However, only up to a 2 dB reduction in overall levels at the receptors</u>. Enclosure would also require fan ventilation system which in itself will generate noise and require silencers. Ventilation system may also cause plant to need to run at a higher capacity if airflow is limited. • Extending the roof such that it covers the noisier components, i.e. the screw compressors and the oil separators. <u>Up to a 1 dB reduction in overall levels at the receptors.</u> • Look for an alternative type of chiller (not a cooled water rotary screw chillers). High speed rotary components produce clear pure tone noises which can vary in frequency (giving the siren type quality in this case). <u>Depends on what's installed, assumed up to a 5 - 10 dB reduction at source if the right models chosen. However, only up to a 1 dB reduction in overall levels at the boundary/receptors.</u> • Installing anti-vibration fixings, replacing bolts/screws with new ones which include rubber fittings/washers to reduce the high frequency metallic ringing sound. <u>Likely a minor reduction of up to 2 dB at source. Negligible reduction in overall levels at the boundary.</u> • Improved maintenance of equipment including cleaning and lubrication with oil around fixings. <u>Likely a minor reduction of up to 2 dB at source. Negligible reduction in overall levels at the boundary.</u>	No Recent acoustic lagging to the oil separators appears to have made a significant difference. The other measures are likely to be far too expensive vs not enough reduction in overall levels at the boundary.

Source	Noise generating parts (in order of dominance)	Current Noise Control Measures	Already employing BAT?	Potential BAT Measures	Recommended for Improvement?
Cooling Tower Pumps	• Rotary component (speed/vane passing frequency) Tonal noise is created by the rotary components, and ringing of metal-on-metal contact from lack of anti-vibration fixings.	• Partial enclosure installed around the pumps – the size of the enclosure has increased recently which has benefited residents to the south. • Contained at the corner of the Boiler House which provides some screening to residents to the west.	No	• Improving the enclosure to close all significant air gaps around it on all sides and adding sections to reduce noise breaking out underneath the cooling tower escaping to the east. <u>Anticipated 5 – 10 dB improvement directly outside of of the enclosure. However, only a 1 - 2 dB improvement in overall levels at the boundary/receptor.</u> • Adding acoustic lagging/jackets to the pumps. Potentially a 3 - 5 dB reduction at source (as many of the pumps have some lagging already). <u>However, only a 1 dB improvement in overall levels at the boundary/receptor.</u> • Installing anti-vibration fixings, replacing bolts/screws with new ones which include rubber fittings/washers to reduce the high frequency metallic ringing sound. <u>Likely a minor reduction of up to 2 dB at source. Negligible reduction in overall levels at the boundary.</u> • Improved maintenance of equipment including cleaning and lubrication with oil around fixings. <u>Likely a minor reduction of up to 2 dB at source. Negligible reduction in overall levels at the boundary.</u> • Adding silencers if possible, to the pump outlets. <u>Anticipated 5 – 10 dB improvement directly outside of the enclosure. However, only a 1 - 2 dB improvement in overall levels at the boundary/receptor.</u>	No Negligible reduction at the boundary vs cost outlay.

Source	Noise generating parts (in order of dominance)	Current Noise Control Measures	Already employing BAT?	Potential BAT Measures	Recommended for Improvement?
Milk Tankers (pumping and idling)	• Engine idling • Pumps	• Low noise emission pumps are installed (engine noise is dominant). • Operations limited to daytime only.	No	• An electric pumping system – noise emissions could be reduced by using an electric motor/pump system rather than powering pumps from the tankers diesel engine. Electric motors can be retrofitted to existing trucks and is charged while the vehicle is in motion. This could achieve a 5 – 10 dB reduction at source. Up to a 2 - 3 dB reduction in overall levels at the boundary/receptors to the east/south-east. • Installing a noise attenuating fence along the site boundary. Likely only a 2 – 3 dB improvement in overall levels at receptors given that the fence won't be able to be placed directly next to source and cover enough area to have a significant affect (fences can usually achieve up to a 10 – 15 dB reduction if placed right by the source or right by the receptor, at a height of 3 – 4m).	No Will require a significant overhaul which will not provide enough benefit against cost.
Vat Room Exhausts (east elevation)	• Fan	• None to PJA's knowledge.	No	• Installing in-duct noise silencers between the fan and exhaust. This would usually achieve a 15 – 25 dB reduction at source/outside of the louvres. However, only a 2 dB reduction in overall levels at the boundary/receptor. • Replacing the existing louvres with acoustic louvres. This could achieve a 5 dB reduction at source and a 1 dB reduction at the receptors. • Installing an angled cowl/hood over the exhaust to direct noise emissions either downwards, upwards, or to the north, may improve noise at the boundary by up to 1 - 2 dB.	No Broadband noise with no tonal qualities but may be a significant noise contributor which has a clear line of sight to receptors.

Source	Noise generating parts (in order of dominance)	Current Noise Control Measures	Already employing BAT?	Potential BAT Measures	Recommended for Improvement?
					Negligible reduction at boundary vs significant cost outlay.
Vat Room Exhaust (south elevation)	• Fan	• None to PJA's knowledge.	No	• Ducting the fan and Installing in-duct noise silencers between the fan and exhaust. This would usually achieve a 15 – 25 dB reduction at source/outside of the louvres. However, a negligible dB reduction in overall levels at the boundary/receptor. • Replacing the existing louvres with acoustic louvres. This could achieve a 5 dB reduction at source/outside of the louvres. However, a negligible dB reduction in overall levels at the boundary/receptor.	No Recently installed and less noise contributions than other sources, no tonal quality. Negligible reduction at boundary vs significant cost outlay.
New ETP Plant	• Pump • Knife valve • Water rushing through pipes	• Acoustic lagging installed around the blower pipe. • Acoustic louvres installed to the blower house. • Pump recently fixed to remove high frequency tonal element.	No	• A partial enclosure/screen could be constructed between the buffer and aeration tanks. However, likely to only achieve a small reduction in levels at the boundary of up to 1 dB. • A screen could be installed around the knife valve to reduce the intermittent noise characteristic which is faintly audible at the boundary. However, likely to only achieve a small reduction in overall average levels at the boundary of up to 1 dB. • Installing anti-vibration fixings, replacing bolts/screws with new ones which include rubber fittings/washers to reduce the high frequency metallic ringing sound. Negligible reduction in overall levels at the receptors/boundary.	No Negligible reduction at boundary vs significant cost outlay. Significant improvements already made to the blower pipe.

Source	Noise generating parts (in order of dominance)	Current Noise Control Measures	Already employing BAT?	Potential BAT Measures	Recommended for Improvement?
				• Improved maintenance of equipment including cleaning and lubrication with oil around fixings. Negligible reduction in overall levels at the receptors/boundary.	
Borehole Pump Room	• Several pumps	• Installed within a ventilated room rather than located outside	Yes	• No further at this stage, the room previously had the door left open, this has now been closed and the ventilation fan switched back on.	No Already improved recently
Boiler House Pressure Valve Release	• Valve	• Exhausts at the rear of the building without line of sight to most residents.	No	• An exhaust silencer could be installed on the flue. This would usually achieve a 15 – 25 dB reduction in noise levels at source from the pressure release. No significant effect on average overall noise levels at the boundary as this noise source is intermittent.	No As this only occasionally happens, it would not appear critical to treat this before other noise sources.
LNG (alarm)*	• Tonal alarm	• Alarm within a small box/enclosure – door can be closed	Yes	• Keeping the door on the alarm closed, with the operator nearby (alarm is loud enough to be heard without needing the door open). Around 25 dB reduction at source. No significant effect on average overall noise levels at the boundary as this noise source is intermittent.	No The alarm is necessary.
Cooling Towers	• Fans/airflow	• New cooling towers recently installed with acoustic silencers on all exhausts.	Yes	None.	No Already improved recently
Glycol Pumps (Chiller Base)	• Rotary component (speed/vane passing frequency)	• Installed in an open top enclosure with acoustic absorption installed to the walls. Roof recently installed over the top.	No	• Construct a smaller enclosure around the pumps. Likely a 10 – 15 dB reduction at source. However, a negligible reduction (close to 0 dB) in overall noise levels at the receptors/site boundary. • Improvements to the chiller compound, i.e. extending roof, or making into a full, ventilated enclosure. Negligible	No Negligible reduction at boundary vs significant cost outlay.

Source	Noise generating parts (in order of dominance)	Current Noise Control Measures	Already employing BAT?	Potential BAT Measures	Recommended for Improvement?
	Tonal noise is created by the rotary components, and ringing of metal-on-metal contact from lack of anti-vibration fixings.	• Acoustic insulation/lagging has been installed on to sections of the 3 pumps since the last audit.		reduction (close to 0 dB) in overall noise levels at the receptors/site boundary. Reduction more noticeable to the chillers, not the glycol pumps. • Installing anti-vibration fixings, replacing bolts/screws with new ones which include rubber fittings/washers to reduce the high frequency metallic ringing sound. Likely a minor reduction of up to 2 dB at source. Negligible reduction in overall levels at the boundary. • Improved maintenance of equipment including cleaning and lubrication with oil around fixings. Negligible reduction in overall levels at the boundary. • Adding silencers if possible, to the pump outlets. 5 – 10 dB improvement at source. However, negligible reduction in overall levels at the boundary.	
Whey Dispatch Pump	• Rotary component (speed/vane passing frequency creates a whine)	• Acoustic insulation/lagging is installed on some of the components.	No	• Add acoustic lagging/jackets to all noise generating parts. Parts appeared to have this already, but parts that did not were clearly noisier. Around 4 – 8 dB reduction at source. However, negligible reduction in overall levels at the boundary. • Construct a one-side enclosure or barrier around the pump on it's east side (between it and the tanker). Could achieve a 10 – 15 dB reduction at source, though a <1 dB reduction in overall levels at the boundary/receptors. • Installing anti-vibration fixings, replacing bolts/screws with new ones which include rubber fittings/washers to reduce the high frequency metallic ringing sound. Negligible reduction in overall levels at the boundary.	No Not critical in comparison to other noise sources. Negligible reduction at boundary vs significant cost outlay.

Source	Noise generating parts (in order of dominance)	Current Noise Control Measures	Already employing BAT?	Potential BAT Measures	Recommended for Improvement?
				• Improved maintenance of equipment including cleaning and lubrication with oil around fixings. Negligible reduction in overall levels at the boundary.	
Boiler House Louvres	• General broadband noise from inside	• None to PJA's knowledge	No	• Replacing the existing louvres with acoustic louvres. Around a 5 –10 dB reduction at source. Negligible reduction in overall levels at the receptors/boundary. • Using a ducted ventilation system with an induct silencer rather than louvres. Around a 15 dB reduction at source. Negligible reduction in overall levels at the receptors/boundary.	No Not critical in comparison to other noise sources. Negligible reduction at boundary vs significant cost outlay.
Pump House	• Several pumps	• Door now installed	No	• Installing a better ventilation system would enable a smaller façade open area through which noise escapes. Around a 15 dB reduction at source. Negligible reduction in overall levels at the receptors/boundary.	No Not critical in comparison to other noise sources. Negligible reduction at boundary vs significant cost outlay.
Production Hall Exhausts	• Fans/airflow	• None to PJA's knowledge.	No	• Installing in-duct noise silencers between the fan and exhaust – around a 15 – 25 dB reduction at source. Around a 2 dB reduction in overall levels at the receptor on the west boundary. Negligible impact at eastern receptors. • Replacing the existing louvres with acoustic louvres. Around a 5 –10 dB reduction at source. Around a 1 - 2 dB	No Not particularly loud or disturbing.

Source	Noise generating parts (in order of dominance)	Current Noise Control Measures	Already employing BAT?	Potential BAT Measures	Recommended for Improvement?
				reduction in overall levels at the receptor on the west boundary. Negligible impact at eastern receptors. • Installing an angled cowl/hood over the exhaust to direct noise emissions either downwards, upwards, or to the north, Around a 5 –10 dB reduction at source. Around a 1 - 2 dB reduction in overall levels at the receptor on the west boundary. Negligible impact at eastern receptors.	Negligible reduction at boundary vs significant cost outlay.
LNG (pressure fill)	• Valves on the rear of the tanker	• Recently changed from pumping mechanism to 'silent' pressure fill process.	Yes	N/A	No Already improved recently and not audible at residents
Borehole Water Tank	• Pump and water flow noise	• None to PJA's knowledge (though the tank is relatively well screened from residents)	No	• Enclosure could be constructed around the pump – around a 10 – 15 dB reduction at source. Negligible reduction in overall levels at the receptors/boundary.	No Not particularly loud or disturbing. Negligible reduction at boundary vs significant cost outlay.

3.4 Fixed/Boundary Noise Monitors

As part of the assessment, fixed position noise monitors were placed in two positions at the boundary (highlighted in Figure 2.1) to monitor over a 24-hour period. Similar exercises at the same positions were carried out in the July 2021 noise audit and previous noise audits/assessments by PJA since June 2020.

Both sound level meters were set to log noise levels over continuous 5-minute averaging periods with a 1-second time history rate. The following noise indices were recorded (amongst others):

- $L_{A90,T}$: The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level' and is therefore used in determining the 'representative background sound level' as defined by BS 4142:2014;
- $L_{Aeq,T}$: The A-weighted equivalent continuous noise level over the measurement period T. This parameter is typically considered as a good representation of the average ambient sound level; and
- $L_{AFmax,T}$: The maximum A-weighted noise level during the measurement period T.

Further information on the methodology and the full graphical results of the survey are given in Appendix B.5.

Table 3.3 provides a summary of the background noise levels measured at the position next to east site entrance used by the ETP tankers, close to the boundary of the residential property defined as NSR 1. The table presents the minimum and modal values of $L_{A90,5mins}$ measured over the past 2 years. It is seen that since the last survey in July 2021, levels appear to have dropped by 4 dB at this boundary, seemingly as a result of the recent mitigation to the chillers, and the old ETP plant ceasing operations entirely. A reduction of 2 dB is noted at the NSR 2 monitoring position since the last survey in July.

Before PJA's involvement in the project, it is understood that levels at the boundary (or in the residents' curtilage) were significantly higher due to the water cooling tower, at around 62 – 63 dB L_{Aeq}, which likely corresponds to an L_{A90} value of 60 – 61 dB (the L_{A90} is often 2 dB lower than the L_{Aeq} when the noise source is continuous and dominant).

Hence overall, the reduction in levels at the boundary has gone from around 60 – 61 dB down to 44 – 45 dB, a significant amount.

It should also be noted that the L_{A90} parameter is the best representation of continuous noise, i.e. plant which runs for 24 hours a day. Significant reductions have also been made in terms of the L_{Aeq}, predominantly due to the new ETP plant which has significantly reduced the number of tankers required to remove effluent waste, due to the increased efficiency of the new plant. Similar improvements have been made with the LNG tankers.

Any further reduction is likely to require a significant level of mitigating measures in several areas, as there is no longer a single, clear, dominant noise source. In PJA's opinion, it is not realistic to expect that the reduction in levels of approximately 16 dB over the last 2 years could be repeated. Marginal improvements of 2 – 3 dB overall are more realistic. However, the level of cost and interruption to operations required to achieve this marginal improvement is likely to be prohibitive and not beneficial enough to justify the expense.

Table 3.3 – Summary of measured noise levels – close to NSR 1

Position	Date	Period	Minimum $L_{A90,5mins}$ (dB)	Modal $L_{A90,5mins}$ (dB)
NSR 1	November 2021	Daytime (07:00 – 23:00)	45	45
		Night-time (23:00 – 07:00)	44	45
	July 2021	Daytime (07:00 – 23:00)	49	50
		Night-time (23:00 – 07:00)	48	49
	September 2020	Daytime (07:00 – 23:00)	50	52
		Night-time (23:00 – 07:00)	49	50
	June 2020	Daytime (07:00 – 23:00)	50	52
		Night-time (23:00 – 07:00)	48	50
	August/September 2019	Daytime (07:00 – 23:00)	62 – 63 L_{Aeq} (≈60 – 61 dB L_{A90}) (NRW report/measurements prior to cooling tower silencer installation) Measurement location not clear	
		Night-time (23:00 – 07:00)		

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio of the root-mean-square pressure of the sound and a reference pressure (2x10-5 Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano. Frequency is often divided into ('first') octave bands for analysis, with the range above considered within 7 octave bands with centre frequencies at 63 Hz, 125 Hz, 250 Hz, 1 kHz, 2 kHz and 4 kHz. 'Third' octave bands split this further into smaller frequency bands. This is typically only referenced in assessment of tonality of a noise source by identifying peaks (tones) in the frequency spectrum, i.e. when applying a rating penalty for tonality within a BS 4142:2014 assessment.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period. This parameter is typically considered as a good representation of the 'average' overall noise level. It is referred to technically as the A-weighted equivalent continuous sound level and is a dB(A) as defined above.
$L_{A90,T}$	The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level'.
$L_{A10,T}$	The A-weighted noise level that is exceeded for 10% of the measurement period T. This parameter is often considered as the 'average maximum level';
$L_{AFmax,T}$	The maximum A-weighted noise level during the measurement period T.

A.2 – Subjective Changes in Noise Level

Table A.2 – Subjective loudness from an increase or decrease in sound pressure level

Change in sound pressure level	Relative change in sound power energy (multiplier)		Change in apparent subjective loudness (for mid-frequency range)
	Decrease	Increase	
3 dB	1/2	2	'Just perceptible'
5 dB	1/3	3	'Clearly noticeable'
10 dB	1/10	10	'Half or twice as loud'
20 dB	1/100	100	'Much quieter, or louder'

Appendix B – Measurement/Modelling Details

B.1 – Survey Equipment

The monitoring equipment used for the baseline noise survey is detailed in the table below. The sound level meters were calibrated before and after the survey, with no significant drifts of greater than 0.5 dB observed. The sound level meters has been calibrated to a traceable standard within the 24 months preceding the survey, and the calibrators have been calibrated to a traceable standard within the 12 months preceding the survey. The equipment complies with the standards of as BS EN 60942:2003 Class 1 device.

Table B.1 – Equipment used for the noise survey

Name	Serial Number	Last Calibrated	Calibration Due
Bruel & Kjaer 2250 Class 1 Sound Level Analyser	2600458	Dec-20	Dec-22
Bruel & Kjaer 4189 Class 1 Microphone	2643174	Dec-20	Dec-22
Bruel & Kjaer ZC 0032 Preamplifier	11447	Dec-20	Dec-22
SVAN 949 Class 1 Sound Level Meter	9719	Nov-21	Nov-23
SV22 Class 1 Microphone	4011862	Nov-21	Nov-23
SVAN 949 Class 1 Sound Level Meter	9720	Nov-21	Nov-23
SV22 Class 1 Microphone	4012386	Nov-21	Nov-23
Pulsar Quantifier 95 Class 1 Sound Level Meter	B21270	Oct-20	Oct-22
Pulsar MK:244 Class 1 Microphone	20043748	Oct-20	Oct-22
Cirrus CRL511E Class 1 Acoustic Calibrator	035235	Nov-21	Nov-22

B.2 – Noise Modelling

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package which implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

The noise model has been used to help predict noise contributions from each process/plant based upon measurements taken close to source. This is necessary as most noise sources are not loud enough to be dominant over the background noise at the nearby residents. The noise model has assumed:

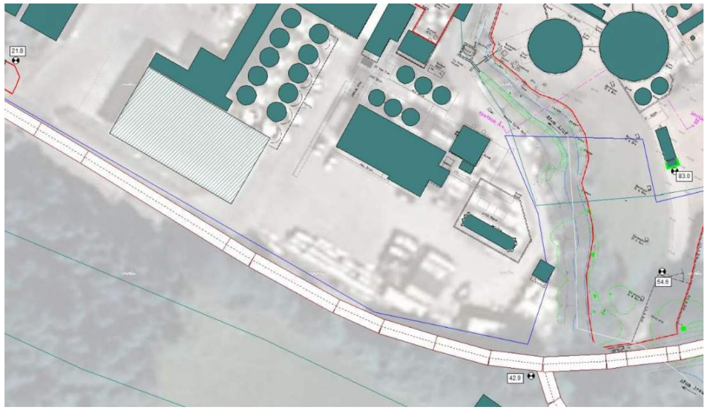
- downwind propagation, i.e. a wind direction that assists the propagation of sound from source to receptor;
- a ground absorption factor of 0 on any roads, car parks, buildings, and any tarmacked/concreted areas;
- a ground absorption factor of 1 on grassy areas;
- a maximum reflection factor of three where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;

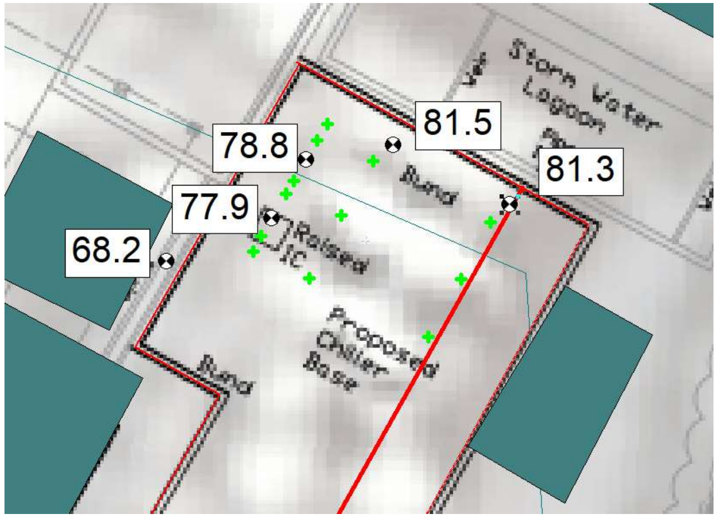
- atmospheric sound absorption based upon a temperate of 10^{o}C and a humidity level of 70%, as per Table 2 of ISO 9613-2:1996.
- Source heights representing the heights of the noise generating components observed on site.

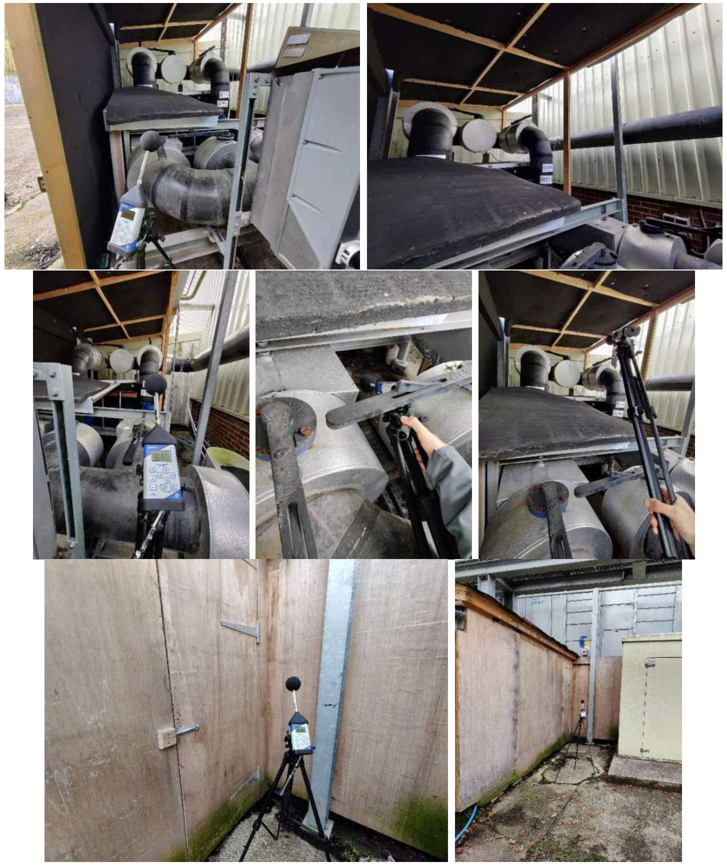
B.3 – Operational Noise Results

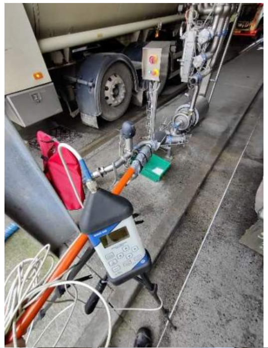
Shown on the subsequent pages. The results are those taken from the most recent measurements conducted on the 17th – 18th November 2021, unless otherwise stated. Measurements presented from July 2021 or September 2020 are done so because either a) the noise source did not operate during the latest survey or b) the noise source is sufficiently quiet and/or reliable measurements could not be taken due to the presence of other noise sources.

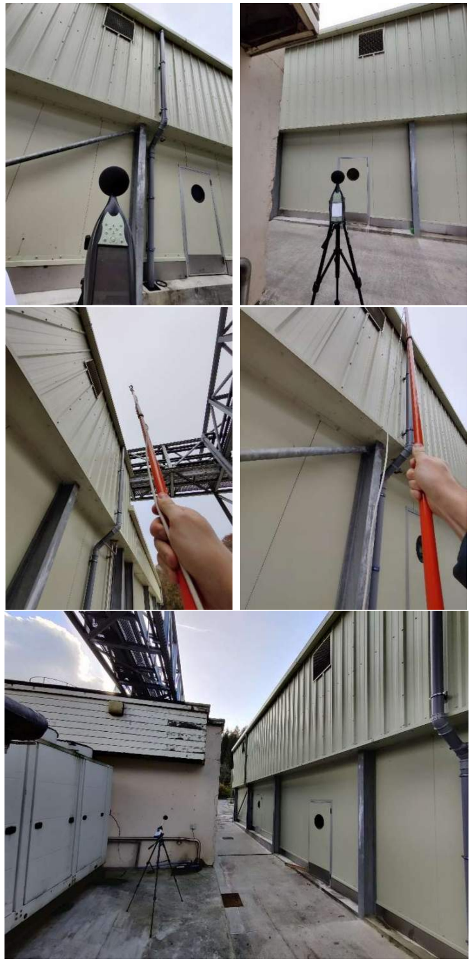
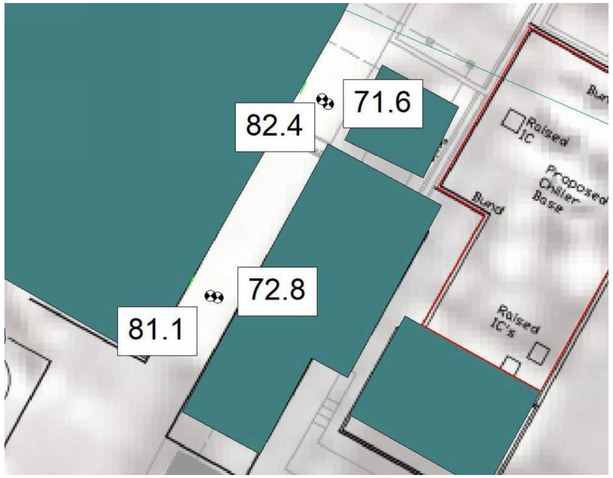
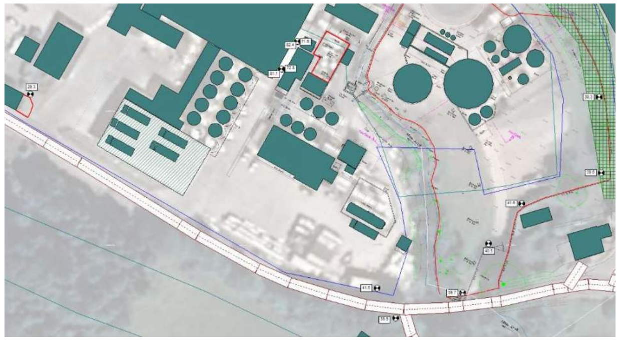
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
ETP Tankers (pumping)	**Source** 84 dB @ 1m from Vacuum Pump and Hydraulic Cooler 81 dB – July 2021 89 – 91 dB Sept 2020 **NSR 1** 65 dB (dominant) 62 dB – July 2021 72 dB - Sept 2020 **NSR 2** 55 dB 52 dB – July 2021 60 dB - Sept 2020 **NSR 3** 39 dB estimated in Sept 2020, not audible on most recent survey. Likely 29 – 32 dB. Levels likely to fluctuate from tanker to tanker.	     	Not required as noise source was clearly dominant during the measurements.

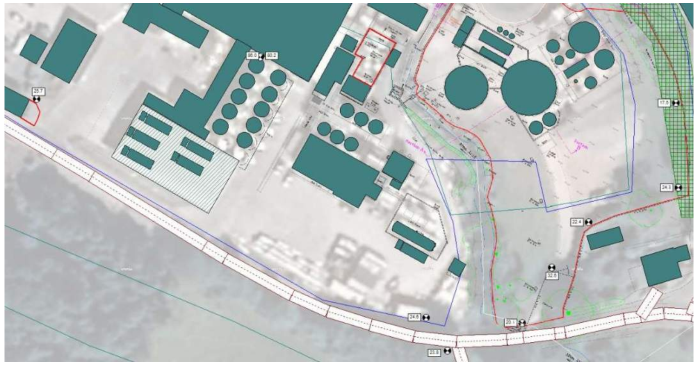
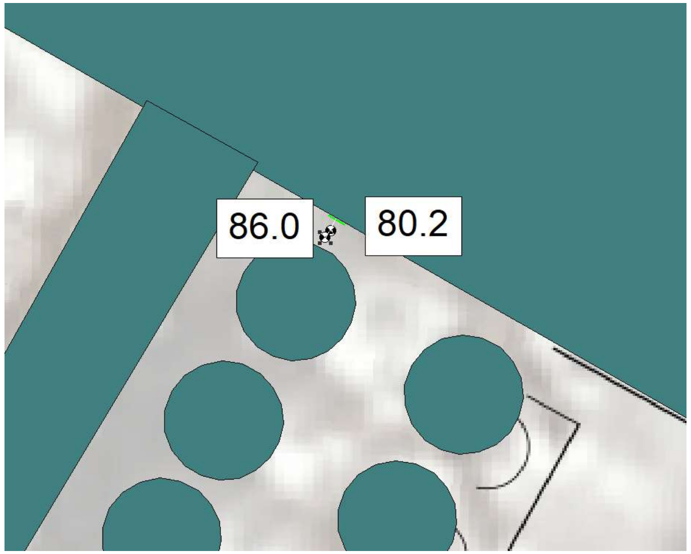
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
ETP Tankers (idling)	**Source** 83 dB @ 1m from front cab **NSR 1** 55 dB (dominant) **NSR 2** 43 dB (distinguishable) **NSR 3** 22 dB (not perceptible)	 	 

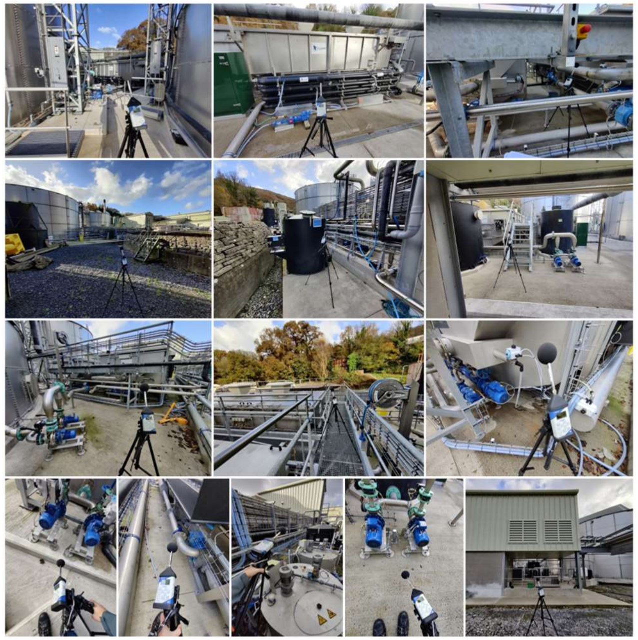
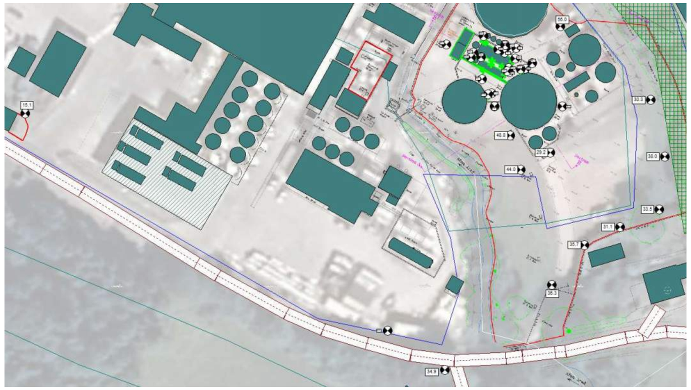
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Chillers	<u>Source</u> 72 - 82 dB average inside chiller compound depending on load. 76 dB between chiller 1 and 2 oil separators (89 dB – July 21) 72 dB between chiller 2 and 3 oil separators (85 dB – July 21) 79 dB by side of screw compressor of chiller 1 (87 dB – July 21) 81 dB at bottom of entrance stairs (82 dB – July 21) <u>NSR 1</u> - 38 dB (perceptible) <u>NSR 2</u> - 38 dB (perceptible) <u>NSR 3</u> - 22 dB (not perceptible)		 

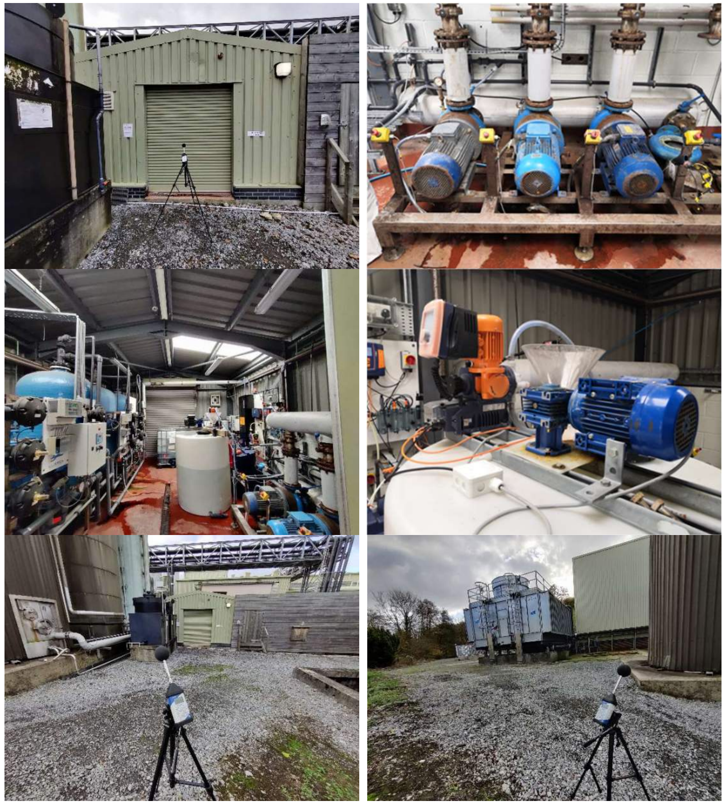
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Cooling Tower Pumps	**Same levels measured in Nov 21 as July 21.** <u>Source</u> 66 dB @ 0.5m in front of enclosure door (previously 81 dB) and 61 dB @ 4m 81 dB inside the enclosure. 87 dB with the microphone placed directly in centre of pump area. <u>NSR 1</u> 38 dB (barely perceptible) <u>NSR 2</u> ≈40 dB (just perceptible during periods of low traffic) <u>NSR 3</u> 22 dB (not perceptible)		 

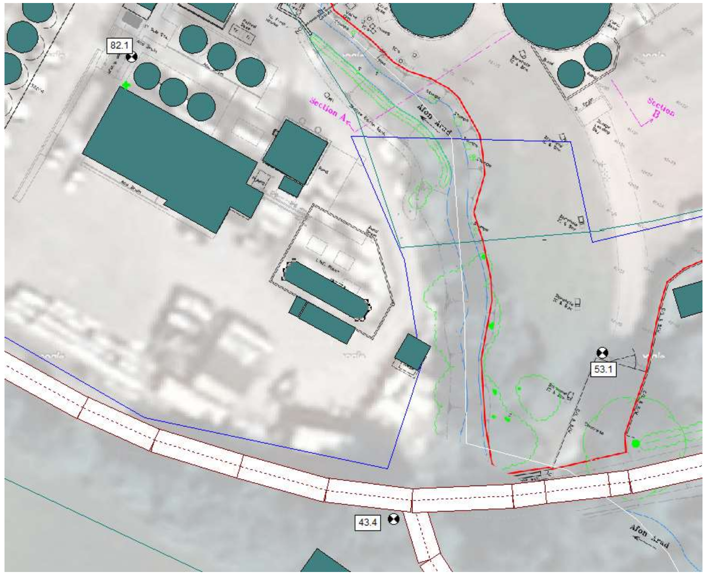
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Milk Tankers (pumping and idling)	**Same levels measured in Nov 21 as July 21.** **<u>Source</u>** 85 dB @ 1m from front cab 74 dB @ 1m from pump (though mostly idling noise from the lorry) **<u>NSR 1</u>** 40 dB (barely perceptible) **<u>NSR 2</u>** 48 dB (perceptible at most times, particularly during quiet periods of road traffic) **<u>NSR 3</u>** 65 dB (dominant) (with 5 lorries) 55 dB (with 1 lorry)	     	 

Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Vat Room Exhausts (east elevation)	<u>**Source**</u> 72 dB at 1.5m height below (same as July 21) 82 dB at 1m (and on axis) in front of the exhaust. <u>**NSR 1**</u> 41 dB (audible broadband noise – not clear where it is these exhausts or the chiller compound) <u>**NSR 2**</u> 40 dB (audible broadband noise – as per above) <u>**NSR 3**</u> 20 dB (inaudible)		 

Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Vat Room Exhaust (south elevation)	<u>**Source**</u> 80 dB at 1.5m height below (same as July 21) 86 dB at 1m in front and on-axis <u>**NSR 1**</u> 33 dB (not distinguishable from other more dominant noise sources) <u>**NSR 2**</u> 24 dB (not perceptible) <u>**NSR 3**</u> 26 dB (not perceptible)		 

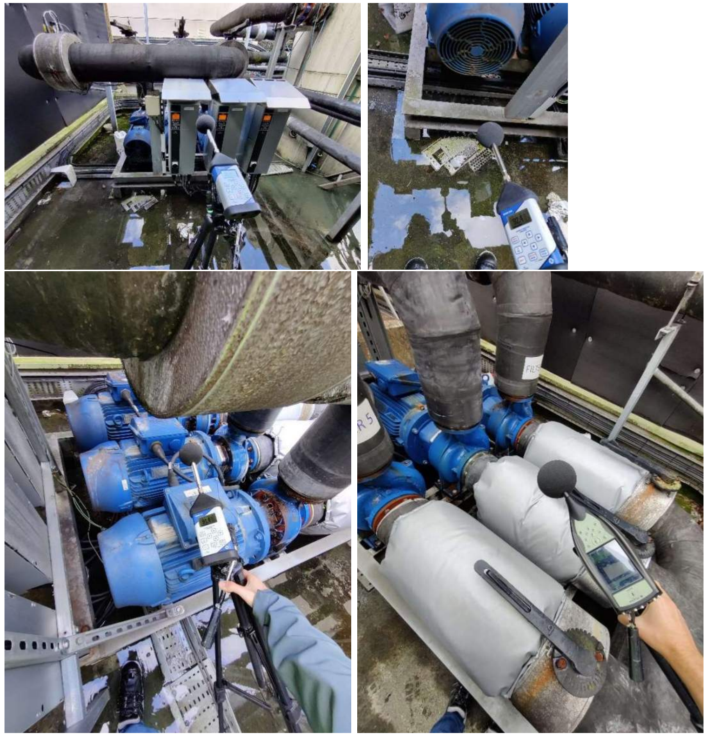
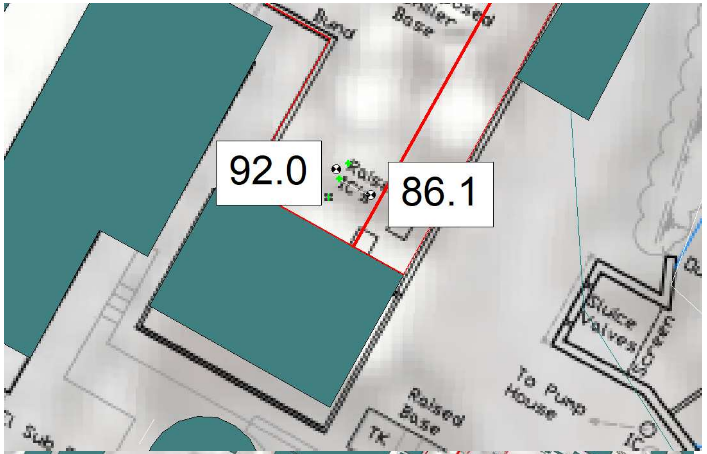
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
New ETP (all plant)	**Source** 60 to 85 dB at 1m depending on location. **NSR 1** 36 dB (perceptible but not clearly distinguishable from other more dominant noise sources) **NSR 2** 35 dB (perceptible but not clearly distinguishable) **NSR 3** 15 dB (not perceptible)		 

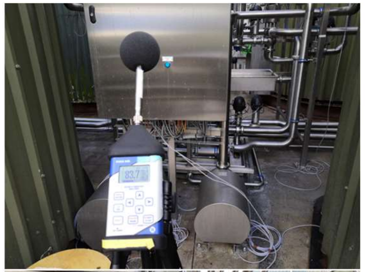
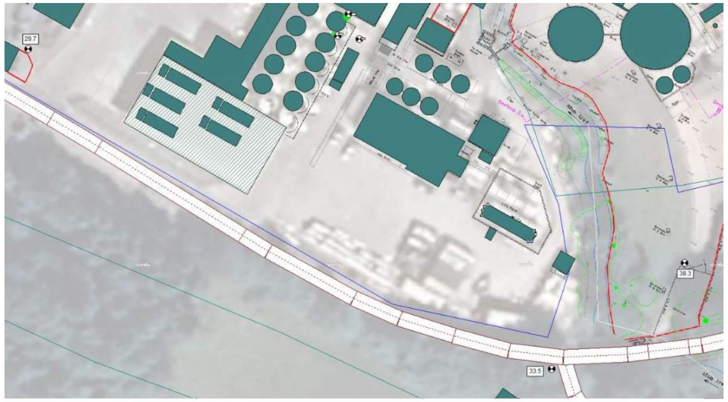
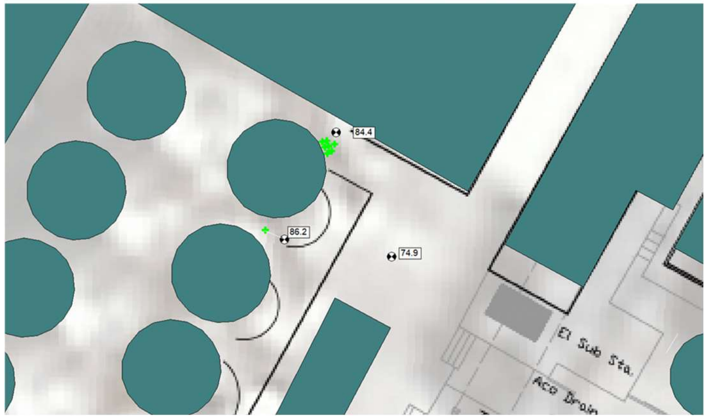
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Borehole Pump Room	**Same levels measured in Nov 21 as July 21.** **<u>Source</u>** 66 dB 1m outside of the door. 70 dB 0.5m outside of fan on front elevation. **<u>NSR 1</u>** 29 dB (barely perceptible) **<u>NSR 2</u>** 20 dB (not perceptible) **<u>NSR 3</u>** 7 dB (inaudible)		

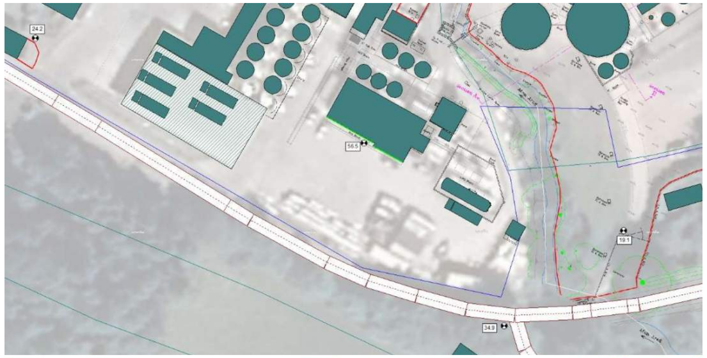
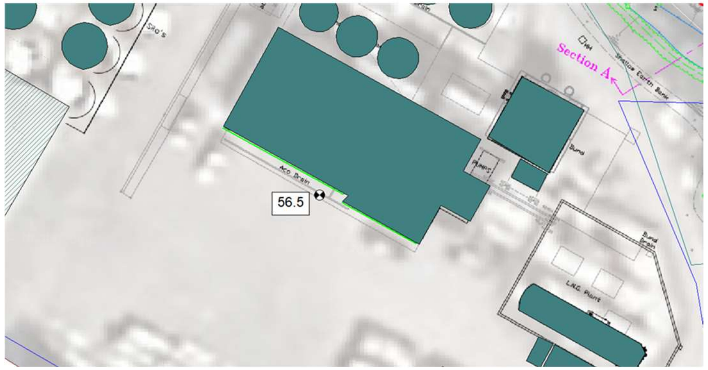
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Boiler House Pressure Valve Release	**<u>Measurements below from Sept 2020. Noise source did not operate during the most recent survey.</u>** <u>Source</u> <82 dB at ground level beneath the exhaust <u>NSR 1</u> 54 dB when on (audible broadband noise – 49 dB when off) <u>NSR 2</u> 50 dB when on (audible broadband noise – 48 dB when off) <u>NSR 3</u> 47 dB (audible broadband noise)	 	

Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
LNG (alarm)	**<u>Measurements below from Sept 2020.</u>** **<u>Source</u>** 95 dB @ 1m from alarm (door open) 71 dB @ 1m from alarm (door closed) Alarm sounds for a couple of seconds every 3 minutes <u>NSR 1</u> 45 dB (open) 21 dB (closed) <u>NSR 2</u> 67 dB (open) 43 dB (closed) <u>NSR 3</u> 45 dB (open) 21 dB (closed)		

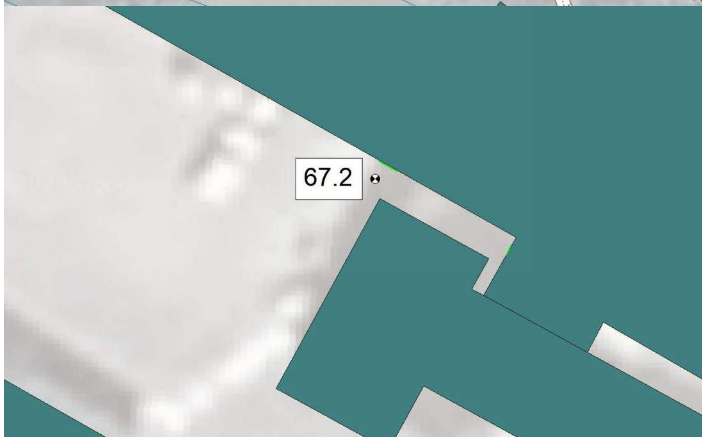
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Cooling Towers	**Same levels measured in Nov 21 as July 21.** **<u>Source</u>** ≈58 dB @ 3m **<u>NSR 1</u>** 31 dB (barely perceptible – broadband noise) **<u>NSR 2</u>** 33 dB (barely perceptible – broadband noise) **<u>NSR 3</u>** 11 dB (not audible)		

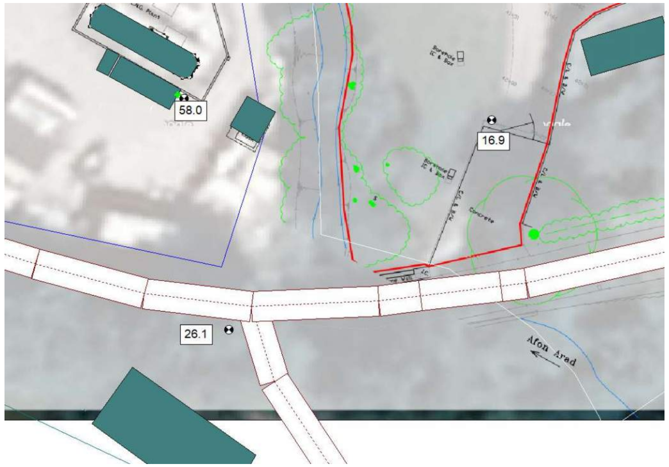
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Glycol Pumps (Chiller Base)	<u>**Source**</u> 86 dB @ 1m in front of 3 pumps (81 dB – July 21) 92 dB with mic within 20cm of top of the pumps <u>**NSR 1**</u> 37 dB (just perceptible – slight tonal quality) <u>**NSR 2**</u> 31 dB (barely perceptible) <u>**NSR 3**</u> 23 dB (not perceptible)		 

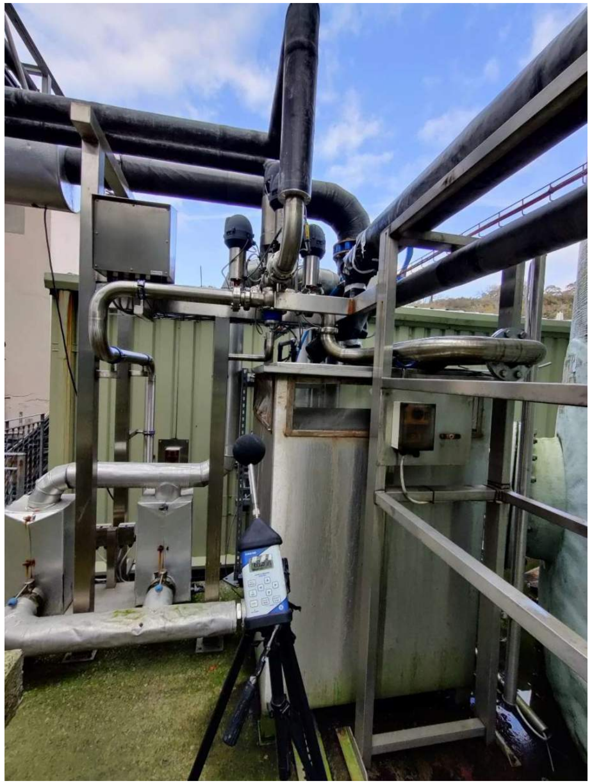
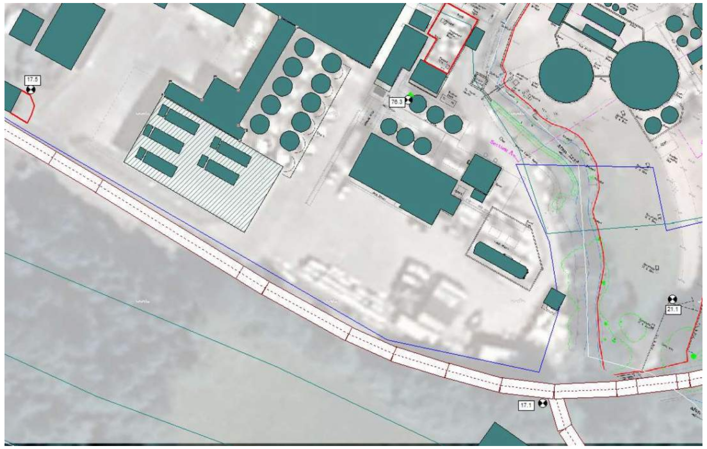
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Whey Dispatch Pump	**<u>Measurements below from Sept 2020.</u>** **(Measurements were made with a tanker pumping in the recent survey but the results suggest the pumps were operating at a much lower capacity).** <u>Source</u> 86 dB at 1m from noisiest dispatch pump <u>NSR 1</u> 38 dB (just perceptible) <u>NSR 2</u> 33 dB (just perceptible) <u>NSR 3</u> 30 dB (just perceptible)	     	 

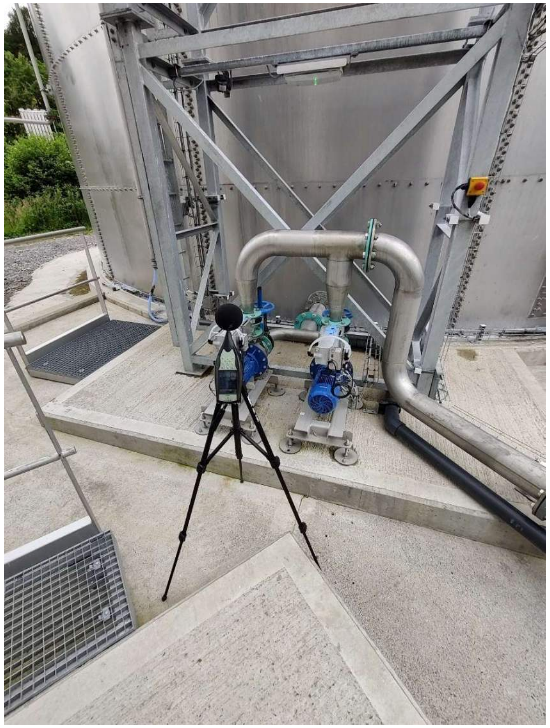
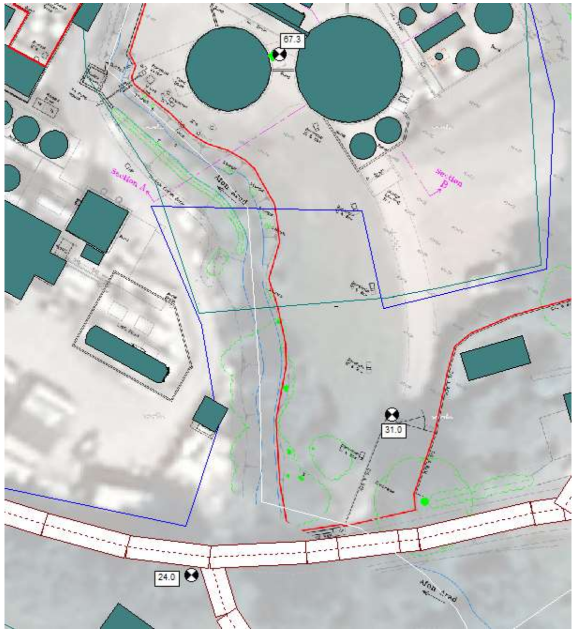
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Boiler House Louvres	**Same levels measured in Nov 21 as July 21.** __Source__ ≈55 dB at ground level beneath the exhaust __NSR 1__ 20 dB (not perceptible) __NSR 2__ 35 dB (just perceptible broadband noise thought not typically distinguishable from residual noise) __NSR 3__ 25 dB (just perceptible)		 

Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Pump House	**<u>Source</u>** 60 dB 1m outside door 78 dB – July 21 86 dB inside when on – 53 dB when off. **<u>NSR 1</u>** 19 dB (not perceptible) **<u>NSR 2</u>** 18 dB (not perceptible) **<u>NSR 3</u>** 3 dB (inaudible)	  	 

Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Production Hall Exhausts	**Same levels as measured previously.** **<u>Source</u>** <67 dB at ground level in sight of two exhausts <u>NSR 1</u> 13 dB (inaudible) <u>NSR 2</u> 13 dB (inaudible) <u>NSR 3</u> 34 dB (just perceptible)	 	 

Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
LNG (pressure fill)	**Measurements below from Sept 2020.** **Source** ≈58 dB @ 1m (quiet – other noise sources influencing) **NSR 1** <17 dB (inaudible) **NSR 2** <26 dB (not perceptible) **NSR 3** Negligible	 	

Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
Borehole Water Tank	<u>**Source**</u> 67 dB @ 1m 76 dB @ 1m in July 21. <u>**NSR 1**</u> 21 dB (not perceptible) <u>**NSR 2**</u> 17 dB (not perceptible) <u>**NSR 3**</u> 18 dB (not perceptible) NSR levels based upon July measurements		 

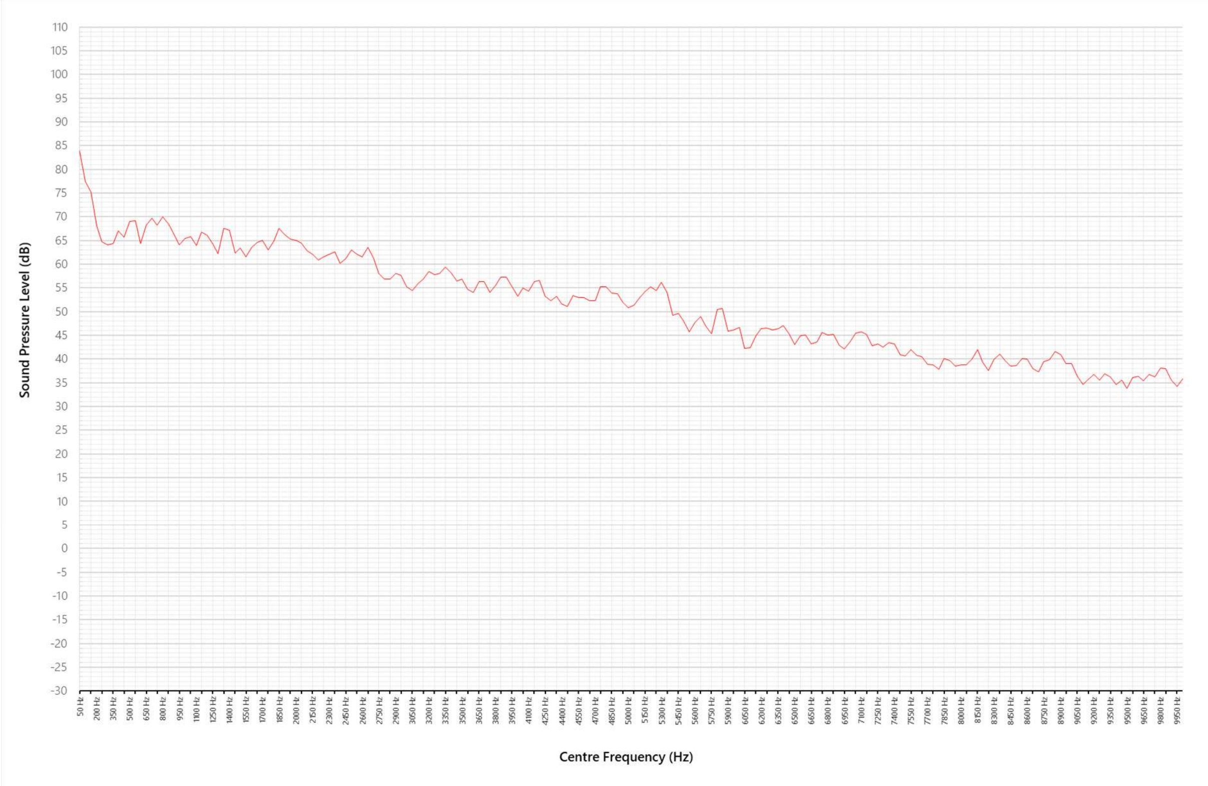
Noise Source	Measured/ Predicted Noise Levels (L_{Aeq}) / Subjective Observations	Site Photographs	Noise Model Screenshots
New ETP	**Source** 67 dB @ 1m **NSR 1** 31 dB (slight 8 kHz tone occasionally audible) **NSR 2** 24 dB (imperceptible) **NSR 3** 3 dB (not perceptible)		 

B.4 – Tonal Data

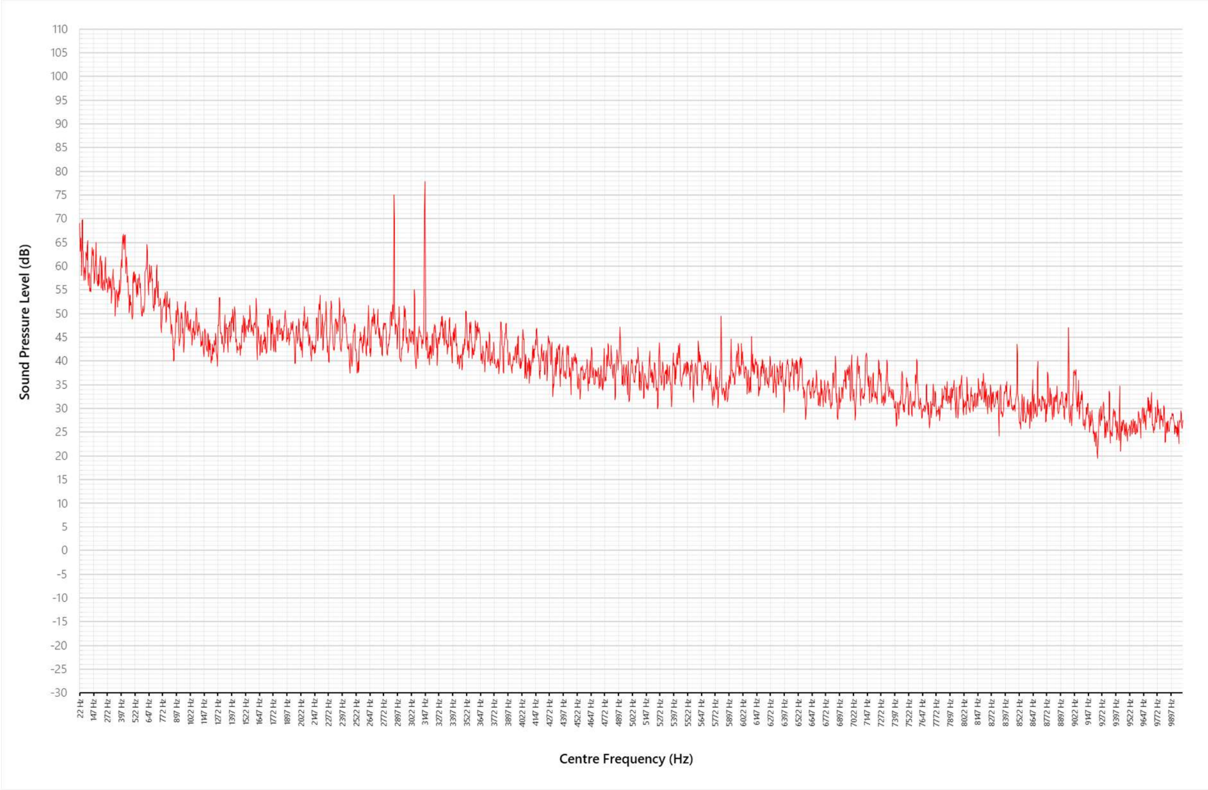
B.4.1 – FFT Graphs/Tone Identification

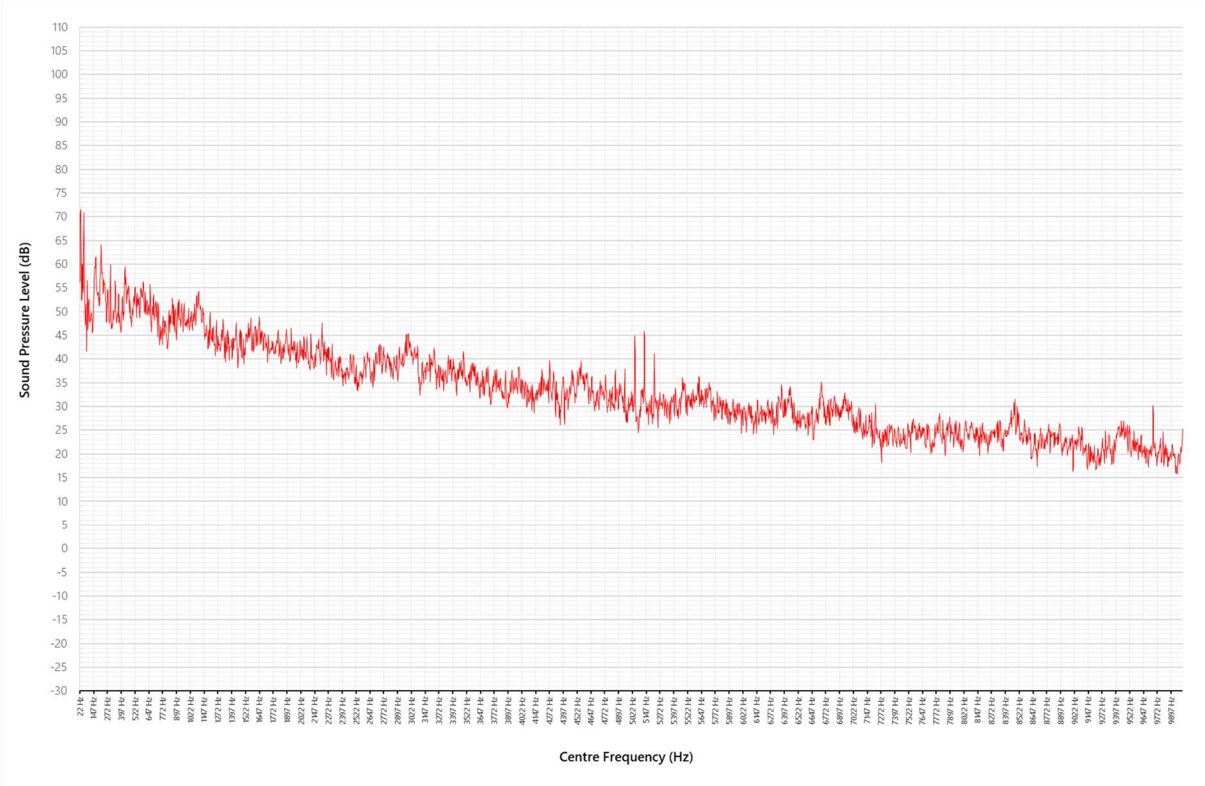
<table>
<tr><th>Noise Source</th><th>Measured L_{Aeq} / Measurement Position</th><th>FFT Graph</th></tr>
<tr><td>ETP Tankers (pumping)</td><td>84 dB L_{Aeq}

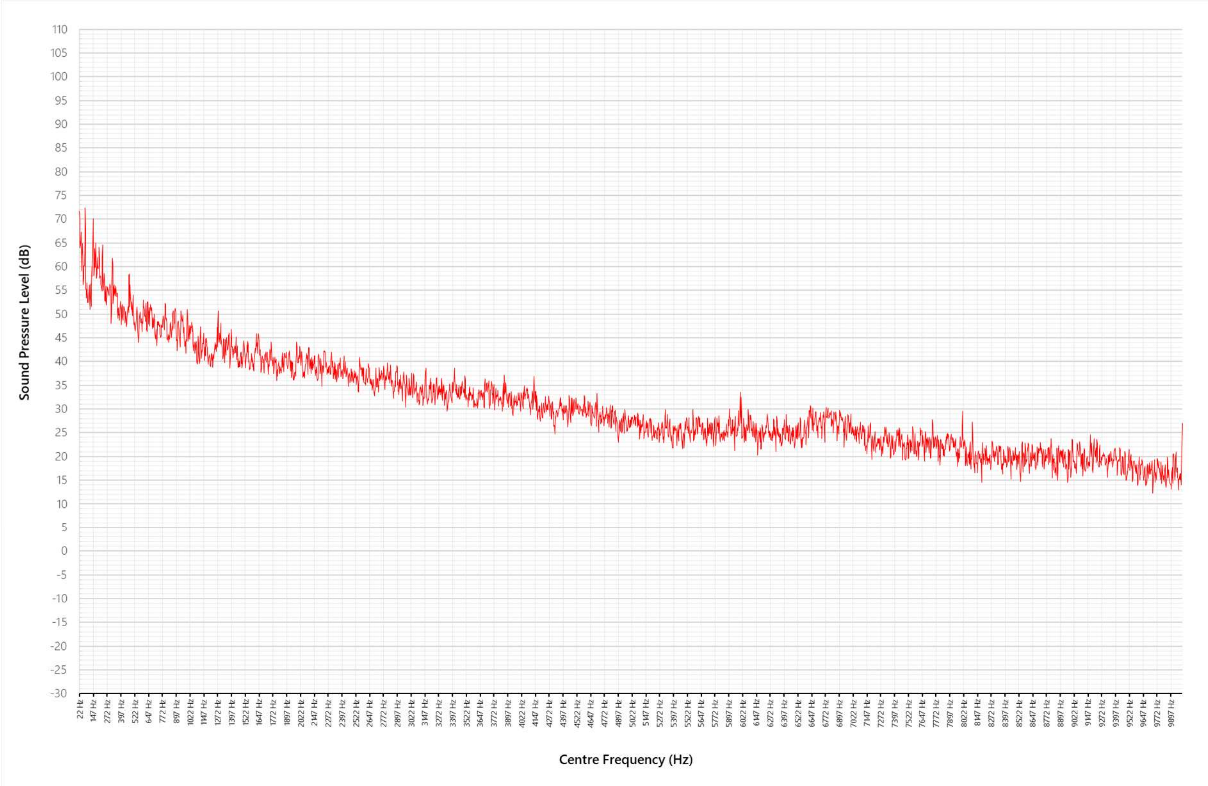
1m from Vacuum Pump and Hydraulic Cooler

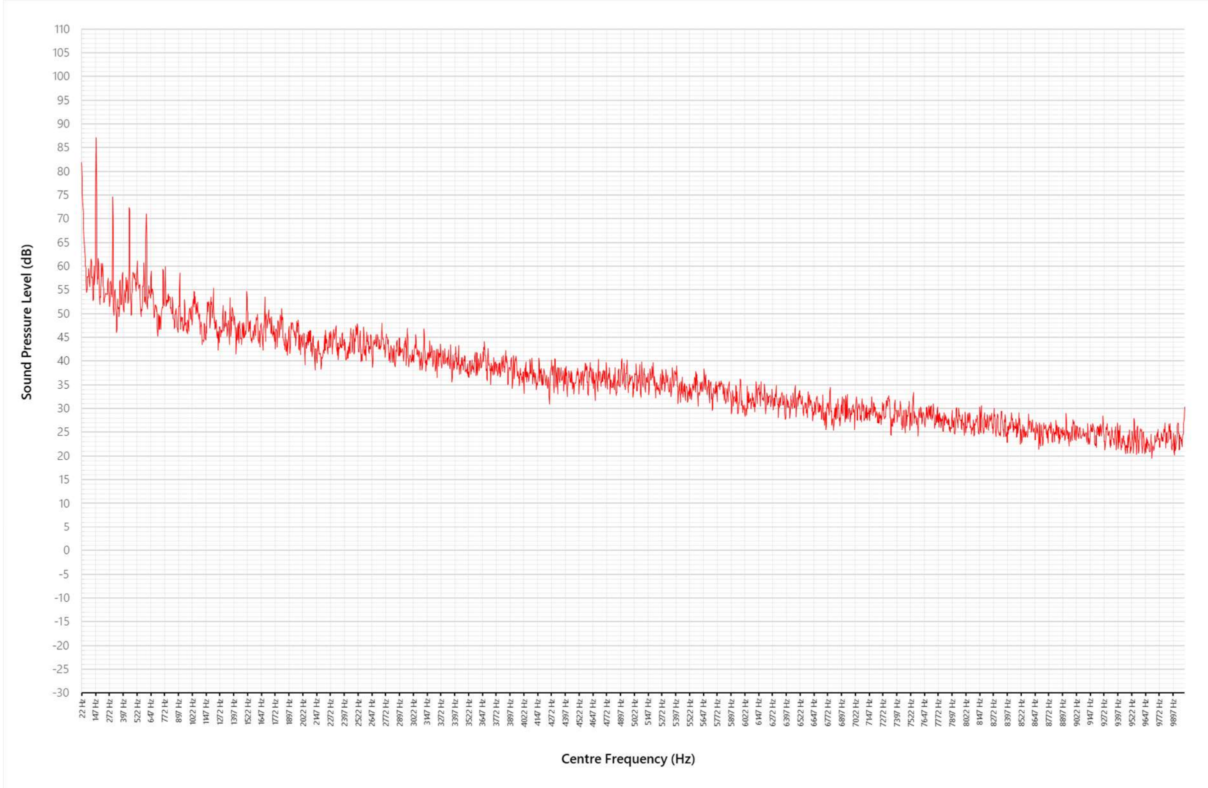
</td><td>
</td></tr>
<tr><td>Comments</td><td colspan="2">Low frequency bias associated with engine noise, but no particular tonal qualities.</td></tr>
</table>

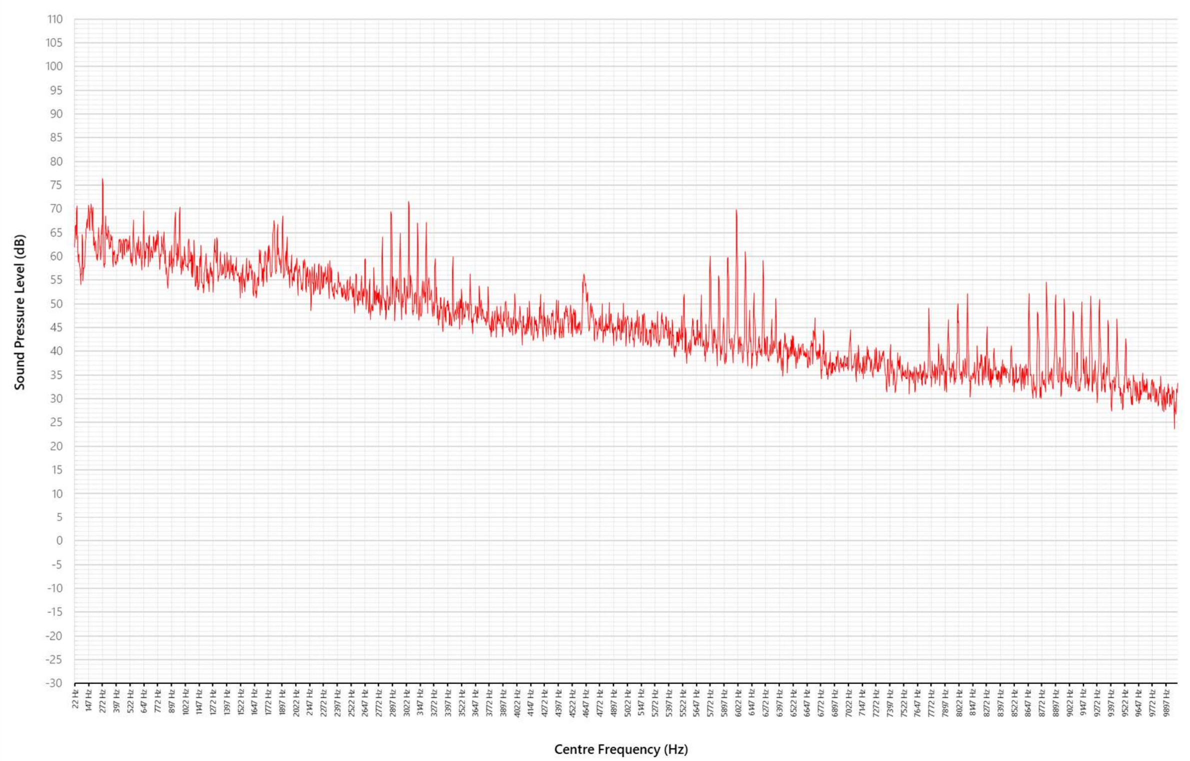
<table>
<tr><th>Noise Source</th><th>Measured L_{Aeq} / Measurement Position</th><th>FFT Graph</th></tr>
<tr><td>Cooling Tower Pumps</td><td>81 dB L_{Aeq}

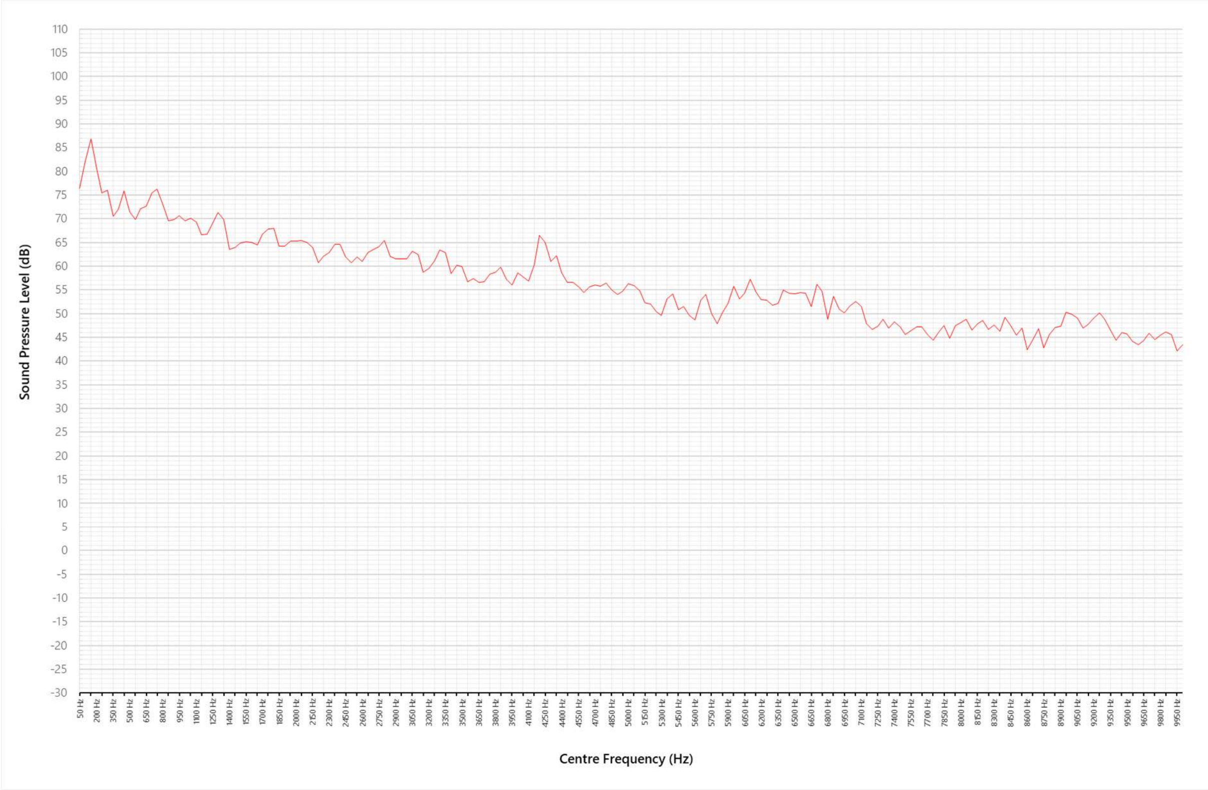
Inside the enclosure as shown below.
</td><td>
</td></tr>
<tr><td>Comments</td><td colspan="2">Tonal qualities observed in the graph at 2866 Hz and 3144 Hz. Also a small spike at 428 Hz. However, not particularly noticeable when standing at the site boundary.</td></tr>
</table>

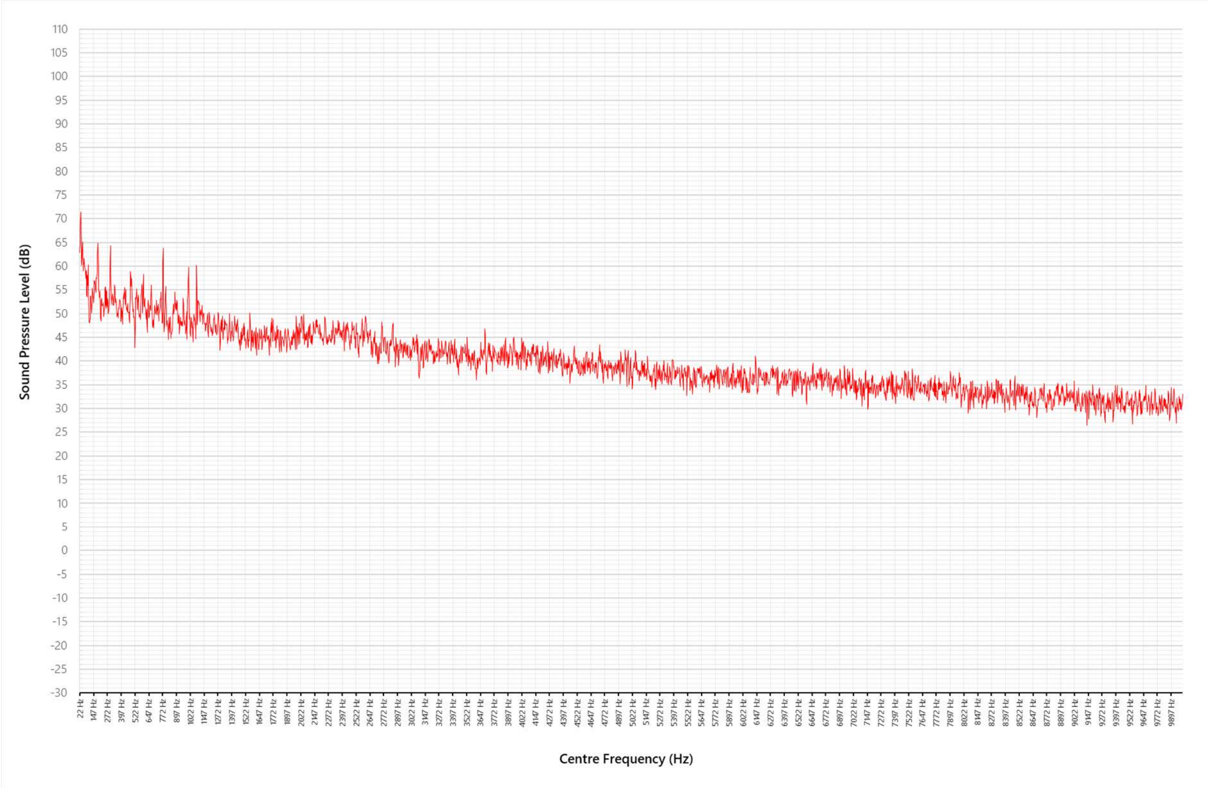
Noise Source	Measured L_{Aeq} / Measurement Position	FFT Graph
Milk Tankers (Pumping and Idling)	74 dB L_{Aeq} 1m from the tanker pump.  	
Comments	No particular tonal qualities observed. Noise mostly from the tankers idling (which is understood to be necessary for the pump to work).	

Noise Source	Measured L_{Aeq} / Measurement Position	FFT Graph
Vat Room Exhausts (east elevation)	78 dB L_{Aeq} 1m under/1m away from southernmost exhaust) (Photo not possible due to practicalities/safety of measuring at height).	
Comments	No particular tonal qualities observed in the graph or subjectively. Some low frequency emphasis which is likely to be from turbulent flow generated noise, or from the blade passing frequency (assuming a large fan with a low RPM). No mid-to-high frequency tones, very much broadband in nature.	

Noise Source	Measured L_{Aeq} / Measurement Position	FFT Graph
Vat Room Exhaust (new) (south elevation)	80 dB L_{Aeq} 2m underneath the fan. 	
Comments	Perceived as a broadband noise though the fundamental tone and harmonics at low-to-mid frequency are observed in the graph, which is likely to be from the blade passing frequency. These subjectively however are not perceived as tonal.	

Noise Source	Measured L_{Aeq} / Measurement Position	FFT Graph
Glycol Pumps (chiller compound)	86 dB L_{Aeq} 1m in front of 3 pumps. 	
Comments	Graph suggests three areas with evenly spaced tones, at around 3 kHz, 6 kHz, and 9 kHz. Suggesting there may be a fundamental tone at 3 kHz. Subjectively, the noise is mostly broadband with a harmonic type ringing, not perceptible at any one particular frequency. High frequency tonal noise may be attributable to a lack of resilient anti-vibration fixings and the 'ringing' of loose screws/metal on metal contact. Some tonal quality may also be heard from the chillers within the compound.	

Noise Source	Measured L_{Aeq} / Measurement Position	FFT Graph
Pump House	86 dB L_{Aeq} Inside the pump room 	
Comments	Graph suggested a relatively broadband noise with some possible tonal element at around 4 kHz. Not noticeable at the receptors.	

Noise Source	Measured L_{Aeq} / Measurement Position	FFT Graph
Borehole Water Tank	76 dB L_{Aeq} 1m from the water tank (Photo not taken during the survey)	
Comments	Broadband noise – noise characteristic is of flowing water rather than a mechanical noise.	

B.4.2 – 1/3 Octave Bands

Item	Description	L_{Aeq} (dB)	dB in 1/3 Octave Frequency Bands (Hz)																						
			50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000
ETP Tankers (pumping)	1m from Vacuum Pump	84	66	71	68	67	70	80	71	73	69	70	67	73	75	76	72	73	75	73	72	72	69	66	63
Chillers	Bottom of entrance stairs	82	60	56	58	64	63	65	66	60	63	63	70	70	75	74	77	69	68	68	67	63	59	60	57
	1m from the side of Chiller 1	79	64	59	57	62	61	64	59	60	61	59	69	67	67	71	75	68	66	64	63	61	56	60	52
	Between blue oil separators of Chiller 1 and Chiller 2	76	59	58	57	62	64	68	63	62	67	63	62	64	64	64	72	65	64	61	59	56	51	52	48
	Between blue oil separators of Chiller 2 and Chiller 3	72	60	60	59	62	65	67	62	59	70	61	59	62	62	60	67	60	58	57	56	53	49	50	49
Cooling Tower Pumps	1m outside of enclosure door	65	65	63	63	59	61	60	59	62	61	61	58	56	52	52	51	51	51	54	56	49	47	46	40
	3m outside of enclosure door	56	61	59	57	56	57	54	54	52	51	50	48	47	46	46	45	43	42	42	45	41	38	38	34
	1m inside of enclosure door	79	69	63	67	65	71	69	72	73	72	71	71	71	69	66	66	67	67	68	70	65	65	63	60
Vat Room Exhausts (east elevation)	1m in front of left exhaust	82	83	80	79	75	73	76	71	70	75	71	72	71	72	72	71	72	73	72	69	68	65	63	61
	1m in front of right exhaust	82	71	74	71	71	72	82	78	75	79	72	72	72	72	73	72	70	69	69	67	65	62	60	58
Borehole Pump Room	Inside room	82	64	64	60	76	64	68	68	69	73	71	73	73	71	72	73	73	72	71	70	69	66	64	62
	1m outside door	66	66	61	55	74	59	59	57	55	60	57	57	58	56	56	58	55	54	53	50	53	46	44	45

Item	Description	L_{Aeq} (dB)	dB in 1/3 Octave Frequency Bands (Hz)																						
			50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000
Boiler House Pressure Valve Release	Below flue	82	64	65	65	62	63	64	66	69	68	71	71	72	76	74	71	72	71	71	71	69	67	64	60
LNG (alarm)*	1m - Alarm door open	95	61	68	54	52	56	59	64	60	61	75	74	73	67	66	71	74	75	89	92	82	60	59	50
	1m - Alarm door closed	71	60	64	53	51	52	54	50	53	56	55	62	62	52	51	55	58	62	64	66	56	47	48	40
Cooling Towers	3m - Not dominant noise source, broadband noise from cooling towers	56	59	56	56	55	54	53	52	50	50	49	47	47	47	46	44	43	42	42	47	44	38	37	36
Glycol Pumps (Chiller Base)	1m in front	87	61	61	62	66	70	70	72	72	92	74	70	78	73	75	71	71	71	69	71	64	62	67	65
	20cm above pumps	91	75	72	71	72	77	76	77	77	89	77	74	81	78	80	77	78	79	78	81	70	69	75	68
Whey Dispatch Pump	1m from dispatch pump	86	68	66	62	63	62	67	70	69	68	77	70	68	83	73	74	73	75	76	74	73	73	72	69
Boiler House Louvres	Below - not dominant noise source (milk lorries dominant)	63	60	60	61	58	56	54	52	54	53	49	50	53	56	55	51	48	48	49	49	51	49	45	41
Pump House	Inside room	90	64	62	61	69	70	85	75	74	80	83	84	80	80	80	81	78	76	79	76	72	69	68	65
	1m outside closed door	60	53	51	54	51	53	62	57	53	64	51	48	48	47	46	47	45	44	43	41	41	39	37	35
Production Hall Exhausts	Below exhaust	67	71	68	68	66	62	65	61	64	62	61	60	59	57	57	57	57	56	53	52	52	50	48	46
LNG (pressure fill)	1m from pump - very quiet, not the dominant noise source	60	61	61	53	50	50	49	48	47	49	57	51	52	47	47	47	47	47	48	48	49	47	44	42
Borehole Water Tank	1m in front	76	75	74	65	64	60	66	68	68	70	69	67	66	65	67	65	64	63	63	63	62	61	59	58

B.5 – Fixed/Boundary Noise Monitors

B.5.1 – NSR 1

The microphone was positioned within the edge of the site boundary next to the ETP tanker entrance, in the direction of the residential property to the east (NSR 1), as has been done previously. The position is highlighted in Figure 2.1 (Section 2.4). The position should represent a worst-case given that it is closer to the facility than the residents garden and windows. It is the same position used for surveys conducted several times at the facility including in July 2021 and September 2020.

The measured noise levels include for day-to-day operational noise and therefore background noise levels should not be interpreted from these results as 'true' baseline noise levels which would occur if the facility were not there/were to cease operating entirely. The most useful parameter is the L_{A90}, which represents the background noise level that is mostly unaffected by intermittent traffic along the road (which affects the L_{Aeq} and L_{AFMax}).

The results show that the minimum values of $L_{A90,5min}$ were 45 dB during the day and 44 dB at night, over a 24 hour period. The survey conducted in July 2021 measured minimums of 49 dB and 48 dB respectively, over just shy of 48 hours. Hence the baseline levels appear to have dropped by 4 dB between the two surveys.

Table B.1 – Summary of measured noise levels – close to NSR 1

Time Period	Parameter	Maximum	Minimum	Logarithmic Average	Mean Average	Modal Average	Median Average
Daytime (07:00 – 23:00)	$L_{Aeq,5min}$ (dB)	67	46	56	54	54	54
	$L_{AFMax,5min}$ (dB)	84	48	N/A	67	65	66
	$L_{A90,5min}$ (dB)	66	**45**	N/A	49	45	48
Night-time (23:00 – 07:00)	$L_{Aeq,5min}$ (dB)	53	45	48	48	46	47
	$L_{AFMax,5min}$ (dB)	71	47	N/A	57	48	61
	$L_{A90,5min}$ (dB)	47	**44**	N/A	45	45	45

Figure B.1 – Photographs of the fixed noise monitor close to NSR 1 (including day-to-day operational noise)

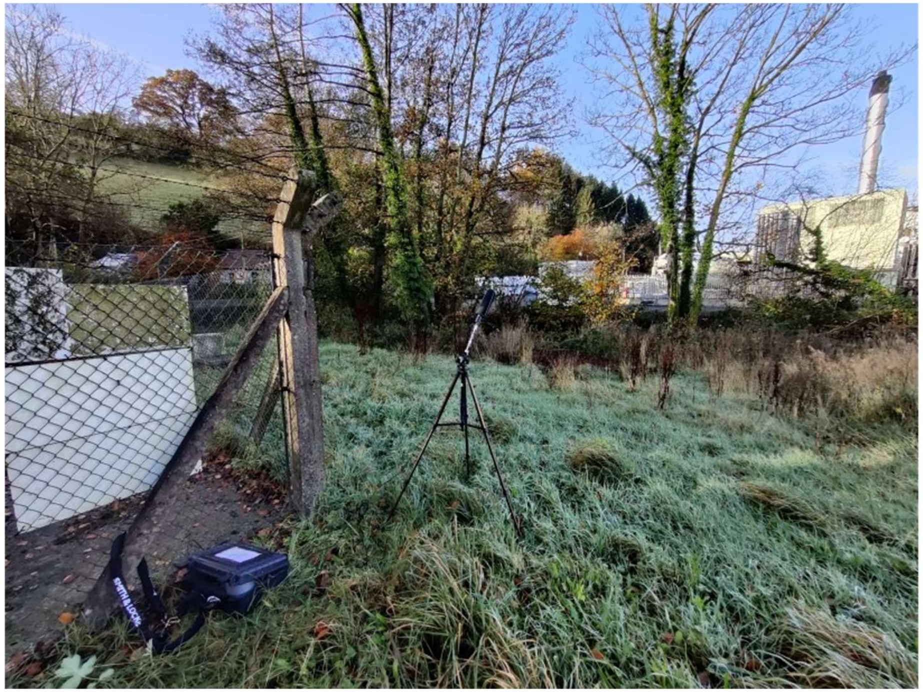
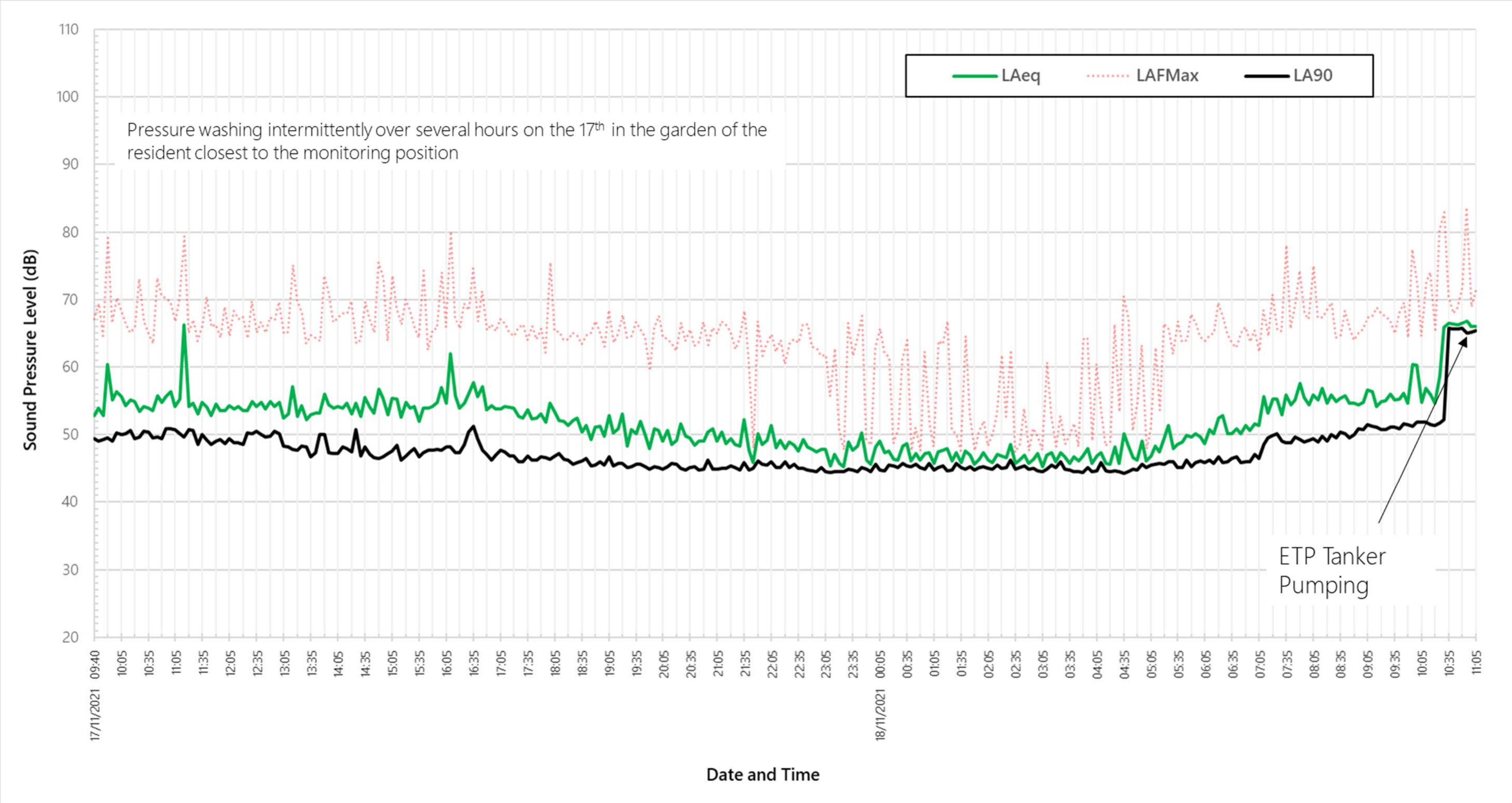


Figure B.2 – Noise levels close to NSR 1 (including day-to-day operational noise)



B.5.2 – NSR 2

The microphone was positioned within the edge of the site boundary along the road, opposite the entrance to the residential property defined as NSR 2. The position is highlighted in Figure 2.1 (Section 2.4). The position should represent a worst-case given that it is closer to the facility than the residents garden and windows.

The measured noise levels include for day-to-day operational noise and therefore background noise levels should not be interpreted from these results as 'true' baseline noise levels which would occur if the facility were not there/were to cease operating entirely. The most useful parameter is the L_{A90}, which represents the background noise level that is mostly unaffected by intermittent traffic along the road (which affects the L_{Aeq} and L_{AFMax}).

The results show that the minimum values of $L_{A90,5min}$ were 43 dB during the day and 42 dB at night, over a 24 hour period. The survey conducted in July 2021 measured minimums of 45 dB and 44 dB respectively, over just shy of 48 hours. Hence the baseline levels appear to have dropped by 2 dB between the two surveys.

Table B.2 – Summary of measured noise levels – close to NSR 2

Time Period	Parameter	Maximum	Minimum	Logarithmic Average	Mean Average	Modal Average	Median Average
Daytime (07:00 – 23:00)	$L_{Aeq,5min}$ (dB)	80	46	65	63	66	65
	$L_{AFMax,5min}$ (dB)	98	50	N/A	80	80	80
	$L_{A90,5min}$ (dB)	55	43	N/A	47	50	48
Night-time (23:00 – 07:00)	$L_{Aeq,5min}$ (dB)	63	43	55	51	43	52
	$L_{AFMax,5min}$ (dB)	85	44	N/A	64	48	72
	$L_{A90,5min}$ (dB)	47	42	N/A	43	43	43

Figure B.3 – Photographs of the fixed noise monitor close to NSR 2 (including day-to-day operational noise)

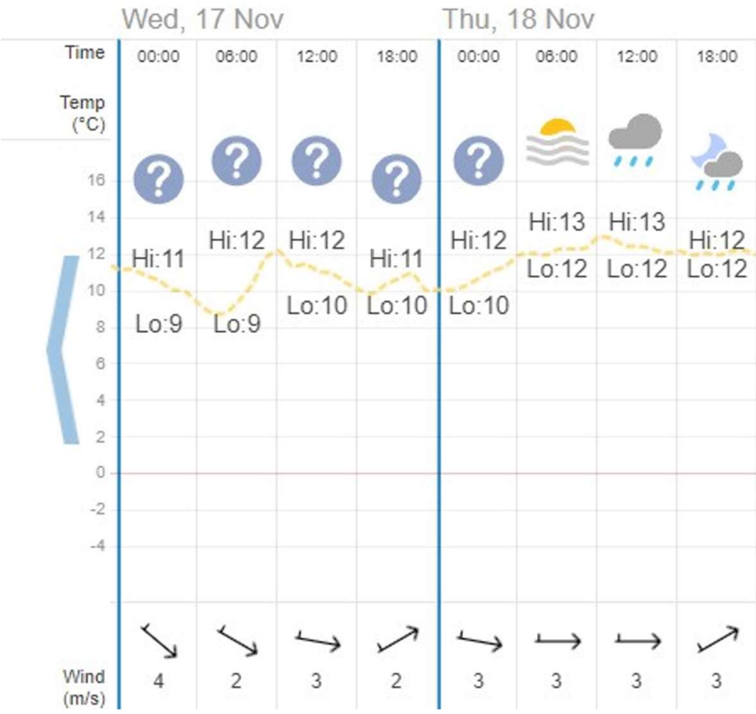
Figure B.4 – Noise levels close to NSR 2 (including day-to-day operational noise)

B.6 – Weather Conditions (17th to 18th)

During the survey, weather conditions were dry throughout with low levels of wind and mild temperatures. The microphone was fitted with a weather protection kit/windshield. These weather conditions are suitable for the measurement of environmental noise in accordance with BS 7445 '*Description and Measurement of Environmental Noise*'.

The weather conditions are sourced from https://www.timeanddate.com/weather/@2641676/historic?month=11&year=2021.

Figure B.6 – Meteorological conditions during the survey



Appendix C – Relevant Guidelines

C.1 - Horizontal Guidance Note for Noise Assessment and Control

The purpose of the *Horizontal Guidance Note for Noise Assessment and Control* is to provide supplementary information, relevant to all sectors, to assist in preventing and minimising emissions of noise as described in the Sector Guidance Notes (or the General Sector Guidance Note).

The guidance is in two parts:

Part 1 – Regulation and Permitting – outlines the main considerations relating to the setting of Permit conditions and subsequent regulation of noise. Part 1 is aimed primarily at the information needs of regulators.

Part 2 – Noise Assessment and Control – describes the principles of noise measurement and prediction and the control of noise by design, by operational and management techniques and abatement technologies. Outline methods of noise control are provided such as:

- use of inherently quieter processes;
- selection of inherently quiet plant or "low-noise options";
- site layout to maximise natural screening, screening by buildings and separation distances;
- the orientation of directional noise sources away from sensitive receptors; and
- noise barriers or bunding.

C.2 - BS 4142:2014

BS 4142:2014 *'Methods for rating and assessing industrial and commercial sound'* is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations within the context of the existing sound environment. The method is based upon assessing the predicted noise emissions from plant against the existing background sound levels at NSRs. The predicted emissions are termed as a 'rating level', which is the specific sound level from plant, plus 'penalties' which account for whether the noise has distinguishing characteristics such as tonality, intermittency, impulsivity, or is generally distinguishable from the ambient noise environment. Such features may attract attention and be considered annoying, hence sounds with these qualities should be penalised over sounds at the same specific noise level which is less intrusive.

The significance of the impact of an industrial or commercial sound source depends on both the margin by which the rating level $L_{Ar,Tr}$ exceeds the background sound level $L_{A90,T}$ and the context in which the sound occurs. It is therefore essential to place the sound in context. But in general, *"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."* However, if the rating level does exceed the background sound level, "a difference of around + 5 dB is likely to be an indication of an adverse impact, depending on the context", and "a difference of around +10 dB or more is likely to be an indication of a significant adverse impact depending on the context."

C.3 - BS 8233:2014

BS 8233:2014 '*Guidance on Sound Insulation and Noise Reduction for Buildings*' suggests appropriate criteria and limits for different situations. This includes internal noise criteria for residential developments. The limits with BS 8233:2014 are similar to those in the WHO's *'Guidelines for Community Noise* and *Night Noise Guidelines for Europe'* document.

Table 4 of BS 8233:2014 provides internal ambient noise level (IANL) limits for dwellings from *"steady external noise sources"*. These are summarised in Table 3.1 below.

Table C.1 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

In Annex G.1 of BS 8233:2014 it suggests that "*if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB*". Therefore, a noise limit directly outside of the nearest residential windows could be set based upon the values above plus 15 dB.

Therefore, to meet internal noise targets in nearby residential dwellings, noise from the proposed plant should not exceed 50 dB L_{Aeq} during the daytime and 45 dB L_{Aeq} during the night-time when measured/calculated directly outside of a residential bedroom or living room window.

C.4 - World Health Organisation (WHO) Environmental Noise Guidelines

The WHO document *Guidelines for Community Noise 1999* has recently been superseded by the *Environmental Noise Guidelines for the European Region*. However, the updated guidance states that *'all WHO guidelines for community noise (CNG) indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid'*.

The document sets out guidance as to noise levels at which there will be an unacceptable impact on the local community. WHO guidelines state:

- To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise.
- To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB $L_{Aeq.}$

Therefore, noise from the proposed plant should ideally be designed to not exceed 50 dB L_{Aeq} during the daytime when measured or calculated within a residential garden, patio, or balcony.

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