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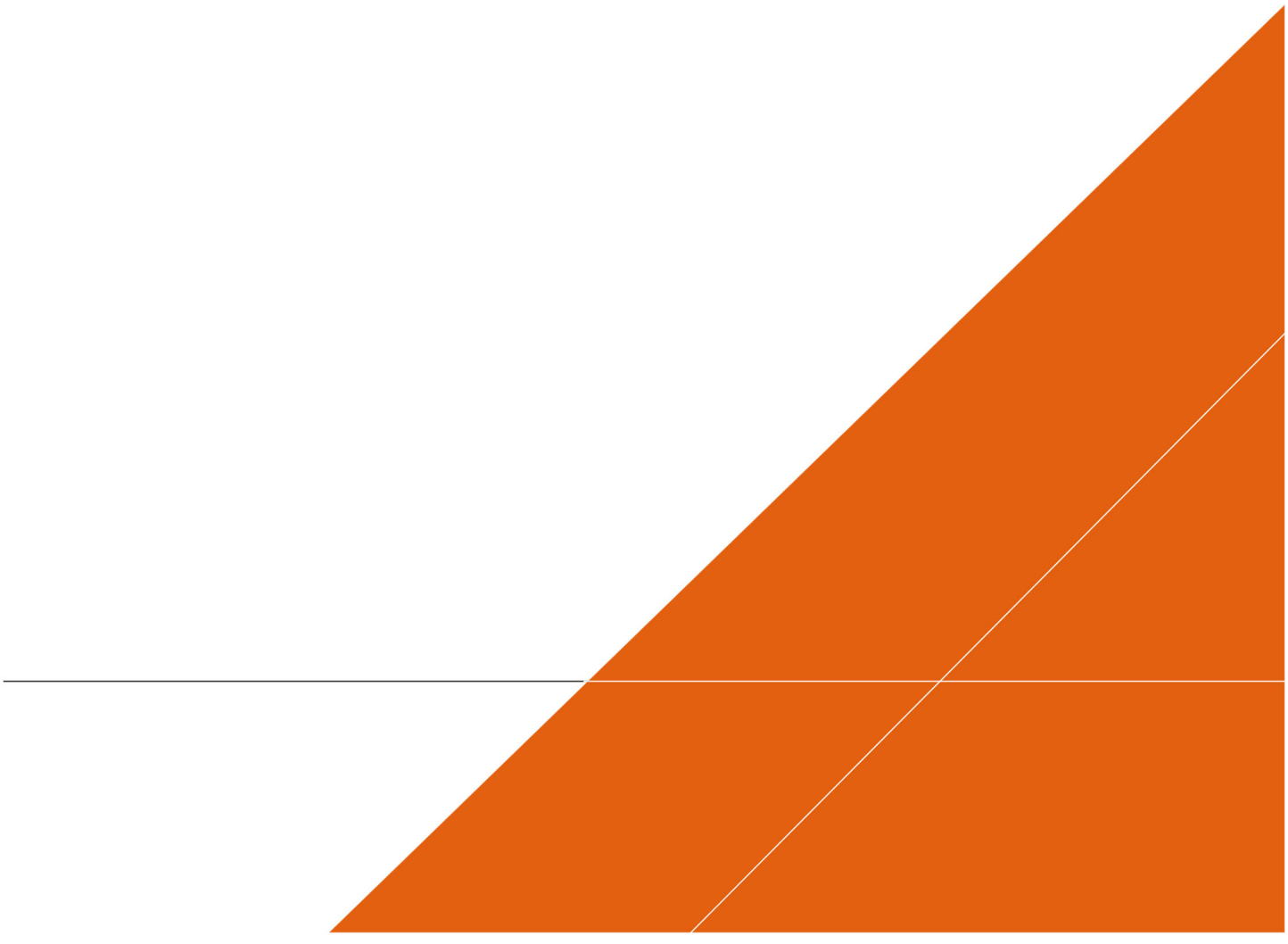
CHELSON MEADOW, PLYMOUTH

Noise Impact Assessment – LTP Air Blowers

JULY 2020



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Noise Impact Assessment – LTP Air Blowers

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	8th April 2020	S Russon	M Arnold	P Tallantyre	
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APPENDICES

EXECUTIVE SUMMARY

Arcadis Consulting (UK) Ltd has been commissioned to complete a noise impact assessment associated with the replacement of existing electrical air blowers installed at the Chelson Meadow Leachate Treatment Plant, Plymouth.

Existing baseline background noise levels have been quantified in the vicinity of the nearest noise sensitive receptors in order to represent the prevailing noise climate of the area. The data supporting this report was quantified during January 2020 and March 2020.

It has been recommended that impacts associated with noise emissions from the new air blowers should be controlled in line with the methodology of BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* such that emissions are controlled, as far as practically possible, to a cumulative rating level not exceeding the existing typical background (L_{A90}) noise climate at the nearest noise sensitive receptor.

As final plant selections for the replacement of the existing air blowers have not yet been determined, the methodology and assessment protocols of BS 4142:2014+A1:2019 have been used to establish appropriate noise emission limits for the new, individual plant items.

With the implementation of the recommended noise emission limits specified, it is concluded that the operational noise associated with the new air blower units would be classified to be at a level indicative of the specific sound source having a low impact.

1 INTRODUCTION

Arcadis Consulting (UK) Ltd has been commissioned to complete a noise impact assessment associated with the replacement of existing electrical air blowers installed at the Leachate Treatment Plant (LTP) at the Chelson Meadow Waste Facility and Landfill site, Plymouth.

A new residential development is being constructed to the south of the LTP site and the Environment Agency has raised concerns that the replacement blowers may generate noise complaints from new and future residents.

The assessment is based upon a background and ambient noise measurement survey undertaken in the vicinity of the site and the nearest noise sensitive receptors between the 21st and 23rd January 2020 and the 17th and 18th March 2020.

Details regarding the assessment methodology employed, together with the results of the survey undertaken, and the subsequent conclusions and recommendations drawn are presented within the following report.

1.1 Site Location and Setting

The Leachate Treatment Plant is located in Plymouth on the former landfill site at Chelson Meadow Recycling Centre. The site is located within postal code area PL9 7JS and is centred at approximate grid reference SX 50624 54484. The general location of the site is as indicated within the red outline on Image 1 below.

Image 1: Site Location

(Image Source: Imagery ©2020 Bluesky, DigitalGlobe GeoEye Getmapping plc. Infoterra Ltd & Bluesky, The Geoinformation Group, Map data ©2020 Google)

To the west of the site is the site access road, The Ride, past which is the River Plym. To the north and east of the site is the Chelson Meadow Recycling Centre. Beyond the Recycling Centre is the former landfill site which has since been landscaped into grassland; it is understood that the former landfill site is not accessible to the general public. To the south of the site is a new 1,500-unit residential-led development, Saltram Meadow, which is located on the site of the former Plymstock Cement Works and Quarry; much of this development has been completed, however the area nearest to the LTP is currently still under construction by Persimmons Homes.

Image 2 below indicates the location of the LTP plant in relation to the residential-led development site.

Image 2: Location of LTP plant (outlined in red) and area of residential development to the south (blue)

(Image Source: Imagery ©2020 Bluesky, DigitalGlobe GeoEye Getmapping plc. Infoterra Ltd & Bluesky,

The Geoinformation Group, Map data ©2020 Google)

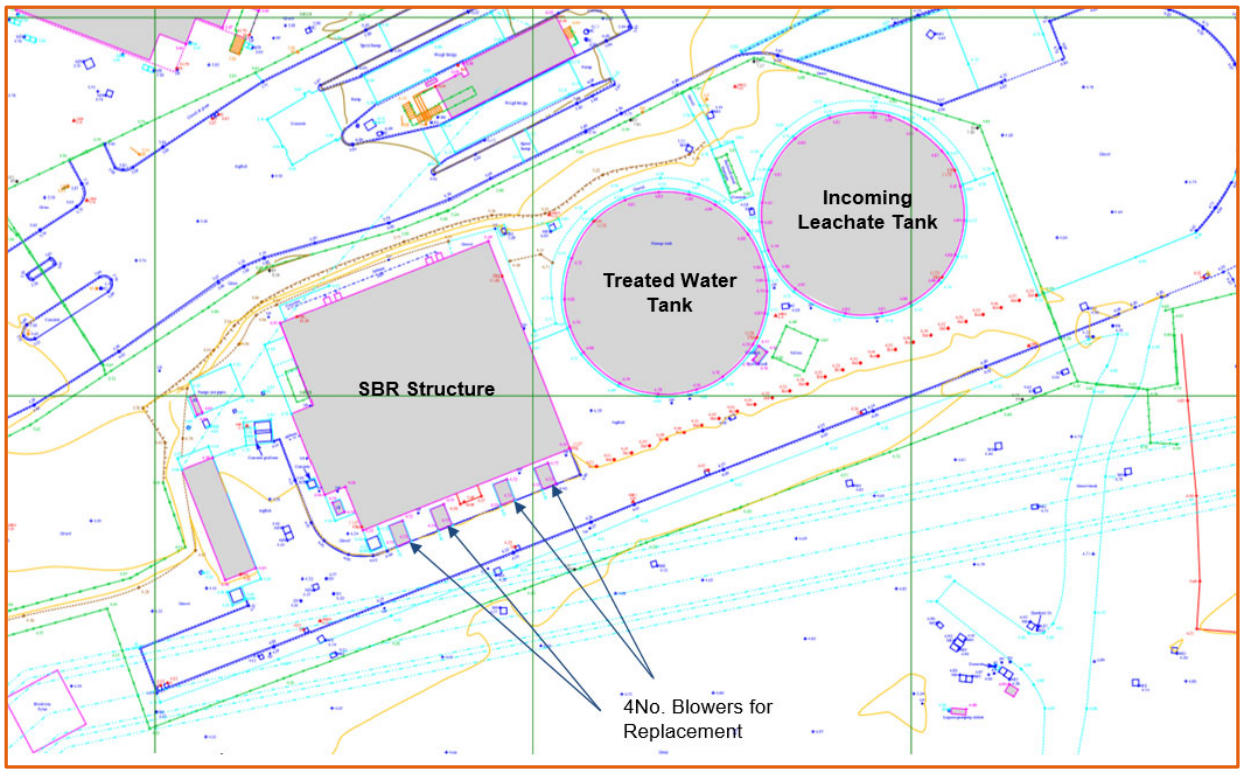
1.2 Description of Works Proposal

The existing blower arrangement at the Leachate Treatment Plant (LTP) has been identified as exceeding its expected design life and has therefore been highlighted for replacement. The existing arrangement has each of the four Sequencing Batch Reactor (SBR) tanks supplied with pressurised air from a dedicated air blower, all of which are lobe displacement blowers manufactured by Hick Hargreaves.

The replacement blowers will utilise the existing fixed pipework arrangement, and will be integrated into the existing control philosophy. Enclosures will be utilised to provide weather protection to the blowers and to reduce the noise emissions where required. The new air blowers will be located within the same position as the existing blowers as indicated on Image 3 below.

Specific plant selections relating to the new air blowers have not yet been undertaken; rather the intention of this assessment is to benchmark the existing ambient background noise climate at the location of the nearest noise sensitive receptors such that an appropriate noise limit for the new blowers and any additional noise reduction measures can be established. Following this, appropriate plant selections can be made to ensure compliance with this limit.

Image 3: Location of the LTP air blowers



1.3 Operating Hours

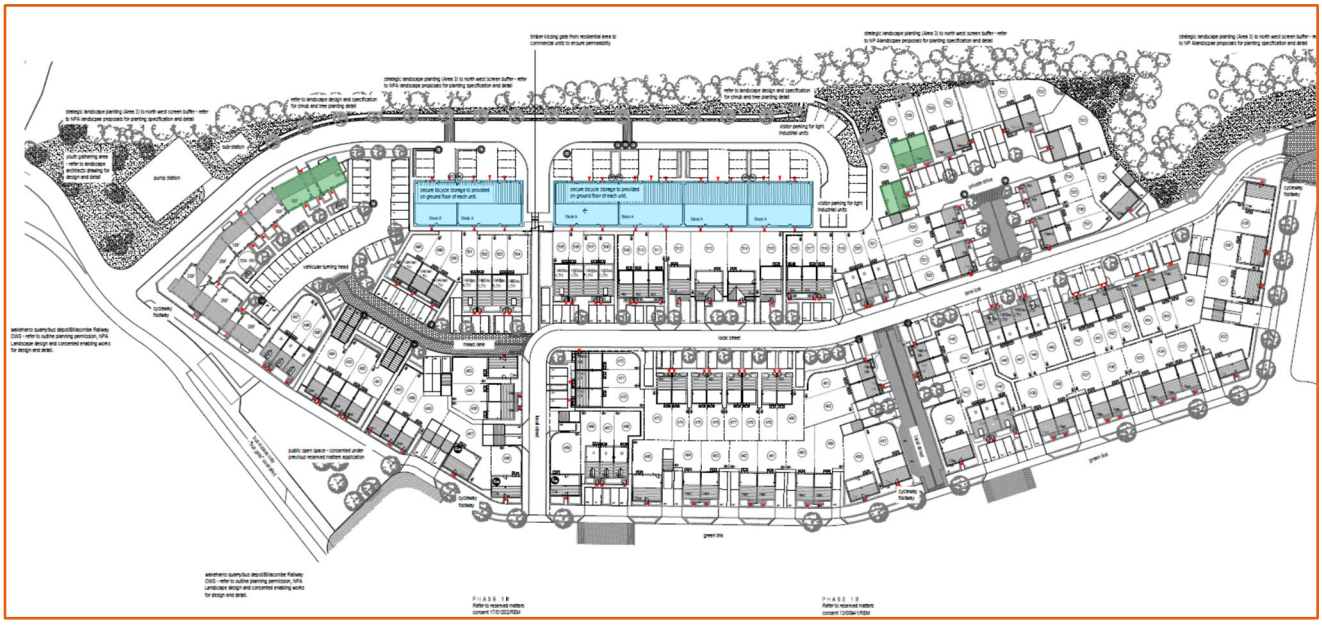
The existing blowers operate on a 24 hour, 7 days a week basis, with the blowers starting up as and when they are needed. They do operate intermittently at times, however when they are in operation they will usually remain so for a number of hours before cutting off. The new blowers will operate in the same manner as the existing ones, therefore, for the purposes of this assessment, it has been assumed that the new plant will be in operation on a 24 hour, 7 days a week basis.

1.4 Identification of Nearest Noise Sensitive Receptors

The nearest noise sensitive receptors to the LTP site are considered to be residential dwellings associated with the new Persimmons housing development located to the south. Image 2 above identifies the general location of this site.

Image 4 below identifies the specific location of the nearest new residential dwellings within the Persimmon development site, as based on the proposed site layout plans submitted as part of the planning application for the site; areas shaded in blue indicate non-residential units, with the location of the nearest residential receptors to the air blowers shaded in green. Whilst the current plans indicate that the blue shaded areas are commercial units, during the site visit the Persimmon site contact mentioned that these may potentially change to residential units in the future. However, for the purposes of this assessment, the Persimmons site layout detailed in Image 4 has been referenced as this is the layout/land usage which has current planning consent.

Image 4: Nearest noise sensitive receptor locations, as identified by the green shaded areas; commercial units are shaded in blue (plan extract from Persimmon Homes drawing no. 2017/PLYMQ/RM4sk121 Rev P4 Site Layout Plan)



1.5 Consultation

The site is licensed by the Environment Agency (EA) and as such, the proposed survey and assessment methodology has been provided to the relevant EA Officer for their comment.

Email contact was made with Mary Rees, PPC Officer (Devon, Cornwall and the Isles of Scilly) on the 10th September 2019 to provide details of the proposed assessment methodology. A response was received from the EA on the 14th October 2019 which included comments regarding the collection of ambient noise level data in the absence of the specific sound source (that being the existing air blowers) and potential noise mitigation measures for the control of noise emissions.

The comments received from the EA following the consultation undertaken has been implemented into the scope of this report where appropriate.

2 NATIONAL POLICY AND GUIDANCE

The following assessment has been completed in accordance with the following current policy, standards and industry guidance, including:

- BS 4142:2014+A1:2019 Method for rating and assessing industrial and commercial sound;
- Integrated Pollution Prevention and Control (IPPC) Horizontal Guidance for Noise Part 2 – Noise Assessment and Control 2004;
- ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation;
- BS 7445-2:1991 Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use;
- BS 8233: 2014 Guidance on sound insulation and noise reduction for buildings;
- World Health Organisation (WHO) Environmental Noise Guidelines 2018; and,
- World Health Organisation (WHO) Guidelines for Community Noise 1999.

Further details relating to the above guidance documents and assessment methodologies are included within Appendix A of this report.

3 NOISE MONITORING SURVEY

This section of the report describes the specifics of the background and ambient noise surveys undertaken within the scope of the assessment.

3.1 Introduction

In order to determine the existing noise climate of the area, a baseline and ambient noise monitoring survey was conducted at locations representative of the nearest noise sensitive receptors to the site on the 22nd January 2020 and 17th March 2020.

In addition, sample measurements in close proximity to the existing sound sources on the LTP and adjacent waste recycling site were completed during 22nd January 2020; the sound emissions from the current site have not been used within the following assessment but have been benchmarked and reported for use within future noise modelling exercises, if so required.

3.2 Weather Conditions

The weather conditions during the survey periods were deemed to be acceptable for the measurement of environmental noise in accordance with the requirements of BS 7445:1-2003 '*Description and measurement of environmental noise*' and are as described below:

- The weather during the 21st - 22nd January 2020 survey period was noted to be cold with a daytime ambient temperature of around 6°C and a night-time temperature of 7°C. Cloud cover was consistent, noted to be around 100%. There was noted to be a wind of 1 – 5m/s in an ENE direction for the majority of the survey duration.
- The weather during the 17th - 18th March 2020 survey period was noted to be mild with a daytime ambient temperature of around 10°C and a night-time temperature of 7°C. Cloud cover was consistent, noted to be around 90%. There was noted to be a wind of around 3m/s in an SW direction for the majority of the survey duration.
- Ground conditions were noted as dry for the duration of all the monitoring surveys, with no precipitation falling immediately prior to or during the survey periods.

3.3 Monitoring Equipment

The monitoring was undertaken in line with the guidance set out within BS 7445:2003, with the sound level meters programmed to monitor over 15-minute intervals unless otherwise specified within the result tables below. The equipment used was set to record the following parameters with both single-figure and octave band data collected:

L_{A10} is the A-weighted sound level that is exceeded for 10% of the sample period; this parameter gives an indication of the upper limit of fluctuating noise such as that from road traffic;

L_{A90} is the A-weighted sound level that is exceeded for 90% of the sample period; generally used to quantify background noise;

$L_{Aeq,T}$ is the A-weighted equivalent continuous sound level during the sample period (T) and effectively represents an average value;

$L_{Amax,f}$ is the A-weighted maximum noise level measured during the sample period (T);

$L_{Amin,f}$ is the A-weighted minimum noise level measured during the sample period (T).

The measurement equipment used complies with the performance specifications for Class 1 devices in accordance with BS EN 61672-1:2003. Table 1 provides information regarding the monitoring equipment.

Table 1: Noise monitoring equipment

Equipment	Manufacturer	Type	Serial number	Date of last calibration
Sound level meter	01dB	Fusion	11036	03/02/2020
	Rion	NL-52	34936367	04/06/2018
Calibrator	Rion	NC 74	50541131	03/02/2020

The following set-up parameters remained unaltered through all noise measurements:

Time weighting: Fast

Frequency weighting: 'A'

The sound level meters were locally calibrated using an electronic calibrator prior to commencement and upon completion of the overall survey; no drift in calibration was observed.

The external calibration documentation for the equipment used can be provided upon request.

3.4 LTP Site Monitoring Results

The on-site noise monitoring locations are presented on Image 5. Short-term manned measurements were completed at a number of positions around the site. Unless otherwise noted, measurements were completed at a height of 1.5m above local ground levels, in close proximity to each identified noise-generating source.

Image 5: LTP site monitoring locations

A summary of the monitored levels is presented within Table 2.

Table 2: Summary of Leachate Treatment Plant and adjacent Waste Recycling site sample measurements

Monitoring Location	Description	Time	L_{Aeq}, dB	$L_{A90,T}$ dB	L_{AFmin}, dB	L_{AFmax}, dB
1	LTP Site: 1m from SBR1 Blower (SBR2 Blower also in operation at time of measurement)	09:33 – 09:34	96.4	96.2	95.9	96.9
		09:34 – 09:35	95.9	95.6	95.2	96.7
		09:35 – 09:36	95.5	95.3	95.1	95.9
2	LTP Site: 1m from small Blower (SBR 1 & 2 Blowers also in operation at time of measurement)	09:39 – 09:40	69.0	68.6	67.9	69.8
		09:40 – 09:41	68.9	68.6	68.0	70.6
3	LTP Site: 1m from compressor near Washroom door	09:43 – 09:44	77.2	73.7	72.2	84.6
4	LTP Site: 1m in front of SBR1 Blower	09:49 – 09:50	77.9	77.4	76.9	78.8
		09:50 – 09:51	78.0	77.6	77.0	78.7
5	LTP Site: 1m in front of Blower 3	11:09 – 11:10	76.6	75.9	75.6	77.6
	LTP Site: Ambient level (no blowers in operation)	11:34 – 11:35	56.2	48.5	47.4	72.5
	LTP Site: Blower 3	11:34 – 11:35	88.1	76.5	75.3	92.6
	LTP Site: 1m in front of Blower 3	11:36 – 11:37	78.6	78.4	78.0	79.9
		11:37 – 11:38	78.7	78.5	78.3	79.2
	LTP Site: 1m to the right of Blower 3	11:38 – 11:39	80.7	80.2	79.8	81.3
		11:39 – 11:40	80.3	80.1	79.9	81.2
	LTP Site: 1m to the left of Blower 3	11:41 – 11:42	82.3	82.0	81.5	83.3
		11:42 – 11:43	82.2	81.8	81.6	83.3
6	Garden Waste Area: HGV movements and shredding activities	10:01 – 10:02	64.6	64.0	63.2	70.5
		10:02 – 10:03	64.0	63.5	63.0	66.4
		10:03 – 10:04	64.2	63.4	62.7	68.7

Monitoring Location	Description	Time	L_{Aeq}, dB	$L_{A90,T}$ dB	L_{AFmin}, dB	L_{AFmax}, dB
7	Garden Waste Area: HGV movements and shredding activities	10:04 – 10:05	69.8	68.4	66.0	72.4
8	Garden Waste Area: HGV movements and shredding activities	10:06 – 10:07	91.9	83.4	81.3	97.2
9	Garden Waste Area: HGV movements and shredding activities	10:08 – 10:09	76.9	70.2	67.3	88.0
		10:09 – 10:10	78.9	70.7	69.1	92.0
10	HWRC Site: Bin pick-up activities	10:19 – 10:20	74.2	67.0	65.3	90.5
		10:21 – 10:22	76.0	68.7	63.0	88.2
11	RTC Site: Breakout noise from door no. 1	10:25 – 10:26	70.1	64.2	60.5	82.3
		10:26 – 10:27	71.6	62.9	57.2	91.0
12	RTC Site: Breakout noise from door no. 2	10:31 – 10:32	70.6	64.5	59.0	82.3
		10:32 – 10:33	66.9	60.3	57.8	75.9
13	RTC Site: Breakout noise from door no. 3	10:36 – 10:37	72.6	60.7	59.9	83.3
		10:37 – 10:38	69.3	64.2	62.7	81.1
		10:38 – 10:39	75.3	64.2	63.6	87.6
14	MRF Site: Noise breakout from dust extraction system	10:49 – 10:50	82.5	78.8	78.1	98.3
		10:50 – 10:51	81.7	78.8	78.1	98.0
15	MRF Site: Breakout noise from door	10:53 – 10:54	75.1	66.0	60.5	88.7
		10:54 – 10:55	71.7	64.2	61.6	83.8

3.5 Off-site Monitoring Results

Long-term data logging sound level meters were positioned on site at NML 1 and NML2, as indicated on Image 6. Measurement data was collected continually over the following time periods:

- 09:00 hours on Wednesday 22nd January 2020 to 09:20 hours on Thursday 23rd January 2020; and,
- 14:15 hours on Tuesday 17th March 2020 to 10:19 hours on Wednesday 18th March 2020.

The noise monitoring locations are described below and presented geographically on Image 5.

- NML 1: Boundary of the LTP site with the Saltram Meadow residential-led development site, representative of noise sensitive receptors to the west of the Persimmon site; and,
- NML 2: Boundary of the LTP site with the Saltram Meadow residential-led development site; representative of noise sensitive receptors located to the east of the Persimmon site and facades shielded from The Ride.

Although the nearest noise sensitive facades are located approximately 30m further into the development site, it is considered that the monitoring locations chosen are representative of the existing noise climate at the nearest noise sensitive receptors.

Image 6: Noise monitoring locations

(Image Source: Imagery ©2020 Bluesky, DigitalGlobe GeoEye Getmapping plc. Infoterra Ltd & Bluesky, The Geoinformation Group, Map data ©2020 Google)

To determine appropriate noise limits for the new air blowers and to enable a full BS 4142 assessment to be completed further down the line, then the ambient noise climate needs to be established in the absence of the specific sound source, this being the existing LTP air blowers. As there were already operational air blowers on the site, consultation was undertaken with the operators of the LTP site whereby it was agreed that the existing blowers could be switched off for a reasonable time period to allow for collection of ambient data in the absence of the specific sound source. The specific time periods during which the existing air blowers were switched off are listed below:

- 19:15 hours to 22:38 hours on the 22nd January 2020; and,
- 19:30 hours on 17th March 2020 to 07:00 hours on 18th March 2020.

The absence of the existing air blowers during the above time periods means that the existing background L_{A90} sound level can be benchmarked during the evening and night-time periods in the absence of the specific sound source. From review of the above time periods it is acknowledged that sufficient data has not been collected to enable benchmarking of the existing daytime background noise climate, however it is not considered that this is critical to the overall assessment as it is reasonable to expect that the night-time monitored levels will be lower than daytime levels. As the new air blowers will operate 24/7 measures necessary to control sound emissions from the new air blowers during night-time periods will also be sufficient in nature to control sound emissions to appropriate levels during daytime periods.

In addition, the on-going construction works on the adjacent residential development site would have prevented a representative existing daytime background level from being established even if the air blowers were also switched off during the day.

The results presented within the table below represents a summary of the levels monitored during the time periods during which the air blowers were switched off and the adjacent construction site was not operational. With regards to the levels monitored in March 2020, there was a distinct increase in sound levels from 03:15hrs through to 06:30hrs which was attributable to the dawn chorus. As the dawn chorus is only really prevalent during the months of March to July, it has not been considered to be part of the typical noise climate of the area and therefore these levels have also been excluded from the data presented below. Full summary data of all time periods during which data was collected is included within Appendix B.

Table 3: Summary of existing background noise level in absence of LTP air blowers

Location	Date	Time period, hrs	Description	Levels, dB			
				$L_{Aeq,T}$	$L_{A90,T}$	L_{Amax}	L_{Amin}
NML 1	22/01/20	19:15 – 22:30 (daytime, evening)	Construction site inactive; air blowers off	45.9	42.6	57.8	40.1
	17/03/20	19:30 – 23:00 (daytime, evening)	Construction site inactive; air blowers off	43.6	40.9	65.6	36.4
	17-18/03/20	23:00 – 03:15 (night-time)	Construction site inactive; air blowers off	41.6	39.2	61.0	35.1
NML 2	22/01/20	19:20 – 22:30 (daytime, evening)	Construction site inactive; air blowers off	46.1	42.0	61.0	38.6
	17/03/20	19:34 – 23:04 (daytime, evening)	Construction site inactive; air blowers off	43.5	39.3	63.4	36.0
	17-18/03/20	23:04 – 03:19 (night-time)	Construction site inactive; air blowers off	42.6	36.0	64.5	33.0

4 NEW AIR BLOWERS, NOISE LIMITS

From a noise control perspective, to aid the appropriate selection of new air blowers for the LTP site, the background sound level monitoring results detailed within the previous section have been used to determine suitable noise limits for the new plant items. The following section describes the methodology used to establish the plant noise limits.

4.1 Methodology

The impacts associated with the proposed facility will need to be assessed in line with the following standard:

- British Standard BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound.

The determination of appropriate noise limits for the new LTP air blowers have therefore been established in line with the guidance of this standard.

It is noted that BS4142 stipulates that the methodology is not suitable for assessing noise within buildings or in areas with low background noise climates (when facility noise is also low). Given this, where necessary additional consideration of the potential noise impacts based upon absolute levels will be made. The use of BS4142:2014+A1:2019 has therefore been augmented where required by consideration in line with the following guidance:

- BS8233:2014 Guidance on sound insulation and noise reduction for buildings; and,
- World Health Organisation Guidelines.

4.2 Baseline Noise Climate Analysis

With regard to the baseline noise climate used within the scope of any BS 4142 assessment and, in this case, for establishing appropriate noise limits for the new air blowers, the Standard states that:

> *"In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods.*
>
> *Among other considerations, diurnal patterns can have a major influence on background sound levels and, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes."*

As the new air blowers will operate 24/7 then it can be assumed that the most noise sensitive time period will be evening/night-time periods, particularly the time periods when people are going to sleep. The background (L_{A90}) data collected during these time periods has been analysed to determine the modal value recorded at each of the monitoring locations during these time periods; this ensures that the typical noise climate of the receptor is accounted for. The range of background L_{A90} levels monitored and the modal values of the datasets are presented below:

Table 4: Measured background levels, modal values

Location	Measurement period	Range $L_{A90,\ 15mins}$ dB	Modal $L_{A90,15mins}$ dB value
NML 1	22/01/20 19:15 – 22:30	42 - 49	43
	17/03/20 19:30 – 23:00hrs	39 - 46	41
	17-18/03/20 23:00 – 03:15hrs	38 - 42	39
NML 2	22/01/20 19:20 – 22:35hrs	41 - 45	42
	17/03/20 19:34 – 23:04hrs	38 - 42	40
	17-18/03/20 23:04 – 03:19hrs	35 - 39	37

A level of $L_{A90,15mins}$ 37dB has therefore been taken to be representative of the existing typical background level at the nearest noise sensitive receptors located within the Persimmon site during the most noise sensitive time period during which the new air blowers will be in operation.

4.3 Character Corrections

Within the methodology of BS 4142:2014+A1:2019 it is necessary to calculate a specific external sound level at the sensitive receptor location from the operations under consideration. This specific sound level then requires converting to a 'rating' level in order to take account of tonal or noticeable characteristics of the specific sound source.

As final plant selections have not been made, it is not yet possible to determine the specific sound level at the sensitive receptor hence why appropriate noise limits for plant noise emissions are to be determined instead. However, any limit proposed must also include consideration of any noticeable characteristics associated with sound emissions from the new air blowers.

BS 4142:2014+A1:2019 specifies three ways in which such characteristics can be considered; these are:

- Subjective method: a rating penalty is established based on a subjective assessment of its characteristics;
- Objective method for tonality: the need for a rating penalty is established by reviewing the one-third-octave spectral component of the sound source; or,
- Reference method: use of the Joint Nordic Method 2 in ISO 1996-2 to establish the presence of audible tones.

In this instance, the subjective method has been identified as the most appropriate approach to determine the need for any rating penalty to be applied. Table 5 presents the proposed character corrections for the new air blowers, as based on the subjective assessment methodology described within Section 9.2 of BS 4142:2014+A1:2019.

Table 5: BS 4142:2019 character corrections, new air blowers

Characteristic	Subjective Perception	Justification	BS 4142 Correction
Tonality	Potentially	Whilst specific product selections have not yet been made, due to the type of plant under consideration and the fact that a noise assessment completed in 2014 for the LTP site identified a need to include a penalty correction it is proposed that a correction for tonality is applied. A correction of +6dB which relates to tonality being 'highly perceptible' is considered appropriate to account for a worst-case situation.	+6dB
Impulsivity	None	No correction is proposed for this type of characteristic. The existing blowers do not exhibit such sound characteristics therefore it is not expected that the new air blowers will do so either.	0dB
Other Characteristics	None	No other sound characteristics associated with the new air blowers have been identified	0dB
Intermittency	Potentially	Whilst the air blowers will not be in constant operation all of the time, they are not expected to switch on/off numerous times within a short time period. It is therefore expected that any perceptibility within regards to intermittency will be minimal, particular as the noise emission limits for the new air blowers will be determined to ensure that emissions do not exceed the existing background level. For these reasons it is not considered necessary to include a penalty for intermittency.	0dB
		Total Character Correction	+ 6dB

4.4 Noise Emission Limits at Nearest Sensitive Receptors

The following determination of appropriate noise emission limits for the new air blowers have been based upon the impact assessment principles described within BS 4142:2014+A1:2019.

The Standard is based around the premise that the significance of the impact of an industrial/commercial sound source can be derived from the numerical subtraction of the background noise climate in the absence of the specific industrial sound source from the measured/calculated rating level of the specific industrial sound under consideration. This comparison enables the impact of the said sound source to be concluded based upon the premise that typically 'the greater this difference, the greater the magnitude of the impact'. This difference is then considered as follows:

- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5dB is likely to be an indication of an adverse impact, depending upon context; and,

- 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.

BS4142 further states that '*where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact'*. The Standard further qualifies the assessment protocol by outlining conditions to the comparative assessment and stating that '*not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact*', thus implying that all sites should be assessed on their own merits and specifics.

Using the above principles as a basis for the setting of limits, it is considered appropriate that noise emissions from the new air blowers should be controlled to a level equal to or below the existing monitored background noise level (in the absence of any air blower noise). As the air blowers will operate throughout the night-time, it is considered appropriate to use the typical night-time $L_{A90,15min}$ background level monitored at position NML 2 as a basis for this, this being $L_{A90,15mins}$ 37dB.

Potential sound characteristics associated with the operation of the new air blowers also need to be taken into consideration when setting appropriate limits, as detailed in Section 4.3 above. The review of the potential sound characteristics associated with the new air blowers concluded that a rating penalty of +6dB would be appropriate.

Table 6 below brings together the above information to establish an appropriate overall limit for noise emissions from the new blowers at the façade of the nearest noise sensitive receptors, these being the new residential dwellings to the south of the LTP site as indicated previously on Image 5.

Table 6: Proposed overall noise limit at the nearest noise sensitive receptors

Description		Commentary
Background sound level (night)	$L_{A90,15mins}$ = 37 dB	The background sound was monitoring during a temporary shutdown of the existing air blowers at the boundary of the residential development site.
Acoustic feature correction	6 dB	See Table 5 for full explanation
Proposed overall noise limit for emissions from new air blowers	**$L_{Aeq,15mins}$ = 31 dB**	The limit is applicable at the façade of the nearest noise sensitive receptor to the air blowers, this being new residential dwellings to the south of the site. The limit relates to the overall sound emissions from all the new air blowers, see below for further explanation on this point.

The application of the above limit would ensure that the sound emissions from the new air blowers would be controlled to a level at or below the existing L_{A90} night-time background noise levels, which, as stated within BS 4142, would indicate that the introduction of the new specific sound source would have a low noise impact.

As noted in Table 6, the proposed limit relates to the combined sound emissions from all new air blowers and is applicable at the location of the nearest sensitive noise receptors to the air blowers. To determine an individual limit for each new air blower at a distance of 1m from the air blower, proprietary environmental sound modelling software, SoundPLAN 8.0 has been used.

4.5 Noise Emission Limits at 1m from Air Blowers

A 3D noise model has been constructed using the proprietary SoundPLAN noise modelling software package to determine appropriate noise emission limits in close proximity to the air blowers such that these limits can be included within the technical specifications/procurement documentation when the selection process of the new plant is progressed.

4.5.1 Noise Modelling Protocols and Assumptions

Within the scope of this modelling exercise acoustic propagation has been calculation in accordance with the following standard:

- General Propagation: ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors: Part 2: General method of calculation.

The noise model was constructed utilising the following information:

- Site layout and terrain information:
  - Drawing no. HYD114_LS Chelson Meadow Landfill, Plymouth;
  - Open Source LIDAR Composite Digital Terrain Model (DTM); and,
  - 1m Digital Surface Model (DSM) for surrounding building heights.
- The source height associated with the air blowers has been taken as 1.95m, which is the maximum height of the existing units.
- It has been assumed that 4no. new air blowers will be installed to replace the 4no. existing air blowers.
- To provide a worst-case assessment, it has been assumed that all 4no. air blowers will be operation. In practice usually only 3no. will be in operation at any one time but there may be occasions when 4no. blowers would be called upon, particularly in the winter.
- The ground cover in the area between the air blowers and sensitive receptors has been assumed to consist primarily of grassland.
- The nearest noise sensitive receptors to the location of the air blowers are new residential dwellings associated with the Persimmon construction site to the south of the LTP site.
- The receptor height at the sensitive properties is taken to be at first floor level to account for noise-sensitive sleeping accommodation.

4.5.2 Modelling Outputs

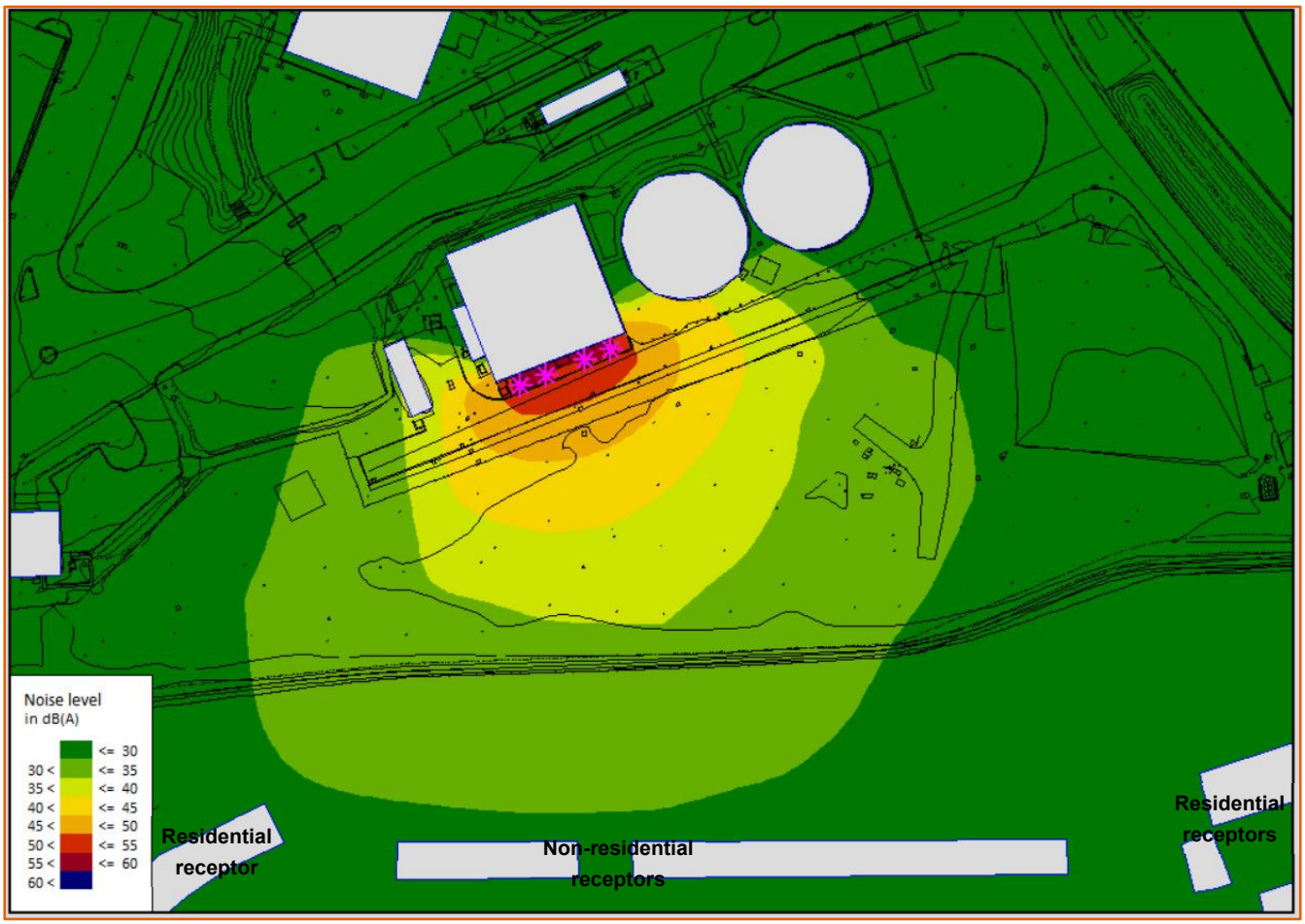
An iterative process has been followed to determine the sound power emission limits from the new air blowers in order to achieve the overall noise emission limit, as detailed in Table 6, at the nearest sensitive receptors. The modelling process indicates that emissions from each individual air blower should be limited to the following.

- **For each individual new air blower, noise emissions (including provision of all attenuation measures such as acoustic enclosures) should be limited to an overall source Sound Power Level (SWL) of 73dBA**.
- **This is approximately equivalent to a Sound Pressure Level (SPL) of 65dBA at a distance of 1m from each individual air blower (including consideration of any necessary additional attenuation measures such as acoustic enclosures).**

The above limits includes for a 6dB noise characteristic correction as defined within Table 5. Once plant selections are made and the relevant manufacturer octave band noise data is provided, the need for this correction and hence a subsequent possible relaxation of the above limit can be reviewed.

Image 7 presents the predicted noise propagation from the new air blowers with the application of the above limit; the image indicates that at the nearest sensitive receptors, emissions will be limited to or below the limit detailed within Table 6.

Image 7: Noise modelling output, first floor height



5 CONCLUSIONS

Arcadis Consulting (UK) Ltd has been commissioned to complete a noise impact assessment associated with the replacement of existing electrical air blowers installed at the Chelson Meadow Leachate Treatment Plant, Plymouth.

Within the scope of this report, baseline noise levels have been quantified within the vicinity of the site to establish the prevailing noise climate at the nearest noise sensitive receptors. The data was quantified in January and March 2020 and was collected during periods when the existing air blowers were not in operation.

As specific product selections associated with the new blowers have not yet been completed, the assessment has focussed on establishing appropriate noise emission limits for the new plant items. The determination of such limits was based on the methodology and assessment protocols of BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound.*

Based on the assumption that the new unit selections will be made with full consideration to the noise emission limits specified within this report, then it is predicted that the night time operational noise associated with the new air blower units would be classified to be at a level indicative of the specific sound source having a low impact.

APPENDIX A

Summary of National Policy and Guidance

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

British Standard 4142, reissued most recently in 2019, provides a methodology for the rating and assessing of sound associated with both industrial and commercial premises. The purpose of the Standard is clearly outlined in the opening section where it states the method to be appropriate for the considered of:

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

The Standard is based around the premise that the significance of the impact of an industrial/commercial facility can be derived from the numerical subtraction of the background noise climate level (not necessarily the lowest background level measured, but the typical background of the receptor) from the measured/calculated rating level of the specific sound under consideration. This comparison will enable the impact of said sound to be concluded based upon the premise that typically 'the greater this difference, the greater the magnitude of the impact'. This difference is then considered as follows:

- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5dB is likely to be an indication of an adverse impact, depending upon context; and,
- 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.

BS4142 further states that '*where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact*' again depending upon the specific context of the site. The Standard further qualifies the assessment protocol by outlining conditions to the comparative assessment and stating that '*not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact*', thus implying that all sites should be assessed on their own merits and specifics.

The Standard quantifies the typical reference periods (for the purposes of the standard) to be used in the assessment of noise:

Typical Daytime	07:00 – 23:00	1hr assessment period
Typical Night-time	23:00 – 07:00	15min assessment period

The Standard outlines a number of methods for defining appropriate 'character corrections' within the rating levels to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency. These are a) the Subjective Method, b) the Objective Methods for tonality, and c) the Reference Method. It is noted by the Standard that where multiple features are present the corrections should be added in a linear fashion to the specific level.

The Subjective Method has been implemented within the scope of this study and is based on the following corrections:

Table A1: BS4142 Subjective method rating corrections

Level of Perceptibility	Tonal Correction	Impulsivity Correction	Correction for "Other sound characteristics"	Intermittency Correction
No Perceptibility	+0 dB	+0 dB	Where neither tonal nor impulsive but clearly identifiable +3 dB	If intermittency is readily identifiable +3 dB
Just Perceptible	+2 dB	+3 dB		
Clearly Perceptible	+4 dB	+6 dB		
Highly Perceptible	+6 dB	+9 dB		

The Objective Methods are based around the actual quantifications of 1/3 octave data for the sound under investigation where possible.

However, the Standard states that the assessment methodology provided is not intended for the derivation of internal noise levels arising from sound levels outside or '*where background sound levels and rating levels are low*', however, with regard to the latter no definition of '*low*' is provided. Where these situations prevail, it is considered appropriate to reference the absolute guidance levels provided in British Standard BS 8233:2014 – *Guidance on Sound Insulation and Noise Reduction for Buildings* and the World Health Organisation '*Guidelines for Community Noise' and Night Noise Guidance for Europe*'.

Integrated Pollution Prevention and Control (IPPC) Horizontal Guidance for Noise Part 2 – Noise Assessment and Control 2004

This document describes the principles of noise measurement and prediction and the control of noise by design, by operational and management techniques and abatement technologies. The aim of the document is to provide supplementary information to assist Applicants in preventing and minimising emissions of noise and vibration.

The document covers the following subjects:

- Noise physics, units and measurement parameters;
- The measurement and evaluation of noise; and,
- Noise control techniques and technologies.

The guidance contained within this document makes reference to a number of other British Standards and guidance documents, including BS 4142, BS 5228, BS 7445 and World Health Organisation Guidelines for Community Noise.

ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation

ISO 9613-2 describes a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method specified within this standard consists specifically of octave-band algorithms for calculating the attenuation of sound which originates from a point sound source, or an assembly of point sources. The source(s) may be moving or stationary. Specific terms are provided in the algorithms for the following physical effects:

- Geometrical divergence;
- Atmospheric absorption;
- Ground effect;
- Reflection from surfaces; and,
- Screening from obstacles.

Additional information is also included concerning propagation through housing, foliage and industrial sites.

The method can be applied to a variety of noise sources and environments. It is applicable, directly or indirectly, to most situations concerning road or rail, industrial noise sources, construction activities, and many other ground-based noise sources.

To apply the method of the standard requires several parameters to be known with respect to the geometry of the source and the environment, the ground surface characteristics, and the source strength in terms of octave-band sound power levels for directions relevant to the propagation.

BS 7445-2:1991 Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use

BS 7445-2 describes methods to be used for measuring and describing environmental noise relevant to general land use. The use of different measuring methods, such as continuous integration, sampling techniques and measurements under selected meteorological conditions is considered.

The standard details methods for the acquisition of data which provide descriptors that enable:

a) A description of the environmental noise in a specified area of land to be made in a uniform way; and,

b) The compatibility of any land use activity or projected activity to be assessed with respect to existing or predicted noise.

BS8233: 2014 Guidance on Sound Insulation and Noise Reduction for Buildings

The 2014 revision of BS8233: 2014 '*Guidance on Sound Insulation and Noise Reduction for Buildings*' has been issued as a formal guidance document.

The Standard is mainly concerned with building design from an acoustic standpoint. It does however contain information relevant to environmental noise, more specifically by stating guidance for desirable internal noise levels for dwellings and other building types. Extracts from BS8233:2014 detailing the recommended levels are included below.

Table A2: Indoor ambient noise levels for dwellings (source: Table 4: BS8233-2014)

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35dB $L_{Aeq,(16hour)}$	-
Dining	Dining room /area	40dB $L_{Aeq,(16hour)}$	-
Sleeping (Daytime resting)	Bedroom	35dB $L_{Aeq,(16hour)}$	30dB $L_{Aeq,(8hour)}$

Note - within BS8233 details that "*Where development is considered necessary or desirable, despite external noise levels above World Health Organisation guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved*".

With regard to external noise levels, BS8233: 2014 states that "*For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments*". However, it also recognises that these levels are not achievable in all situations and further states that "*In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited*".

The internal values detailed within the scope of BS8233: 2014 generally accord well with the recommendations of the World Health Organisation.

The World Health Organisation Guidelines for Community Noise

The World Health Organisation (WHO) updated its noise guidelines for the European Region in October 2018. The main purpose of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various sources: transportation (road traffic, railway and aircraft) noise, wind turbine noise and leisure noise. The WHO Guidelines 2018 do not however cover indoor noise levels and in this regard, the WHO recommends that the provisions on indoor noise levels in the WHO Guidelines (1999) remain valid.

The World Health Organisation's (WHO) '*Guidelines for Community Noise*' provide guidance on indoor and the external environment.

With regard to external environmental noise levels, WHO Guidelines 1999 states that;

"4.2.7 Annoyance responses

During the daytime, few people are seriously annoyed by activities with L_{Aeq} levels below 55dB; or moderately annoyed with L_{Aeq} levels below 50dB. Sound pressure levels during the evening and night should be 5-10dB lower than during the day…."

APPENDIX B

Noise Monitoring Data

Noise Monitoring Position 1: 21st – 22nd January 2020

	Construction site and air blowers operational
	Construction site not operational; air blowers operational
	Construction site and air blowers not operational

Date and start time	L_{Aeq} dB	L_{Amin} dB	L_{Amax} dB	L_{A90} dB	L_{A10} dB
22/01/2020 09:00	60.5	55.9	71.9	57.2	63.2
22/01/2020 09:15	60.8	57.8	69.7	58.7	62.1
22/01/2020 09:30	60.9	57.8	69.8	58.5	62.8
22/01/2020 09:45	59.3	56.8	70.5	57.7	60.6
22/01/2020 10:00	58.0	55.0	72.3	56.0	59.5
22/01/2020 10:15	57.5	54.7	64.5	55.6	59.6
22/01/2020 10:30	58.5	54.5	68.4	55.5	60.7
22/01/2020 10:45	60.2	54.9	73.8	56.3	63.2
22/01/2020 11:00	59.9	55.7	71.2	57.0	62.4
22/01/2020 11:15	60.3	54.8	72.3	56.5	62.2
22/01/2020 11:30	60.1	50.4	72.3	51.4	65.0
22/01/2020 11:45	64.6	55.6	74.4	58.1	68.4
22/01/2020 12:00	60.6	54.7	70.8	56.2	63.7
22/01/2020 12:15	60.7	55.2	71.2	56.3	63.8
22/01/2020 12:30	60.9	54.6	83.3	56.0	62.1
22/01/2020 12:45	61.5	54.7	73.4	56.6	63.7
22/01/2020 13:00	62.0	56.0	70.5	58.1	64.3
22/01/2020 13:15	61.5	57.5	74.9	58.7	63.6
22/01/2020 13:30	59.5	51.1	69.7	54.1	61.8
22/01/2020 13:45	61.5	56.6	70.4	59.1	63.2
22/01/2020 14:00	62.2	57.8	71.0	59.6	63.7
22/01/2020 14:15	60.1	55.9	64.4	58.4	61.1
22/01/2020 14:30	63.8	51.7	77.0	54.7	65.6
22/01/2020 14:45	62.2	54.8	70.9	59.4	64.2
22/01/2020 15:00	61.8	51.2	79.2	53.5	64.3
22/01/2020 15:15	58.2	51.9	72.3	53.2	60.4
22/01/2020 15:30	60.0	51.7	74.3	53.3	64.3
22/01/2020 15:45	56.6	49.7	71.7	50.9	58.2
22/01/2020 16:00	58.3	50.0	73.1	51.8	60.0
22/01/2020 16:15	61.0	52.0	80.4	53.3	62.2
22/01/2020 16:30	56.2	50.1	67.6	51.7	58.7
22/01/2020 16:45	52.8	50.1	58.2	51.5	54.0
22/01/2020 17:00	52.6	50.1	66.6	51.0	53.2

Chelson Meadow, Plymouth

Date and start time	L_{Aeq} dB	L_{Amin} dB	L_{Amax} dB	L_{A90} dB	L_{A10} dB
22/01/2020 17:15	52.5	50.7	61.5	51.4	53.1
22/01/2020 17:30	52.1	50.2	59.2	51.0	52.9
22/01/2020 17:45	53.7	50.0	72.1	50.6	52.6
22/01/2020 18:00	51.8	50.0	63.6	50.8	52.4
22/01/2020 18:15	51.8	49.2	66.3	50.4	52.1
22/01/2020 18:30	54.5	50.2	69.4	50.7	55.8
22/01/2020 18:45	51.8	48.8	66.7	49.6	51.8
22/01/2020 19:00	50.3	48.5	56.4	49.3	51.0
22/01/2020 19:15	50.4	48.1	57.8	49.4	51.1
22/01/2020 19:30	47.3	42.2	57.6	44.2	49.8
22/01/2020 19:45	44.9	41.8	52.9	42.9	46.0
22/01/2020 20:00	45.6	41.4	53.9	43.1	47.2
22/01/2020 20:15	45.3	42.1	54.9	43.3	46.9
22/01/2020 20:30	45.7	41.1	52.7	43.2	47.6
22/01/2020 20:45	45.6	42.0	57.0	43.3	47.0
22/01/2020 21:00	45.0	40.2	54.6	42.2	46.2
22/01/2020 21:15	44.2	41.6	51.3	42.7	45.4
22/01/2020 21:30	44.6	41.2	52.3	42.4	45.8
22/01/2020 21:45	44.6	40.5	53.2	42.2	46.4
22/01/2020 22:00	44.2	40.9	56.0	41.9	45.4
22/01/2020 22:15	43.5	40.1	51.6	41.8	44.7
22/01/2020 22:30	58.8	39.9	76.9	41.2	52.8
22/01/2020 22:45	50.2	46.7	55.8	48.4	51.4
22/01/2020 23:00	49.1	45.2	51.8	47.5	50.3
22/01/2020 23:15	48.6	46.0	52.0	47.0	49.8
22/01/2020 23:30	49.1	46.1	53.5	47.6	50.2
22/01/2020 23:45	48.9	45.2	53.5	47.3	50.0
23/01/2020 00:00	48.5	45.7	53.1	47.0	49.6
23/01/2020 00:15	49.1	45.3	51.6	47.9	50.0
23/01/2020 00:30	48.7	45.5	50.8	47.3	49.5
23/01/2020 00:45	48.7	45.3	52.0	47.0	49.8
23/01/2020 01:00	48.5	45.4	50.8	47.1	49.5
23/01/2020 01:15	48.6	45.5	55.7	47.0	49.4
23/01/2020 01:30	48.3	44.6	52.7	46.9	49.3
23/01/2020 01:45	48.5	45.1	53.3	46.9	49.6
23/01/2020 02:00	49.0	45.4	59.2	46.9	49.9
23/01/2020 02:15	48.9	46.0	53.5	47.3	50.1
23/01/2020 02:30	49.0	45.7	52.9	47.7	49.8
23/01/2020 02:45	48.9	45.2	54.5	47.3	50.0
23/01/2020 03:00	48.4	44.6	52.5	46.8	49.4
23/01/2020 03:15	48.8	45.4	51.7	47.2	50.0
23/01/2020 03:30	48.8	45.5	51.8	47.4	49.7
23/01/2020 03:45	48.4	46.2	51.3	47.1	49.4
23/01/2020 04:00	48.7	46.6	51.2	47.4	49.5

Chelson Meadow, Plymouth

Date and start time	L_{Aeq} dB	L_{Amin} dB	L_{Amax} dB	L_{A90} dB	L_{A10} dB
23/01/2020 04:15	48.6	45.9	51.1	47.2	49.5
23/01/2020 04:30	48.8	45.8	51.6	47.4	49.7
23/01/2020 04:45	53.0	47.3	60.8	48.3	55.6
23/01/2020 05:00	53.6	50.6	56.3	51.9	54.8
23/01/2020 05:15	52.7	47.3	58.8	49.0	54.5
23/01/2020 05:30	53.7	50.9	56.4	52.3	54.6
23/01/2020 05:45	53.9	50.7	57.1	52.5	54.8
23/01/2020 06:00	54.1	51.4	56.3	52.8	54.9
23/01/2020 06:15	53.8	48.0	63.6	49.8	55.5
23/01/2020 06:30	55.1	52.6	57.6	53.9	55.8
23/01/2020 06:45	55.1	51.9	60.7	53.9	55.9
23/01/2020 07:00	55.5	52.3	62.4	54.3	56.2
23/01/2020 07:15	55.3	50.7	69.4	52.0	56.9
23/01/2020 07:30	57.1	53.3	66.2	54.5	58.6
23/01/2020 07:45	59.8	54.5	72.9	56.1	60.9
23/01/2020 08:00	64.3	54.4	79.7	56.8	67.1
23/01/2020 08:15	62.9	52.7	77.9	54.4	64.8
23/01/2020 08:30	57.7	50.3	70.3	53.0	60.4
23/01/2020 08:45	59.0	52.0	70.6	53.3	62.1

Noise Monitoring Position 2: 21st – 22nd January 2020

Construction site and air blowers operational
Construction site not operational; air blowers operational
Construction site and air blowers not operational

Time	L_{Aeq}, dB	L_{Amin}, dB	L_{Amax}, dB	L_{A90}, dB	L_{A10}, dB
22/01/2020 09:20	60.8	55.5	79.1	56.6	62.4
22/01/2020 09:35	58.8	56.2	71.2	57.7	59.9
22/01/2020 09:50	59.4	55.4	79.3	56.5	60.1
22/01/2020 10:05	59.4	55.8	71.7	57.3	61.3
22/01/2020 10:20	57.9	55.6	65.8	56.9	58.8
22/01/2020 10:35	59.2	54.9	72.7	56.6	59.7
22/01/2020 10:50	59.5	54.8	70.9	56.1	61.9
22/01/2020 11:05	63.3	56.0	82.0	57.4	64.5
22/01/2020 11:20	63.6	49.0	81.2	56.9	67.3
22/01/2020 11:35	58.0	52.1	71.6	53.4	60.3
22/01/2020 11:50	61.2	55.1	73.0	57.5	62.9
22/01/2020 12:05	61.2	55.3	73.9	57.7	61.3
22/01/2020 12:20	60.4	56.2	74.9	57.9	60.1
22/01/2020 12:35	61.5	56.2	78.4	57.1	63.3
22/01/2020 12:50	65.3	56.3	84.6	59.0	68.0
22/01/2020 13:05	67.5	56.7	83.3	59.1	71.6

Chelson Meadow, Plymouth

Time	L_{Aeq}, dB	L_{Amin}, dB	L_{Amax}, dB	L_{A90}, dB	L_{A10}, dB
22/01/2020 13:20	66.8	56.8	84.2	58.8	69.9
22/01/2020 13:35	60.8	54.2	76.2	56.3	63.4
22/01/2020 13:50	63.2	54.7	81.4	57.9	65.5
22/01/2020 14:05	64.4	55.8	83.2	57.1	66.9
22/01/2020 14:20	58.8	55.8	73.1	56.9	60.0
22/01/2020 14:35	63.8	53.9	86.6	56.0	65.8
22/01/2020 14:50	58.8	53.0	76.6	55.2	60.2
22/01/2020 15:05	60.9	53.4	76.6	54.5	62.4
22/01/2020 15:20	59.8	53.2	75.9	55.2	61.9
22/01/2020 15:35	58.4	50.2	76.2	51.7	59.3
22/01/2020 15:50	58.9	47.7	74.6	49.1	61.3
22/01/2020 16:05	57.5	53.7	76.6	54.7	57.4
22/01/2020 16:20	61.6	52.2	80.8	54.0	64.3
22/01/2020 16:35	57.5	53.4	73.6	54.2	57.9
22/01/2020 16:50	54.4	53.0	59.3	53.9	55.0
22/01/2020 17:05	54.2	52.4	58.5	53.7	54.7
22/01/2020 17:20	54.6	52.6	64.5	53.9	55.2
22/01/2020 17:35	54.3	52.7	60.1	53.7	55.1
22/01/2020 17:50	54.3	52.1	63.8	53.4	54.7
22/01/2020 18:05	54.1	52.5	66.0	53.6	54.6
22/01/2020 18:20	54.2	52.5	66.1	53.5	54.7
22/01/2020 18:35	54.9	52.2	69.1	53.3	55.6
22/01/2020 18:50	53.6	52.3	55.6	53.1	54.2
22/01/2020 19:05	53.5	51.9	59.0	52.9	54.2
22/01/2020 19:20	53.1	42.7	58.3	44.7	54.4
22/01/2020 19:35	45.4	40.3	58.8	42.5	46.8
22/01/2020 19:50	43.1	40.0	52.6	41.5	44.3
22/01/2020 20:05	44.7	41.0	51.7	42.9	46.3
22/01/2020 20:20	44.9	40.4	55.6	42.2	47.1
22/01/2020 20:35	44.6	39.7	54.4	42.0	46.5
22/01/2020 20:50	45.5	39.5	61.0	42.0	47.1
22/01/2020 21:05	44.2	39.1	52.8	41.0	46.0
22/01/2020 21:20	44.3	39.5	48.8	42.1	45.5
22/01/2020 21:35	44.3	38.6	51.0	41.5	46.0
22/01/2020 21:50	44.1	39.3	53.2	41.7	46.0
22/01/2020 22:05	42.8	39.7	52.6	41.3	44.2
22/01/2020 22:20	42.4	39.2	52.5	40.6	43.8
22/01/2020 22:35	59.5	38.9	80.8	41.1	53.3
22/01/2020 22:50	51.5	49.9	53.2	51.0	52.2
22/01/2020 23:05	51.3	49.7	53.5	50.8	51.9
22/01/2020 23:20	51.4	49.7	53.3	50.9	52.0
22/01/2020 23:35	51.5	49.7	53.3	51.1	52.1
22/01/2020 23:50	51.5	49.7	53.7	50.8	52.2
23/01/2020 00:05	51.5	49.8	54.3	51.0	52.1

Chelson Meadow, Plymouth

Time	L_{Aeq}, dB	L_{Amin}, dB	L_{Amax}, dB	L_{A90}, dB	L_{A10}, dB
23/01/2020 00:20	51.3	49.4	53.2	50.9	51.8
23/01/2020 00:35	51.3	49.5	53.8	50.8	51.8
23/01/2020 00:50	51.3	49.9	54.1	50.8	51.9
23/01/2020 01:05	51.2	49.9	52.7	50.7	51.7
23/01/2020 01:20	51.4	49.5	56.8	50.8	52.1
23/01/2020 01:35	51.3	49.8	54.1	50.8	52.0
23/01/2020 01:50	51.5	49.3	57.1	50.8	52.2
23/01/2020 02:05	51.4	50.0	53.9	50.9	52.1
23/01/2020 02:20	51.3	49.8	54.2	50.8	51.9
23/01/2020 02:35	51.3	49.9	53.0	50.9	51.8
23/01/2020 02:50	51.3	49.9	54.9	50.8	51.9
23/01/2020 03:05	51.2	49.3	54.8	50.7	51.9
23/01/2020 03:20	51.3	49.9	53.7	50.8	52.0
23/01/2020 03:35	51.4	49.8	53.8	50.8	52.0
23/01/2020 03:50	51.1	49.5	53.0	50.6	51.6
23/01/2020 04:05	51.1	49.8	53.5	50.6	51.6
23/01/2020 04:20	51.2	49.8	61.1	50.7	51.7
23/01/2020 04:35	51.2	49.7	53.2	50.7	51.8
23/01/2020 04:50	55.1	50.4	63.6	52.6	56.3
23/01/2020 05:05	54.6	51.6	57.0	53.3	55.7
23/01/2020 05:20	54.2	50.0	62.5	51.2	55.9
23/01/2020 05:35	55.1	52.1	60.1	53.8	56.1
23/01/2020 05:50	54.9	51.3	57.1	53.7	55.9
23/01/2020 06:05	55.1	52.2	64.6	54.0	56.1
23/01/2020 06:20	54.6	50.6	60.7	51.8	56.3
23/01/2020 06:35	55.8	53.4	59.1	54.7	56.7
23/01/2020 06:50	55.6	52.9	57.9	54.5	56.5
23/01/2020 07:05	55.9	53.0	62.3	54.8	56.8
23/01/2020 07:20	55.3	52.0	67.5	53.1	57.1
23/01/2020 07:35	56.8	53.5	65.6	55.1	58.2
23/01/2020 07:50	66.1	54.8	83.2	56.9	69.5
23/01/2020 08:05	63.8	54.8	83.0	56.8	64.8
23/01/2020 08:20	57.6	53.0	71.3	54.4	59.1
23/01/2020 08:35	59.7	53.4	78.2	54.7	61.6
23/01/2020 08:50	57.9	53.5	73.1	54.8	59.2
23/01/2020 09:05	57.8	53.5	72.8	54.9	58.9

Chelson Meadow, Plymouth

Noise Monitoring Position 1: 17th – 18th March 2020

Construction site and air blowers operational
Construction site not operational; air blowers operational
Construction site and air blowers not operational
Construction site and air blowers not operational, dawn chorus

Date and start time	L_{Aeq} dB	L_{Amax} dB	L_{Amin} dB	L_{A90} dB
2020/03/17 14:15:00	64.1	84.7	50.6	54.0
2020/03/17 14:30:00	59.8	83.5	49.3	52.8
2020/03/17 14:45:00	58.5	76.1	47.9	51.6
2020/03/17 15:00:00	59.6	78.0	48.5	51.8
2020/03/17 15:15:00	58.7	78.0	48.7	51.9
2020/03/17 15:30:00	56.2	70.9	49.8	52.0
2020/03/17 15:45:00	59.5	78.3	50.3	52.1
2020/03/17 16:00:00	60.4	76.3	49.6	52.2
2020/03/17 16:15:00	62.9	81.2	51.0	53.6
2020/03/17 16:30:00	56.6	73.1	48.1	49.9
2020/03/17 16:45:00	59.6	76.8	48.4	50.2
2020/03/17 17:00:00	62.0	76.6	49.4	54.2
2020/03/17 17:15:00	59.5	81.5	46.4	48.3
2020/03/17 17:30:00	52.4	67.3	47.1	48.7
2020/03/17 17:45:00	50.1	68.1	46.4	48.0
2020/03/17 18:00:00	52.1	65.6	43.7	46.3
2020/03/17 18:15:00	49.6	62.2	46.3	48.0
2020/03/17 18:30:00	49.3	68.8	44.9	46.9
2020/03/17 18:45:00	50.0	78.6	43.9	46.1
2020/03/17 19:00:00	47.2	54.8	44.6	46.2
2020/03/17 19:15:00	46.8	55.1	44.4	45.8
2020/03/17 19:30:00	46.9	58.5	41.5	45.8
2020/03/17 19:45:00	44.6	60.4	40.3	42.3
2020/03/17 20:00:00	44.3	60.4	39.8	41.8
2020/03/17 20:15:00	43.4	60.8	39.2	41.4
2020/03/17 20:30:00	44.2	57.5	38.2	40.8
2020/03/17 20:45:00	43.9	65.6	37.4	40.5
2020/03/17 21:00:00	43.0	60.0	38.5	40.5
2020/03/17 21:15:00	45.3	61.4	38.9	41.3
2020/03/17 21:30:00	44.1	62.3	38.7	40.8
2020/03/17 21:45:00	42.0	52.7	36.9	39.8
2020/03/17 22:00:00	41.8	49.5	38.4	40.2
2020/03/17 22:15:00	41.1	54.5	37.4	39.4
2020/03/17 22:30:00	40.8	48.3	36.5	38.8
2020/03/17 22:45:00	40.6	51.5	36.4	38.9
2020/03/17 23:00:00	41.0	50.1	36.0	38.8

Chelson Meadow, Plymouth

Date and start time	L_{Aeq} dB	L_{Amax} dB	L_{Amin} dB	L_{A90} dB
2020/03/17 23:15:00	41.4	54.0	36.1	38.5
2020/03/17 23:30:00	39.6	52.9	35.1	37.3
2020/03/17 23:45:00	42.8	61.0	36.9	39.1
2020/03/18 00:00:00	42.1	52.8	37.3	39.5
2020/03/18 00:15:00	42.0	52.6	37.8	39.8
2020/03/18 00:30:00	41.7	49.5	38.1	39.9
2020/03/18 00:45:00	42.8	51.3	37.4	39.7
2020/03/18 01:00:00	43.7	58.6	40.2	41.8
2020/03/18 01:15:00	42.6	55.3	39.4	41.3
2020/03/18 01:30:00	42.1	47.5	38.5	40.9
2020/03/18 01:45:00	40.6	53.4	37.2	38.8
2020/03/18 02:00:00	39.5	48.8	36.2	37.8
2020/03/18 02:15:00	40.4	50.7	36.0	38.1
2020/03/18 02:30:00	41.0	53.1	37.4	39.1
2020/03/18 02:45:00	41.0	48.7	36.6	38.6
2020/03/18 03:00:00	40.9	55.4	36.2	38.2
2020/03/18 03:15:00	43.1	55.4	38.0	40.0
2020/03/18 03:30:00	43.0	57.2	38.2	40.3
2020/03/18 03:45:00	44.0	53.4	38.8	41.1
2020/03/18 04:00:00	43.5	56.2	38.2	40.4
2020/03/18 04:15:00	42.7	54.1	38.4	40.6
2020/03/18 04:30:00	44.3	57.6	38.9	41.1
2020/03/18 04:45:00	44.8	54.4	39.1	41.8
2020/03/18 05:00:00	44.0	54.2	39.9	41.8
2020/03/18 05:15:00	46.0	71.1	39.8	41.9
2020/03/18 05:30:00	47.1	59.9	40.2	44.3
2020/03/18 05:45:00	48.8	65.7	42.4	44.7
2020/03/18 06:00:00	52.8	69.8	42.6	45.1
2020/03/18 06:15:00	47.8	67.7	43.1	45.4
2020/03/18 06:30:00	49.1	65.4	44.8	46.4
2020/03/18 06:45:00	51.3	66.5	45.3	47.1
2020/03/18 07:00:00	50.5	66.9	45.5	47.9
2020/03/18 07:15:00	50.0	60.9	45.8	48.1
2020/03/18 07:30:00	56.9	76.0	46.5	49.0
2020/03/18 07:45:00	55.3	71.7	48.8	50.8
2020/03/18 08:00:00	64.1	82.5	48.6	51.2
2020/03/18 08:15:00	70.5	90.3	51.1	53.9
2020/03/18 08:30:00	70.0	93.5	51.8	53.5
2020/03/18 08:45:00	59.7	75.6	49.4	53.2
2020/03/18 09:00:00	61.3	79.2	49.4	53.4
2020/03/18 09:15:00	65.3	81.6	50.7	53.7
2020/03/18 09:30:00	64.3	78.3	51.1	54.4
2020/03/18 09:45:00	60.8	78.3	49.5	51.9
2020/03/18 10:00:00	60.9	91.6	48.0	50.4

Chelson Meadow, Plymouth

Octave-band data

Date and start time	Parameter	dBA	Octave band level, dB								
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
2020/03/17 14:15:00	Leq	64.1	31.1	46.5	49.9	54.3	56.8	58.8	57.2	53.7	51.7
	L90	54.0	23.8	34.7	42.2	40.0	44.1	50.0	43.8	37.8	32.5
2020/03/17 14:30:00	Leq	59.8	28.2	39.0	48.3	47.1	51.0	55.6	53.0	49.6	46.3
	L90	52.8	22.2	34.4	40.3	39.3	43.3	48.5	43.2	37.3	31.6
2020/03/17 14:45:00	Leq	58.5	28.0	37.7	47.4	44.5	49.9	54.2	51.8	48.4	46.0
	L90	51.6	23.3	32.5	40.1	38.3	42.9	46.8	41.9	35.4	29.7
2020/03/17 15:00:00	Leq	59.6	29.0	39.0	47.2	48.0	50.9	54.1	53.1	50.9	48.6
	L90	51.8	22.4	33.9	41.1	39.1	43.0	46.5	42.8	36.5	30.6
2020/03/17 15:15:00	Leq	58.7	26.7	38.3	47.3	47.2	49.7	53.3	52.5	49.5	47.5
	L90	51.9	20.3	32.6	39.5	38.3	42.6	47.5	41.8	35.7	30.0
2020/03/17 15:30:00	Leq	56.2	28.2	37.0	46.2	42.6	47.3	52.0	48.5	46.1	44.2
	L90	52.0	21.6	33.1	44.1	38.2	42.7	47.5	41.1	34.4	28.5
2020/03/17 15:45:00	Leq	59.5	28.8	40.1	47.7	48.7	50.7	54.1	53.3	50.2	47.0
	L90	52.1	21.1	36.8	45.8	38.4	42.5	47.4	40.9	35.0	28.8
2020/03/17 16:00:00	Leq	60.4	31.1	42.2	48.4	47.9	51.0	54.8	54.8	51.5	48.7
	L90	52.2	21.4	37.4	43.4	39.2	43.1	47.5	42.5	36.3	30.5
2020/03/17 16:15:00	Leq	62.9	29.6	43.4	49.5	52.1	55.5	57.3	55.8	53.3	52.6
	L90	53.6	21.9	38.7	46.2	40.6	43.7	48.7	43.2	38.0	32.0
2020/03/17 16:30:00	Leq	56.6	25.9	42.4	47.0	46.8	48.9	51.0	48.9	46.8	42.8
	L90	49.9	20.9	37.1	43.4	38.8	41.1	44.1	39.6	32.5	26.4
2020/03/17 16:45:00	Leq	59.6	26.5	43.7	49.9	48.8	51.0	54.9	51.3	49.4	47.0
	L90	50.2	19.7	37.5	43.6	38.8	41.2	44.7	40.4	34.5	28.6
2020/03/17 17:00:00	Leq	62.0	28.9	44.4	51.6	51.6	53.4	56.1	55.1	54.2	48.1
	L90	54.2	21.0	38.4	43.7	44.9	46.1	48.0	45.0	41.2	36.7
2020/03/17 17:15:00	Leq	59.5	24.6	42.4	48.4	48.2	51.9	53.3	52.3	52.7	42.0
	L90	48.3	18.3	35.2	42.8	36.2	38.7	42.7	38.1	30.0	24.5
	Leq	52.4	21.3	36.3	44.1	38.4	41.7	48.0	44.7	43.0	39.7

Chelson Meadow, Plymouth

Date and start time	Parameter	dBA	Octave band level, dB								
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
2020/03/17 17:30:00	L90	48.7	17.2	35.1	43.1	36.2	38.5	43.0	38.4	30.5	23.7
2020/03/17 17:45:00	Leq	50.1	20.8	36.1	43.6	37.0	39.7	45.6	42.3	38.1	32.4
	L90	48.0	16.7	34.9	42.5	35.3	37.8	42.6	37.7	28.8	22.7
2020/03/17 18:00:00	Leq	52.1	20.1	34.7	42.1	36.3	39.8	46.5	46.5	44.2	41.7
	L90	46.3	16.6	28.0	29.2	33.4	37.4	42.0	37.3	28.5	23.1
2020/03/17 18:15:00	Leq	49.6	19.0	36.0	44.7	38.2	42.3	43.5	39.7	33.5	31.1
	L90	48.0	15.9	34.8	43.1	35.9	37.9	41.4	37.1	28.6	24.3
2020/03/17 18:30:00	Leq	49.3	18.9	34.7	44.7	36.6	39.1	43.7	40.0	34.7	35.0
	L90	46.9	15.3	28.7	41.5	33.6	37.4	41.2	36.6	27.7	23.2
2020/03/17 18:45:00	Leq	50.0	18.7	30.3	42.6	36.2	39.0	42.5	38.5	31.3	46.3
	L90	46.1	14.9	28.3	41.5	33.5	36.8	40.0	35.7	26.0	22.5
2020/03/17 19:00:00	Leq	47.2	18.3	30.0	42.4	35.8	38.8	42.1	37.2	27.2	24.1
	L90	46.2	14.8	28.5	41.4	33.7	37.0	40.4	35.3	25.6	22.1
2020/03/17 19:15:00	Leq	46.8	17.2	29.8	42.3	35.0	38.2	41.6	36.8	27.5	24.3
	L90	45.8	13.9	28.2	41.0	33.6	36.6	39.8	35.2	25.7	22.6
2020/03/17 19:30:00	Leq	46.9	17.1	29.9	42.5	35.0	38.0	41.7	37.1	28.3	24.8
	L90	45.8	13.6	28.0	41.1	33.7	36.3	39.6	35.1	25.7	22.7
2020/03/17 19:45:00	Leq	44.6	16.3	25.2	28.2	33.7	37.7	41.5	36.3	28.3	25.4
	L90	42.3	12.5	22.1	25.6	29.8	35.1	39.3	34.1	24.9	22.8
2020/03/17 20:00:00	Leq	44.3	16.3	24.7	27.7	33.7	37.6	41.2	36.1	26.9	24.9
	L90	41.8	12.1	21.5	24.2	28.7	34.3	38.9	33.7	24.5	22.6
2020/03/17 20:15:00	Leq	43.4	15.0	24.4	27.3	31.4	35.9	40.5	36.0	26.1	25.0
	L90	41.4	11.0	21.1	23.7	28.6	33.9	38.3	33.0	24.0	22.5
2020/03/17 20:30:00	Leq	44.2	16.1	27.1	32.7	35.2	37.5	40.3	35.6	26.1	24.2
	L90	40.8	12.0	21.8	24.8	28.8	33.6	37.4	32.2	23.9	22.3
2020/03/17 20:45:00	Leq	43.9	14.7	24.9	28.5	34.8	38.4	39.9	35.2	26.9	24.2
	L90	40.5	11.1	21.3	23.5	28.2	33.1	37.2	32.1	24.1	22.4
2020/03/17 21:00:00	Leq	43.0	15.4	24.3	26.1	30.5	35.0	40.2	36.0	25.7	24.1
	L90	40.5	11.4	20.9	22.6	27.6	32.8	37.4	32.3	23.7	22.2

Chelson Meadow, Plymouth

Date and start time	Parameter	dBA	Octave band level, dB								
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
2020/03/17 21:15:00	Leq	45.3	16.3	26.8	32.1	38.1	39.4	40.8	35.9	28.1	26.0
	L90	41.3	12.4	22.4	24.8	28.8	33.7	37.7	32.7	24.4	22.9
2020/03/17 21:30:00	Leq	44.1	16.5	25.4	29.3	31.7	36.4	40.4	37.7	30.7	27.5
	L90	40.8	12.1	21.4	24.7	28.7	33.6	37.0	32.1	24.3	22.7
2020/03/17 21:45:00	Leq	42.0	14.9	25.7	26.9	30.6	35.2	38.8	33.5	25.3	24.3
	L90	39.8	10.8	21.6	23.8	27.6	32.6	36.3	31.2	23.3	21.9
2020/03/17 22:00:00	Leq	41.8	14.9	24.5	27.1	30.3	34.9	38.7	33.3	25.1	24.0
	L90	40.2	11.3	21.4	24.0	27.9	33.2	36.7	31.2	23.3	21.8
2020/03/17 22:15:00	Leq	41.1	14.5	27.5	27.0	29.5	33.8	37.7	32.7	26.4	26.1
	L90	39.4	11.6	22.2	23.6	26.8	31.6	35.5	30.7	23.8	22.6
2020/03/17 22:30:00	Leq	40.8	15.7	24.7	28.7	29.1	33.2	37.4	32.5	26.6	25.4
	L90	38.8	12.2	21.9	24.9	26.9	30.9	34.9	30.2	24.3	23.3
2020/03/17 22:45:00	Leq	40.6	17.0	24.5	29.2	29.2	33.7	36.9	31.9	25.6	24.7
	L90	38.9	13.3	21.6	25.0	27.2	31.7	34.6	29.7	23.6	22.4
2020/03/17 23:00:00	Leq	41.0	15.1	26.6	28.3	29.2	33.9	37.6	32.3	27.2	24.6
	L90	38.8	12.0	21.3	24.4	27.2	31.8	34.7	29.8	23.8	22.7
2020/03/17 23:15:00	Leq	41.4	15.4	26.4	29.7	31.9	34.4	37.5	32.3	26.5	25.6
	L90	38.5	11.6	20.3	23.7	26.8	31.4	34.6	29.9	24.4	23.3
2020/03/17 23:30:00	Leq	39.6	14.1	23.0	28.1	28.9	32.6	35.8	30.8	25.6	25.1
	L90	37.3	10.4	19.4	23.6	25.9	30.1	32.8	28.6	23.8	23.0
2020/03/17 23:45:00	Leq	42.8	14.7	23.4	29.5	32.9	36.4	38.5	34.5	29.7	29.2
	L90	39.1	9.3	19.8	24.7	27.5	32.1	34.7	30.6	25.3	24.0
2020/03/18 00:00:00	Leq	42.1	14.8	22.3	30.1	30.6	34.4	37.1	33.9	32.4	32.4
	L90	39.5	9.2	19.0	25.0	27.3	31.6	34.4	31.0	28.3	28.0
2020/03/18 00:15:00	Leq	42.0	14.4	23.4	29.3	29.4	33.4	36.0	34.1	33.9	34.3
	L90	39.8	10.0	19.7	24.9	26.8	30.8	33.1	31.4	30.8	31.1
2020/03/18 00:30:00	Leq	41.7	14.0	22.8	29.5	29.8	33.6	35.8	33.7	33.1	33.7
	L90	39.9	10.5	19.0	25.5	27.3	31.7	33.8	31.5	29.9	30.5
2020/03/18 00:45:00	Leq	42.8	15.4	24.1	28.9	30.1	35.4	38.4	35.3	32.4	32.0
	L90	39.7	11.2	19.7	25.3	27.3	32.0	34.0	31.4	29.8	30.1

Chelson Meadow, Plymouth

Date and start time	Parameter	dBA	Octave band level, dB								
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
2020/03/18 01:00:00	Leq	43.7	16.9	25.7	29.9	31.4	36.1	39.5	36.3	32.6	31.9
	L90	41.8	13.7	23.3	26.8	27.4	33.4	37.2	34.5	31.0	30.1
2020/03/18 01:15:00	Leq	42.6	16.4	26.1	31.0	28.8	34.6	38.3	35.3	31.8	31.4
	L90	41.3	12.8	23.4	27.2	26.8	32.7	36.4	33.8	30.6	30.0
2020/03/18 01:30:00	Leq	42.1	15.7	26.2	32.7	29.0	34.0	37.4	34.3	30.9	30.8
	L90	40.9	12.5	23.2	27.1	27.0	32.5	35.8	32.4	29.4	29.3
2020/03/18 01:45:00	Leq	40.6	13.0	22.3	32.4	28.3	32.6	35.2	32.0	30.2	30.7
	L90	38.8	8.3	18.7	25.0	25.8	30.3	33.1	30.5	28.5	28.9
2020/03/18 02:00:00	Leq	39.5	11.5	22.7	29.6	27.9	32.1	34.0	30.9	29.1	30.0
	L90	37.8	8.1	18.6	23.7	25.4	29.5	31.6	28.9	27.3	28.1
2020/03/18 02:15:00	Leq	40.4	10.8	22.2	30.7	29.5	32.9	34.4	31.2	30.4	31.7
	L90	38.1	6.9	18.7	24.6	26.3	30.2	31.2	28.7	28.0	29.4
2020/03/18 02:30:00	Leq	41.0	12.9	24.0	29.3	29.9	32.8	34.7	32.5	32.4	33.5
	L90	39.1	8.1	19.9	25.2	26.4	30.2	31.8	30.1	30.0	31.4
2020/03/18 02:45:00	Leq	41.0	13.7	24.1	28.5	29.2	33.6	35.6	32.5	31.6	32.5
	L90	38.6	8.9	20.0	24.0	26.2	30.3	31.9	29.9	29.2	30.2
2020/03/18 03:00:00	Leq	40.9	14.1	22.2	26.4	29.1	33.3	35.3	32.6	32.3	32.6
	L90	38.2	8.2	18.5	21.7	25.5	29.9	31.6	29.7	29.3	30.0
2020/03/18 03:15:00	Leq	43.1	15.1	22.1	27.1	31.9	35.6	37.3	35.3	34.7	34.8
	L90	40.0	9.1	18.6	23.1	27.8	31.8	34.2	31.9	30.9	31.1
2020/03/18 03:30:00	Leq	43.0	15.3	23.6	28.1	31.6	35.8	37.1	35.2	34.3	34.1
	L90	40.3	10.4	20.5	25.0	28.1	32.5	34.2	32.5	31.1	30.9
2020/03/18 03:45:00	Leq	44.0	15.3	24.6	28.8	31.0	35.0	37.6	39.3	34.6	33.6
	L90	41.1	10.8	21.3	25.1	27.9	32.3	34.9	33.6	31.3	30.7
2020/03/18 04:00:00	Leq	43.5	15.1	24.7	28.1	31.4	35.1	36.8	38.6	34.3	33.2
	L90	40.4	10.9	20.9	24.9	28.4	32.6	34.4	32.3	30.3	29.8
2020/03/18 04:15:00	Leq	42.7	16.8	27.0	32.2	31.6	35.2	37.0	35.8	32.1	31.2
	L90	40.6	11.8	23.2	27.4	29.0	32.7	34.3	31.8	29.0	28.1
2020/03/18 04:30:00	Leq	44.3	18.2	26.9	32.5	33.2	37.7	38.9	36.6	33.9	33.0
	L90	41.1	12.4	22.9	27.6	29.5	33.8	35.5	32.8	29.2	28.0

Chelson Meadow, Plymouth

Date and start time	Parameter	dBA	Octave band level, dB								
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
2020/03/18 04:45:00	Leq	44.8	17.4	26.1	31.0	32.8	37.2	39.1	39.3	34.3	32.7
	L90	41.8	12.0	22.1	27.2	29.6	33.8	35.9	33.8	30.0	28.6
2020/03/18 05:00:00	Leq	44.0	17.5	26.2	32.6	31.3	36.5	38.8	37.2	34.9	31.5
	L90	41.8	12.9	22.1	26.9	29.0	33.9	36.5	33.7	29.5	28.1
2020/03/18 05:15:00	Leq	46.0	17.3	25.8	29.6	31.5	37.8	39.8	41.3	36.9	35.3
	L90	41.9	12.4	21.8	26.5	28.8	33.7	36.7	34.0	29.9	28.6
2020/03/18 05:30:00	Leq	47.1	17.1	27.2	32.2	32.2	38.0	41.1	43.0	37.8	34.0
	L90	44.3	13.3	23.9	27.9	30.0	35.7	39.0	36.6	31.2	28.9
2020/03/18 05:45:00	Leq	48.8	21.5	28.0	31.6	33.0	38.8	42.0	42.4	40.1	43.1
	L90	44.7	16.7	24.6	28.3	30.8	36.4	40.1	36.9	30.6	28.2
2020/03/18 06:00:00	Leq	52.8	19.8	28.2	31.7	34.5	39.6	46.2	48.8	42.3	46.3
	L90	45.1	15.3	25.3	28.9	31.8	36.8	40.8	36.7	30.9	28.5
2020/03/18 06:15:00	Leq	47.8	19.2	27.5	32.0	34.4	39.8	43.6	41.4	36.6	36.7
	L90	45.4	15.6	24.7	28.8	32.3	37.8	41.5	37.3	30.2	27.3
2020/03/18 06:30:00	Leq	49.1	21.0	29.9	34.4	36.2	40.5	44.5	42.4	38.1	40.1
	L90	46.4	17.4	26.8	31.0	33.6	38.6	42.5	38.2	31.2	28.0
2020/03/18 06:45:00	Leq	51.3	21.5	30.2	33.8	36.5	41.5	45.7	42.8	45.2	43.8
	L90	47.1	17.3	26.7	30.6	33.8	39.1	43.2	38.7	32.2	28.7
2020/03/18 07:00:00	Leq	50.5	21.9	30.5	34.5	37.1	43.1	45.9	42.5	40.8	41.5
	L90	47.9	17.8	27.3	30.8	34.5	39.9	43.7	39.6	32.6	29.8
2020/03/18 07:15:00	Leq	50.0	24.2	30.9	34.4	37.2	43.8	45.8	42.1	38.6	37.8
	L90	48.1	20.4	27.3	30.3	34.7	41.8	43.9	40.0	33.2	30.6
2020/03/18 07:30:00	Leq	56.9	26.5	37.1	42.9	44.9	48.9	52.0	50.3	47.7	45.1
	L90	49.0	21.6	29.3	31.8	35.9	41.3	44.8	40.5	35.0	31.4
2020/03/18 07:45:00	Leq	55.3	27.5	38.1	41.7	44.2	47.3	50.2	48.9	45.3	43.0
	L90	50.8	21.4	33.9	37.7	40.6	43.0	45.7	42.9	37.1	32.4
2020/03/18 08:00:00	Leq	64.1	30.7	44.7	48.5	55.1	57.9	58.5	56.7	53.2	50.8
	L90	51.2	23.1	35.7	41.6	39.6	43.4	46.1	42.7	37.5	33.6
2020/03/18 08:15:00	Leq	70.5	32.2	46.0	52.0	58.4	63.6	63.5	65.6	60.8	60.1
	L90	53.9	26.1	39.2	45.0	40.8	44.7	48.4	45.7	40.9	36.1

Chelson Meadow, Plymouth

Date and start time	Parameter	dBA	Octave band level, dB								
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
2020/03/18 08:30:00	Leq	70.0	30.8	45.9	50.2	57.5	62.5	62.6	66.7	58.2	56.9
	L90	53.5	23.7	39.5	45.6	41.6	45.7	48.2	45.1	39.3	34.3
2020/03/18 08:45:00	Leq	59.7	27.8	43.8	47.5	51.1	51.2	54.3	53.3	48.9	46.3
	L90	53.2	22.2	37.7	43.3	40.7	43.7	48.0	43.8	38.5	33.6
2020/03/18 09:00:00	Leq	61.3	28.0	44.7	49.2	50.4	53.0	56.6	54.5	51.3	48.8
	L90	53.4	21.9	39.1	42.9	41.7	43.8	48.2	43.7	38.8	34.9
2020/03/18 09:15:00	Leq	65.3	31.4	46.5	52.8	53.4	58.7	60.5	58.7	53.7	50.2
	L90	53.7	23.2	38.2	43.7	41.7	44.2	48.4	45.0	41.1	37.0
2020/03/18 09:30:00	Leq	64.3	31.4	46.1	53.2	53.6	56.9	59.4	57.0	53.3	50.4
	L90	54.4	24.2	38.7	43.9	40.8	44.2	49.0	46.2	43.0	38.2
2020/03/18 09:45:00	Leq	60.8	28.3	44.6	51.2	50.3	52.7	55.8	53.6	50.2	46.9
	L90	51.9	22.3	35.7	42.7	38.9	43.0	46.4	44.8	40.2	35.2
2020/03/18 10:00:00	Leq	60.9	27.3	37.8	43.9	43.5	47.5	51.5	54.3	54.6	56.0
	L90	50.4	20.6	33.1	41.4	37.6	41.3	45.2	42.6	38.5	32.5

Chelson Meadow, Plymouth

Noise Monitoring Position 2: 17th – 18th March 2020

Construction site and air blowers operational
Construction site not operational; air blowers operational
Construction site and air blowers not operational
Construction site and air blowers not operational, dawn chorus

Period start	L_{Aeq} dB	L_{Amin} dB	L_{Amax} dB	L_{A90} dB
17/03/2020 14:19	64.4	54.3	83.9	56.6
17/03/2020 14:34	59.2	52.7	72.7	54.7
17/03/2020 14:49	55.7	49.6	65.1	51.9
17/03/2020 15:04	61.3	56.4	79.8	57.9
17/03/2020 15:19	59.5	53.7	69.0	56.9
17/03/2020 15:34	58.3	52.6	67.1	54.1
17/03/2020 15:49	62.2	56.1	73.0	58.2
17/03/2020 16:04	64.0	56.9	79.7	58.6
17/03/2020 16:19	58.2	50.3	70.1	51.4
17/03/2020 16:34	53.7	50.3	67.0	51.2
17/03/2020 16:49	57.1	50.4	67.2	51.9
17/03/2020 17:04	59.1	48.7	71.5	51.7
17/03/2020 17:19	52.1	49.9	59.8	50.5
17/03/2020 17:34	53.9	50.1	61.6	50.7
17/03/2020 17:49	51.7	49.0	59.2	50.0
17/03/2020 18:04	54.8	43.8	68.8	46.1
17/03/2020 18:19	51.3	48.7	58.0	49.8
17/03/2020 18:34	50.0	46.3	60.9	47.9
17/03/2020 18:49	48.7	46.0	57.8	47.4
17/03/2020 19:04	48.6	46.1	55.0	47.3
17/03/2020 19:19	48.2	45.5	55.9	47.0
17/03/2020 19:34	46.8	40.4	50.1	42.0
17/03/2020 19:49	44.3	39.4	54.8	41.6
17/03/2020 20:04	43.5	40.0	56.1	41.2
17/03/2020 20:19	43.5	39.3	58.9	40.7
17/03/2020 20:34	44.8	38.4	62.3	40.6
17/03/2020 20:49	42.0	37.8	47.0	39.7
17/03/2020 21:04	44.9	38.7	63.4	39.8
17/03/2020 21:19	43.9	38.3	60.8	40.4
17/03/2020 21:34	43.9	38.3	57.6	40.2
17/03/2020 21:49	41.8	37.2	53.2	39.4
17/03/2020 22:04	41.7	36.8	52.3	39.3
17/03/2020 22:19	40.9	37.4	48.7	38.5
17/03/2020 22:34	40.3	36.3	49.8	38.0
17/03/2020 22:49	40.4	36.0	52.2	37.9
17/03/2020 23:04	42.2	38.0	55.3	39.1

Chelson Meadow, Plymouth

Period start	L_{Aeq} dB	L_{Amin} dB	L_{Amax} dB	L_{A90} dB
17/03/2020 23:19	40.1	35.7	52.2	37.1
17/03/2020 23:34	40.4	34.3	50.6	37.1
17/03/2020 23:49	42.4	34.6	61.4	36.8
18/03/2020 00:04	44.2	35.0	62.0	36.9
18/03/2020 00:19	43.2	35.7	61.4	37.2
18/03/2020 00:34	45.8	35.7	64.5	37.2
18/03/2020 00:49	41.9	35.3	55.0	37.0
18/03/2020 01:04	42.3	34.0	56.5	35.8
18/03/2020 01:19	39.9	33.7	54.6	35.2
18/03/2020 01:34	40.6	33.7	58.7	35.8
18/03/2020 01:49	42.6	33.0	59.2	35.8
18/03/2020 02:04	42.8	33.5	56.5	36.1
18/03/2020 02:19	42.4	33.9	57.9	36.7
18/03/2020 02:34	42.8	34.6	57.9	37.3
18/03/2020 02:49	45.4	33.5	64.5	36.8
18/03/2020 03:04	46.6	35.8	59.2	37.9
18/03/2020 03:19	50.7	37.1	63.3	40.5
18/03/2020 03:34	47.2	37.0	62.3	40.4
18/03/2020 03:49	48.4	38.4	60.7	41.6
18/03/2020 04:04	49.8	38.4	64.3	42.0
18/03/2020 04:19	48.0	37.9	60.9	41.9
18/03/2020 04:34	50.3	38.9	67.2	42.7
18/03/2020 04:49	48.3	38.6	60.3	41.6
18/03/2020 05:04	45.9	39.9	60.1	41.9
18/03/2020 05:19	46.3	39.5	59.7	41.6
18/03/2020 05:34	46.2	41.7	54.5	43.5
18/03/2020 05:49	47.8	42.4	57.1	44.3
18/03/2020 06:04	46.9	42.6	54.8	43.9
18/03/2020 06:19	47.9	43.1	62.1	45.0
18/03/2020 06:34	47.1	44.0	54.1	45.4
18/03/2020 06:49	47.8	44.0	58.1	45.6
18/03/2020 07:04	48.8	44.3	59.3	45.9
18/03/2020 07:19	48.2	44.8	57.3	46.2
18/03/2020 07:34	51.1	45.9	61.9	47.7
18/03/2020 07:49	53.5	47.0	67.2	48.2
18/03/2020 08:04	59.5	48.9	77.2	51.3
18/03/2020 08:19	57.9	52.4	71.0	53.1
18/03/2020 08:34	55.8	53.2	62.1	54.1
18/03/2020 08:49	56.8	52.9	66.6	54.3
18/03/2020 09:04	59.4	53.3	70.9	54.7
18/03/2020 09:19	63.9	54.3	73.9	56.5
18/03/2020 09:34	64.6	58.0	74.0	61.0
18/03/2020 09:49	63.5	57.9	70.5	60.6
18/03/2020 10:04	65.5	51.4	89.8	59.2

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CHELSON MEADOW LEACHATE TREATMENT PLANT

NOISE MANAGEMENT PLAN

2021

Site Context

Chelson Meadow Leachate Treatment Plant (LTP) is operated by Plymouth City Council (PCC) and is located adjacent to the east bank of the River Plym, east of the city of Plymouth and south of the A38 trunk road. The National Grid Reference for the centre of the site is approximately SX50612 54476 (Figure 1.1 & Plate 1.1). The LTP Permit boundary (CP3731LZ) occupies an area of approximately 0.63 ha.

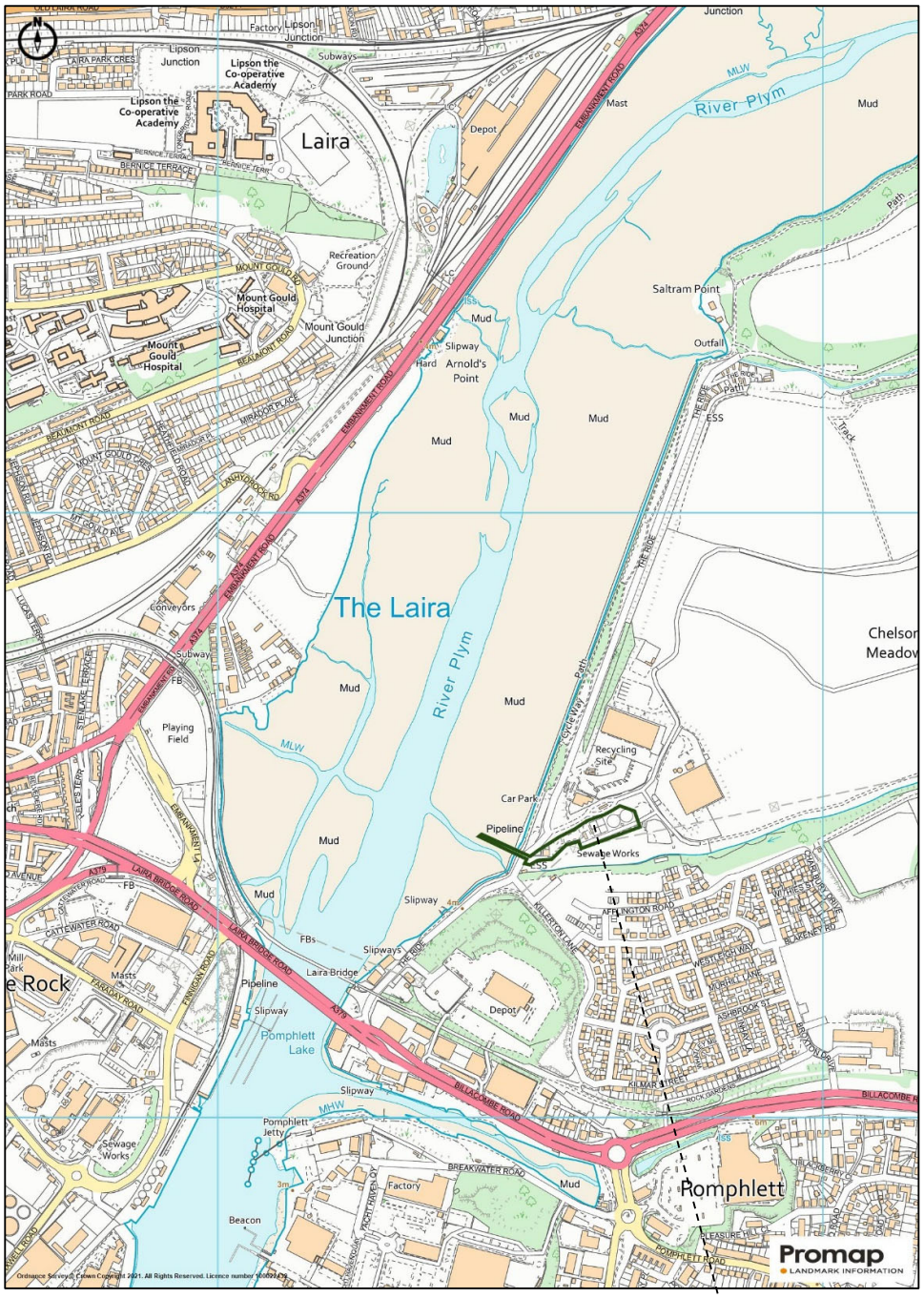

Figure 1.1: Location and permit boundary of Chelson Meadow LTP outlined in green

Plate 1.1: Aerial view of Chelson Meadow LTP, with the permit boundary shown in green, 2017

Plates 1.2-1.5 illustrate the context of the LTP.

Plate 1.2: Haul road to access the LTP and the wider facility, looking west-south-west and showing the south end of the permit area, viewed from on top of the SBRs, 2021

Plate 1.3: Southeast boundary to the permit area, looking southeast across the old lagoon towards the new residential development, viewed from the top of the SBR, 2021

Plate 1.4: Looking southwest across the old lagoon towards the new residential development, viewed from the top of the SBR, 2021

Plate 1.5: Looking north across the adjacent waste facility, viewed from the top of the SBR, 2021

The LTP permit area is in the southwest corner of the closed Chelson Meadow landfill, adjacent to the inter-related permitted waste facilities comprised of Waste Transfer Station (Transfer Station), Household Waste Recycling Centre (HWRC) and Biffa Materials Recycling Facility (MRF), as shown on Figure 1.2.

Operations, Noise source & Constraints

The LTP is a fully automated 24/7 operation for continuous treatment of leachate generated constantly by the landfill. The site is manned approximately 40 hours per week, but it can be monitored and operated remotely and is provided with a comprehensive alarm and fault diagnostic system.

The basic infrastructure is comprised of storage tanks for incoming and treated leachate (STOR1 & 2), reaction tanks (SBRs) for the biological treatment of leachate, a pumping station to drive leachate from the storage tank to the reaction tanks, a control room and valve chambers (Figure 1.2 & Plate 1.6). A full description of the infrastructure and treatment process is provided in the Management System.

Permit conditions for noise for the LTP specify:

> *3.4.1 Emissions from the activities shall be free from noise and vibration at levels likely to cause pollution outside the site, as perceived by an authorised officer of the Environment Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved noise and vibration management plan to prevent or where that is not practicable to minimise the noise and vibration.*
> *3.4.2 The operator shall:*
> > *(a) if notified by the Environment Agency that the activities are giving rise to pollution outside the site due to noise and vibration, submit to the Environment Agency for approval within the period specified, a noise and vibration management plan which identifies and minimises the risks of pollution from noise and vibration;*
> > *(b) implement the approved noise and vibration management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.*

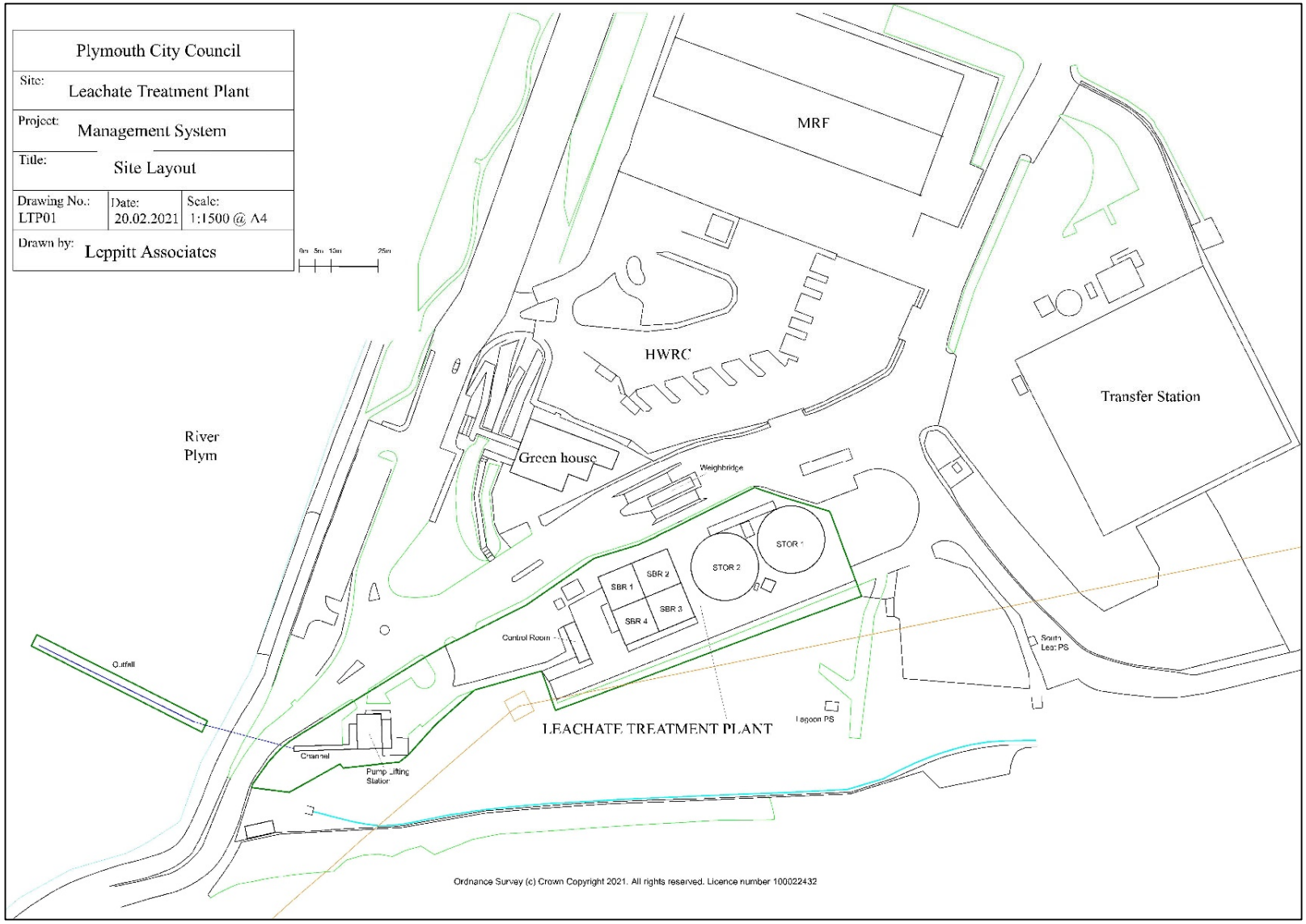

Figure 1.2 Chelson Meadow LTP permit boundary, showing major infrastructure and additional waste facilities on the closed landfill

Plate 1.6: Leachate Treatment Plant, looking southwest from the lagoon pumping station, Chelson Meadow, Plymouth 2021. Infrastructure components from left to right are: Sequential Batch Reactors (SBRs), STOR 2 & STOR 1

Part of the treatment process within the SRBs requires aeration of the liquor to ensure bacterial biomass is distributed evenly to maximise treatment efficiency. Air is forced into the tank by mechanical blowers and is distributed by diffusers. Each SBR has its own blower situated on the south wall (Plate 1.7), housed in an acoustic cabinet (Plate 1.8).

Plate 1.7: Blower cabinets alongside the SBR complex, 2021

Plate 1.8: Air blower inside the acoustic cabinet external to the SBR

The LTP operates continuously because leachate is generated and stored continuously. Treated leachate is discharged during a specified tidal window, the time of which changes daily. Consequently, any number of blowers may be activated at any point during a 24 period. The duration of aeration in a treatment cycle depends on concentration of ammoniacal nitrogen in the leachate (stronger leachate requires greater aeration) and abiotic factors.

Noise Assessment

At the time the current LTP was constructed in 1996 there was a cement works to the south, which closed subsequently. Approximately 5 years ago planning permission was granted for a substantial residential development on the former cement works. Development commenced at the south boundary of the planning area and has extended to the landfill boundary, separated from it by a narrow corridor of vegetation (Figure 1.3).

The LTP is one facet of the wider waste facility, some elements of which are also operational 7 days a week (but not 24 hours a day) with associated vehicle and mechanical activity.

Concerns about noise from operation of the blowers was raised by an EA officer at the time the residential development commenced: a statement was made that noise would have to be reduced once the development was occupied, although there is no history of complaints regarding noise from the LTP up to March 9th 2022.

Noise Assessments have been commissioned by PCC in response to these concerns. The most recent assessment was undertaken by Arcadis in July 2020 and this forms part of the permit variation application: the report conclusions were as follows:

.....Within the scope of this report, baseline noise levels have been quantified within the vicinity of the site to establish the prevailing noise climate at the nearest noise sensitive receptors. The data was quantified in January and March 2020 and was collected during periods when the existing air blowers were not in operation. As specific product selections associated with the new blowers have not yet been completed, the assessment has focussed on establishing appropriate noise emission limits for the new plant items.

The determination of such limits was based on the methodology and assessment protocols of BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound*. Based on the assumption that the new unit selections will be made with full consideration to the noise emission limits specified within this report, then it is predicted that the night time operational noise associated with the new air blower units would be classified to be at a level indicative of the specific sound source having a low impact.*

Noise Receptors

The site is separated from the River Plym by the Ride/footpath/cycle way, which is a popular public access route to the Saltram Estate. The LTP permit boundary is within 2km of a biological SSSI (Billacombe Field). The mudflats of the adjacent river are Priority Habitat (PH) as is the deciduous woodland, wood pasture and parkland within the boundary of the National Trust Saltram Estate. The new housing estate is 70m (at closest) to the south boundary of the LTP (Figure 1.3, additional housing now occupies the northwest sector of the ongoing development). The LTP permit boundary is immediately adjacent to other components of the wider waste facility at Chelson Meadow.

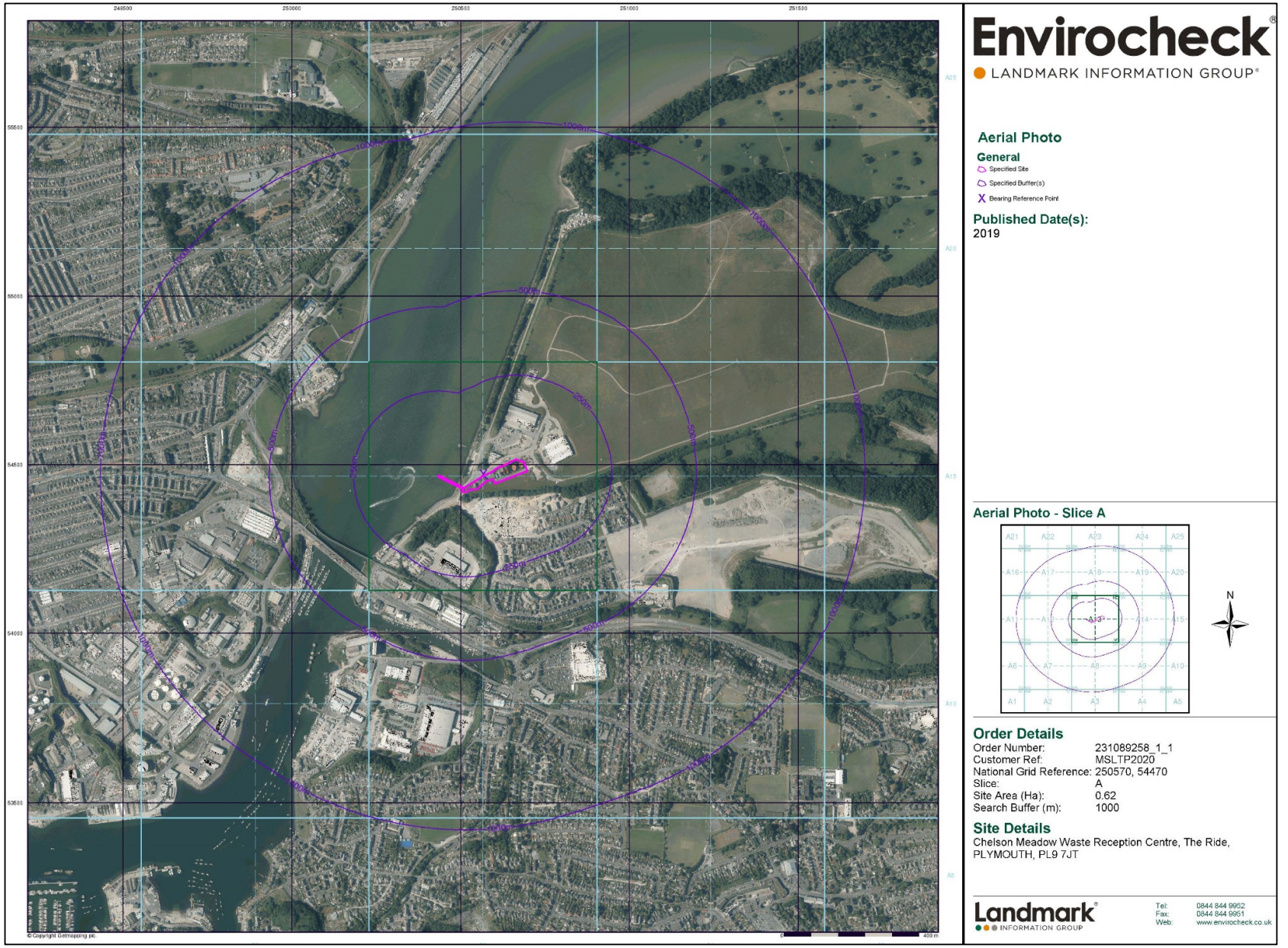

Figure 1.3: Aerial view of the LTP (pink boundary) showing the wider site context, with the post-construction residential development to the south (2019)

Wind rose

Wind speed and direction influence how noise may affect sensitive receptors. The wind rose for Plymouth (2015 to 2019, Figure 1.4) indicates that the prevailing winds are in the sector between west and southwest. Winds in the sectors north to north-north-east and south to east-south-east are least frequent. Over the specified period, easterly winds occurred ca. 10% of the time. Based on these data, Table 1.1 indicates vulnerable receptors for noise arising from the site: shade intensity is directly proportional to risk, which may be primarily because of proximity.

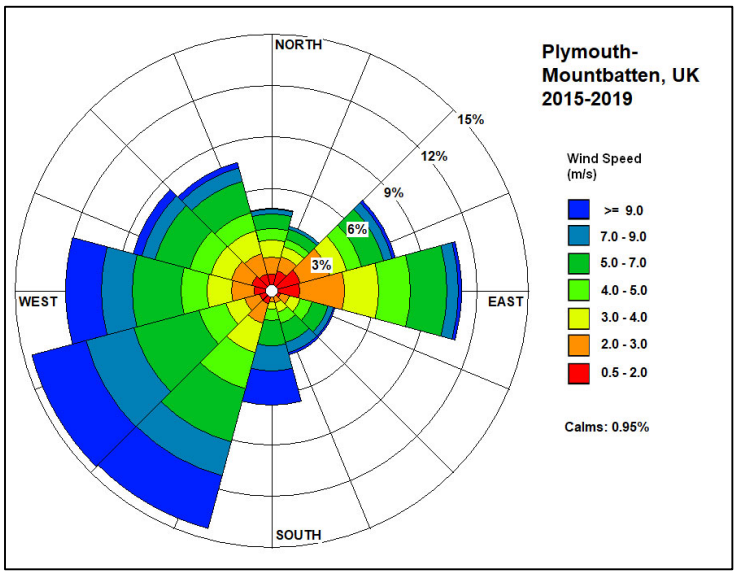

Figure 1.4: Wind rose from Plymouth (2015-2019)

Key receptors are the Ride, the HWRC, the residential area of the new housing estate and PH deciduous woodland.

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Table 1.1: Potential sensitive receptors to noise within 1km of the permit boundary of the LTP; receptors down gradient of prevailing winds and at proximity are shaded in blue, with increasing depth of shade signifying increased risk

	Potential Receptor	**From Permit Boundary**	
		Distance (m)	**Direction**
1	River Plym	0	-
2	The Ride	0	W
3	HWRC boundary	20	N
4	Housing estate	70 minimum	S
5	Priority Habitat Deciduous Woodland	125	ESE
6	School	415	SE
7	Traveller's Camp	680	N
8	Saltram Estate	770	NNE

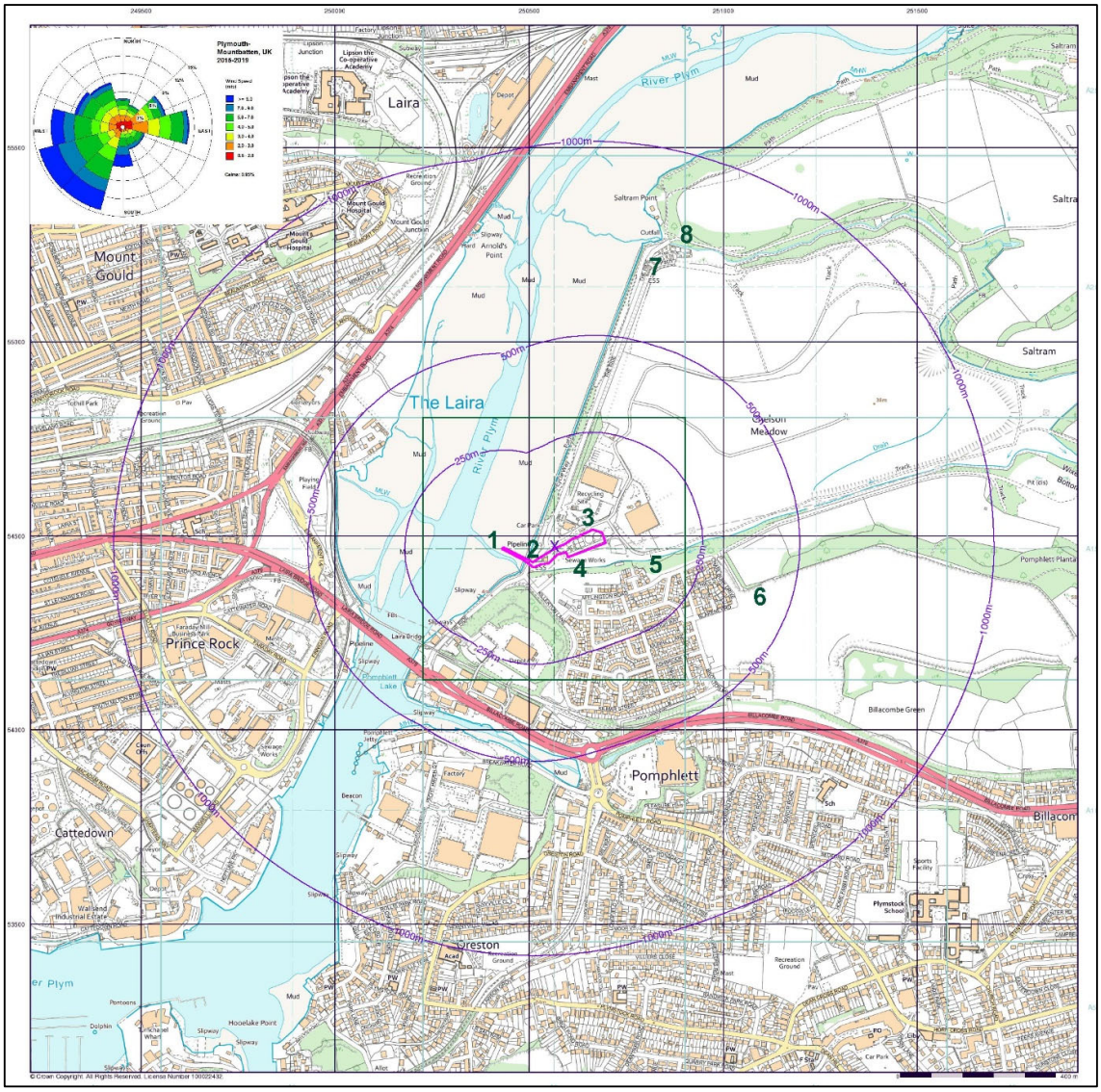

Figure 1.5: Potential sensitive receptors to noise within 1km of the permit boundary of the LTP; receptors are numbered sequentially according to proximity and relationship to prevailing winds (see Table 1.1)

Noise Mitigation

The site generates noise because operations are continuous and require mechanical infrastructure. Most noise is generated by the blowers at the side of the SBR complex opposite the new residential development, especially during the start-up process. When large volumes of leachate are being generated and treated, the blowers are required more frequently and more SBRs are in use, each with its own blower system. Leachate production is determined by weather, with large volumes arising during periods of persistent or intense rainfall. There is a

finite capacity to store leachate and release of treated effluent is determined by the tide; consequently, it is not possible to constrain use of the blowers to normal working hours.

The programme of upgrading the LTP has been delayed by the Covid-19 pandemic. PCC aim to complete sourcing and contracting of the replacement blowers by the end of 2022. The new blowers will conform to the requirements stated in the most recent Noise Assessment (Arcadis 2020).

In the interim period, current noise mitigation is outlined below.

Control of Noise
Mitigation of noise emissions from the site is achieved by:

- Ensure optimal use of blowers as part of an effective leachate treatment operation e.g. by maintaining high bacterial efficacy and ensuring the infrastructure for measuring dissolved oxygen (which triggers use of the blowers) is operating optimally;
- Maintain acoustic integrity of the blower housing cabinets;
- Maintaining and servicing all relevant infrastructure regularly to ensure that noise emissions are minimised, in compliance with all relevant legislation;
- Time, as far as possible, non-routine operations with the potential to create noise (tanker and crane movements) within the central section of the working day unless circumstances prevent to minimise additional noise nuisance.

Noise Monitoring
Noise monitoring will be carried out by the operator if requested, utilising an integrating sound level meter, to ensure that noise levels from site operations shall not exceed the existing background level at the noise sensitive receptors closest to the site. Any measurement and assessment shall be made according to BS4142:2014 + A1:2019. A record of all complaints and the actions taken in response will be kept in the site diary, as detailed in the Management System.