MARSHALL DAY Acoustics

HCC NEW WATER RESERVOIRS
ASSESSMENT OF ACOUSTIC EFFECTS

Rp 002 r01 20241335 | 7 August 2025

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Project: **HCC NEW WATER RESERVOIRS**

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1.0 REPORT SUMMARY AND CONCLUSIONS

Construction noise is predicted to infringe the relevant limits at times. We have identified the activities that could cause an infringement risk and have recommended mitigation and management measures using a Construction Noise Management Plan (CNMP). With this in place via a condition in the designation, we consider adverse effects will be acceptably mitigated and controlled.

Hamilton City Council (HCC) has engaged Marshall Day Acoustics to assess acoustic impacts associated with the construction and operation of two large water reservoirs on Ruakiwi Road. This report is a supporting document to the Notice of Requirement (NoR) for expansion of the land designation to enable HCC to construct and operate the reservoirs.

These reservoirs are associated with a proposed new booster pump station (BPS) to be constructed on Clarence Street. We have assessed noise and vibration effects from the BPS in a separate report.

The primary issue of concern we address in this report is noise and vibration from the construction of the project, and the management of potential adverse effects arising from this. We consider that operation noise and vibration from the project will be negligible and therefore have not been addressed further in this report.

We calculate that typical daytime construction noise will comply with the guideline limits in the underlying zone. We have identified some activities which will exceed the guideline limits for relatively short periods. These include sheet piling (~10-15 days of activity) which is predicted to exceed by up to 10 dB at the closest receivers. This activity will require management using a CNMP.

The size of the project means that early morning concrete pours are required for the reservoir floor and roof. Noise from these pours will not comply with the night-time noise limit at the closest receivers. This activity will also require management using a CNMP.

We calculate that construction vibration will comply with the guideline cosmetic damage vibration limits in the underlying zone, and our recommended amenity vibration threshold. No adverse effects from vibration will occur.

A glossary of terminology is provided in Appendix A.

2.0 PROJECT SITE AND DESCRIPTION

2.1 Project background

In November 2022, HCC secured Government Infrastructure Acceleration Fund (IAF) support for specific infrastructure projects. The purpose of the IAF agreement is to enable infrastructure development that facilitates the delivery of residential housing in the central city. The Reservoirs and BPS project (Project) is a critical infrastructure initiative aimed at improving the efficiency of water supply from the reservoir into the central city, thereby supporting residential and commercial/office development along with firefighting water pressure requirements.

This Project is essential to meet the demands of a growing population. Current growth projections and modelling indicate that the 25 megalitre reservoir will be sufficient to meet population needs until at least 2041. Beyond that point, a second 25 megalitre water reservoir will be required to ensure continued service capacity.

HCC, in its capacity as a Requiring Authority, will undertake the planning work for both reservoirs at this time but will only construct one reservoir now. The design and construction of the second reservoir will be determined at a later date based on existing and forecast population growth in the central city.

HCC has conducted a comprehensive investigation and site assessment to identify a preferred location for the new reservoir and an associated booster pump station. The evaluation considered 30 potential sites situated between the existing Waiora Water Treatment Plant (WTP) and the Ruakiwi

Road Reservoir. Each site was assessed based on several key criteria, including land ownership, site size, elevation, proximity to the bulk water network and the WTP, energy efficiency (a critical factor for resilience and operations), distance to the central city, and underlying geological conditions.

Based on the outcomes of the investigation and site assessment, HCC has identified the Ruakiwi Road Reserve site as the preferred location. As a result, further investigation and concept design work have been initiated for this site to support the next phase of project development.

A further options analysis was undertaken for the Ruakiwi Road site to refine the site layout to best meet the project objectives while striving to address effects on the Lake Domain Reserve and the surrounding residential area as much as possible, with the concept site layout reflecting that balance.

The purpose of this report is to provide sufficient technical information in relation to noise to support the Notice of Requirement for an Alteration to Designation.

Project Facts:

Fact	Agreed words or number
Reservoir internal diameter	62 metres
Reservoir external diameter	62.65 metres (325 mm thick walls)
Reservoir capacity	25 megalitres (million litres - ML)
Reservoir walls	9.85 m high (to underside of roof)
Reservoir top water level	RL = 69.95 metres
Reservoir bottom water level	RL = 61.35 metres
Design life	100 years

2.2 Site description

The project site is located at the Hamilton Lake Domain, specifically the area adjacent to 18 Ruakiwi Road where an existing water reservoir is located. Residential receivers are located eastward on the eastern side of Ruakiwi Road.

Figure 1 shows the site and surrounding receiving environment.

Figure 1: Project site and surrounding receivers

2.3 Project description

HCC is proposing to construct two new 10m high, 25ML capacity concrete reservoirs on the site to expand the existing capacity. We understand that the reservoirs will be constructed in two stages, with Reservoir 1 constructed first and the second as a separate future project. Our assessment assumes that the reservoir closest to Ruakiwi Road – Reservoir 1, will be constructed first.

Refer to Appendix B for the proposed site layout.

2.4 Identified potentially noise sensitive receivers

Table 1 lists the receivers we have identified as potentially noise and/or vibration sensitive. The table lists each receiver, the zoning/primary use, and minimum distance to the proposed reservoirs. 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.

Figure 1 shows the location of the identified receivers. Appendix C details receiver legal descriptions.

Table 1: Receiver table

Rec no.	Address	Zoning/usage	Min. distance to site works (m)
R1	17 Ruakiwi Road (4 units)	Residential[1]/dwelling	33
R2	19 Ruakiwi Road (17 units)	Residential[1]/dwelling	37
R3	16 Ruakiwi Road	Residential[1]/dwelling	37
R4	14 Ruakiwi Road (12 units)	Residential[1]/dwelling	40
R5	145/145A Clarence Street	Residential[1]/dwelling	64

Notes to table:
1) Residential refers to the High Density Residential Zone in the HCODP.

3.0 ACOUSTIC PERFORMANCE STANDARDS

The existing reservoir land is designated – *A67 Water Storage and Supply* in the Hamilton City Operative District Plan (HCODP). This designation does not contain any construction noise and vibration performance standards.

The project area, encompassing the expanded designation footprint (refer to red outline in Figure 2) is located in the *Destination Open Space Zone.* The closest residential receivers are in the *High Density Residential Zone*. To assist in determining the 'reasonableness' of project noise and vibration we have taken guidance from HCODP Rules 25.8.3.2 and 25.8.3.3 (these would apply if the site was not designated). The following sections summarise the underlying zone standards for construction noise and vibration.

Figure 2 shows the existing and proposed site designation boundaries as well as zoning of the site and surrounding receivers.

Figure 2: Site zoning and existing designation boundary (dashed line) as per the HCODP

3.1 Construction noise performance standards

Rule 25.8.3.2 of the HCODP states that all construction noise shall comply with the relevant noise levels in NZS 6803:1999 *"Acoustics – Construction Noise"*. Noise shall be measured and assessed in accordance with the Standard.

In summary, the guideline noise limits applying to typical construction hours (7.30am to 6pm) for projects exceeding 20 weeks in duration are 70 dB L_{Aeq} and 85 dB L_{Amax}. Noise levels are assessed at 1m from the façade of occupied buildings.

The full suite of limits as they appear in NZS 6803:1999 are listed in Appendix C.

3.2 Construction vibration performance standards

Rule 25.8.3.3. of the HCODP states that all construction vibration received by any building on any other site shall comply with the provisions of, and be measured and assessed in accordance with, DIN 4150-3:1999 *"Structural vibration – Effects of vibration on structures"*.

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 2: 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 3: 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

While the primary vibration concern is typically cosmetic building damage, people may be disturbed at significantly lower levels. However, structural vibration damage can only occur at an order of magnitude well above the threshold of perception.

Likely subjective responses to vibration levels are described in BS 5228, with additional levels added to provide a fuller picture, are shown in Table 4.

Based on our experience, we recommend an amenity criterion of 2 mm/s PPV. This criterion should only be used as a management plan threshold to trigger communication and consultation.

Table 4: Subjective response to vibration levels

Vibration level	Likely subjective response
0.14 mm/s PPV	Just perceptible in particularly sensitive environments
0.3 mm/s PPV	Just perceptible in normal residential environments
1 mm/s PPV	Typically acceptable with prior notification
2 mm/s PPV	Vibration would clearly be felt. However, can typically be tolerated in indoor environments such as offices, houses and retail, if it occurs intermittently during the day and where there is effective prior engagement.
5 mm/s PPV	Highly unsettling for both workplaces and dwellings. If exposure is prolonged, some people may want to leave the building. Computer screens would shake, and items could fall off shelves if they are not level.
10 mm/s PPV	Likely to be intolerable for any more than a very brief period

4.0 CONSTRUCTION NOISE ASSESSMENT

Construction noise will exceed the relevant noise limits at times. We have identified high-noise activities and we recommend that a Construction Noise Management Plan form a condition in the designation. Where all project works are managed using a CNMP we consider adverse effects can be acceptably mitigated and controlled.

4.1 Calculated typical construction noise levels

Construction works associated with the project will consist of:

- Soil preloading of the site
- Site enabling works and bulk earthworks
- Stormwater pipeline works
- Drilling of discharge mains
- Construction of valve chamber
- Reservoir construction
    - Preparation works
    - Importing of engineered subbase
    - Reservoir floor concrete poured in-situ
    - Precast concrete panel installation and infill pours
    - Roof concrete poured in-situ
    - Finishing and commissioning works
- Finishing works, site landscaping and remediation

The works are expected to take between 24 – 30 months in total per reservoir.

We have predicted noise from typical construction activities. The tables in the following sections include 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 3.1).

We expect that all construction activity will occur during normal hours (7.30am – 6.00pm Monday to Friday), i.e., no early morning, night or weekend work apart from early morning concrete pours of each reservoir floor pad and roof (see Section 4.1.6). The results indicate that there is potential for exceedance of the relevant limits some of the time.

4.1.1 Site enabling works, preloading, bulk earthworks

Our calculations indicate that noise from site enabling works can, in the main, comply with Rule 25.8.3.2, with screening from the recommended site hoarding except as noted below. Refer to Section 6.0 for further details regarding the recommended hoardings.

This excludes noise from vibratory sheet piling, which cannot be screened due to the source height. Use of a wood chipper will also result in minor exceedances (up to 3 dB) at the closest receivers. We recommend that these activities are managed via a Construction Noise Management Plan (CNMP). Management techniques that can be considered in these circumstances include but are not limited to, the following:

- scheduling noisy work to occur when neighbours are not home, or
- locating mobile equipment (e.g. wood chippers) away from adjacent receivers where practicable (a minimum setback of 44m is recommended).

Table 5: Calculated construction noise levels – site establishment and preloading (incl. 2.4m site hoarding)

Equipment	BS5228 source ref.	Sound Power	Screening (dB)	Façade Noise Level (dB L_{Aeq})			Limit Setback (m)
		(dB L_{WA})		R1 33m	R2 37m	R3 40m	70 dB L_{Aeq}
Truck and trailer	C5.2	105	-10	59	58	57	10
Articulated dump truck	C2.32	102	-10	56	55	54	7
Wheeled loader	C2.26	107	-10	61	60	59	13
Excavator (5T)	C4.67	102	-10	56	55	54	7
Excavator (20T)	C4.64	103	-10	60	59	58	11
Excavator (40T)	C4.63	105	-10	62	61	60	14
Mobile crane (35T)	C4.43	98	-10	52	51	50	4
Chainsaw	D2.14	114	-10	68	67	66	28
Wood chipper	MDA4542	119	-10	**73**	**72**	**71**	44
Vibratory sheet piling	C3.8	116	0	**80**	**79**	**78**	83

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) The maximum noise level limit (85 dB L_{AFmax}) will be readily complied with at all receivers

We have carried out 3D acoustic modelling of vibratory sheet piling at the worst-case positions relative to receivers on Ruakiwi Road. The results, shown in Figure 3 and Figure 4, indicate that some receivers may experience up to 82 dB L_{Aeq} when sheet piling occurs in the worst-case position.

Vibratory sheet piling is expected to take 10-15 days to complete, therefore receivers could experience elevated noise levels over this period. We consider that the management of sheet piling activities using a CNMP is the most appropriate way to control effects from this activity.

Figure 3: Vibro sheet piling noise received by 14 & 16 Ruakiwi Road

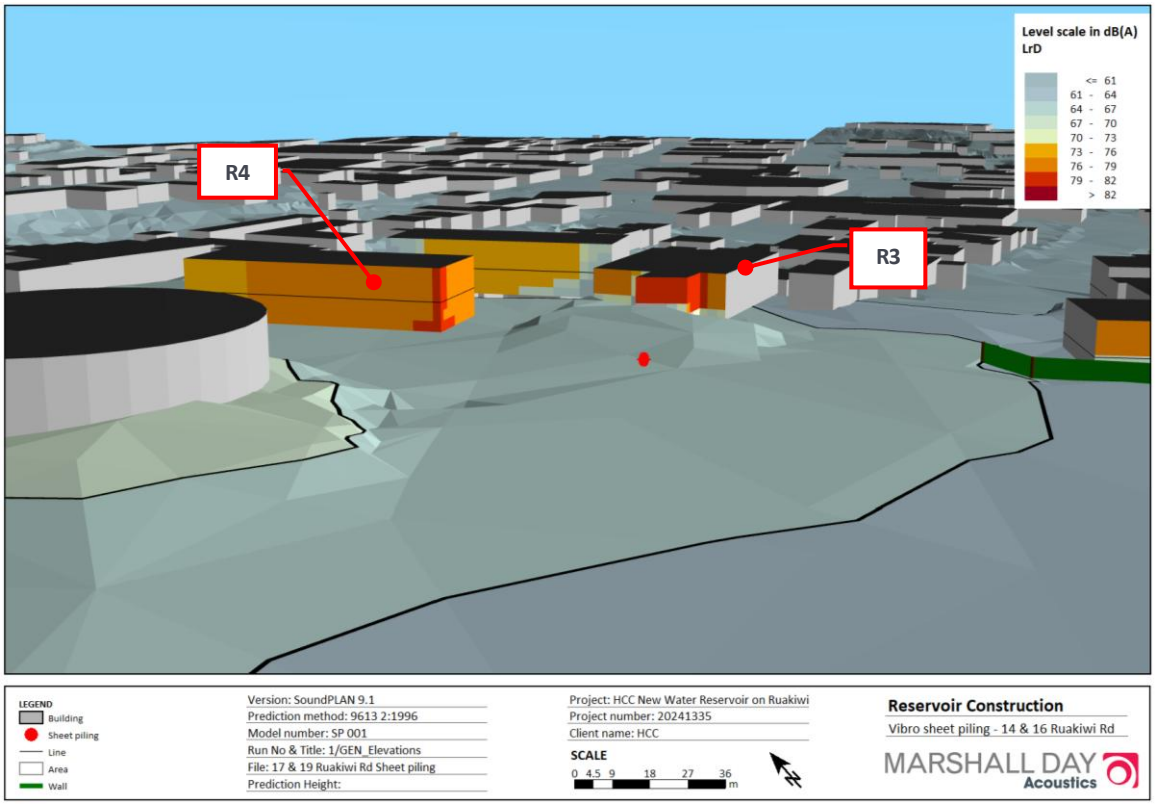


Figure 4: Vibro sheet piling noise received by 17 & 19 Ruakiwi Road

4.1.2 Stormwater pipeline works

Work to construct the new scour outlet between Hamilton Lake and the proposed reservoirs will not occur near dwellings. We have calculated indicative construction noise levels at various setback distances representative of receivers within the domain.

We note that the Verandah Café and associated playground and outdoor play area is approximately 200m to the southeast of the reservoirs.

Construction noise levels of 55 to 65 dB L_{Aeq} outside may affect communication, and conversations may require raised voices. People are likely to seek respite (move away) from noise levels above 65 dB L_{Aeq} if they occur for extended periods.

Table 6: Calculated construction noise levels – stormwater pipeline works

Equipment	BS5228 source ref.	Sound Power	Screening (dB)	Façade Noise Level (dB L_{Aeq})			Distance setback to achieve 70 dB L_{Aeq}
		(dB L_{WA})		100m	150m	200m	(m)
Excavator (5T)	C4.67	102	0	55	51	47	25
Excavator (20T)	C4.64	103	0	54	50	46	22
Paving machine	C5.30	103	0	55	51	47	25
Concrete cutting	C5.36	115	0	67	63	59	76

4.1.3 Discharge mains

Our calculations indicate that noise from discharge mains drilling will exceed the noise levels in Rule 25.8.3.2. We recommend that this activity is managed via a CNMP and that the drilling compound uses site hoardings to practicably reduce noise.

Table 7: Calculated construction noise levels – discharge mains (incl. 2.4m site hoarding)

Horizontal directional drilling	Source ref.	Sound Power (dB L_{WA})	Screening (dB)	Façade Noise Level (dB L_{Aeq}) R1 18m	R2 23m	R3 24m	Distance setback to achieve 70 dB L_{Aeq} (m)
Mud Pump		113	-10	**78**	**75**	**75**	**39**
HPU (intake)		109					
Centrifuge		107					
Mud Shakers		110					
HPU (Exhaust)		103					
HDD Rig		101					
Suction Tank		110					
Genset 1 (silenced)		103					
Genset 2 (silenced)		100					
Combined noise	MDA:20230751	**118**					

4.1.4 Valve chamber works

Our calculations indicate that noise from construction of the valve chamber can comply with Rule 25.8.3.2 with a site hoarding in place.

Table 8: Calculated construction noise levels – valve chamber works (incl. 2.4m site hoarding)

Equipment	BS5228 source ref.	Sound Power (dB L_{WA})	Screening (dB)	Façade Noise Level (dB L_{Aeq}) R1 43m	R3 48m	R4 49m	Limit Setback (m) 70 dB L_{Aeq}
Excavator (20T)	C4.64	103	-10	54	53	53	8
Plate compactor	C2.41	108	-10	59	58	58	14
Static or vibratory roller	C5.25	103	-10	54	53	53	8
2-axle truck	MDA4082	103	-10	54	53	53	8
Concrete truck + pump	C4.28	103	-10	54	53	53	8
Crane	C4.38	106	-10	57	56	56	11

4.1.5 Reservoir construction

Our calculations indicate that noise from construction of the reservoir can comply with Rule 25.8.3.2. We recommend a 2.4m high site hoarding be placed between the project site and receivers on the eastern side of Ruakiwi Road to practicably reduce noise levels.

Table 9: Calculated construction noise levels – reservoir construction (incl. 2.4m site hoarding)

Equipment	BS5228 source ref.	Sound Power	Screening (dB)	Façade Noise Level (dB L_{Aeq})			Limit Setback (m)
		(dB L_{WA})		R1 33m	R2 37m	R3 40m	70 dB L_{Aeq}
Excavator (40T)	C4.63	105	-10	59	58	57	10
Excavator (20T)	C4.64	103	-10	57	56	55	8
2-axle truck	MDA4082	103	-10	57	56	55	8
Concrete truck + pump	C4.28	103	-10	57	56	55	8
Crane	C4.38	106	-10	60	59	58	11

4.1.6 Early morning concrete pours

The floor and roof of the reservoirs require large in-situ concrete pours that will start as early as 5am. This is so the concrete supplier can fulfil the batch order and to allow for trowelling/final finishing to occur early in the curing process.

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 in Table 10.

The results confirm that combined noise from early morning concrete pours will not comply with the night-time noise limit in Rule 25.8.3.2 at the assessed receivers. The exceedances could result in appreciable short-term effects unless this activity is managed using a CNMP.

Table 10: Calculated concrete pour noise levels (incl. 2.4m site hoarding)

Equipment	BS5228 source ref.	Sound Power	Screening (dB)	Façade Noise Level (dB L_{Aeq})			Limit Setback (m)
		(dB L_{WA})		R1 33m	R2 37m	R3 40m	45dB L_{Aeq}
Concrete pump	C4.28	105		-	-	-	-
Truck idling	C4.5	91		-	-	-	-
Concrete vibrator	D6.32	100					
Power float	D6.44	100					
Generator (150kVA)	C6.39	93		-	-	-	-
Combined Noise	-	**107**	**-10**	**61**	**60**	**59**	**145**

4.1.7 Finishing works

Our calculations indicate that noise from finishing works can comply with Rule 25.8.3.2, aside from minor exceedances (up to 2 dB) from the use of a plate compactor. We recommend using a small static or vibratory roller instead of a plate compactor to practicably reduce noise to compliant levels.

Table 11: Calculated construction noise levels – finishing works

Equipment	BS5228 source ref.	Sound Power	Screening (dB)	Façade Noise Level (dB L_{Aeq})			Limit Setback (m)
		(dB L_{WA})		R1 33m	R2 37m	R3 40m	70 dB L_{Aeq}
2-axle truck	MDA4082	103	0	67	66	65	25
Excavator (20T)	C4.64	103	0	67	66	65	25
Excavator (5T)	C4.67	102	0	66	65	64	22
Mobile Crane (35T)	C4.43	98	0	62	61	60	14
Plate compactor	C2.41	108	0	72	71	70	40
Static or vibratory roller	C5.25	103	0	67	66	65	25
Concrete truck and pump	C4.28	103	0	67	66	65	25
Augur piling (small excavator-mounted)	C3.18	103	0	67	66	65	25
Telehandler	C4.44	88	0	52	51	50	4
Grinder (hand tools)[4]	C4.93	108	0	69	68	67	30

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) The maximum noise level limit (85 dB L_{AFmax}) will be readily complied with at all receivers
(4) Hand tools are not typically used constantly, therefore we have applied a 50% duration correction

4.2 Construction noise prediction methodology

We have calculated construction noise in general accordance with the method detailed in Annex D[1] of NZS 6803:1999 based on the construction method statement prepared by Traction Room[2]. The calculation 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.

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

[2] *Reservoir Construction Method Statement* (draft, v1 26 June 2025)

5.0 CONSTRUCTION VIBRATION ASSESSMENT

Construction vibration will comply with the HCODP cosmetic damage limit and our recommended amenity vibration threshold. No adverse effects will occur.

5.1 Construction vibration high-level screening assessment

We have undertaken a high-level vibration screening assessment for construction activities. Using the identified high-vibration sources, we have calculated the vibration levels received at the closest dwelling (R1). Table 12 lists the activities, the identified highest-vibration source associated with that activity and the closest source-to-receiver distance. The vibration screening assessment indicates compliance with the HCODP cosmetic damage limit, and our recommended 2mm/s amenity criterion.

Table 12: Screening summary table

Activity	Source	Min. distance to receiver (m)	Vibration level (mm/s PPV)	Potential to exceed criteria, warranting further assessment?
Piling	Vibratory sheet piling	33	1.2	No. Complies with HCODP cosmetic damage limit and our recommended amenity criteria.
	Auger piling	33	0.1	No. Readily complies with HCODP cosmetic damage limit and our recommended amenity criteria
Compaction	Plate compactor	33	0.3	No. Readily complies with HCODP cosmetic damage limit and our recommended amenity criteria
	Vibratory roller	33	1.1	No. Complies with HCODP cosmetic damage limit and our recommended amenity criteria

6.0 CONSTRUCTION NOISE MITIGATION

Temporary noise barriers or 'hoardings' are used to reduce construction noise levels. They should be installed prior to works commencing and maintained throughout the works. Effective noise barriers typically reduce received noise at ground level by 10 decibels, unless the source of noise is elevated, such as for sheet piling.

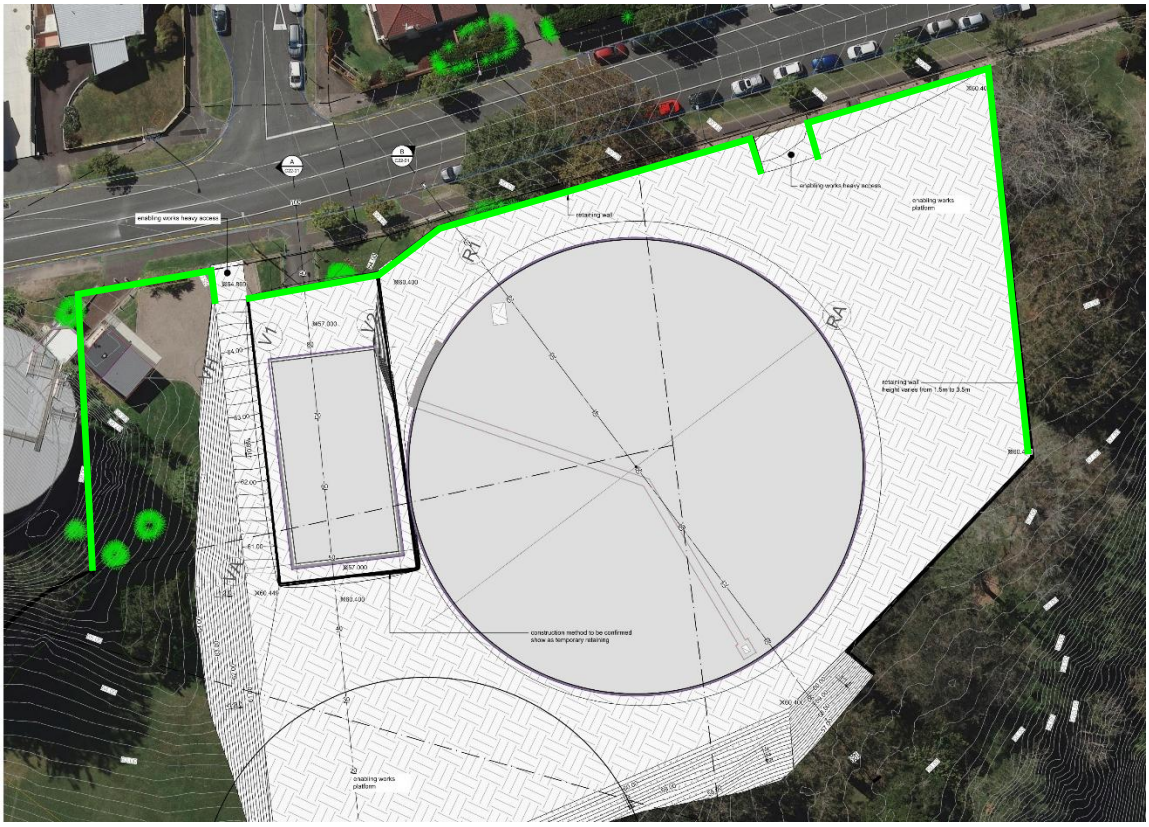
The following are our recommended guidelines for the design and use of temporary noise barriers:

- The panels should be constructed from a material with a minimum surface mass of 6.5 kg/m^2 for flexible barriers or 10kg/m^2 for timber. Suitable solutions include 18-20 mm plywood on timber frame or the following proprietary 'noise curtains':
  - SealedAir 'WhisperFence 24dB' (www.sealedair.com)
  - Hushtec 'Premium Series Noise Barrier' (www.duraflex.co.nz)
  - Soundbuffer 'Performance Acoustic Curtain' (soundbuffer.co.nz)
  - Hoardfast 'Fast Wall Premium PVC partition panels' (www.ultimate-solutions.co.nz)
  - Safesmart 'Acoustic Curtain 6.5kg/m^2' (www.safesmartaccess.co.nz)
  - Alternatives should be approved by a suitably qualified and experienced acoustic specialist
- The panels should be minimum 2.4m in height, and higher if practicable to block line-of-sight

- The panels should be abutted or overlapped to provide a continuous screen without gaps at the bottom or sides of the panels
- A combination of barrier materials / systems can be used e.g., plywood barrier along Ruakiwi Road and noise curtains around openings and on the northern and southern 'arms'
- The panels should be positioned as close as practicable to the noisy construction activity to block line-of-sight. Where positioned on the site boundary, additional local barriers should be considered near noisy activities to ensure effective mitigation for sensitive receivers on upper floor levels

Figure 5 indicates the location of the recommended site hoarding.

Figure 5: Indicative hoarding extent



7.0 CONDITIONS OF DESIGNATION

We propose the following noise conditions be included in the update to the designation, should the Notice of Requirement be approved.

Construction Noise

1. 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.

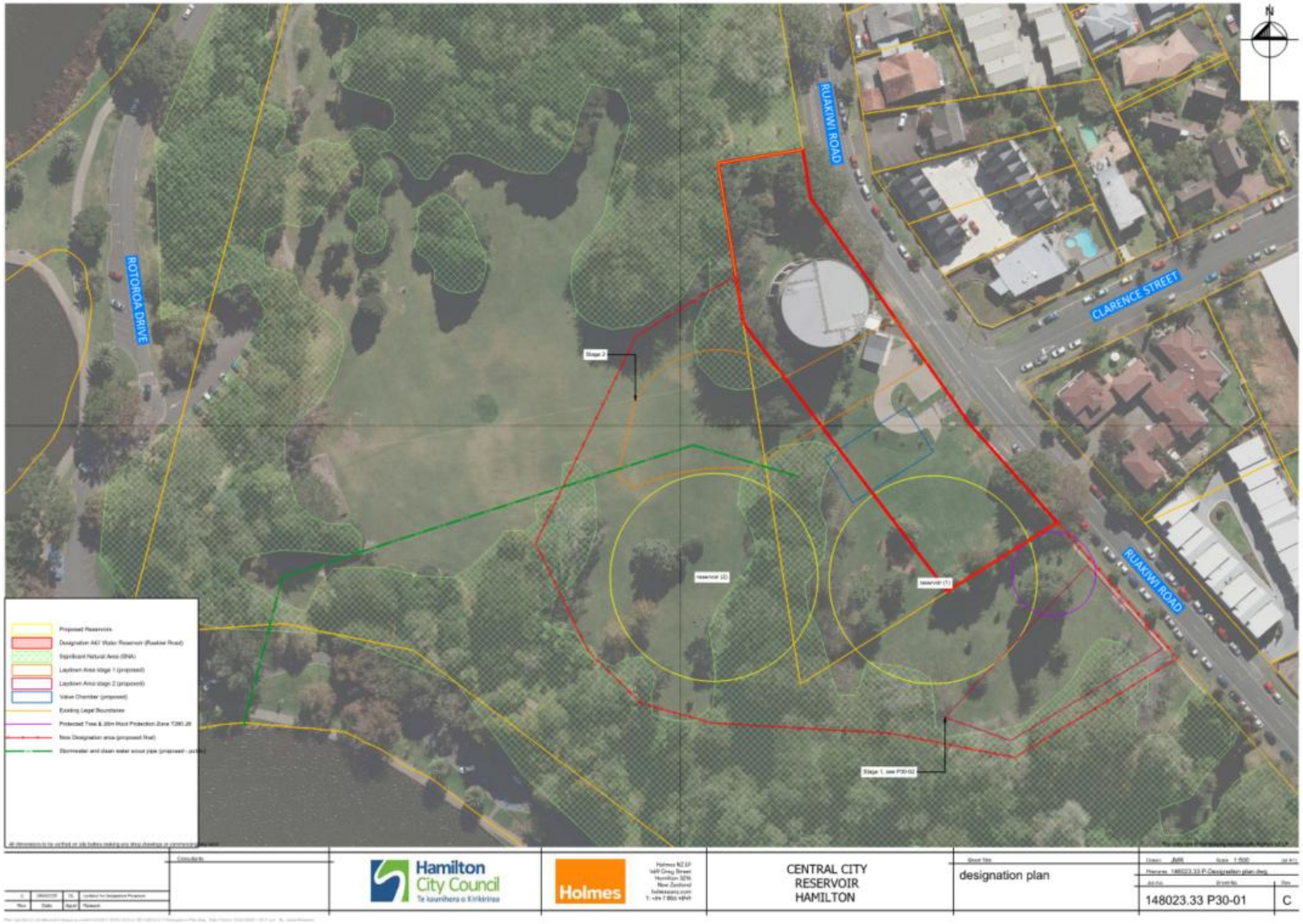
Time	Weekdays (dBA)		Saturdays (dBA)		Sundays and Public Holidays (dBA)	
	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
0630 - 0730	55	75	45	75	45	75
0730 – 1800	70	85	70	85	55	85
1800 – 2000	65	80	45	75	45	75
2000 - 0630	45	75	45	75	45	75

2. All construction work must comply with the vibration limits in German Standard DIN 4150-3:2016 "*Vibration in buildings – Part 3: Effects on structures"* when measured in accordance with that Standard on any structure not on the same site.
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, including where full compliance with the levels in Condition 1 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;
    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 including but not limited to early morning concrete pours;
    e. Identify and adopt the BPO for minimising adverse construction noise and vibration effects on neighbours;
    f. When noise and vibration levels approach or exceed relevant limits, implement specific mitigation measures such as but not limited to acoustic screening, time management, and alternative construction methodologies;
    g. Schedule and methods for monitoring and reporting on construction noise and vibration;
    h. Define the procedures to be followed to ensure that the construction noise and vibration standards in (refer to Conditions 1 and 2) are being met.

APPENDIX A GLOSSARY OF TERMINOLOGY

A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear. All noise levels are quoted relative to a sound pressure of $2x10^{-5}$Pa
BS 5228:2009	British Standard BS 5228:2009 "Code of practice for noise and vibration control on construction and open sites, Part 1: Noise, Part 2: Vibration"
dB	Decibel. The unit of sound level. Expressed as a logarithmic ratio of sound pressure 'P' relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level, which has its frequency characteristics modified by a filter (A-weighted) to approximate the frequency bias of the human ear.
DIN 4150-3:2016	German Standard DIN 4150-3:2016 "Vibrations in buildings – Part 3: Effects of vibration on structures"
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the measurement time interval to which the noise level relates, e.g. (8 h) will represent a period of 8 hours, (15 min) will represent a period of 15 minutes and (2200-0700) will represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level that occurs during the measurement period.
NZS 6801:2008	New Zealand Standard NZS 6801:2008 "Acoustics – Measurement of environmental sound"
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics - Environmental Noise"*
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*
SWL or L_W	Sound Power Level A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
PPV	Peak Particle Velocity (PPV) is the measure of the vibration amplitude, zero to maximum, measured in mm/s.
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 vertical (up and down vibration), horizontal transverse (side to side) and horizontal longitudinal direction (front to back) components.

APPENDIX B PROPOSED SITE PLAN



APPENDIX C RECEIVER LEGAL DESCRIPTIONS

Table 13: Receiver table

Rec no.	Address	Legal Description
R1	17 Ruakiwi Road (four units)	
	Unit 1/17	Flat 1 DP S39987
	Unit 2/17	Flat 2 DP S39987
	Unit 3/17	Flat 3 DP S39987
	Unit 4/17	Flat 4 DP S39987
R2	19 Ruakiwi Road (17 units)	
	Unit 2/19	UNT:2 DP 523417
	Unit 3/19	UNT:3 DP 523417
	Unit 4/19	UNT:4 DP 523417
	Unit 5/19	UNT:5 DP 523417
	Unit 6/19	UNT:6 DP 523417
	Unit 7/19	UNT:7 DP 523417
	Unit 8/19	UNT:8 DP 523417
	Unit 9/19	UNT:9 DP 523417
	Unit 10/19	UNT:10 DP 523417
	Unit 11/19	UNT:11 DP 523417
	Unit 12/19	UNT:12 DP 523417
	Unit 13/19	UNT:13 DP 523417
	Unit 14/19	UNT:14 DP 523417
	Unit 15/19	UNT:15 DP 523417
	Unit 16/19	UNT:16 DP 523417
	Unit 17/19	UNT:17 DP 523417
R3	16 Ruakiwi Road	Lot 4 DP 32692
R4	14 Ruakiwi Road (12 units)	
	Unit 1/14	UNT:1 AU:13 DP 552465
	Unit 2/14	UNT:2 AU:14 DP 552465
	Unit 3/14	UNT:3 AU:15 DP 552465
	Unit 4/14	UNT:4 AU:16 DP 552465
	Unit 5/14	UNT:5 AU:17 DP 552465
	Unit 6/14	UNT:6 AU:18 DP 552465
	Unit 7/14	UNT:7 AU:19 DP 552465

Rec no.	Address	Legal Description
	Unit 8/14	UNT:8 AU:20 DP 552465
	Unit 9/14	UNT:9 AU:21 DP 552465
	Unit 10/14	UNT:10 AU:22 DP 552465
	Unit 11/14	UNT:11 AU:23 DP 552465
	Unit 12/14	UNT:12 AU:24 DP 552465
R5	145 Clarence Street	Flat 5 DP S39987
	145A Clarence Street	Flat 6 DP S39987

APPENDIX D CONSTRUCTION NOISE PERFORMANCE STANDARD

NZS 6803:1999 sets out the following noise limits for noise received in residential and rural areas.

Table 14: – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas (long-term duration construction limits shown)

Time of week	Time period	Duration of work Long-term duration (dBA)	
		L_{eq}	L_{max}
Weekdays	0630-0730	55	75
	0730-1800	70	85
	1800-2000	65	80
	2000-0630	45	75
Saturdays	0630-0730	45	75
	0730-1800	70	85
	1800-2000	45	75
	2000-0630	45	75
Sundays and public holidays	0630-0730	45	75
	0730-1800	55	85
	1800-2000	45	75
	2000-0630	45	75