SECTION 9: Noise and Vibration

9.1 Introduction

This Section of the Environmental Impact Assessment Report (EIAR) assesses the impact of the Castletroy Wastewater Treatment Plant Upgrade (hereafter referred to as the Proposed Development) on noise and vibration levels during the Construction and Operational Phases.

This noise and vibration impact assessment has been prepared to assess the potential noise and vibration impact of the Proposed Development on the nearest residential properties and educational receptors in the vicinity of the Proposed Development site.

The construction activities of the Proposed Development have been examined to identify those that have the potential to give rise to noise and vibration and a suitable construction impact assessment has been undertaken. As appropriate, construction phase mitigation measures have been outlined.

The assessment and evaluation of the potential noise and vibration impact arising from the Proposed Development involved the following:

- Reference to the Environmental Protection Agency (EPA) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA 2016); Add note: the existing plant will continue to operate during the construction of the upgrade.
- Baseline Noise Survey – noise monitoring survey representative of daytime and night-time periods to determine the existing noise climate in proximity to the sensitive residential and educational receptors in the vicinity of the Proposed Development site;
- Identification and assessment of potential noise and vibration sources from the construction of the Proposed Development;
- Identification and assessment of potential noise and vibration sources from the operation of the Proposed Development;
- Noise prediction modelling using CadnaA noise prediction software;
- A British Standard (BS) 4142: 2014+A1:2019 'Method of Rating and Assessing Industrial and Commercial Noise' assessment has been carried out to assess the potential for 'adverse impact' at the nearest noise sensitive locations due to the proposed operations;
- A comparison of the measured noise levels and the noise impact on the nearest sensitive residential and educational receptors against relevant guidelines and standards; and
- A recommendation of appropriate construction and operational noise and vibration mitigation measures.

9.1.1 Study Area

The Castletroy Wastewater Treatment Plant (WwTP) is located within the Dromroe townland, immediately northwest of the University of Limerick (UL). It is located on the banks of the Lower River Shannon and is accessed via the road system that traverses through the university campus, off Plassey Park Road. The EPA definition of a Noise Sensitive Location (NSL) is "Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels". The assessment has addressed nearby

sensitive residential and educational locations. There is no particular designated amenity area in the immediate vicinity, i.e. park, etc.

The nearest sensitive receptors are located as follows;

- Properties to the north-east of the WwTP site, at a distance of approximately 130m – 200m from the WwTP site boundary.
- At Dromroe Student Village (Rowan House) to the east of the WwTP site, at a distance of approximately 130m from the WwTP site boundary.
- At Thomond Village (Heron House) to the north-east of the WwTP site, at a distance of approximately 280m from the WwTP site boundary.
- At Stanford Close to the south of the WwTP site, at a distance of approximately 275m from the WwTP site boundary.
- The nearest non-residential receptors to the WwTP site are UL Western Carpark 25m south of the WwTP and UL Boathouse approximately 60m west of the WwTP. Various University of Limerick educational buildings are located in excess of 175m to the south-east from the WwTP site boundary.
- The Castletroy WwTP site area is approximately 3.166 ha.

9.1.2 Relevant Guidelines, Policy and Legislation

EPA Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

The EPA Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA 2016) assists licensed sites with the assessment of their potential and actual noise impact on the local environment. This guidance note was updated in January 2016 to provide clear guidance in relation to the background understanding of environmental noise, monitoring and assessment of noise impact as well as applying applicable noise criteria and outlining suitable approaches to noise mitigation design and Best Available Techniques (BAT). The guidance note advises that noise assessment periods are now expressed in terms of day, evening and night and outlines recommended minimum durations for environmental noise surveys. The January 2016 update also provides additional information and clarifications including the following:

- Updated guidance to reflect the publication of BS 4142;
- Examples of circumstances where it may be appropriate to use detailed reference methods for the assessment of tonality and impulsivity; and
- Guidance on the use of L_{AF90} in instances where extraneous noise sources may have an influence on measured L_{Aeq} values.

In the EPA Guidance Note (NG4) (EPA 2016) the steps to be followed in order to derive appropriate noise limit criteria are outlined as follows;

Step 1 – Quiet Area Screening of the Development Location

Step 2 – Baseline Environmental Noise Survey

Step 3 – Screen for Areas of Low Background Noise

Step 4 – Determine Appropriate Noise Criteria

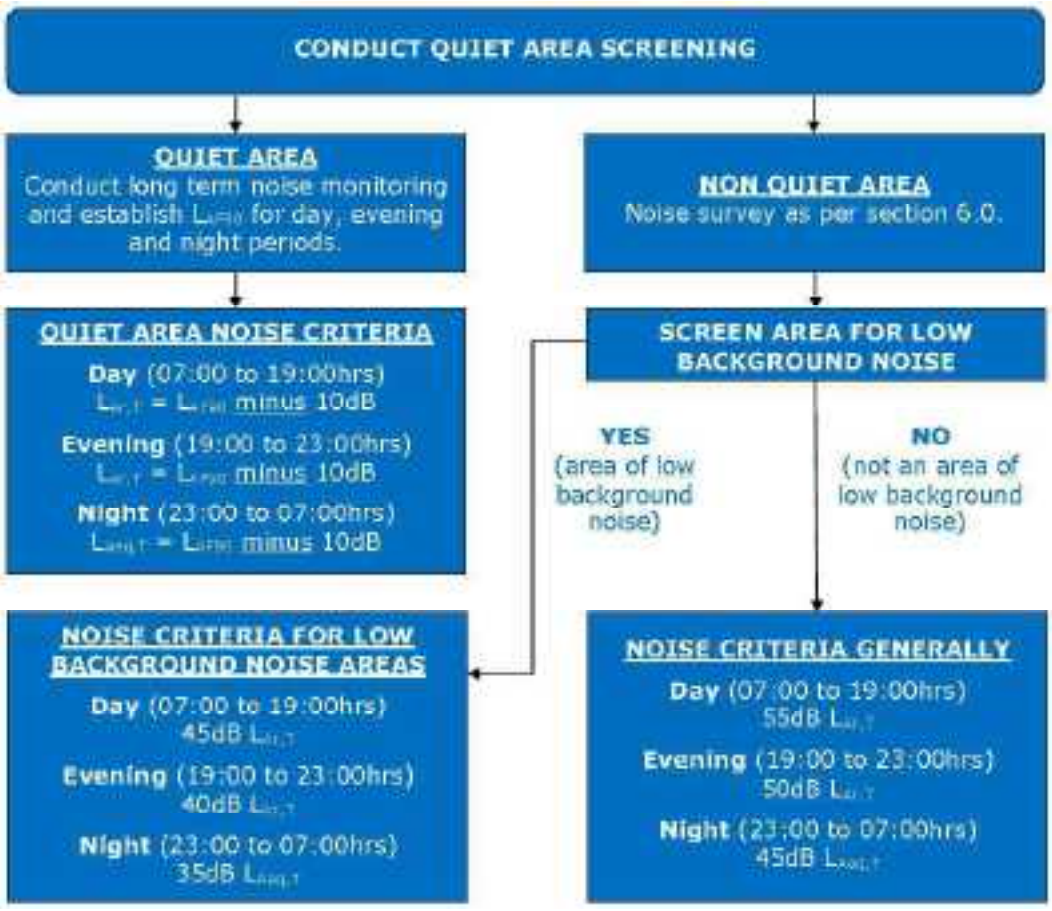

Figure 9-1: Extract from EPA Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) - Steps to be Followed in Order to Derive Appropriate Noise Limit Criteria (Ref. EPA Guidance Note (NG4) (EPA 2016))

Table 9.1: Noise Limit Criteria to be Applied Depending on the Results of the Screening Processes below outlines the noise limit criteria to be applied depending on the results of the screening processes in Steps 1 and 3, and the noise survey discussed in Step 2.

Table 9.1: Noise Limit Criteria to be Applied Depending on the Results of the Screening Processes

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night-time Noise Criterion, dB $L_{Aeq,T}$ (23:00 to 07:00hrs)
Quiet Area	Noise from the licensed site to be at least 10dB below the average daytime background noise level measured during the baseline noise survey.	Noise from the licensed site to be at least 10dB below the average evening background noise level measured during the baseline noise survey.	Noise from the licensed site to be at least 10dB below the average night-time background noise level measured during the baseline noise survey.
Areas of Low Background Noise	45dB	40dB	35dB
All other Areas	55dB	50dB	45dB

BS 4142+A1:2019 Method of Rating and Assessing Industrial and Commercial Noise

BS 4142+A1:2019 'Method of Rating and Assessing Industrial and Commercial Noise' (BSI 2019) describes methods for rating and assessing sound of an industrial or commercial nature. It enables the effects on people nearby to be assessed and the associated risks to be minimised. It is designed to give consistent results across situations ranging from a single air-conditioning unit to a large industrial installation. BS 4142 takes account of the advances in technology and improves the accuracy of final assessments. The revised standard:

- Helps assess sound levels at proposed new residential premises.
- Enables the investigation of complaints by determining sound levels.
- Reduces the likelihood of financial penalties.
- Supports current UK planning guidance and Environment Agency guidance.

BS 4142 states that:

> '*the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context'.*

BS 4142 states that you should '*obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level',* and consider the following;

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

BS 4142 states that '*adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact'.*

World Health Organisation Guidelines for Community Noise

The World Health Organisation (WHO) has published Guidelines for Community Noise (WHO 1999), the outcome of a WHO expert task force meeting in April 1999. The WHO guidelines recommend a daytime limit of 50 – 55 decibels (dB(A)) for outdoor living areas. The report states that:

'to protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development'.

According to the WHO guidelines noise impacts within dwellings include annoyance, speech interference and sleep disturbance. WHO considers that for bedrooms, the critical effect is sleep disturbance. Guideline values for bedrooms consider that the sleep disturbance criteria should be taken as internal noise levels of 30 dB L_{Aeq} or 45 dB L_{Amax} or external levels of 45 dB L_{Aeq} or 60 dB L_{Amax}. Table 9.2 outlines the WHO Guideline noise levels applicable to residential properties.

Table 9.2: Guideline Values for Community Noise in Specific Environments (WHO 1999)

Specific Environment	Critical Health Effects	L_{Aeq} (dB)	Time Base (Hrs)	L_{Amax} (dB)
Outdoor Living Area During Daytime	Serious Annoyance, daytime & evening Moderate Annoyance, daytime & evening	55 50	16 16	- -
Outside Bedrooms During Night-Time	Sleep disturbance, window open (outdoor values)	45	8	60

Institute of Environmental Management and Assessment (IEMA) Guidelines for Noise Impact Assessment (2014)

The Guidelines for Noise Impact Assessment (produced by IEMA) address the key principles of noise impact assessment and are applicable to all development proposals where noise effects are likely to occur. The guidelines state that the noise level threshold and significance should be determined, based upon the specific evidence and likely subjective response to noise. The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3 dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear under most normal conditions. A 10 dB(A) change in noise represents a doubling or halving of the noise level. The difference between the minimum perceptible change and the doubling or halving of the noise level is split to provide greater definition to the assessment of changes in noise level. An impact scale offered by the IEMA guidelines is shown in Table 9.3, the noise effects descriptors offered by the IEMA guidelines are shown in Table 9.4 and the definition of the relationship between noise impact, effect and significance offered by the IEMA guidelines are shown in Table 9.5

Table 9.3: Impact from the Change in Sound Levels (IEMA 2014)

Sound Level Change LpAeqT (positive or negative) T = either 16hr day or 8hr night	Long-Term Impact Classification	Short-Term Impact Classification
>0 dB and <1 dB	Negligible	Negligible
>1 dB and <3 dB		Minor
>3 dB and <5 dB	Minor	Moderate
>5 dB and <10 dB	Moderate	Major
>10 dB	Major	

To determine the overall noise impact, the magnitude and sensitivity to changes in noise levels, the Noise Effects Descriptors presented in Table 9.4 are offered by the IEMA guidelines.

Table 9.4: Noise Effects Descriptors (IEMA 2014)

Level of Impact	Description
Very Substantial	Greater than 10 dB L_{Aeq} change in sound level perceived at a receptor of great sensitivity to noise
Substantial	Greater than 5 dB L_{Aeq} change in sound level at a noise sensitive receptor, or a 5 to 9.9 dB LAeq change in sound level at a receptor of great sensitivity to noise
Moderate	A 3 to 4.9 dB L_{Aeq} change in a sound level at a sensitive or highly sensitive noise receptor, or a greater than 5 dB L_{Aeq} change in sound level at a receptor of some sensitivity
Slight	A 3 to 2.9 dB L_{Aeq} change in a sound level at a receptor of some sensitivity
None/not significant	Less than 2.9 dB L_{Aeq} change in sound level and/or all receptors of negligible sensitivity to noise or marginal to the zone of the influence of the Proposed Development

Table 9.5: Relationship Between Noise Impact, Effect and Significance (IEMA 2014)

Magnitude (Nature of Impact)	**Description of Effect** **(on a specific sensitive receptor)**	**Significance**	
Beneficial	Substantial	Receptor Perception = Marked Change Causes a material change in behaviour and/or attitude, e.g. individuals begin to engage in activities previously avoided due to preceding environmental noise conditions. Quality of life enhanced due to change in character of the area.	More Likely to be Significant (Greater justification needed- based on impact magnitude and receptor sensitivities- to justify a non-significant effect) ↕
	Moderate	Receptor Perception = Noticeable Improvement Improved noise climate resulting in small change in behaviour and/or attitude, e.g. turning down volume of	(Greater justification needed- based on impact magnitude and receptor sensitivities- to justify a significant effect)

		television; speaking more quietly; opening windows. Affects the character of the area such that there is a perceived change in the quality of life.	Less Likely to be Significant
	Slight	Receptor Perception = Just Noticeable Improvement Noise impact can be heard, but does not result in any change in behaviour or attitude. Can slightly affect character of the area but not such that there is a perceived change in quality of life.	
-	Negligible	N/A = no discernible effect on receptor	Not Significant
Adverse	Slight	Receptor Perception = Non-intrusive Noise impact can be heard, but does not cause change in behaviour or attitude, e.g. turning up volume of television, speaking more loudly; closing windows. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Less Likely to be Significant Greater justification needed- based on impact magnitude and receptor sensitivities- to justify a significant effect) 
	Moderate	Receptor Perception = Intrusive Noise impact can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows. Potential for non-awaking sleep	Greater justification needed- based on impact magnitude and receptor sensitivities- to justify a non-significant effect)

		disturbance. Affects the character of area such that there is a perceived change in the quality of life.	More Likely to be Significant
	Substantial	Receptor perception = Disruptive Causes material change in behaviour and /or attitude, e.g. avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in getting to sleep, premature awakening, and difficulty in getting back to sleep. Quality of life diminished due to change in character of area.	
	Severe	Receptor Perception = Physically Harmful Significant Changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or psychological effects, e.g. regular sleep deprivation / awakening ; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Significant

ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures

ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures (ISO 2016) defines the basic quantities to be used for the description of noise in community environments and describes assessment procedures. It also specifies methods to assess environmental noise and gives guidance on predicting the potential annoyance response of a community to long-term exposure from various types of environmental noises. Application of the method to predict annoyance response is limited to areas where people reside and to related long-term land uses. ISO 1996-

1:2016 describes adjustments for sounds that have different characteristics. The term rating level is used to describe physical sound predictions or measurements to which one or more adjustments have been added. Based on these rating levels, the long-term community response can be estimated. The potential noise is assessed either singly or in combination, allowing for consideration, when deemed necessary by responsible authorities, of the special characteristics of their impulsiveness, tonality and low-frequency content, and for the different characteristics of road traffic noise, other forms of transportation noise (such as aircraft noise) and industrial noise.

9.1.3 Data Collection and Collation

Baseline Noise Survey Methodology

A daytime and night-time baseline noise monitoring survey was carried out in proximity to the existing Castletroy WwTP site at a location representative of the nearest adjacent residential properties on Tuesday 21st September 2021. The noise monitoring survey was undertaken in accordance with the methodologies outlined in ISO 1996 and BS 4142. A Norsonic Nor140 Sound Level Meter (Serial No. 1402988 – Calibration Date – 26/03/2021) was used during the noise monitoring survey. A wind shield was used on the microphone throughout the survey and the sound level meter was calibrated before and after the survey period. The sound level meter was placed at a height of approximately 1.25m above ground level at the monitoring locations (see Figure 9-2 below). The noise monitoring survey durations in proximity to the nearest noise sensitive receptor locations were undertaken over consecutive 15-minute periods. The meteorological conditions during the noise survey periods were noted as ideal with no periods of rainfall or higher wind speeds. The weather conditions during the noise survey on Tuesday 21st September 2021 were noted to be calm to light breeze, with a temperature of approximately 18°C during daytime and a temperature of approximately 12°C during night-time with no rainfall.

The measurement parameters recorded and reported during the baseline noise survey are defined as follows:

- A-weighted Decibel (dBA): Decibels measured on a sound level meter incorporating a frequency weighting (A Weighting) which differentiates between sound of different frequency (pitch) in a similar way to the human ear. This takes account of the fact that the human ear has different sensitivities to sound at different frequencies;
- L_{Aeq} is the A-weighted equivalent continuous steady sound level during the sample period;
- L_{A10} is the A-weighted sound level that is exceeded for 10% of the sample period and is generally used to quantify traffic noise;
- L_{A90} is the A-weighted sound level that is exceeded for 90% of the sample period and is generally used to quantify background noise;
- L_{Amin} is the minimum A-weighted sound level measured during the sample period; and
- L_{Amax} is the maximum A-weighted sound level measured during the sample period.

Frequency analysis was also undertaken to determine if there is an existing tonal noise impact from passing vehicles or local noise sources. BS 4142 states the following with regard to the:

> *'Objective method for assessing the audibility of tones in sound: One-third octave method; The test for the presence of a prominent, discrete-frequency spectral component (tone) typically compares the $L_{Zeq,T}$ sound pressure level averaged over the time when the tone is present in a one-third-octave band with the time-average linear sound pressure levels in the adjacent one-third-octave bands. For a prominent, discrete tone to be identified as present, the time-averaged sound pressure level in*

the one-third-octave band of interest is required to exceed the time-averaged sound pressure levels of both adjacent one-third-octave bands by some constant level difference. The level differences between adjacent one-third-octave bands that identify a tone are:

- 15 dB in the low-frequency one-third-octave bands (25 Hz to 125 Hz);
- 8 dB in the middle-frequency one-third-octave bands (160 Hz to 400 Hz); and
- 5 dB in the high-frequency one-third-octave bands (500 Hz to 10 000 Hz)'.

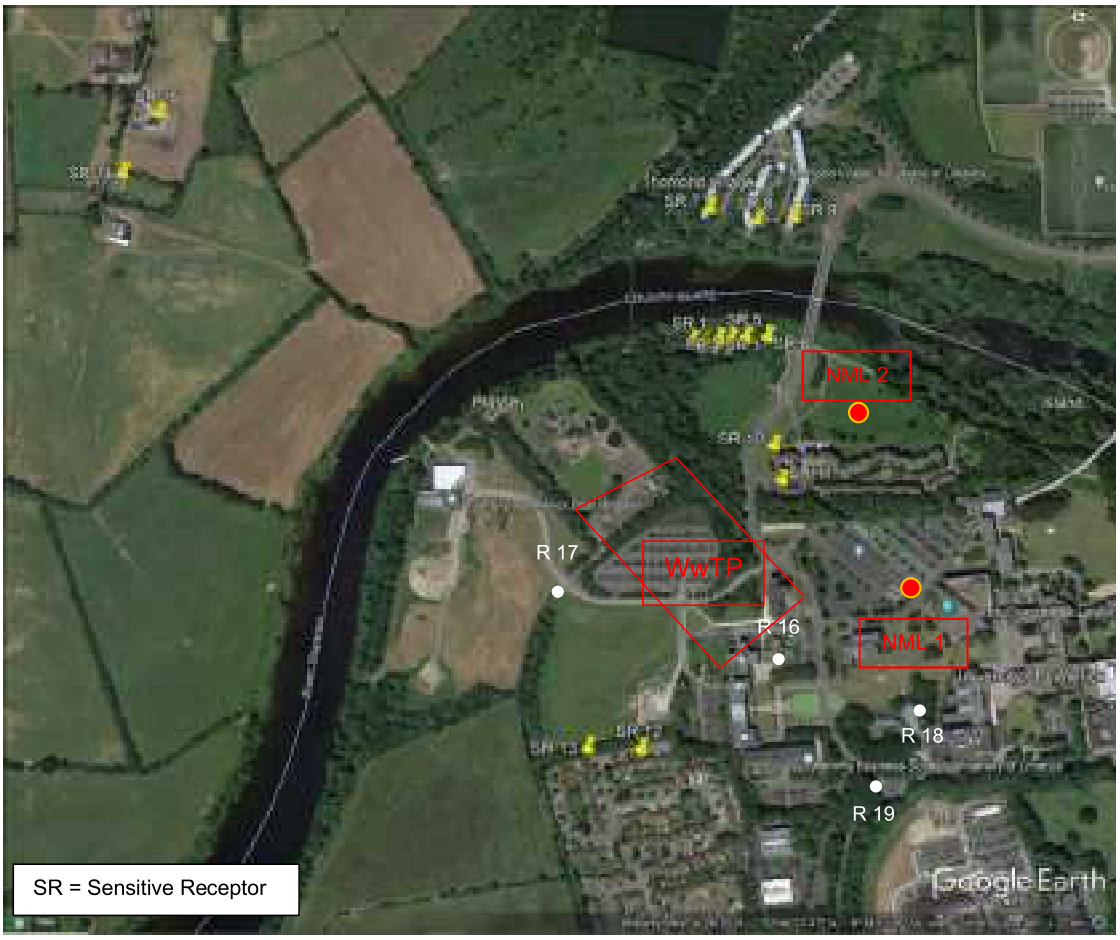

Figure 9-2: Nearest Sensitive Residential Receptor Locations to the Proposed Development and Baseline Noise Monitoring Locations (NML).

Baseline noise measurements were undertaken in proximity to the nearest residential receptors and in proximity to the existing on-site noise sources in accordance with ISO 1996-1:2016, and as shown in Figure 9-2. All noise measurement data was downloaded at the company office, exported from the manufacturer's software and stored as Microsoft Excel spreadsheet files. The procedures for the interpretation of the noise monitoring data during specific time periods as outlined in the Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA 2016) have been used to assess noise levels during the daytime (07:00-19:00) and night-time (23:00-07:00) monitoring periods.

9.2 Assessment Methodology

9.2.1 Noise Prediction Methodology

Noise prediction modelling has been undertaken using CadnaA noise modelling software to predict the potential worst-case noise impact from the Proposed Development on the nearest

sensitive receptors to the site. A noise model has been run to determine if the future noise impact will be in compliance with the relevant guidelines as outlined above. The modelling software calculated noise levels based on the emission parameters and spatial settings. Table 9.6 outlines the parameters, sources, settings and assumptions that have been incorporated into the model.

Table 9.6: Modelling Parameters, Sources and Assumptions

Parameter	Details
Horizontal Distances	Scaled development drawings in AutoCad outlining the noise levels specific distances from each potential noise source as taken from OSI mapping.
Topographical Data	Topographical data from OSI was used in the noise model.
Proposed Development Dimensions	Scaled development drawings in AutoCad. Including location of proposed tanks, existing buildings and dimensions.
Building Heights	Scaled development drawings in AutoCad.
Reflections & Façade Correction	Façade corrections for the buildings have been incorporated into the modelling. All surfaces have been assumed to be “smooth, reflective surfaces”. The facades of Proposed Development have been included.
Ground Absorption	A default ground absorption rate of 0.5 has been used in the noise model

The following receptor locations in proximity to the Castletroy WwTP have been selected for detailed assessment in the noise prediction model. All other receptors in the wider area surrounding the Castletroy WwTP site will experience lower noise levels. Table 9.7 outlines the location of the sensitive residential and educational receptors input into the model and their locations are shown in Figure 9-2.

Table 9.7: Nearest Sensitive Residential Receptor Locations to the Proposed Development

Receptor Reference	ITM Grid Reference		Distance to Nearest Site Boundary (m)
	X (m)	Y (m)	
SR1	560847.5	658623.5	130m
SR2	560865.9	658624.4	142m
SR3	560883.9	658620.5	152m
SR4	560899.3	658625.2	165m
SR5	560919	658626.9	183m
SR6	560946.8	658630.4	202m
SR7	560872.4	658806.8	268m
SR8	560934.1	658781.5	295m
SR9	560981.9	658789.1	338m
SR10	560957.1	658487.4	130m
SR11	560954.5	658443.3	130m
SR12	560782.3	658095.2	275m
SR13	560680.8	658086.9	280m

SR14	560101.5	658848.1	580m
SR15	560145.8	658929.4	585m
R16 (Car park to south)	560799.9	658379.2	30m
R17 (UL Boathouse)	560556.9	658466.3	75m
R18 (Nexus Innovation Centre)	560950.6	658317.2	170m
R19 (UL Building)	560917.5	658244.7	210m

9.3 Baseline Conditions

9.3.1 Baseline Noise Surveys

Operational Noise Limits

Step 1 – Baseline Area Description

The existing environment in the area of the Proposed Development is described in accordance with the Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA 2016).

Table 9.8: Quiet Area Screening of the Development Location - Step 1

Licence Application Reference	N/A
Site Address	Dromroe townland, immediately northwest of the University of Limerick (UL)
Quiet Area Screening of the Development Location	
Screening Question	Answer – Yes / No
Is the site >3km away from urban areas with a population >1,000 people?	No
Is the site >10km away from urban areas with a population >5,000 people?	No
Is the site >15km away from urban areas with a population >10,000 people?	No
Is the site >3km away from any local industry?	No
Is the site >10km away from any major industry centre?	No
Is the site >5km away from any national primary route?	No
Is the site >9.5km away from any motorway or dual carriageway?	No
QUIET AREA?	No.
Other Relevant Comments	The site is not considered to be a “Quiet Area” as per the EPA NG4 definition.

Step 2 – Baseline Noise Surveys

The screening process in Step 1 has not identified a 'quiet area', and a noise measurement survey has been undertaken in proximity to the nearest residential properties to the Castletroy WwTP site to determine a representative prevailing background noise level for the area. The noise monitoring locations are shown in Figure 9-2.

The baseline noise surveys were undertaken in proximity to the nearest residential properties to the Castletroy WwTP site during the following periods and weather conditions:

- Afternoon on Tuesday 21st September 2021 - weather conditions during the assessment period were dry and warm (~18°C), wind direction was from a west-south westerly direction and wind strength was characterised as “Light Air” using the Beaufort scale.
- Early night-time on Tuesday 21st September 2021 - weather conditions during the assessment period were dry and mild (~12°C), wind direction was from a south westerly direction and wind strength was characterised as “Calm” to “Light Air” using the Beaufort scale.
- During both survey periods, Castletroy WwTP was in operation. The noise surveys were undertaken during weather conditions in accordance with ISO 1996: 2016 which were most likely to allow for noise to propagate towards the nearest residential properties.

During the noise surveys, a series of 15-minute noise level measurements were undertaken at each measurement location in proximity to a noise sensitive receptor. All sources of noise from the Castletroy WwTP, as well as noise sources from any other source were noted.

During the noise surveys, noise from the existing Castletroy WwTP tank and building noise sources was noted to be not significant outside the boundary of the existing Castletroy WwTP site. However, during the noise surveys, between periods when occasional passing traffic occurred on the access road through the University of Limerick campus a faint shrill noise was noted to be audible in proximity to the nearest residential properties in closest proximity to the Castletroy WwTP site.

During the noise survey period on the afternoon of Tuesday 21st September 2021, noise level measurements were also undertaken in close proximity to the main noise sources identified on the existing Castletroy WwTP site. This allowed for a fully calibrated noise prediction model to be developed. This noise model was then utilised to include for the Proposed Development works and to determine the resultant future predicted worst-case noise level at the nearest residential properties.

It is understood that no noise complaints have been reported to the site operators in recent years.

The results of the baseline noise survey are presented in Table 9.9: Results of the Baseline Noise Survey.

Table 9.9: Results of the Baseline Noise Survey

Measurement Location	Time	Duration	L_{Aeq} (dB)	L_{AMax} (dB)	L_{AMin} (dB)	L_{A10} (dB)	L_{A90} (dB)	Notes
NML 1	15:24	00:15:00	59.8	73.8	39.4	62.5	41.1	Occasional passing car and students talking - WwTP faintly audible between passing cars. Light breeze
	15:39	00:15:00	58.5	71.1	40.7	61.3	41.8	
NML 2	14:53	00:15:00	52	74.7	36.3	54.2	38.3	

	15:08	00:15:00	50.5	71.1	36.6	52.6	37.6	WwTP audible. Faint shrill noise. Occasional passing car. Distant voices. Light breeze & leaf rustle
NML 1	23:00	00:15:00	49.9	74.1	32.7	50.9	34.8	2 passing cars - WwTP faintly audible. Calm night
NML 2	23:26	00:15:00	44.7	68.7	36.9	46.2	37.3	WwTP audible - low shrill noise from blowers/pumps

The existing daytime and night-time noise levels are broadly in compliance with the World Health Organisation (WHO) has published Guidelines for Community Noise (WHO 1999).

Step 3 – Screen for Areas of Low Background Noise

The existing environment in the area of the Proposed Development site is described in accordance with the EPA Guidance Note for Noise (NG4) (EPA 2016).

For all areas not identified as Quiet Areas in Step 1, the existing background noise levels measured during the environmental noise survey, should be examined to determine if they satisfy the following criteria:

- Average Daytime Background Noise Level ≤40dB L_{AF90} – No
- Average Evening Background Noise Level ≤35dB L_{AF90} - No
- Average Night-time Background Noise Level ≤30dB L_{AF90} - No

As all three of the above criteria are not satisfied, this location is not deemed to be an area of low background noise, and the reduced noise limits detailed in Step 4 are not applicable at receptors in proximity to this Proposed Development location.

Step 4 – Determine Appropriate Operational Noise Criteria

The operational noise limit criteria has been determined based on the results of the screening processes discussed in Steps 1 and 3, and the noise survey discussed in Step 2 above. This location is not deemed to be an 'area of low background noise' or a 'quiet area' and the operational noise limits detailed in **Table 9.10**: Recommended Operational Noise Limits (Based on EPA Guidance (EPA 2016)) are applicable at receptors in proximity to this Proposed Development location.

Table 9.10: Recommended Operational Noise Limits (Based on EPA Guidance (EPA 2016))

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night-time Noise Criterion, dB $L_{Aeq,T}$ (23:00 to 07:00hrs)
All other areas	55dB	50dB	45dB

9.4 Characteristics of the Proposed Development

Details of the Proposed Development are provided in the EIAR **Part A , Section 4.**

9.5 Likely Significant Effects

9.5.1 'Do Nothing' Scenario

The operation of the existing Castletroy WwTP currently has no significant impact on noise levels at existing residential properties in the surrounding area. However, as stated above a faint shrill noise was noted to be audible in proximity to the nearest residential properties in closest proximity to the Castletroy WwTP site. This faint shrill noise was attributed to the existing pumping station at the inlet and the blower units near to the aeration tanks.

It is understood that the operation of the existing Castletroy WwTP has not resulted in noise complaints. The nearest residential properties are located relatively remote from the Castletroy WwTP boundary. The nearest sensitive receptor location is located approximately 130m west of the Castletroy WwTP site boundary. This will remain unchanged with the Proposed Development in operation.

9.5.2 Construction Phase

Construction Noise Limits

There are no Irish statutory limits regarding construction noise. BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Noise (BSI 2014) provides guidance on assessing the potential significance of noise effects from construction activities in Annex E.

In relation to Construction Noise Limits, BS 5228 details the 'ABC method', which recommends a construction noise limit based on the existing ambient noise level. General and short-term construction noise impacts that are deemed typical of any construction site noise sources, including activities such as ground preparation, site clearance, foundation earthworks, roadway construction, erection of new buildings, etc. are assessed in accordance with the 'ABC method' defined in BS 5228. The ambient noise levels have been determined through the baseline noise survey and then rounded to the nearest 5dB to determine the appropriate category (A, B or C) and subsequent threshold value. A potential significant effect is indicated if the construction noise level exceeds the appropriate category threshold value. If the existing ambient level exceeds the threshold category threshold values, then a potential significant impact is indicated if the total noise level, including both the ambient noise and the various contributions of construction noise, is greater than the ambient noise level by more than 3dB.Table 9.11, reproduced from BS 5228, demonstrates the criteria for selection of a noise limit for a specific receptor location.

Table 9.11: : Construction Noise Threshold Levels Based on the BS 5228 'ABC' Method

Assessment Category and Threshold Value Period (L_{Aeq})	Threshold Value, in decibels (dB)		
	Category A	Category B	Category C
Night time (23.00 to 09.00)	**45**	50	55
Evening and weekends (D)	**55**	60	65
Daytime (09.00 – 19.00) and Saturdays (09.00 - 13.00)	**65**	70	75

Notes:
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

No night-time construction works will take place. At the nearest noise sensitive receptors, the ambient noise levels (rounded to the nearest 5 dB) are 50 dB - 55 dB $L_{Aeq,T}$ during daytime. Therefore, all noise sensitive receptors fall into Category A of the 'ABC' assessment methodology and daytime construction noise will be subject to a limit of 65 dB $L_{Aeq,T}$.

Construction Noise Impact Prediction

There is the potential for temporary and intermittent increases in noise levels during the Construction Phase of the Proposed Development at the nearest residential properties. The main sources of noise due to construction of the Proposed Development will be from activities such as truck movements of excavated and construction materials as well as excavator, loader and concrete mixer noise sources. Sheet-piling will also be required. During the Construction Phase, the Proposed Development will generate heavy goods vehicle (HGV) movements. The noise impact of passing HGVs will be short-term at receptor locations in the area. The construction of the Proposed Development will include associated construction site traffic, comprising of contractors' vehicles and cars.

Construction noise can be assessed in terms of the equivalent continuous sound level and/or in terms of the maximum level. The level of sound that arises from a construction site depends on a number of factors and the estimation procedures need to take into account the following significant factors:

- The sound power outputs of processes and plant;
- The periods of operation of processes and plant;
- The distances from sources to receptor;
- The presence of screening by barriers;
- The reflection of sound;
- Ground attenuation;
- Meteorological conditions (particularly wind speed and direction); and
- Atmospheric absorption. Table 9.12 outlines the noise levels from typical road construction noise sources during different phases of the construction process as referenced from BS 5228.

Table 9.12 outlines the noise levels from typical road construction noise sources during different phases of the construction process as referenced from BS 5228.

Table 9.12: Typical Noise Levels During Different Construction Processes as Referenced from BS 5228-1:2009+A1:2014

Ref No.	Equipment	A-Weighted Sound Pressure Level, L_{Aeq}, dB @ 10m
Table C.2 Sound level data on site preparation		
Clearing Site & Ground Excavation / Earthworks		
1	Dozer ж (142 kW, 20T)	75 ж
3	Tracked excavator (102 kW, 22T)	78
12	Dozer (142 kW, 20T)	80

Ref No.	Equipment	A-Weighted Sound Pressure Level, L_{Aeq}, dB @ 10m
Table C.2 Sound level data on site preparation		
Clearing Site & Ground Excavation / Earthworks		
14	Tracked excavator (226 kW, 40T)	79
Loading Lorries		
27	Wheeled loader (493 kW)	80
Distribution of Material		
30	Dump truck (tipping fill) (306 kW, 29T)	79
31	Dump truck (empty) (306 kW, 29T)	87
Rolling and Compaction		
37	Roller (rolling fill) ж	79 ж
Table C.4 Sound level data on general site activities		
Distribution of Materials		
1	Articulated dump truck ж	81 ж
Mixing & Pumping Concrete		
20	Concrete mixer truck	80
Trenching		
63	Tracked excavator	77
Power for Site Cabins		
84	Diesel generator	74
Pumping Water		
88	Water pump (diesel) (10 kW, 100Kg)	68
Sweeping and Dust Suppression		
90	Road sweeper (70 kW)	76
91	Dust suppression unit trailer	78

ж Drive-by maximum sound pressure level in L_{Amax} (overall level)

Worst-case on site noise levels from construction works likely to take place during the Construction Phase of the Proposed Development are outlined in **Table 9.13**.

Table 9.13: Worst-Case Sound Power Level from Construction Works Likely to Take Place During the Construction Phase of Proposed Development (Ref: BS 5228)

Activity	Plant	L_{Aeq} at 10m	Equivalent L_w used in Noise Prediction Model
Clearing Site & Ground excavation/earthworks	Dozer, Tipping Lorries, Dump Trucks, Rolling & Compaction (drive by)	79 dB - 87 dB	Construction activities represented as a continuous three distinct area of

Distribution of materials	Articulated dump truck ж	81 dB	works on site = Point Source L_w 115 dB(A) @ height of 2m.
Mixing & Pumping concrete	Concrete mixer truck	80 dB	

Worst-case construction noise levels at noise sensitive receptors in the area of the Proposed Development have been predicted as outlined in Table 9.14. The closest residential noise sensitive receptor is approximately 130m east from the nearest construction areas of the Proposed Development. A worst-case assessment of construction noise from the Proposed Development indicates that there will be no exceedance of the daytime construction noise limit of 65 dB $L_{Aeq,T}$ at the noise sensitive receptors in the area. It will be incumbent on the contractor to ensure that construction works are undertaken with particular sensitivity to ensure no significant construction noise impact. As stated, all construction works will take place during daytime hours and so the relative construction noise impact will not be significant.

Table 9.14: Predicted Worst-Case Construction Noise Levels Due to Plant and Equipment Noise Levels as Outlined in BS5228(See CadnaA Output in Appendix 9A Figure 9-3)

Receptor	Predicted Worst-Case Construction Noise Level
SR1	50.8
SR2	50.3
SR3	51.5
SR4	51.2
SR5	51.6
SR6	50.8
SR7	45.8
SR8	44.5
SR9	43.9
SR10	51
SR11	49
SR12	50.4
SR13	49.4
SR14	44.3
SR15	43.7
R16 (UL Boathouse)	58.6
R17 (Nexus Innovation Centre)	46
R18 (UL Building)	44.3
Suggested Construction Noise Limit Value	65 dB(A)

The Construction Phase noise impact is therefore predicted to be a Negative, Slight, Short-Term impact.

Construction Vibration Impact Prediction

No blasting is proposed as part of the Construction Phase of the Proposed Development. As stated, the nearest residential properties are located relatively remote from the Castletroy WwTP boundary with the nearest sensitive receptor location located 130m to the east. Therefore, there will be no potential for a vibration impact at the nearest residential properties.

Table 9.15: Summary of Predicted Construction Phase Impacts

Assessment Topic	Predicted Impact
Noise	Slight, Short-term Negative Impact
Vibration	No impact

9.5.3 Operational Phase

Operational Noise Impact Prediction

The main potential noise sources from the Proposed Development will be due to the following:

1. Noise from water movements within tanks and associated noise from pumps, blowers and buildings;

The following noise sources have been input into the noise prediction model. The proposed future noise sources are realistic as the future installed plant and equipment noise sources are based on sound level readings taken in proximity to the existing noise sources on the Castletroy WwTP. The noise prediction model has been calibrated against the sound level readings taken in proximity to the existing noise sources as outlined inTable 9.16.

The predicted operational noise levels during daytime and night-time include for no traffic movements on site. The Castletroy WwTP site only generates occasional site traffic movements in terms of both staff cars and sludge tankers. The Proposed Development will not generate additional traffic movements and therefore, will not result in a significant traffic noise impact.

Table 9.16: Measured Noise Level in Proximity to Main Noise Sources on the Existing Castletroy WwTP and Noise Prediction Model Calibration(Appendix 9A, Figure 9-3)

On Site Monitoring Location	Noise Prediction Model Location	Measured Noise Level – Existing dB(A)	Predicted Noise Level – Existing dB(A)	Level of Model Calibration
S1	At final discharge	68.3	-	Good
S2	At Sludge Building Door	69.8	71.3	Good
S3	At PFT tanks	47.7	50.9	Good
S4	At Clarifier No 3	58.3	58.1	Good
S5	At Pumps & Clarifier 1 & 2	71.7	71.1	Good
S6	At Aeration Tanks - Loud shrill from Pump audible	70.7	71	Good
S7	At Blowers between Aeration Tanks & Inlet Works - loud shrill noise	76.7	76.4	Good
S8	At Inlet Works Pumps	66.3	-	Good
S9	At Inlet Pumping Station	77.6	76.3	Good

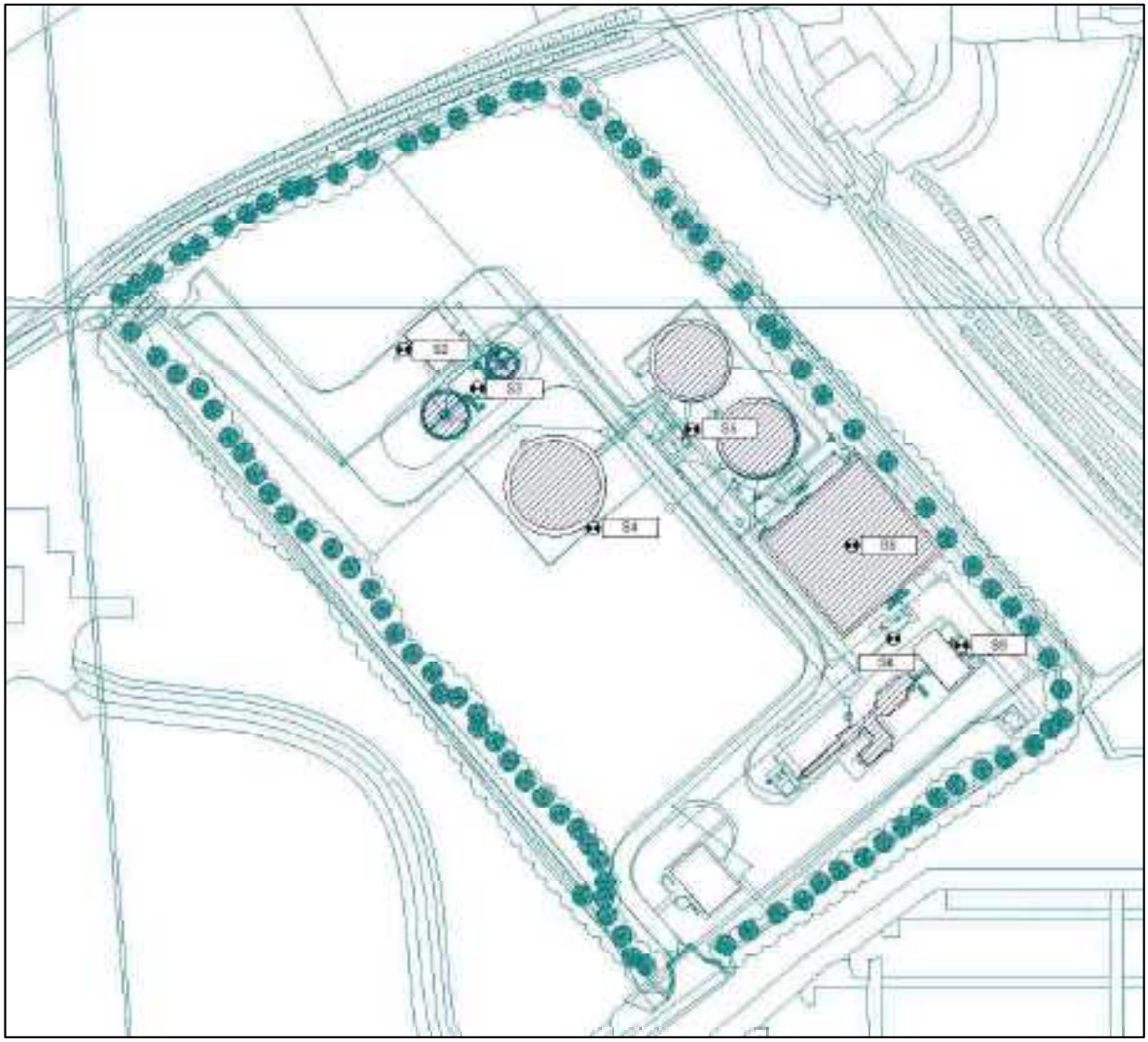

Figure 9-3: Noise Monitoring Locations in Proximity to the Main Noise Sources on the Existing Castletroy WwTP Site to Allow for Accurate Noise Prediction Model Validation

Table 9.17: Predicted Worst-Case 1-Hour Noise Levels at Sensitive Receptor Locations when operating the upgraded plant (See CadnaA Output Appendix 9A Figure 9.6 & Figure 9.7)

Receptor Location	Existing Level Lr dB(A)	With Proposed Development Level Lr dB(A)	Difference Lr dB(A)
SR1	37.8	36.3	-1.5
SR2	39.3	37.3	-2
SR3	39.4	37.7	-1.7
SR4	38.8	37.1	-1.7
SR5	38.3	36.5	-1.8
SR6	37.4	35.6	-1.8
SR7	31.1	29.6	-1.5
SR8	32.4	30	-2.4
SR9	32.4	30.4	-2
SR10	39	36.8	-2.2
SR11	36.9	35.3	-1.6
SR12	35.4	33.1	-2.3
SR13	34.4	32.1	-2.3
SR14	29.9	28	-1.9
SR15	29.6	27.6	-2
R16 (UL Boathouse)	40.9	39.1	-1.8
R17 (Nexus Innovation Centre)	33.4	31.6	-1.8
R18 (UL Building)	37.8	35.2	-2.6
Noise Limit	Daytime – 55 dB(A) $L_{eq,\ 1\ Hour}$ Evening – 50 dB(A) $L_{eq,\ 1\ Hour}$ Night-time – 45 dB(A) $L_{eq,\ 1\ Hour}$		

The predicted operational noise levels with the upgrade of the Castletroy WwTP in operation during daytime and night-time will be quieter than the existing WwTP due to the proposed changes including, an upgrade of the existing Aerzen blowers which produce a 'shrill' noise, the proposed covering of the inlet works and improvements to the Sludge Building with negative pressure system improvements and permanent closing of the doors. The upgrade improvements are defined in Section 4 The Proposed Development.

In comparison to the WHO Guidelines for Community Noise (WHO 1999), the predicted 1-hour noise levels outlined in Table 9.17 due to the operation of the upgraded external plant and equipment noise sources is well in accordance with the WHO daytime guideline of 50 – 55 dB(A) for outdoor living areas and the WHO night-time external guideline of 45 dB(A) at the receptor locations.

The predicted difference in noise level L_r dB(A) between the existing Castletroy WwTP and with the Proposed Development results in a noise level decrease of 1 - 3 dB(A) with a cumulative noise level of <37 dB(A) at all receptor locations. This is not a significant noise level and in

terms of the IEMA classification of impact from the change in sound levels the Proposed Development will result in a Negligible, Not Significant, Long-Term Impact.

BS 4142 Assessment

A BS 4142 assessment has been carried out to assess the potential for '*adverse impact*' due to the specific plant noise sources and associated traffic noise at the nearest worst affected residential receptor SR4. The measured daytime and night-time background noise level has been recorded in proximity to the nearest residential properties. The representative L_{A90} background noise level recorded during daytime and night-time has been used in the BS 4142 assessment.

Table 9.18: BS 4142 Assessment of the Predicted Specific Noise Levels from Existing Castletroy WwTP Site and the Proposed Development at SR 3, During Daytime and Night-Time

BS 4142 Assessment	SR 3		Notes
	Daytime	Night-time	
Measured Ambient Sound Level L_{Aeq}	~51 dB L_{Aeq}	~45 dB L_{Aeq}	*Existing Noise level in proximity to the receptor at NML 2.*
Residual Sound Level	~51 dB L_{Aeq}	~45 dB L_{Aeq}	*Existing Residual Noise level in proximity to the receptor at NML 2.*
Background Sound Level L_{A90}	~38 dB L_{A90}	~37 dB L_{A90}	*Measured Background Sound Level L_{A90} during daytime & night-time at NML 2..*
Predicted specific 1-hour noise level	37.7 dB(A) $L_{eq,\ 1\ Hour}$	37.7 dB(A) $L_{eq,\ 1\ Hour}$	*Worst-case Predicted Specific Noise Level during daytime and night-time at SR 3.*
Acoustic Feature Correction	+0 dB	+0 dB	*Acoustic feature correction – No tonal penalty added as there will be no tonal aspect to the existing or Proposed Development noise sources.*
Rating Level (Specific Noise Level + Acoustic Feature Correction)	37.7 dB(A) L_{Ar}	37.7 dB(A) L_{Ar}	
Background Sound Level L_{A90}	~38 dB L_{A90}	~37 dB L_{A90}	*Background Sound Level L_{A90} during daytime & night-time.*
Excess of Rating Level over Background Sound Level	-0.3 dB(A)	+0.7 dB(A)	According to BS 4142:2014 the greater the difference between the Background Sound Level L_{A90} and the Rating Level L_{Ar} the greater the magnitude of the impact. No potential adverse impact is likely to occur.

BS 4142 states that '*a difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context'.* In terms of *context*, the Proposed Development is within the existing Castletroy WwTP site and will operate in association with the existing tanks and buildings on site. The BS 4142 assessment indicates that the Proposed Development will not cause an adverse noise impact at the nearest residential noise sensitive receptors in comparison to the existing noise levels in the area.

Operational Vibration Impact Prediction

The operation of the existing Castletroy WwTP and the Proposed Development do not contain any aspect which have the potential to give rise to a perceptible vibration impact at any of the nearest residential noise sensitive receptors.

Table 9.19: Summary of Predicted Operational Phase Impacts

Assessment Topic	Predicted Impact
Noise	Negligible, Long-term Negative Impact
Vibration	No impact

9.6 Mitigation Measures and Monitoring

9.6.1 Construction Phase

To avoid potentially significant construction noise and vibration impacts during the Construction Phase, the following mitigation measures will be adopted:

- To protect residential amenity, construction activities will be restricted to daytime hours as outlined:
  - Monday to Friday: 0700 hours – 1900 hours;
  - Saturday: 0800 hours – 1300 hours.
- An on-site speed limit will be enforced for all traffic;
- Heras fencing will go in around stormwater storage tank construction area.
- Best practicable means will be employed to minimise noise emissions and will comply with the general recommendations of BS 5228;
- All plant will be maintained in good working order. Where practicable, machines will be operated at low speeds and will be shut down when not in use;
- Mechanical plant used on site will be fitted with effective exhaust silencers. Vehicle reverse alarms will be silenced appropriately to minimise noise breakout from the site while still maintaining their effectiveness;
- If required, compressors will be of the "noise reduced" variety and fitted with properly lined and sealed acoustic covers;
- In all cases, engine and/or machinery covers should be closed whenever the machines or engines are in use;
- All pneumatic percussive tools will be fitted with mufflers or silencers as recommended by the equipment manufactures. Where practicable all mechanical static plant will be enclosed by acoustic sheds or screens;
- Employees working on the site will be informed about the requirement to minimise noise and undergo training on the following aspects:
- The proper use and maintenance of tools and equipment;
- The positioning of machinery on-site to reduce the emission of noise to the noise sensitive receptors;
- Avoidance of unnecessary noise when carrying out manual operations and when operating plant and equipment; and
- The use and maintenance of sound reduction equipment fitted to power pressure tools and machines.
- It is recommended that if complaints are received from nearby residential properties, periodic noise monitoring will be undertaken during construction works to determine noise levels at noise sensitive receptors. Based on the findings of such noise monitoring, appropriate noise mitigation measures will be implemented to reduce noise impacts. Where excessive noise levels are recorded, further mitigation measures will be employed which may include temporary screening of the nearest receptor to on-site activities;
- Responsible Person - It is recommended that the Contractor will appoint a responsible and trained person who will be present on site and who will be willing to answer and act upon complaints and queries from the local public;

- To protect residential amenity, the cumulative noise level from construction activities on the development site (including plant and equipment) shall not exceed 65 dB $L_{Aeq(12\ hour)}$ at residential dwellings outside the nearest window of the occupied room closest to the site boundary (SR 11);
- Low-level vibration technology will be used;
- Works resulting in vibration will be sequenced so that such activities do not occur simultaneously; and
- Vibration levels will be monitored at both the source and the sensitive receptor location (i.e adjacent to the badger sett , assessed separately in **Section 11**).

Table 9.20: Summary of Predicted Construction Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Predicted Impact (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
Noise	Slight, Short-term Negative Impact	Negligible, Short-term Negative Impact
Vibration	No impact	No impact

9.6.2 Operational Phase

The following specific operational noise mitigation measures have been proposed and it is recommended that any new plant and equipment is installed with noise attenuation measures fitted as per manufacturers' guidance.

Figure 9.5: Noise monitoring location in proximity to existing *Aerzen* blowers.

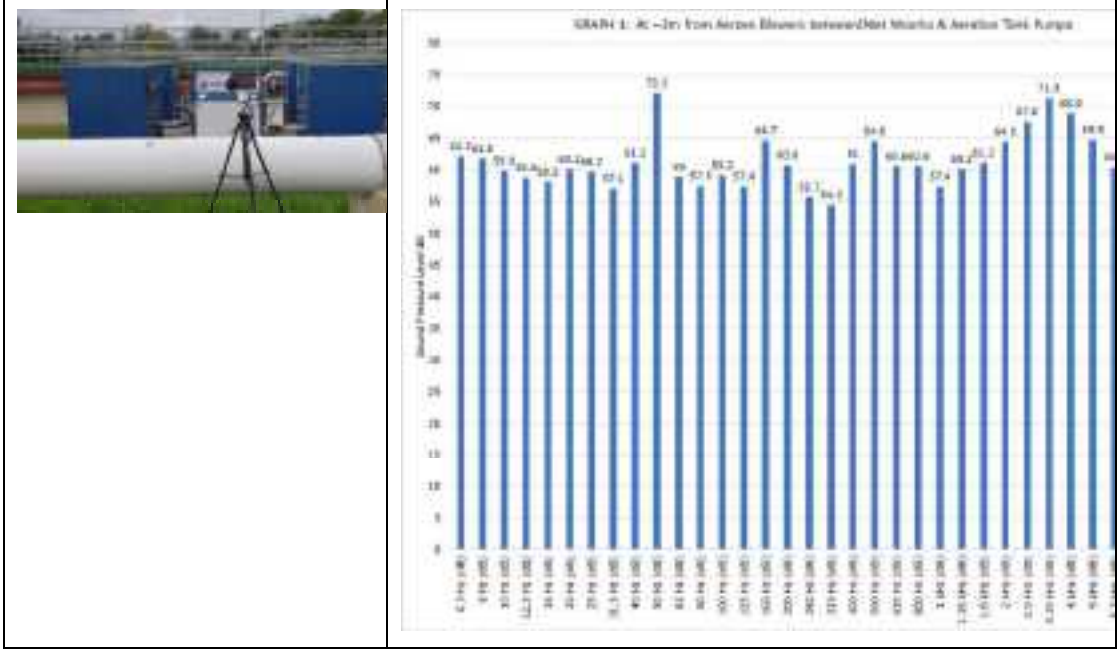

Figure 9.5 indicates that the existing *Aerzen* blowers produce a distinct low frequency tone at 50 Hz. This low frequency tone is most likely responsible for the 'shrill noise' that was noted to be audible off site. It is recommended that these blowers and the proposed additional blowers to be installed at this location are fitted with a suitable noise attenuation enclosure.

Table 9.21: Summary of Predicted Operational Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Predicted Impact (Post Construction and Monitoring)
Noise	Negligible - Minor, Long-term Positive Impact
Vibration	No impact

9.7 Residual Effects

9.7.1 Construction Phase

There will be no residual effects from the Construction Phase of the Proposed Development.

9.7.2 Operational Phase

The noise impact of the Proposed Development will not be significant in relation to the existing background noise level in the area. There will be no significant residual impact from the operation of the Proposed Development. The Proposed Development will result in a negligible to minor long-term noise reduction.

9.8 References

British Standards Institution (BSI) (2014). BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Noise

British Standards Institution (BSI) (2019). BS 4142+A1:2019 Method of Rating and Assessing Industrial and Commercial Noise

Environmental Protection Agency (Ireland) (EPA) (2016). Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

Institute of Environmental Management & Assessment (IEMA) (2014) Guidelines for Noise Impact Assessment

International Organisation for Standardisation (ISO) (2016) ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures

World Health Organization (WHO) (1999). Guidelines for Community Noise