MARSHALL DAY Acoustics

SOUTHWEST WWTP DESIGNATION ACOUSTIC IMPACT ASSESSMENT

Rp 002 20221004 | 31 August 2023

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Project: **SOUTHWEST WWTP DESIGNATION**

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1.0 INTRODUCTION, REPORT SUMMARY AND CONCLUSIONS

Watercare Services Limited (Watercare) is a lifeline utility providing water and wastewater services to 1.7 million people in Auckland. Watercare supplies reliable, high-quality drinking water to homes and businesses in the Auckland region and collects, treats, and discharges their wastewater in environmentally responsible ways. Its services are vital for life, keep people safe and help communities to flourish.

As a council-controlled organisation (CCO), wholly owned by Auckland Council, Watercare manages water and wastewater assets worth over $14 billion and plan and build infrastructure to ensure that growth is supported today and into the future. Watercare's vision is to be "trusted by our communities to deliver exceptional performance every day". Watercare's mission is "reliable, safe and efficient water and wastewater services".

Marshall Day Acoustics have been engaged by Watercare to assess potential acoustic effects associated with the construction and operation of the WWTP. This report is a supporting document to the Notice of Requirement (NoR) for designation of land to enable Watercare to construct the WWTP close to the already consented treated wastewater discharge into the Waiuku Channel.

The primary issues of concern we address in this report are:

- operational noise compliance / effects, and
- noise from the construction of large infrastructure, including sizeable early morning concrete pours and the management of potential adverse effects arising from this.

We have assessed construction and operational vibration as being of no appreciable significance.

We have visited the project site[1] located at 372 Glenbrook Beach Road, Glenbrook on 17 May 2023. We carried out unattended noise logging on an adjacent site to quantify the existing acoustic environment in the vicinity of the closest dwellings. One representative logging position has been selected for this purpose. The results inform our assessment of noise effects.

We have calculated the operational noise envelope for the WWTP based on a noise budget of 113dB L_{WA}. Where the WWTP is designed, constructed and operated to comply with this budget the site will comply with the proposed noise conditions. Operational noise generated at the proposed night-time noise limit of 45 dB L_{Aeq} would have moderate effects in the night-time period in the context of the existing ambient noise environment.

We calculate that typical daytime construction noise will readily comply with the relevant Auckland Unitary Plan limits. We anticipate no adverse noise effects where the works occur during normal construction hours (07:30am to 6:00pm Monday to Saturday).

We anticipate that early morning concrete pours will be required, given the size of the project. Our calculations indicate that noise from these pours will comply with the 45 dB L_{Aeq} night-time limit, albeit marginally so for one property (375 Glenbrook Beach Road). We therefore recommend that all works outside typical daytime construction hours (07:30am to 6:00pm Monday to Saturday) are managed using a Construction Noise Management Plan (CNMP).

We conclude that noise from the proposed Southwest Wastewater Treatment Plant (the project, the WWTP) can be designed, constructed and operated to comply with the proposed noise designation conditions. The conditions mirror the relevant zone standards from the AUP:OP. Compliance with these conditions will result in moderate noise effects.

The report includes proposed designation conditions.

A glossary of terminology is provided in Appendix A.

2.0 PROJECT SITE AND WWTP DESCRIPTION

2.1 Site description

The project site is located at 372 Glenbrook Beach Road (Lot 1 DP 367461). The site has an area of approximately 56 hectares and is a greenfield site currently used for horticulture. The site is bounded predominantly by other rural properties, some containing dwellings. The site's western boundary adjoins Glenbrook Beach Road. The site shares a portion of its eastern boundary with a tidal inlet of the Taihiki River.

Figure 1 overleaf shows the site and surrounding receiving environment.

Figure 1: WWTP site and surrounds

Source: https://mapspublic.aklc.govt.nz

2.2 Project description

Watercare has investigated how best to manage wastewater in Southwest Auckland in response to the anticipated growth identified in the Auckland Unitary Plan (Operative in Part 2016) (AUP: OP). Through this work, they identified the need for a sub-regional WWTP to service the anticipated population growth in the area. The new WWTP is needed to enable Watercare to discharge treated wastewater into the Waiuku Channel in accordance with high quality effluent treatment standards included within a discharge consent granted by the Environment Court in June 2018.

Following an assessment of alternative sites, Watercare has identified the site at 372 Glenbrook Beach Road (Lot 1 DP 367461) as its preferred location for the WWTP and is seeking to designate the full site. Designation of the site will enable construction and operation of the WWTP which will be delivered in stages. The designation provides for a WWTP at full build-out that will provide the capacity to service a long-term population equivalent (PE) of 60,000 in the Southwest area. However, it is initially proposed to construct the first stage, a WWTP for 20,000 PE, shortly followed thereafter by a second stage upgrade for 30,000 PE (in line with the Southwest Discharge Consent population growth).

The site's size and shape provide at least 200 m of separation between the main parts of the treatment plant itself and adjacent properties; The site's existing landscape planting around the streams and wetlands will be retained. The areas not required for the full WWTP are able to be used for farming or will be landscaped which will ensure that the current rural amenity offered by the site is retained.

Construction will commence as soon as possible after the designation is in place and the required regional resource consents are obtained.

Information about the design and operation of the WWTP is set out in the Indicative Design and Operational Report, prepared by Stantec dated August 2023 contained as Appendix A to the Assessment of Environmental Effects supporting the NoR. We understand that the WWTP will have operational staff at the site during weekday hours between 7am and 5pm. Outside of these hours, the WWTP is remotely operated through the Watercare control centre in Newmarket. If a process alarm is tiggered (not audible), the duty operational staff attends to the matter remotely. Should the alarm not be resolved, the duty operational staff travels to the site to manually intervene and correct the issue.

A figure showing the bulk and location of the proposed WWTP is shown in Appendix B.

2.3 Identified potentially noise sensitive receivers

Table 1 lists the receivers we have identified as potentially noise sensitive[2]. The table lists each receiver, zoning / primary use, and minimum distance to the anticipated WWTP envelope. If compliance is shown at the identified receivers, then it can be inferred with confidence for all other, more distant, receivers not included in the assessment.

The NoR discusses the potential for future sensitive receivers to locate adjacent to the project site. It concludes that it is highly unlikely that the subdivision of adjacent lots can occur as the land is defined as "highly productive land". Therefore, it is expected to be protected for use in land-based primary production.

Table 1: Receiver table

Pos. No.	Address/location	Zoning / Usage	Min. Distance to WWTP Acoustic Centre (m)[1]
R1	28 Dunsmuir Road	Rural[2] / dwelling	590
R2	36 Dunsmuir Road	Rural / dwelling	555
R3	62A Dunsmuir Road	Rural / dwelling	542
R4	349 Glenbrook Beach Road	Rural / dwelling	507
R5	375 Glenbrook Beach Road	Rural / dwelling	454
R6	381-389 Glenbrook Beach Rd[3]	Rural / farm	417
R7	393a Glenbrook Beach Road	Rural / dwelling	482
R8	407 Glenbrook Beach Road	Rural / dwelling	665
R9	424 Glenbrook Beach Road	Rural / dwelling	476

[2] AUP:OP Chapter J – Definitions defines activities sensitive to noise as: Any dwelling, visitor accommodation, boarding house, marae, papakāinga, integrated residential development, retirement village, supported residential care, care centres, lecture theatres in tertiary education facilities, classrooms in education facilities and healthcare facilities with an overnight stay facility.

Pos. No.	Address/location	Zoning / Usage	Min. Distance to WWTP Acoustic Centre (m)[1]
R10	431 Glenbrook Beach Road	Rural / dwelling	687
R11	442 Glenbrook Beach Road	Rural / dwelling	638
R12	450 Glenbrook Beach Road	Rural / dwelling	488
R13	454 Glenbrook Beach Road	Rural / dwelling	566
R14	455 Glenbrook Beach Road	Rural / dwelling	764
R15	467 Glenbrook Beach Road	Rural / dwelling	865
R16	338 Glenbrook Beach Road	Rural / dwelling	655

Notes to Table:

(1) The WWTP footprint will be a minimum 200 m from the property boundary and over 400m from an existing dwelling
(2) Rural refers to Rural – Mixed Rural Zone in the AUP:OP
(3) Although no dwelling currently exists on this site one could in the future. The assessment uses an assumed setback of 10m from front yard as the nominal dwelling location

We understand that receiver R16 (338 Glenbrook Beach Road) is home to a bevy of deer. Deer can be sensitive to certain types of noise, including noise which is impulsive (short, sharp and louder) in character. Operational noise emitted by the WWTP will be steady-state, well separated from the site and therefore unlikely to startle deer, in our opinion[3].

Construction noise, by comparison, is more variable and can include intermittent banging and loud short-term activities such as drilling, hammering etc. We recommend stakeholder engagement prior to and during construction so as to ensure that potential effects on the deer are avoided as far as practicable. This will be addressed in the project's CNVMP.

Figure 2 overleaf shows the location of the identified receivers.

[3] Note we are not experts on assessing noise effects on animals. These are general comments.

Figure 2: Closest noise sensitive activities (refer to Table 1 for details)

3.0 EXISTING BASELINE NOISE ENVIRONMENT

We deployed an unattended noise logger close to the project site to quantify the existing noise environment of the area. The summarised results form the basis of an effects assessment.

The processed logging results indicate that existing background noise ranges between 24-56 dB L_{A90} daytime and 24-43 dB L_{A90} night-time. Ambient noise ranges between 30-61 dB L_{Aeq} daytime and 28-51 dB L_{Aeq} night-time. The existing acoustic environment is typically controlled by environmental sounds as well as farming activity.

We installed a noise logger at the location shown in Figure 3. The logger automatically measured sound in 1-second intervals for about nine usable days. We derived 5-minute interval results through post-processing of the data. We removed any measurement intervals where the weather was outside the allowable meteorological window prescribed in NZS 6801:2008.

Figure 3: Noise logger location

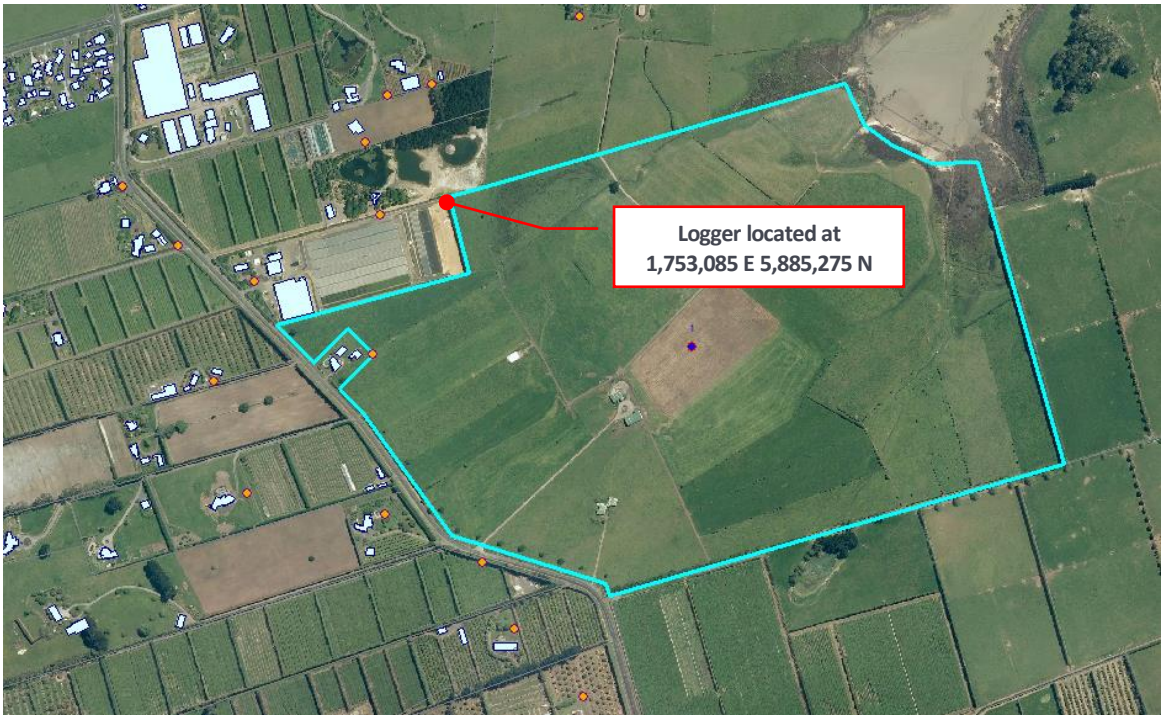


Table 2 summarises the processed noise logger results and shows the range of noise levels and the average per period. Refer to Appendix C for the full summary of noise logging results and level range versus time histogram.

Table 2: Derived existing noise levels

Period	Ambient Noise (dB L_{Aeq})	Background Noise (dB L_{A90})
Monday to Sunday:		
Daytime (7:00am -10:00pm)	30 – 61	24 – 56
Daytime Average	49	42
Night-time (10:00pm -7:00am)	28 – 51	24 – 43
Night-time Average	39	31

Notes:

(1) An explanation of technical terms is provided in Appendix A
(2) Refer to Figure 2 for location of the noise loggers

Based on observations whilst we were on site during the daytime, the existing acoustic environment is typical of a rural setting adjacent to a collector road. Farming activities were audible, and this would likely control the ambient environment during the daytime. Environmental sounds e.g., wind, bird and insect noise would contribute in all periods of the day when present.

4.0 GUIDELINE ACOUSTIC PERFORMANCE STANDARDS

We have reviewed the underlying zone limits contained in the AUP:OP. For operational noise the designation adopts the limits contained in Standard E25.6.3, For construction noise the designation adopts the limits contained in NZS 6803:1999.

4.1 Operative in part Auckland Unitary Plan

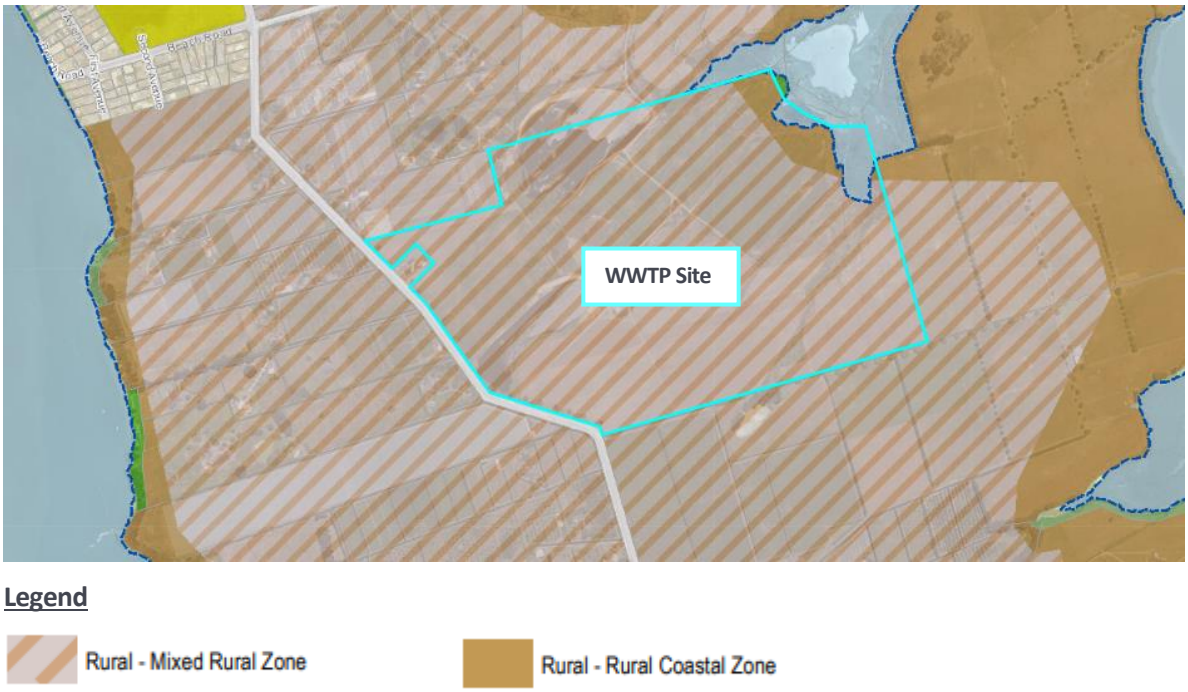
4.1.1 AUP:OP zone overview

The site is predominantly zoned Rural - Mixed Rural Zone under the AUP:OP[4]. The AUP:OP zoning and standards for adjacent sites sensitive to noise are:

- Rural – Mixed Rural Zone Standard E25.6.3(1) / E25.6.27(1)
- Rural – Rural Coastal Zone Standard E25.6.3(1) / E25.6.27(1)

Figure 4 displays the AUP:OP zoning for the WWTP site and surrounding properties.

Figure 4: AUP:OP zones



[4] Part Rural: Rural Coastal zone and part Rural: Mixed Rural Zone refer to Figure 4

4.1.2 AUP:OP operational noise performance standards

The relevant receiver zone limits are summarised in the following table.

Table 3: AUP:OP noise performance standards

Zone	Standard	Daytime[1]	All other times
Rural – Mixed Rural Zone	E25.6.3(1)	55 dB L_{Aeq}	45 dB L_{Aeq} 75 dB L_{AFmax}
Rural – Rural Coastal Zone	E25.6.3(1)	55 dB L_{Aeq}	45 dB L_{Aeq} 75 dB L_{AFmax}

Notes to table:

(1) Daytime is 7am to 10pm Monday to Saturday and 9am to 6pm on Sunday
(2) Noise received in any rural zone is assessed at the notional boundary

The full suite of limits as they appear in the AUP:OP are contained in Appendix D.

In accordance with Standard E25.6.1(1) noise arising from activities must be measured and assessed in accordance with NZS 6801:2008 *"Acoustics – Measurement of environmental sound"* and NZS 6802:2008 *"Acoustics – Environmental noise"*.

4.1.3 AUP:OP operational vibration performance standards

Standard E25.6.30 (2) stipulates vibration levels for stationary vibration sources and any attached equipment to not exceed the limits in AUP:OP Table E25.6.30.2 when measured in any occupied room of any building on another site. In summary, the limits are 0.20 mm/s between 0700 and 2200 hrs and 0.14 mm/s between 2200 and 0700 hrs.

4.1.4 Construction noise performance standard

Standard E25.6.1 (3) of the AUP:OP states that noise from any construction work activity must be measured and assessed in accordance with the requirements of NZS 6803: 1999 *"Acoustics - Construction Noise"*.

Standard E25.6.27(1) sets noise limits for typical[5] duration construction. As the anticipated length of the construction period would exceed 20 weeks, Standard E25.6.27 (4) is relevant. Subsequently, the construction noise limits set out in Table E25.6.27.1 would be decreased by 5 decibels[6].

In summary, the guideline noise limits applying to typical construction hours (7:30am to 6:00pm) would be 70 dB L_{Aeq} and 85 dB L_{Amax} assessed at 1m from the façade of occupied buildings.

4.1.5 AUP:OP construction vibration performance standards

The relevant AUP:OP construction vibration rules are set out in Standard E25.6.30. Standard E25.6.30(1)(a) refers to the German Standard DIN 4150-3:1999 "*Structural Vibration - Effects of Vibration on Structures*" for the prevention of cosmetic damage to buildings.

AUP:OP Standard E25.6.30(1)(b) sets out the amenity limits for construction vibration.

The following sub-sections discuss the relevant rules.

[5] Typical duration construction is defined in Clause 7.2.1(b) of NZS 6803:1999 as "continuous construction lasting more than 14 days but less than 20 weeks"

[6] Standard E25.6.27(4) unintentionally reduces the night-time construction noise limit from 45 dB L_{Aeq} / 75 dB L_{Aeq} down to 40 dB L_{Aeq} / 70 dB L_{Aeq}. This results in limits which are *less* than prescribed in NZS 6803: 1999 Acoustics - Construction Noise. For the avoidance of doubt, we have not applied Standard E25.6.27(4) with respect to the night-time period, instead using the limits in NZS 6803:1999.

Cosmetic damage to buildings

DIN 4150 relates to the avoidance of *cosmetic* building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in DIN 4150 and can generally be easily repaired. The cosmetic building damage thresholds are much lower than those that will result in structural damage. DIN 4150 states: "*Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur*."

The vibration limits in Table 1 and Table 3 of DIN 4150 are presented in the following tables.

Table 4: Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures (Table 1 DIN 4150)

		Guideline values for velocity, v_i, in mm/s			
		Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor, at all frequencies
Line	Type of structure	1 - 10 Hz	10 - 50 Hz	50 - 100 Hz[1]	
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10	8

Notes:

(1) At frequencies above 100 Hz, the values given in this column may be used as minimum values

Table 5: Guideline values for vibration velocity to be used when evaluating the effects of long-term vibration on structures (Table 3 DIN 4150)

Line	Type of structure	Guideline values for velocity, v_i, in mm/s of vibration in horizontal plane of highest floor, at all frequencies
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	10
2	Dwellings and buildings of similar design and/or	5
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	2.5

Construction vibration amenity

AUP:OP Table E25.6.30.1 sets out vibration limits for occupied buildings and is reproduced below.

Table 6: Vibration Limits in (Occupied) Buildings

Receiver	Period	PPV Limit
Occupied Activity sensitive to vibration	Night-time 2200 to 0700 hrs	0.3 mm/s
	Daytime 0700 to 2200 hrs	2 mm/s
Other occupied buildings	At all times	2 mm/s

Works generating vibration are permitted to exceed the limits in Table E25.6.30.1 (refer to Table 6) if:

- The works do not exceed 5m m/s, and
- The works occur for three days or less, and
- The works occur between 0700 to 1800 hrs, and
- occupants located within 50m of the works are advised in advance.

Damage to existing buried pipework

The vibration limits from Table 2 of DIN 4150 are provided in the Table 8. The limits are designed to prevent damage from occurring to existing buried pipework constructed from various materials.

Table 7: Prevention of Damage to Buried Pipework DIN 4150-3: 1999 Vibration Criteria (mm/s PPV)

Line	Pipe Material[7]	Peak Particle Velocity Vibration Level (mm/s)	
		Short-term (transient)[8]	Long-term (continuous)[9]
1	Steel (including welded pipes)	100	50
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal	80	40
3	Masonry, plastic	50	25

4.2 Proposed operational noise and construction noise performance standard

The designation proposes to:

- adopt the AUP standard E25.6.3(1) / E25.6.27(1) for operational noise, and
- the limits contained in NZS 6803:1999 for construction noise.

Refer to Section 9.0 for our proposed designation conditions.

Given there are no operational vibration effects (refer Section 6) and no construction vibration effects (refer Section 8) are anticipated, vibration performance standards are not proposed.

5.0 OPERATIONAL NOISE IMPACT ASSESSMENT

Our assessment confirms that WWTP operational noise can comply with the proposed designation conditions. The WWTP will be audible at times at some receivers. Operational noise generated at the proposed night-time noise limit of 45 dB L_{Aeq} (at zones level) would have moderate effects in the night-time period in the context of the existing ambient noise environment.

5.1 Calculated operational noise levels

Using the modelling methodology detailed in Section 5.3 we have calculated the WWTP's noise envelope. The results are summarised in Table 9 and shown graphically as noise contours in Appendix E. The modelling confirms that where the WWTP is designed, constructed and operated to comply with the recommended noise budget of 113 dB L_{WA} (≤45 dB L_{Aeq} at all receivers) the site will comply with proposed noise condition 1.

Table 8: Calculated operational noise (based on noise budget of 113 dB L_{WA})

Rec. No.	Address	Project Noise Limits [Daytime / Any other time]	Anytime (dB $L_{Aeq\ 15\text{-}min}$)	Complies?
R1	28 Dunsmuir Road	55 / 45	42	Yes
R2	36 Dunsmuir Road	55 / 45	43	Yes
R3	62A Dunsmuir Road	55 / 45	43	Yes
R4	349 Glenbrook Beach Road	55 / 45	43	Yes

[7] Assumes pipes have been manufactured and laid using current technology.

[8] Short-term (transient) vibration is "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*"

[9] Long-term (continuous) vibration includes types not covered by the short-term vibration definition

Rec. No.	Address	Project Noise Limits [Daytime / Any other time]	Anytime (dB $L_{Aeq\ 15\text{-}min}$)	Complies?
R5	375 Glenbrook Beach Road	55 / 45	44	Yes
R6	381-389 Glenbrook Beach Rd	55 / 45	44	Yes
R7	393A Glenbrook Beach Road	55 / 45	45	Yes
R8	407 Glenbrook Beach Road	55 / 45	40	Yes
R9	424 Glenbrook Beach Road	55 / 45	44	Yes
R10	431 Glenbrook Beach Road	55 / 45	39	Yes
R11	442 Glenbrook Beach Road	55 / 45	37	Yes
R12	450 Glenbrook Beach Road	55 / 45	44	Yes
R13	454 Glenbrook Beach Road	55 / 45	44	Yes
R14	455 Glenbrook Beach Road	55 / 45	36	Yes
R15	467 Glenbrook Beach Road	55 / 45	37	Yes
R16	338 Glenbrook Beach Road	55 / 45	37	Yes

Notes to Table:

(1) An explanation of technical terms is provided in Appendix A
(2) Calculated noise levels exclude any rating level adjustments

Discussion regarding compliance of other aspects of the project

With respect to compliance with the maximum noise limit of 75 dB L_{AFmax} applicable outside the prescribed daytime period (refer to Table 4) we note that treatment plants typically emit steady-state noise during operation. Therefore, the plant will readily comply with the maximum noise limit. No further assessment is necessary.

Regarding noise from the operation of mobile plant and on-site vehicle movements (including audible reversing alarms) this will be a very small component of the site's overall noise emission and therefore of minimal consequence. We understand that vehicular movements at night will be minimal therefore noise from audible reversing alarms will not cause adverse effects.

Regarding the fire detection and evacuation alarming system we understand this will be tested monthly during the daytime. The test will consist of short 2-second bursts of each siren approximately five times. If there is a fire, then the siren will go off until the alarm is acknowledged by staff or fire brigade attending site. An emergency could happen anytime.

Regarding the security alarm we understand this will be tested annually during the daytime. The alarm will sound for a moment if someone forgets to disarm building. It will also sound if it has a fault or if there is an intruder. An alarm will go to nerve centre and on-call tech and can be remotely disarmed or disarmed when someone gets to site.

5.2 Assessment of operational noise effects

Comparing the calculated noise levels in Table 9 to the existing noise environment (refer to Section 3.0 and Appendix C for detailed results) we note the following:

- Operational noise (up to 45 dB L_{Aeq}) fits within the range of existing night-time ambient noise (28 to 51 dB L_{Aeq}) however is above the average of 39 dB L_{Aeq}, and
- Operational noise (up to 45 dB L_{Aeq}) is above the range of existing night-time background noise (24 to 43 dB L_{A90} with an average of 31 dB L_{A90}). We are of the opinion that site noise at night will be audible at some locations some of the time.

Based on the above we conclude that noise from the proposed WWTP, when designed and operated to comply with the proposed designation conditions, will result in moderate noise effects in the night-time period as a worst case. In this context "moderate" means audible outside. WWTP noise may be audible inside some dwellings with windows ajar for ventilation. With windows closed WWTP noise will likely be inaudible.

5.3 Operational noise modelling methodology

We have calculated operational sound levels in accordance with the algorithms detailed in ISO 9613 2:1996 and implemented in SoundPLAN® environmental noise modelling software. ISO 9613 considers a range of frequency dependent attenuation factors including atmospheric absorption, ground and barrier effects, directivity, as well as spherical spreading.

The ISO 9613-2 standard adopts the conservative approach of assuming that wind is always blowing from the noise source towards all receivers. The calculations also hold for average propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights.

Specific equipment has not been selected at this stage of the project therefore we have adopted a "noise budget" approach in calculating the WWTP's noise envelope. A noise budget typically allocates a percentage of the total noise that an activity can generate (whilst complying with the relevant noise limits) to individual items of plant, or to a group or particular process e.g., plant room pumps, inlet works etc. In modelling cumulative noise emissions up to and including Stage 3, we have apportioned the full noise budget to an area source encompassing all the noise sources shown in Appendix B[10].

Table 10 provides the indicative sound power level and the maximum allowable sound pressure level at the closest notional boundary position. The sound power levels are intended as a guide for design purposes only. However, it is essential that the maximum allowable sound pressure level at the closest notional boundary position is not exceeded. We have made allowances for future projects on the same site.

The noise budget has been designed to comply with the proposed project night-time noise limit of 45 dB L_{Aeq}. This is the Mixed Rural Zone night-time limit in AUP:OP Standard E25.6.3(1).

[10] Our assessment assumes that no significant noise source will be located outside the 200 m boundary setback shown in Appendix B

Table 9: Project noise budget (locations of sources shown in Appendix B)

Budget item description	Sound power level	Maximum allowable sound pressure level	
	(dB L_{WA})[3] (for guidance)	(dB $L_{Aeq\ (15\ min)}$) at 120 m (for guidance)	(dB $L_{Aeq\ (15\ min)}$) 454 m setback (Critical)
Stage 1 (20,000 PE):			
- Pre-treatment (pumping/screening)	103	50	36
- Secondary treatment (ASR, aeration, MBR)	103	50	36
- Tertiary treatment (UV disinfection, pumping, chemical dosing)	103	50	36
- Sludge handling (Sludge thickening, dewatering by centrifuge, odour control	103	50	36
Stage 1 total:	**109**	**56**	**42**
Future Stage 2 (30,000 PE):			
- Bioreactor 3, MBR train, process building space	105	52	38
Future Stage 3 (60,000 PE):			
- Duplication of Stage 2 processes	105	52	38
Spare allocation	105	52	38
WWTP (cumulative)	**113**	**60**	**45**

Notes:

(1) 'PE' stands for population equivalent
(2) Values in table are rounded
(3) Sound power levels are derived from the overall sound pressure level assessed at the critical receiver distance i.e., 454m

6.0 OPERATIONAL VIBRATION ASSESSMENT

The operation of the WWTP will generate levels of vibration at the closest dwellings similar to the threshold of perception. No vibration effects will occur.

6.1 Operational vibration high-level screening assessment

We have undertaken a high-level vibration screening assessment for the operation of the WWTP. Using the identified high-vibration source we have calculated vibration levels received at the closest dwelling.

British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* provides general guidance on the effects of different vibration levels[11]. It states that a vibration level of 0.3 mm/s PPV is the threshold of perception in residential environments[12]. Comparing BS 5528 guidance to the AUP:OP night-time limit of 0.20 mm/s PPV, we note that the AUP:OP limit is lower than the threshold of perception.

Table 11 lists the activity and the identified highest-vibration source associated with that activity, the closest source-to-receiver distance and AUP:OP compliance status. The screening assessment indicates compliance with the relevant guideline limit. The level of received vibration will be below the threshold of perception.

Table 10: Screening summary table

Activity	Source	Vibration at Source (mm/s PPV)	Min. Rec (distance, m)	Vibration Level mm/s PPV	Potential to Exceed AUP Standards, Warranting Further Assessment?
Dewatering	Centrifuge	2-4[13]	330	<0.20	No. Complies with E25.6.30 (2)

7.0 CONSTRUCTION NOISE ASSESSMENT

Construction noise will readily comply with the relevant limits during typical work hours. Early morning concrete pours are calculated to marginally comply with 45 dB L_{Aeq} at one receiver (375 Glenbrook Beach Road). Where early morning concrete pours are required, these should be managed via a CNMP to avoid adverse effects.

7.1 Calculated typical construction noise levels

Construction works associated with the project will consist of:

- Site enabling works and bulk earthworks
- Construction of haul routes, site entrance, access roads and staff parking
- Foundations and structures
  (see Section 6.2 for a specific assessment of noise from early morning concrete pours)
- Installation of treatment plant and control systems, and
- Site landscaping and remediation

[11] MDA notes that BS 5528 relates to construction. However, the guidance relating to threshold and perception applies to any vibration source.

[12] BS 5228-2:2009 Annex B Table B.1

[13] https://dolphincentrifuge.com/decanter-centrifuge-vibration/

We anticipate the plant and activities shown in Table 12 will be used during construction. The table includes the per unit sound power level, calculated level at the three closest receivers, and the minimum distance required to comply with the construction noise limit (refer to Section 4.1.5).

Table 11: Calculated construction noise levels for three closest receivers

Activity	Equipment	Sound Power	Façade Noise Level (dB L_{Aeq})			Limit Setback (m)
		(dB L_{WA})	R5[3]	R13[4]	R15[5]	70 dB L_{Aeq}
Site enabling works	20T excavator	103	42	39	33	25
	Truck and trailer	105	44	41	35	30
Strip topsoil and bulk excavation to form building platform	20T excavator	103	42	39	33	25
	5-axle dump truck	106	45	42	36	33
	Bulldozer	113	52	49	43	63
Piling / foundations	Vibro sheet piling rig	116	55	52	46	83
	Concrete pump	106	45	42	36	33
	20T Excavator	103	42	39	33	25
	Truck	97	36	33	27	13
	Generator (150 kVA)	93	32	29	23	8
Erect precast concrete wall panels, steel framing, roof structures, pipes etc.	30T mobile crane	98	37	34	28	14
	Grinder (hand tools)	108	47	44	38	40
	Concrete truck and pump	103	42	39	33	25
	Generator (150 kVA)	93	32	29	23	8
	Pump (150m m dia.)	93	32	29	23	8
	Compressor	93	32	29	23	8
	Truck idling	91	30	27	21	6
Site landscaping and access roads	7T excavator	102	41	38	32	22
	20T excavator	103	42	39	33	25
	3-axle dump trucks	106	45	42	36	33
	7t vibratory roller	102	41	38	32	22
	Bitumen truck	103	42	39	33	25

Notes to table:

(1) Appendix A provides an explanation of technical terms
(2) In accordance with Section C.2 of NZS 6803: 1999 results include of 3 dB facade reflection
(3) R5 represents façade of 375 Glenbrook Beach Road located 330 m from the edge of construction

(4) R13 represents 454 Glenbrook Beach Road. Denotes typical receiver located 450 m from the edge of construction
(5) R15 represents 467 Glenbrook Beach Road. Represents receivers located at least 755 m distance from the edge of construction
(6) The maximum noise level limit (85 dB L_{AFmax}) will be readily complied with at all receivers

Noise from construction activities is calculated to readily comply with the relevant daytime noise limits. No adverse effects will occur. In our opinion, if general compliance with the construction noise limit is achieved then construction noise effects will be adequately controlled.

7.2 Early morning concrete pours

We understand that there will be a number of early morning concrete pours associated with the project potentially spaced over a period of approximately 9 months (for Stage 1). The size of the project and resulting concrete pours are such that it may be necessary to start work as early as 3am [14] (the pour would occur 3am to 10am). This is so the concrete supplier can fulfil the batch order and for trowelling / final finishing to occur early in the curing process. We have been advised that pours could also occur between 7am and early afternoon. However, these would readily comply with the daytime noise limit.

We have calculated construction noise associated with early morning pours and assessed the levels against the night-time noise limits of 45 dB L_{Aeq} / 75 dB L_{AFmax} for residential receivers. The results are shown overleaf in Table 13.

The results confirm that combined noise from early morning concrete pours will comply with the guideline night-time noise limits in AUP:OP Standard E25.6.27(1) at the assessed receivers. We calculate marginal compliance at the closest receiver (375 Glenbrook Beach Road). This is on the basis that there is a risk of minor exceedance (3 dB) where multiple concrete pumps are used at the same time. We are of the opinion that the exceedance will not cause adverse effects provided that:

- all concrete pours which occur fully or partially in the night-time period[15] are managed via a CNMP. This will include but not be limited to:
  - notifying nearby residents in advance of each concrete pour
  - reviewing available mitigation / management measures to ensure that the best practicable option is implemented, and
  - monitoring noise to ensure compliance with the limits (as far as practicable)

Table 12: Calculated concrete pour noise levels

Activity	Equipment	Sound Power	Façade Noise Level (dB L_{Aeq})			Limit Setback (m)
		(dB L_{WA})	R5[3]	R13[4]	R15[5]	45dB L_{Aeq}
Foundations	Concrete pump	106	-	-	-	-
	Truck idling	91	-	-	-	-
	Generator (150kVA)	93	-	-	-	-
	Combined Noise	**106**	**45**	**42**	**36**	**331**

Notes to table:

(1) Appendix A provides an explanation of technical terms

[14] The pours will be staged to comply with the project's traffic management plan

[15] As per AUP:OP Table E25.6.27.1: 8:00pm to 6:30am Monday to Saturday and 6:00pm to 6:30am Saturday to Monday

(2) In accordance with Section C.2 of NZS 6803: 1999 inclusive of 3 dB facade reflection
(3) R5 represents façade of 375 Glenbrook Beach Road located 330 m from the edge of construction
(4) R13 represents 454 Glenbrook Beach Road. Represents a typical receiver located 450 m from the edge of construction
(5) R15 represents 467 Glenbrook Beach Road. Represents receivers located at least 755 m distance from the edge of construction
(6) The maximum noise level limit (85 dB L_{AFmax}) will be readily complied with at all receivers

7.3 Construction noise prediction methodology

The contractor will develop a detailed construction programme prior to the commencement of construction activities. This will form part of the Construction Noise Management Plan. We have assumed an indicative construction methodology for our calculations in its absence.

We have assumed that typical construction techniques will be employed on this project. Initial earthworks will be required, followed by the creation of haul routes for construction traffic.

We have calculated construction noise in general accordance with the method detailed in Annex D[16] of NZS 6803:1999. The method considers the sound power level, periods of operation, distance from source to receiver and screening of each source, as well as façade reflection and the degree of soft ground attenuation.

8.0 CONSTRUCTION VIBRATION ASSESSMENT

Construction of any stage of the WWTP will generate imperceptible levels of vibration at the closest dwellings. No vibration effects will occur.

8.1 Construction vibration high-level screening assessment

We have undertaken a high-level vibration screening assessment for construction activities. Using the identified high-vibration source we have calculated the vibration level received at the closest dwelling.

Table 13 lists the activity, the identified highest-vibration source associated with that activity, the closest source-to-receiver distance and AUP:OP compliance status. The vibration screening assessment indicates ready compliance with the relevant guideline limits.

Table 13: Screening summary table

Activity	Source	Min. Rec (distance, m)	Vibration Level mm/s PPV	Potential to Exceed AUP Standards, Warranting Further Assessment?
Foundations, excavation shoring	Vibratory sheet piling	330	<1	No. Complies with E25.6.30 (1)(a&b)

[16]Annex D refers to BS5228-1: 1997 (now superseded by BS 5228-1:2009)

9.0 CONCLUSION

We have calculated the operational noise envelope for the WWTP based on a noise budget of 113 dB L_{WA}. Where the WWTP is designed, constructed and operated to comply with this budget the site will comply with the proposed noise conditions which reflect the relevant AUP:OP standards. Moderate noise effects at night-time may occur.

We calculate that typical daytime construction noise will readily comply with the relevant Auckland Unitary Plan Zone limits. We anticipate no adverse noise effects where the works occur during normal construction hours (07:30am to 6:00pm Monday to Saturday).

We anticipate that early morning concrete pours will be required, given the size of the project. Our calculations indicate that noise from these pours will comply with the 45 dB L_{Aeq} night-time limit, albeit marginally so for one property (375 Glenbrook Beach Road). We therefore recommend that all works outside typical daytime construction hours (07:30am to 6:00pm Monday to Saturday) are managed using a Construction Noise Management Plan (CNMP).

We have assessed construction and operational vibration as being of no appreciable significance.

10.0 PROPOSED CONDITIONS OF DESIGNATION

We propose the following noise conditions, should the Designation be approved.

Operational Noise

1. Noise from the operation of the wastewater treatment plant shall meet the following noise limits at the notional boundary of rural zone receivers:

Receiving Zone	Daytime (7am – 10pm Mon – Sat, 9am – 6pm Sunday)	Night-time (All other times)	Assessment Position
Rural – Mixed Rural/zone/Rural –Rural Coastal zone	55 dB L_{Aeq}	45 dB L_{Aeq} 75 dB L_{AFmax}	Notional boundary

Operational noise levels are to be measured in accordance with New Zealand Standard NZS 6801:2008 *Acoustics – Measurement of environmental sound* and assessed in accordance with New Zealand Standard NZS 6802:2008 *Acoustics - Environmental Noise*.

Construction Noise

2. Construction noise shall be measured and assessed in accordance with the provisions of New Zealand Standard NZS 6803:1999 "Acoustics - Construction Noise" and comply with the limits in the following table-except where authorised by the required CNMP in condition 3.

Time	Weekdays (dBA)		Saturdays (dBA)		Sundays and Public Holidays (dBA)	
	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
0630 - 0730	55	75	45	75	45	75
0730 – 1800	70	85	70	85	55	85
1800 – 2000	65	80	45	75	45	75
2000 - 0630	45	75	45	75	45	75

3. The requiring authority shall engage a suitably qualified person to prepare a Construction Noise Management Plan (CNMP). The CNMP shall identify the best practicable option for management and mitigation of noise from early morning concrete pours, including where full compliance with the levels in condition (2) cannot be achieved at all times. The CNMP shall as a minimum include but not be limited to the following information:

    (a) Construction noise criteria;

    (b) Identification of the most affected premises where there exists the potential for noise effects. This should include:

        i). 338 Glenbrook Beach Road as it pertains to avoiding adverse construction noise effects on farmed deer

    (c) Description and duration of the works, anticipated equipment and the processes to be undertaken;

    (d) Hours of operation, including specific times and days when construction activities causing noise would occur;

    (e) Mitigation options where noise levels are predicted or demonstrated to approach or exceed the relevant limits. Specific noise mitigation measures must be implemented which may include, but not limited to, acoustic screening, time management procedures and alternative construction methodologies;

    (f) The erection of temporary construction noise barriers where appropriate;

    (g) Schedule and methods for monitoring and reporting on construction noise;

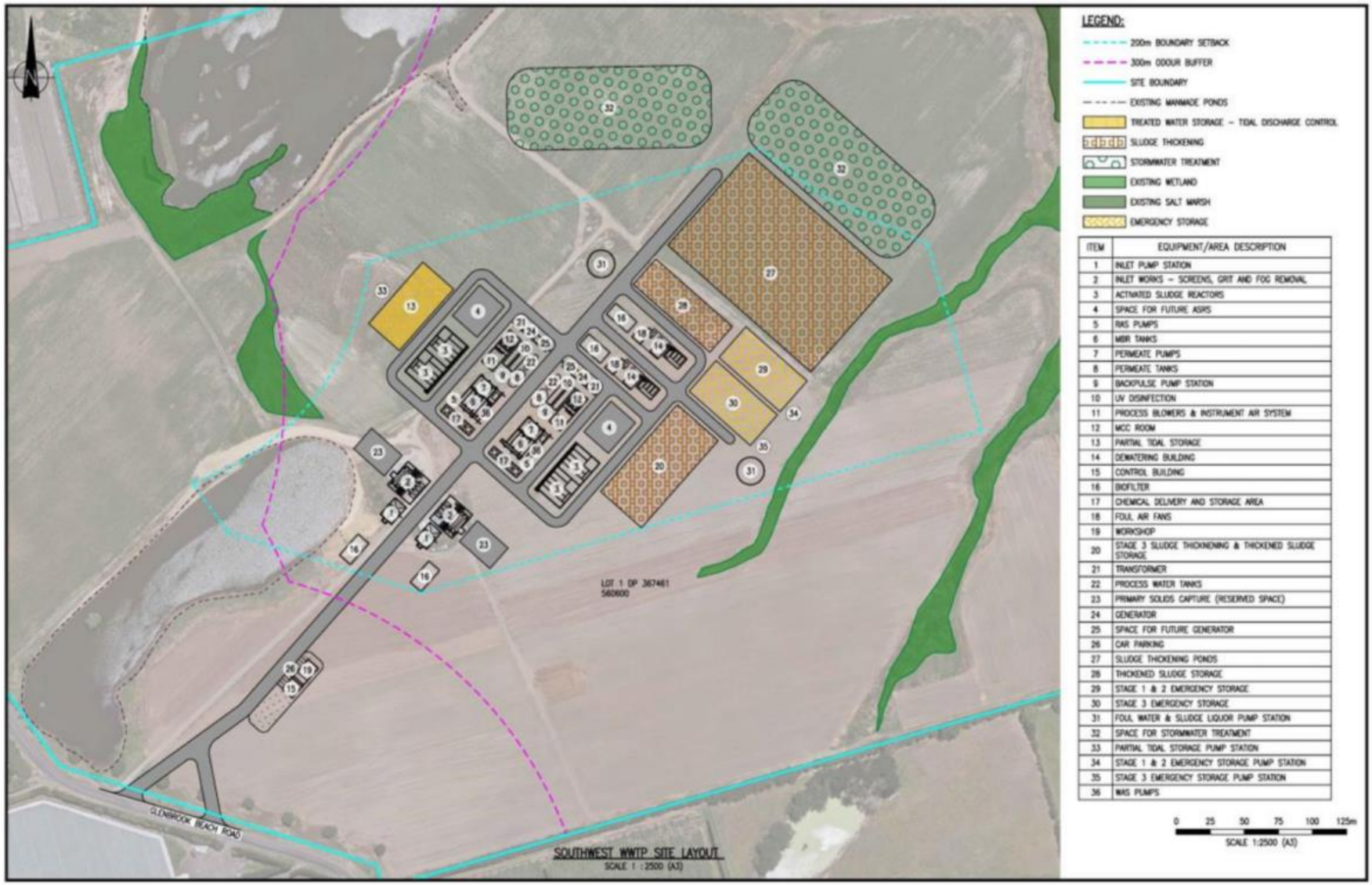
4. The CNMP shall be submitted to Auckland Council for approval in a certifying capacity prior to construction commencing on the site.

5. The requiring authority shall, at all times, comply with the terms of the approved CNMP.

APPENDIX A GLOSSARY OF TERMINOLOGY

Acoustic centre	With respect to an area source or plant dispersed over a relatively wide area, the term refers to a point located in the centre of the area from which noise is emitted. The term is useful for determining source-to-receiver setback distances.
A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB A. Alternative ways of expressing A-weighted decibels are dBA or dB(A).
Background sound	The sound that is continuously present in a room our outdoor location. Often expressed as the A-weighted sound level exceeded for 90 % of a given time period i.e., L_{A90}.
dB	Decibel. The unit of sound level.
L_{Aeq}	The equivalent continuous A-weighted sound level. Commonly referred to as the average sound level and is measured in dB.
L_{AFmax}	The A-weighted maximum sound level. The highest sound level which occurs during the measurement period. Usually measured with a fast time–weighting i.e. L_{AFmax}
L_w	Sound Power Level. The calculated level of total sound power radiated by a sound source. Usually A-weighted i.e. L_{WA}.
Notional boundary	A line 20 metres from any side of a dwelling, or the legal boundary where this is closer to the dwelling. This definition is from NZS 6802:2008.
PPV	Peak Particle Velocity. The measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.
Total sound (Ambient sound)	The totally encompassing sound in a given situation at a given time, from all sources near and far, including the Specific Sound. This definition is from NZS 6802:2008.
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into the vertical direction (up and down vibration), the horizontal transverse direction (side to side) and the horizontal longitudinal direction (front to back).

APPENDIX B INDICATIVE WWTP DESIGN ENVELOPE



APPENDIX C LONG-TERM UNATTENDED NOISE LOGGER RESULTS SUMMARY

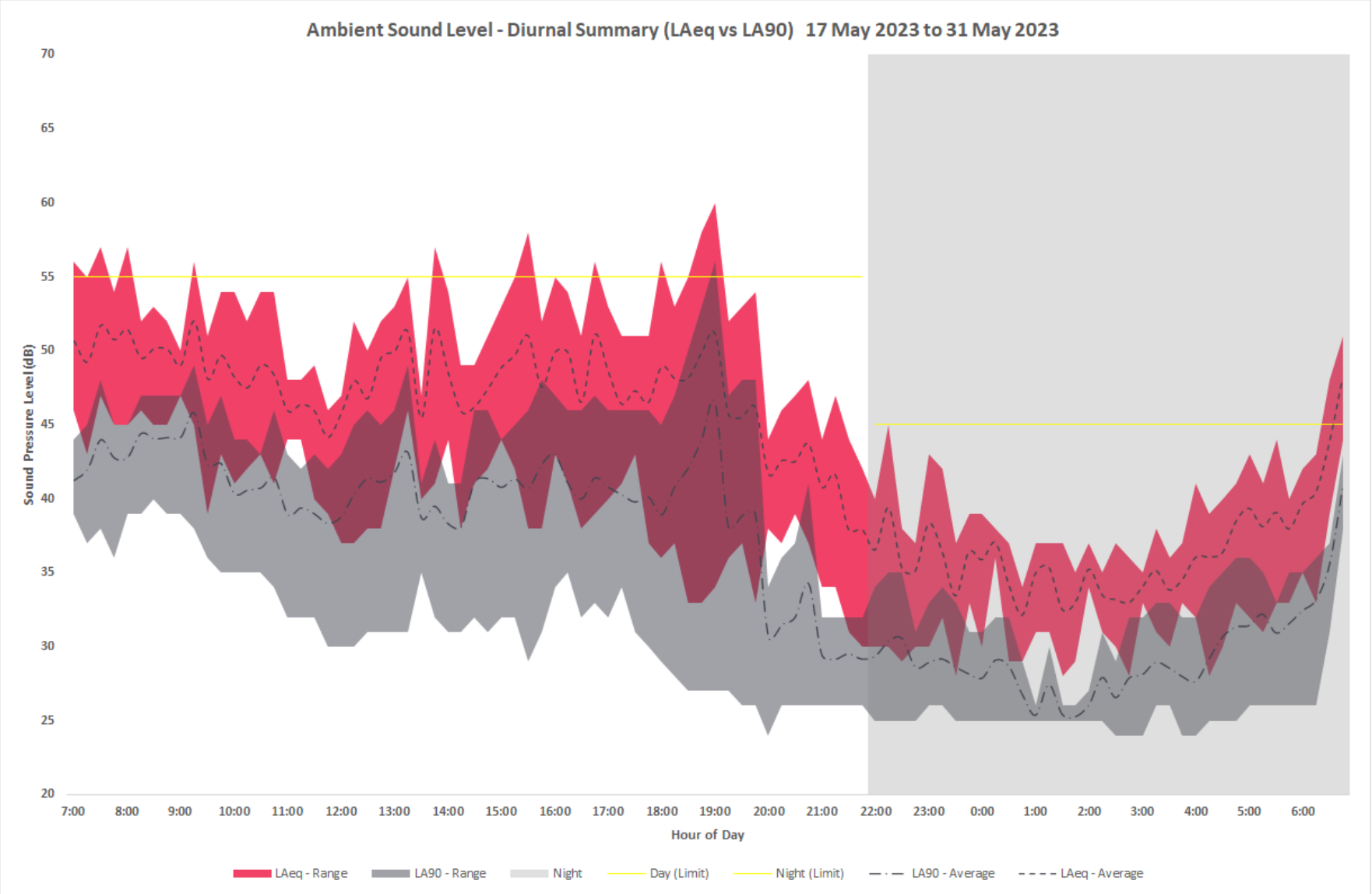
Table 14: Logger derived daily averages and noise level ranges

Refined Dataset (With Acceptable Completeness)	Data completeness:	LAmax (dB)			LA10 (dB)*			LAeq (dB)			LA90 (dB)*		
		L_{24hr} 24hour	LD 7 - 22	LN 22 - 7	L_{24hr} 24hour	LD 7 - 22	LN 22 - 7	L_{24hr} 24hour	LD 7 - 22	LN 22 - 7	L_{24hr} 24hour	LD 7 - 22	LN 22 - 7
17 May '23 (Wed)	28%	40 - 79	---	40 - 62	30 - 59	---	30 - 54	28 - 56	---	28 - 51	24 - 45	---	24 - 43
18 May '23 (Thu)	54%	52 - 74	52 - 74	---	46 - 63	46 - 63	---	44 - 60	44 - 60	---	40 - 56	40 - 56	---
19 May '23 (Fri)	0%	---	---	---	---	---	---	---	---	---	---	---	---
20 May '23 (Sat)	0%	---	---	---	---	---	---	---	---	---	---	---	---
21 May '23 (Sun)	38%	---	46 - 82	---	---	32 - 59	---	---	30 - 55	---	---	26 - 49	---
22 May '23 (Mon)	89%	46 - 77	46 - 77	46 - 63	30 - 58	32 - 58	30 - 51	29 - 54	31 - 54	29 - 47	24 - 41	27 - 41	24 - 41
23 May '23 (Tue)	0%	---	---	---	---	---	---	---	---	---	---	---	---
24 May '23 (Wed)	67%	45 - 74	50 - 74	45 - 64	36 - 58	42 - 58	36 - 54	34 - 56	39 - 56	34 - 50	29 - 48	30 - 48	29 - 42
25 May '23 (Thu)	99%	40 - 74	48 - 74	40 - 61	29 - 58	35 - 58	29 - 47	28 - 54	33 - 54	28 - 45	24 - 47	30 - 47	24 - 40
26 May '23 (Fri)	83%	43 - 75	43 - 75	43 - 62	32 - 63	38 - 63	32 - 47	30 - 57	34 - 57	30 - 44	24 - 43	24 - 43	25 - 39
27 May '23 (Sat)	70%	45 - 68	47 - 67	45 - 68	31 - 54	40 - 54	31 - 49	31 - 51	38 - 51	31 - 48	25 - 47	30 - 47	25 - 38
28 May '23 (Sun)	0%	---	---	---	---	---	---	---	---	---	---	---	---
29 May '23 (Mon)	26%	42 - 67	---	42 - 64	28 - 50	---	28 - 48	28 - 47	---	28 - 45	25 - 39	---	25 - 27
30 May '23 (Tue)	0%	---	---	---	---	---	---	---	---	---	---	---	---
31 May '23 (Wed)	0%	---	---	---	---	---	---	---	---	---	---	---	---
		---	---	---	---	---	---	---	---	---	---	---	---
OVERALL RANGE		40 - 79	43 - 82	40 - 68	28 - 63	32 - 63	28 - 54	28 - 60	30 - 60	28 - 51	24 - 56	24 - 56	24 - 43

*LA10 & LA90 represent the average based on 5-minute interval sound levels

**LAmax is and average of the maximum levels recorded per 5-min intervals

Figure 5: Logger noise level range vs. time histogram



APPENDIX D GUIDELINE AUP:OP NOISE PERFORMANCE STANDARDS

Operational Noise

E25.6. Standards

All activities must comply with the following relevant permitted activity standards.

E25.6.1. General standards

(1) Noise levels arising from activities must be measured and assessed in accordance with the New Zealand Standard NZS 6801:2008 Measurement of environmental sound and the New Zealand Standard NZS 6802:2008 Acoustics - Environmental noise except where more specific requirements apply.

(2) The application of an adjustment for noise containing special audible characteristics in terms of Appendix B4 Special Audible Characteristics in New Zealand Standard NZS 6802:2008 Acoustics – Environmental noise may apply to the A weighted level for any measurement but an adjustment must not be applied to any level measured in the 63Hz and 125Hz octave bands.

(3) The noise from any construction work activity must be measured and assessed in accordance with the requirements of New Zealand Standard NZS6803:1999 Acoustics – Construction noise. Construction work is defined in New Zealand Standard NZS6803:1999 Acoustics – Construction noise.

(4) The noise limits of the Plan do not apply to emergency service sirens and callout sirens during emergency situations.

(5) Where more than one standard applies that requires insulation of a noise-sensitive space from an external noise source, the standards must be applied cumulatively.

(6) Where standards are provided for specific activities, the zone interface standards and the zone standards do not apply to that activity.

E25.6.3. Noise levels in rural and future urban zones

(1) The noise (rating) level from any activity in the Rural – Mixed Rural Zone, Rural – Rural Production Zone, Rural – Rural Coastal Zone or the Future Urban Zone measured within the notional boundary on any site in any rural zone must not exceed the limits in Table E25.6.3.1 Noise levels in the Rural – Mixed Rural Zone, Rural – Rural Production Zone, Rural – Rural Coastal Zone or the Future Urban Zone below:

Table E25.6.3.1 Noise levels in the Rural – Mixed Rural Zone, Rural – Rural Production Zone, Rural – Rural Coastal Zone or the Future Urban Zone

Time	Noise level
Monday to Saturday 7am-10pm	55dB L_{Aeq}
Sunday 9am-6pm	
All other times	45dB L_{Aeq} 75dB L_{AFmax}

Operational vibration

Standard E25.6.30(2)

(2) Permanently installed stationary vibrating, reciprocating and rotating machinery and all piping, ducting and other equipment attached to such machinery must be installed and maintained so that any resulting vibration does not exceed the limits of Table E25.6.30.2 Vibration levels for stationary machinery when measured in any occupied room of any building on another site or in any occupied unit under different ownership from the source of the vibration. Vibration must be measured in accordance with ISO 2631-2:2003 Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 2: Vibration in buildings (1Hz to 80Hz):

Table E25.6.30.2 Vibration levels for stationary machinery

Affected occupied building or area	Time of day	Maximum vibration level in root mean square velocity (mm/s) between 8 and 80Hz
Noise sensitive spaces	7am-10pm	0.20
Bedrooms and sleeping areas only within activities sensitive to noise	10pm-7am	0.14

Construction Noise[17]

Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Time of week	Time Period	Maximum noise level (dBA)	
		L_{eq}	L_{max}
Weekdays	6:30am - 7:30am	60	75
	7:30am - 6:00pm	75	90
	6:00pm - 8:00pm	70	85
	8:00pm - 6:30am	45	75
Saturdays	6:30am - 7:30am	45	75
	7:30am - 6:00pm	75	90
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75
Sundays and public holidays	6:30am - 7:30am	45	75
	7:30am - 6:00pm	55	85
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75

[17] As the anticipated length of the construction period exceeds 20 weeks, Standard E25.6.7 (4) would apply to the project, resulting in the construction noise limits set out in Table E25.6.27.1 decreasing by 5 decibels. See note 4 for further comment.

Construction vibration

Vibration

E25.6.30. Vibration

(1) Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed:

(a) the limits set out in German Industrial Standard DIN 4150-3 (1999): Structural vibration – Part 3 Effects of vibration on structures when measured in accordance with that Standard on any structure not on the same site; and

(b) the limits in Table E25.6.30.1 Vibration limits in buildings in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building.

Table E25.6.30.1 Vibration limits in buildings

Receiver	Period	Peak Particle Velocity Limit millimetres/second
Occupied activity sensitive to noise	Night-time 10pm to 7am	0.3 mm/s
	Daytime 7am to 10pm	2 mm/s
Other occupied buildings	At all times	2 mm/s

Works generating vibration for three days or less between the hours of 7am to 6pm may exceed the limits in Table E25.6.30.1 Vibration limits in buildings above, but must comply with a limit of 5mm/s peak particle velocity in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building, where:

(i) all occupied buildings within 50m of the extent of the works generating vibration are advised in writing no less than three days prior to the vibration-generating works commencing; and

(ii) the written advice must include details of the location of the works, the duration of the works, a phone number for complaints and the name of the site manager.

APPENDIX E CALCULATED WWTP NOISE CONTOUR ENVELOPE