Construction Noise and Vibration Management Plan (CNVMP)

Project Name	Omāroro Reservoir
Project Number	61104
Contract	771.00040
Principal	Wellington Water Ltd
Revision	B
Issue Status	Certified
Date	09/06/21

Document Details	
Document Name	Construction Noise and Vibration Management Plan
Status	Certified
Document No	61104_CNVMP_Rev B_22.04.21
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Project Manager	James Lake

Issue Record					
Revision	**Date**	**Author**	**Reviewed by**	**Approved by**	**Status**
01	28.04.2020	Elisa Chillingworth	Simon Cathcart	James Lake	Draft
02	31.05.2020	Simon Cathcart	James Lake	James Lake	Draft
03	09.06.2020	Simon Cathcart	James Lake	James Lake	Draft
04	17.07.2020	Simon Cathcart	James Lake	James Lake	Draft
05	05.08.2020	Simon Cathcart	James Lake	James Lake	For Certification
A	17/08/20	Simon Cathcart	James Lake	James Lake	Certified
B	09/06/21	Simon Cathcart	James Lake	James Lake	Certified

Issue Status:

Draft: Draft issue for internal review and comment.

IFA: Issue to the Principal / Engineer for review, comment or approval

IFC: Issue for Construction

Revision Details

Once 'Issue for Construction' status is achieved, the CNVMP should be treated as a 'live' working document, with additional information added as the project lifecycle develops.

A summary of the amendments is to be recorded on the Amendments Record below.

Revision	Details
01	Initial Draft
02	Revised to accommodate comments provided by WCC: • Email from Matthew Borich, Wednesday 20th May 2020 at 10:35am.
03	Revised to accommodate comments provided by WCC: • Email from Matthew Borich, Friday 5th June 2020 at 3:12pm. • Email from Bob Barber, Friday 5th June 2020 at 3:12pm
04	Revised to accommodate comments provided by CRG
05	For certification following comments from Bob Barber

A	Update to Certified Status
B	Reference to working hours corrected to reflect consented working hours. Document certified

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1. Introduction

The proposal is to construct a buried concrete reservoir, named Omāroro reservoir, with a capacity of 35,000m^3 in the Town Belt, immediately southwest of the Upper Park of the Prince of Wales Park in Mount Cook, Wellington. This Construction Noise and Vibration Management Plan (CNVMP) is to be incorporated with a series of other Environmental Management Plans, to manage the environmental risks for the construction of the reservoir. Wellington City Council and Greater Wellington Regional Council are the requiring authorities for the Omāroro reservoir.

This document provides an assessment of noise and vibration from the proposed construction activities and is based on the Marshall Day Acoustics document "Prince Of Wales/Omāroro Reservoir Construction Noise Assessment" as well as other corresponding documents i.e. Beca document "Hospital Prince of Wales Reservoir – Preliminary Design Report" (April 2013), its supporting 2017 addendum document, and further updates received by Marshall Day Acoustics on 17 August 2017.

Section 16 of the Resource Management Act (RMA) states that an activity shall adopt the best practicable option to ensure that the emission of noise does not exceed a reasonable level. Section 17 of the RMA also states that there is a duty to avoid, remedy or mitigate any adverse effect on the environment. These two sections also provide an overarching criterion for this CNVMP.

A glossary of acoustic terminology used within this report is in Appendix 1 (*reference: Marshall Day Construction Noise and Vibration Assessment*).

1.1 Objectives

The objectives of this CNVMP are:

I. To operate in full compliance with the requirements of the Resource Consents (4), Designation (1), and a Licence (1) and demonstrate this through reporting procedures.
II. To liaise closely with neighbours and the local community, regarding noise management during construction.
III. To provide the methods that will be employed to avoid, remedy or mitigate adverse effects on the environment due to construction activities.
IV. To provide a safe and healthy working environment for all staff on, or near the site.
V. To not create a noise or vibration nuisance on, or near, the construction site.

2. Background

This Construction Noise & Vibration Management Plan (CNVMP) has been prepared as a sub-management plan of the Construction Environmental Management Plan (CEMP) associated with the Omāroro reservoir, Prince of Wales Park. The CNVMP is specific to the construction of the reservoir involving excavation, backfilling operations and other activities that have the potential to generate noise.

This CNVMP was prepared by HEB Construction and is to be certified by a suitably qualified acoustic specialist Marshall Day prior to commencement of construction. This CNVMP must be approved by WCC prior to commencement of construction.

The works covered by this CNVMP include the construction of the proposed reservoir, associated access, pipework and tie-ins to the existing network, and the raising of the upper and lower Prince of Wales Park playing fields. The proposed Omāroro Reservoir structure has:

I. A capacity of 35,000m^3 (35ML)
II. A footprint of 3,800m^2 (reservoir) / 4,000m^2 (reservoir + pipe tunnel)
III. An internal diameter of 67.0m
IV. A wall height of 12.1m and total height of 15.5m.

2.1 Description of Proposed Activities

This section of the CNVMP describes a summarised version of the physical works involved and the anticipated construction activities. A detailed programme has been added to this document as Appendix 2.

Excavated materials will be utilised for backfilling and burying the reservoir, and to level off the finished ground levels of the upper and lower playing fields. Any excess excavated material remaining will be disposed offsite. Details are given in the earthworks section to this CNVMP.

Five separable portions are defined for the Omāroro Reservoir works. These are:

(a) Separable Portion 1: Works to Achieve an Operational Reservoir
(b) Separable Portion 2: Planting and Landscaping
(c) Separable Portion 3: Reinstatement of the Playing Fields
(d) Separable Portion 4: New and Reinstated Walking Tracks
(e) Separable Portion 5: All Other Works

The Main Scope of Works:

I. Stage 1 - Site Establishment:
   a) Site accommodation set-up (site offices, site parking, changes to Rolleston Street parking);
   b) Construction of access tracks including vehicle access;
   c) Site fencing;
   d) Construction of erosion and sediment control measures;
   e) Clearance of vegetation and topsoil;
   f) Service relocation.

II. Stage 2 – Reservoir Excavation Includes:
   a. Excavation of material from reservoir site;
   b. Stockpiling of excavated material on the upper and lower playing fields;
   c. Trenching for bulk main pipelines and works to utilities.

III. Stage 3 – Reservoir Construction:
   a. Construction of the reservoir and pipe tunnel including in-situ and precast concrete as required;
   b. Connection of services;

c. Import of required material to site;
d. Stabilisation measures for backfilled slopes;
e. Subsoil drainage around the reservoir;
f. Modifications to existing wastewater services on the lower playing field;
g. Modifications to the stormwater services in the vicinity of the top of Rolleston Street;
h. Testing.

IV. Stage 4 – Backfill:
   a. Burial of the reservoir and tunnel.

V. Stage 5 – Site, Upper and Lower Park Restoration:
   a. Reinstatement and landscaping of the reservoir site including planting and reinstatement of tracks and pathways;
   b. Reinstatement of the upper and lower park including reshaping/levelling, installation of surface drainage, top-soiling, grassing, and marking.

2.2 Description of Site and Local Environment

The proposed Omāroro Reservoir site is located on a spur within the Prince of Wales Park. The Prince of Wales Park is located within the Wellington Town Belt in the Brooklyn Hills, Wellington (Figure 1). The park is bordered by the suburbs of Mount Cook, Brooklyn, Vogeltown, and Newtown, with the Renouf Tennis Centre to the north and Macalister Park further to the south. The Wellington CBD lies to the north and northeast. The proposed reservoir will sit in a spur that generally slopes down from Dorking Road to a rounded knoll at the reservoir site and down again to the Prince of Wales Park playing fields. The reservoir site has an existing ground level of approximately 95 mRL. There are two playing fields that have been levelled along the toe of the spur: the upper field (at 69 mRL), which is accessed off Rolleston and Hargreaves Streets, and the lower field (60 mRL), which is accessed from Salisbury Terrace. There are no building facilities on the upper field, but there is a pavilion building on the lower field. The Scottish Harriers clubrooms and a public car parking area are situated to the south of the lower field.

Figure 1: Proposed reservoir location within Prince of Wales Park showing surrounding streets.

The Omāroro reservoir site is located within Prince of Wales Park with access to the site from the top of Rolleston Street. Properties along Dorking Road, approx. 160 metres southwest look onto the site. The Prince of Wales Park is zoned Open Space C in the Wellington City District Plan.

2.3 Designation Conditions

The Omāroro Reservoir Project has been issued numerous regulatory permissions in the form of Resource Consents (4), Designation (1), and a Licence (1). These are identified below:

I. An easement under the Wellington Town Belt Act 2016 (***Licence***).
II. A ***Designation*** under the Resource Management Act 1991 and the Wellington City District Plan.
III. ***Resource Consents*** under the Resource Management Act 1991, the operative Greater Wellington Regional Plans, and the proposed Natural Resources Plan ***WGN180065*** [***35008****]* – Water Permit, [***35009***] – Discharge Permit, [***35010***] – Land Use Consent.
IV. District Consents under National Environmental Standard (**NES**) for Assessing and Managing Contaminants in Soil to Protect Human Health.

GWRC Resource Consents:

I. ***WGN180065*** [***35008****]* – Water Permit: To take and use groundwater for the purposes of dewatering excavations, dust suppression and other purposes related to the construction of the Omāroro Reservoir.

II. ***WGN180065*** [***35009***] – Discharge Permit: To discharge stormwater runoff from areas of bulk earthworks and de-watered groundwater both treated with chemical flocculants to land, the stormwater network or directly to water related to the construction of the Omāroro Reservoir.

III. ***WGN180065*** [***35010***] – Land Use Consent: To undertake earthworks of an area of more than 3,000m^2 including to excavate land that may intercept groundwater (bore) required to construct of the Omāroro Reservoir.

The Greater Wellington Regional Council Resource Consents (GWRCRC), Wellington City Council Designation (WCCD) and Town Belt Act Licence Conditions (TBAC) specify the purpose and objectives of the five (5) management plans to be produced. This CNVMP along with the other management plans will demonstrate how HEB Construction will achieve compliance with these regulatory requirements and constraints. Table 1 below provides a cross-reference to the items specified in the Wellington City Council Designation Conditions and their requirements, provided by The Wellington City Council (WCC) which specifically relate to this CNVMP. The table also directs the reader to which section of the CNVMP, or corresponding management plan, relates to these conditions.

The Wellington City Council District Plan requires that noise from construction activities be assessed in accordance with New Zealand Standard NZS 6803:1999 'Acoustics-Construction Noise' which states similar requirements for the CNVMP.

Table 1: Construction Noise and Vibration Management Identified Within WCC Wellington City Council Designation Regulatory Permissions

Construction Noise & Vibration Management Plan		Associated Management Plan	Specific Section of the Management Plan
DC.28			
a)	At least 15 Working Days prior to Commencement of Construction the Requiring Authority shall submit a CNVMP to the CMO for certification	Construction Environmental Management Plan (CEMP)	7.1.1 Pre-construction Notification Requirements
b)	The CNVMP shall address the matters in conditions DC.29-31	No specific section of the CNVMP addresses this condition. Compliance with this condition by HEB Construction is bona fide.	
c)	The CNVMP shall be prepared in accordance with the requirements of Annexe E to NZS 6803:1999 'Acoustics – Construction Noise'	Construction Noise & Vibration Management Plan (CNVMP)	3.1 Noise
d)	Construction shall not commence until the Requiring Authority has received the CMO's written certification of the CNVMP	Construction Environmental Management Plan (CEMP)	7.3 Construction Noise
e)	The CNVMP must be prepared by (or certified by) a suitably qualified acoustic specialist	Construction Noise & Vibration Management Plan (CNVMP)	2. Background

f)	The CNVMP must be modified at the reasonable request of the CMO to deal with any deficiencies in its operations	No specific section of the CNVMP addresses this condition. Compliance with this condition by HEB Construction is bona fide.	
DC.29			
	The purpose of the CNVMP shall be to provide methods to manage noise/vibration appropriately for the variety of circumstances within the Project area by outlining the measures, procedures and standards for mitigating the effects of noise and vibration during construction of the Project so they will meet:	Construction Noise & Vibration Management Plan (CNVMP)	8. Mitigation
a)	The noise criteria set out in condition DC. 31, where practicable. Where it is not practicable to achieve those criteria, alternative strategies should be described to achieve the best practicable option to minimise the effects of construction noise on neighbours	Construction Noise & Vibration Management Plan (CNVMP)	8.1 Noise Mitigation
b)	The vibration criteria set out in Table 3 of DIN 4150-3: 1999, where practicable. Where it is not practicable to achieve those criteria, a suitably qualified expert shall be engaged to assess and manage construction vibration during the activity that exceed the criteria	Construction Noise & Vibration Management Plan (CNVMP)	8.2 Vibration Mitigation
c)	Where on-site construction works and/or heavy vehicle movements need to be undertaken outside of normal working hours (as defined in DC17) night-time (8:00pm – 6:30am) work shall be avoided where practicable. Where avoidance is not practicable, the best practicable option shall be adopted to minimise or mitigate noise and vibration effects.	Construction Noise & Vibration Management Plan (CNVMP)	4.2 Hours of Operation
Note:	The intent of DC.29c) is to clarify that activities required to be undertaken outside of normal working hours (defined in DC17) should preferably occur between either 6:30am-7:30am or 6:00pm-8:00pm. Night time activities (8:00pm- 6:30am) should be avoided where practicable.	Construction Noise & Vibration Management Plan (CNVMP)	4.2 Hours of Operation
DC.30			
	The CNVMP shall, as a minimum, address the following:		

a)	Description of the Works, anticipated equipment/processes and their scheduled durations	Construction Noise & Vibration Management Plan (CNVMP)	2.1 Description of Proposed Activities
b)	Hours of operation (in accordance with condition DC.17), including times and days when activities causing noise and/or vibration would occur	Construction Noise & Vibration Management Plan (CNVMP)	4.2 Hours of Operation
c)	The construction noise and vibration criteria for the Project	Construction Noise & Vibration Management Plan (CNVMP)	3. Construction Noise & Vibration
d)	Identification of affected houses and other sensitive locations where noise and vibration criteria apply including a list of Noise Sensitive Receivers (as defined in NZS 6803:1999 'Acoustics – Construction Noise')	Construction Noise & Vibration Management Plan (CNVMP)	5. Sensitive Receivers
e)	Requirements for monitoring road surface condition to minimise noise and vibration from trucks travelling over potholes and uneven surfaces	Construction Noise & Vibration Management Plan (CNVMP)	11.2 Vibration Monitoring
f)	Requirements for building conditions surveys at locations close to activities generating significant vibration, prior to and after completion of construction and processes for repair of any damage caused by the Work	Construction Noise & Vibration Management Plan (CNVMP)	11.3 Building Condition Surveys
g)	Mitigation options including alternative strategies where full compliance with the relevant noise and/or vibration criteria cannot be achieved	Construction Noise & Vibration Management Plan (CNVMP)	8. Mitigation
h)	Methods and frequency for monitoring and reporting on construction noise and vibration	Construction Noise & Vibration Management Plan (CNVMP)	11. Monitoring
i)	Operator training procedures and expected behaviours under the CMP as required by condition DC.17	Construction Environmental Management Plan (CEMP)	8 Training & Education
j)	Consultation and notification procedures	Construction Noise & Vibration Management Plan (CNVMP)	9. Stakeholder Engagement & Complaints
k)	Specify an exemption process for approval by the CMO for any construction work that cannot be undertaken during approved working hours	Construction Noise & Vibration Management Plan (CNVMP)	4.2 Hours of Operation
DC.31			
	Construction noise shall be measured and assessed in accordance with NZS 6803:1999 'Acoustics – Construction Noise'. The construction noise shall where practicable comply with the following criteria for the purposes of the CNVMP (Figure 2 below).	Construction Noise & Vibration Management Plan (CNVMP)	3.1 Noise

Time of week	Time period	dB $L_{Aeq(15\ min)}$	dB L_{AFmax}
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

***Figure 2**: NZS 6803:1999 'Acoustics – Construction Noise'*

3. Construction Noise & Vibration

3.1 Noise

The Wellington City Council District Plan requires that noise from construction activities be assessed in accordance with New Zealand Standard NZS 6803:1999 'Acoustics-Construction Noise'. Table 2 demonstrates the construction noise limits which are the "long term duration" limits of NZS 6803, and the most stringent of this Standard.

Table 2: Recommended upper limits for construction noise received in residential zones (from New Zealand Standard NZS 6803: 1999 "Acoustics – Construction Noise")

Time of week	**Time of period**	**Duration of work Long-term duration (dBA)**	
		Leq	Lmax
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

3.2 Vibration

The Wellington City District Plan does not address vibration resulting from constructions activities. However appropriate guidance can be found in DIN 4150-3:1999 *"Structural Vibration – Effects of Vibration on Structures"*. The relevant criteria are shown in Table 3 of this CNVMP.

Table 3: Vibration Units to avoid Building Damage (from DIN 4150-3: 1999)

Building Type	**Short-term vibration**				**Long-term vibration**
	PPV at the foundation at:			**PPV (horizontal plane) of highest floor (mm/s)**	**PPV (horizontal plane) of highest floor (mm/s)**
	1-10Hz (mm/s)	**10-50 Hz (mm/s)**	**50-100 Hz (mm/s)**		
Commercial	20	20 – 40	40 – 50	40	10
Dwellings	5	5 – 15	15 – 20	15	5

'Short-term vibration' applies to transient or impulsive vibration sources such as the bang of a truck tail-gate. Most other construction activities would be classified as 'long-term'.

It is important to understand that the above criteria are the limits to avoid structural damage to buildings. People will however be able to 'feel' vibration at lower levels than these criteria. During consultation, HEB Construction will inform residents of this as part of the stakeholder engagement section of the CNVMP.

If required construction vibration on the project will be measured in accordance with ISO 8041:2005 "Human response to vibration – Measuring Instrumentation" and ISO 4866:2010 "Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures".

Where it is not practicable to achieve those criteria specified in table 3, a suitably qualified acoustic specialist shall be engaged to assess and manage the construction vibration during the activity that exceed the criteria. Given the nature of the construction activities and the relative distances to surrounding buildings vibration is not anticipated to exceed the required standard.

4. Project Overview

4.1 Construction Methodology and Programme

4.1.1 Earthworks, & Pavement Construction

Two significant activities occurring during the reservoir project involve earthworks and pavement construction. This includes bulk earthworks, transporting fill, grading, levelling, and compaction of material, the burial of the reservoir and tunnel and trenching for bulk main pipelines. Pavement is required for the new walking tracks, access roads and car parks. Preparing the aggregate base course and surface will involve the spreading of aggregate, distributing the chips / asphalt, and compaction. In addition to pavement construction signage, fencing, paint marking, and bollards will be installed. Figure 3 provides an overview of the construction works extracted from the latest design drawings.

Excavated materials will be utilised for backfilling and burying the reservoir, and to level off the finished ground levels of the upper and lower playing fields. Any excess excavated material remaining will be disposed offsite.

A guide to the cut to fill schedule and earthworks plan is as follows:

I. All topsoil stripped (200mm from upper and lower playing fields) will be taken off site and new topsoil imported;
II. Erosion and Sediment Controls installed;
III. All residual and highly weathered material from the cut is to be stockpiled and used for the backfill stage;
IV. Initial excavation material will go to lower playing field stockpile;
V. Water main pipes installed in the upper playing field;
VI. When lower playing field has reached consented stockpile capacity, the excavation material will go to the upper playing field;
VII. Any remaining material from the excavation will be disposed offsite (10approx. 19,693m^3).

Estimated stockpile and backfill quantities and types are as follows:

I. 12,210m^3 – Residual soil backfill;
II. 13,198m^3 – Highly weathered greywacke backfill;
III. 6,352m^3 – Moderate weathered greywacke backfill.

Estimated imported material quantities and types are as follows:

I. Prior to excavation: 1,500m^3 GAP65 for haul roads & site facilities;
II. Drainage trenches: 2,452m^3 drainage chip;
III. Upper and Lower Playing Fields: 3130m^3 topsoil;
IV. The backfill of the buried tank: 3900m^3 topsoil.

Areas for Pavement Works Include:

I. The reservoir access road;

II. The top of Rolleston Street including the new carparks; and
III. The Dorking Road access;
IV. The retaining wall at the Dorking Road access; and
V. New walking tracks.

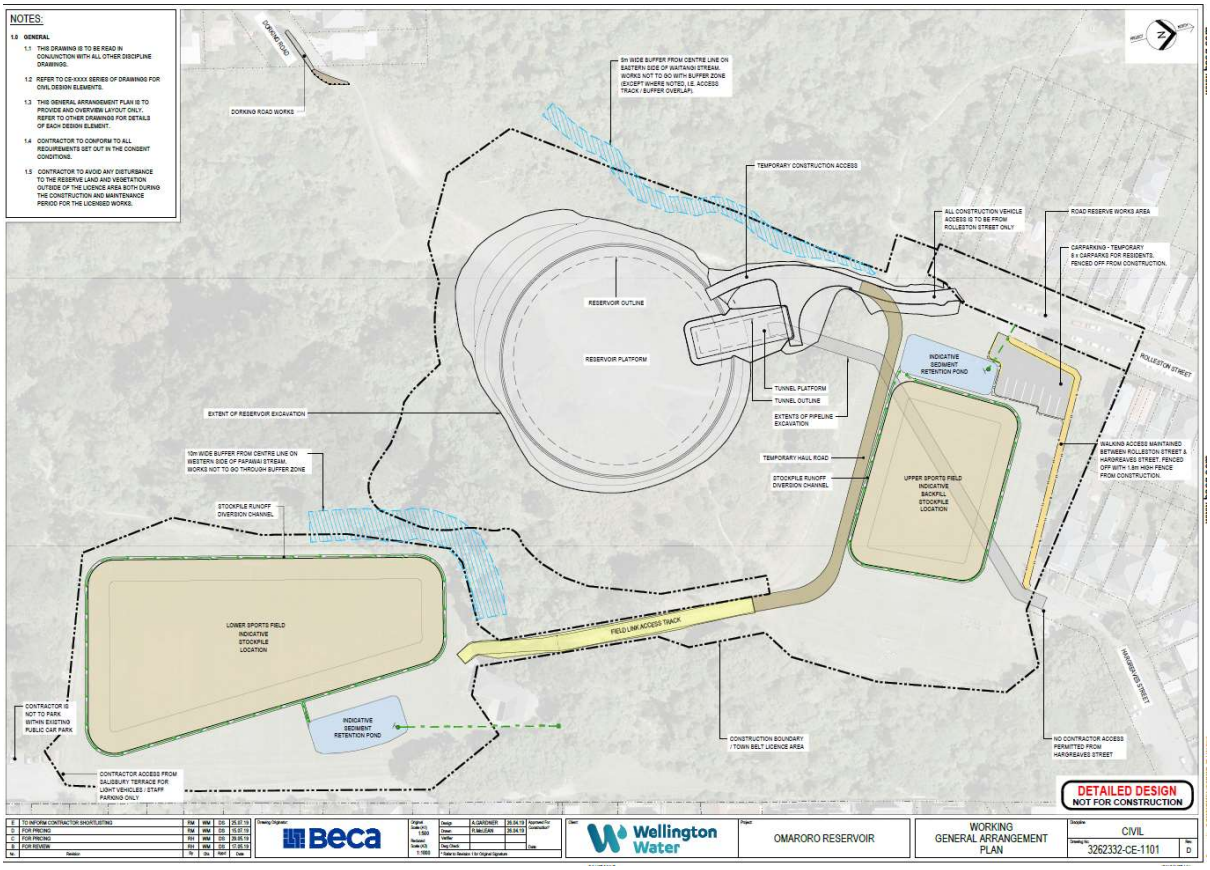

***Figure 3**: General overview design of construction works*

4.1.2 Landscaping and Playing Fields

The landscape treatment will be addressed in accordance with the following objectives:

I. Create a final landform that supports a smooth integration with adjacent areas of topography and optimises effective revegetation conditions;
II. Establish native vegetation, amenity trees and areas of open grass which assist the final landform becoming assimilated within its surrounding open space setting and maintains a wider green backdrop; and
III. Maintain and enhance recreation opportunities, including recreation tracks, lookout opportunities and playing fields.

Following completion of the reservoir installation, the upper and lower playing fields are to be reinstated to at least the same standard as prior to the works. This will be achieved through the

improvement of the existing surface levels and the installation of a primary sports field drainage system and automated irrigation on both fields.

The Main Scope of Works for Landscaping:

I. Tree removal and tree retention protection measures installed;
II. Fencing;
III. New walking tracks; and
IV. Planting of trees, riparian planting and seeding for new grass.

The Main Scope of Works for The Upper and Lower Playing Fields:

I. Acceptance of surfaces following the bulk earthworks including assessment of adequacy of compaction of the playing field sub grade;
II. Initial trimming of sub grade to form general level;
III. (Imported) top-soil placement;
IV. Installation of primary subsoil drainage system;
V. Surface drainage for the upper and lower playing fields;
VI. Final trim of top-soiled surface to correspond to design grades;
VII. Installation of irrigation system including new power and water supplies; and
VIII. Seeding, grow-in and turfgrass establishment.

4.1.3 Vehicle movements

HEB Construction will transport excavated material using single unit rigid trucks. The truck movements will be between different parts of the Project for temporary stockpiling, cut to fill and/or off-site cut to waste operations. These trucks will have three or four axles and be approximately 8-9 metres in length. A comprehensive Construction Traffic Management Plan (CTMP) has been prepared as part of the overarching Construction Environmental Management Plan (CEMP) that thoroughly addresses traffic movement and management.

As the project is retaining most of the excavation material for backfilling, burying the reservoir and for levelling off the upper and lower playing fields, an approximation for the number of offsite truck movements has been calculated. Over the length of the construction programme there is an estimated 6,500 round trips of heavy vehicles to complete the earthworks. Peak hour traffic volumes are expected to vary between 0 and 16 trips in the peak hour depending on the works being undertaken.

Concrete trucks are single unit rigid heavy vehicles. Concrete will be poured on site during the reservoir construction phase of the programme therefore the number of concrete truck movements on any given day will be dependent on whether a pour is taking place on site. The number of concrete vehicle movements can total to six per hour during the completion of the pour.

Some specialised heavy vehicle movements (such as cranes and excavation machinery), associated with the delivery and removal of specialised machinery may be required at some stages during the Omāroro project.

4.1.4 Summary

Due to the stockpiling of material, compaction and landscaping related activities the upper and lower playing fields, the number of off-site truck movements associated with the removal of excavated material for off-site disposal is reduced. This does however involve an equivalent number of onsite truck movements and therefore a potential for noise and vibration related issues to mitigate for.

4.2 Hours of Operation

Table 4: Hours of Operation Identified Within WCC Regulatory Permissions

Construction Management Plan		Associated Management Plan	Specific Section of the Management Plan
DC.17			
	The CMP shall include details of:		
a)	Construction methodologies and construction timeframes, including staging	Construction Environmental Management Plan (CEMP)	
b)	Normal working hours, shall be:		
i)	For on-site construction activities: 7:30am to 6.00pm Monday to Saturday (excluding public holidays)	Construction Noise and Vibration Management Plan (CNVMP)	4.2 Hours of Operation
ii)	For earthworks related heavy vehicle movements on public roads: 9:00am -6:00pm Monday to Friday (excluding public holidays)	Construction Noise and Vibration Management Plan (CNVMP)	4.2 Hours of Operation
iii)	For all non-earthwork related heavy vehicle movements on public roads: 9:00am -6:00pm Monday to Friday (excluding public holidays)	Construction Noise and Vibration Management Plan (CNVMP)	4.2 Hours of Operation
c)	An exemption process for approval by the CMO, for any construction work and specialised heavy vehicle movements that cannot be undertaken during normal working hours.	Construction Noise and Vibration Management Plan (CNVMP)	4.2 Hours of Operation
DC.29c)	Where on-site construction works and/or heavy vehicle movements need to be undertaken outside of normal working hours (as defined in DC17) night-time (8:00pm – 6:30am) work shall be avoided where practicable. Where avoidance is not practicable, the best practicable option shall be adopted to minimise or mitigate noise and vibration effects.	Construction Noise & Vibration Management Plan (CNVMP)	4.2 Hours of Operation
Note:	The intent of DC.29c) is to clarify that activities required to be undertaken outside of normal working hours (defined in DC17) should preferably occur between either 6:30am-7:30am or 6:00pm-8:00pm. Night-time activities (8:00pm- 6:30am) should be avoided where practicable.	Construction Noise & Vibration Management Plan (CNVMP)	4.2 Hours of Operation
DC.30b)	Hours of operation (in accordance with condition DC.17), including times and days when activities causing noise and/or vibration would occur	Construction Noise & Vibration Management Plan (CNVMP)	4.2 Hours of Operation

DC.30k)	Specify an exemption process for approval by the CMO for any construction work that cannot be undertaken during approved working hours	Construction Noise & Vibration Management Plan (CNVMP)	4.2 Hours of Operation

To comply with the noise and vibration criteria detailed in the above conditions from WCC, HEB Construction will restrict normal onsite construction working hours to 7.30am to 6:00pm Monday to Saturday

For all vehicle movements on public roads, working hours will be restricted to 09:00am to 6:00pm Monday to Friday and excluding Public Holidays.

Heavy vehicle movements to and from the site associated with the export of excess fill material will be restricted to 9am to 6pm Monday to Friday. Bulk earthworks will be restricted to the earthworks season from 1 September to 31 May, unless otherwise agreed with WCC and GWRC.

No programmed works are scheduled be undertaken on Sundays or Public Holidays.

On-site construction works and heavy vehicle movements outside of normal working hours be avoided where practicable but there be times where it is simply unavoidable due to either unforeseen circumstances arising or the need for the completion of a construction activity that simply put cannot be completed in a shorter space of time. These types of situations are few. The "time triggers" that relate to these situations are:

- Where onsite construction activity is required between 18:00pm and 0730am on a Monday - Saturday (excluding Public Holidays);
- Where earthworks related heavy traffic movements are required on public roads between 18:00pm and 9:00am on a Monday – Friday (excluding Public Holidays);
- Where any non-earthwork related heavy traffic movements are required on public roads between 18:00pm and 9:00am on a Monday – Friday (excluding Public Holidays).

Where avoidance is not practicable, the best practicable option shall be adopted to minimise or mitigate noise and vibration effects. An exemption process for approval by the CMO, for any construction work and specialised heavy vehicle movements that cannot be undertaken during normal working hours is required. The process will be documented and consider the CMO will assess the following criteria:

- Night-time (8:00pm – 6:30am) work shall be avoided where practicable;
- Where avoidance is not practicable, specify how the best practicable option shall be adopted to minimise or mitigate noise and vibration effects;
- A comment on whether this sort of activity has been undertaken previously within the Project and the success, or otherwise, of any mitigation measures that may have been utilised.
- Specify proposed noise mitigation measures;
- Identification whether the noise and/or vibration criteria is likely to be exceeded. If so, explain how the best practicable option shall be adopted to minimise or mitigate noise and vibration effects to a reasonable level

- A through description of work activity involved, including machinery and anticipated noise and/or vibration levels at the source.
- The location(s) where the noise and/or vibration is to be generated.
- A description of the anticipated approximate noise levels for those sensitive receiver properties.
- Dates and times when the work is to be completed.
- Identification of those properties that will likely be affected by the activities.
- An explanation of why the work cannot be completed within normal work hours and whether the situation could have been avoided.

Identifying the approach that will be taken will involve liaison with WCC to help facilitate the best outcome. The process will be documented and consider the following criteria:

- An explanation of why the work cannot be completed within normal work hours and whether the situation could have been avoided.
- A comment on whether this sort of activity has been undertaken previously with the Project and the success, or otherwise, of any mitigation measures that may have been utilised.
- Identification of the noise and/or vibration criteria that is likely to be exceeded.
- A through description of work activity involved, including machinery and anticipated noise and/or vibration levels at the source.
- The location(s) where the noise and/or vibration is to be generated.
- A description of the anticipated approximate noise levels for those sensitive receiver properties.
- Dates and times when the work is to be completed.
- Identification of those properties that will likely be affected by the activities.
- A thorough description of any mitigation measures that is to be used including the effectiveness and anticipated sound and/or vibration level outcomes at those properties identified.
- Noise levels to be received at affected properties with mitigation.
- Description of the method(s) of communication with affected parties/properties and a record of the content of that communication and when it was provided.

If the work is approved, then following completion of the activity HEB Construction will within 5 working days of the completion of the activity provide WCC information on the following:

- A record of any complaints received in relation to the completion of that activity and any addition measures that were utilised to resolve the complaint(s).
- The actual noise levels involved in the activity at source.
- Noise levels, where they able to be obtained, at a representative number of affected properties.

Activities and specialised heavy vehicle movements which cannot be undertaken during normal working hours and are exempt for approval by the CMO, are works which are necessary to avoid, remedy or mitigate an emergency situation. Any emergency works which are essential and cannot

be undertaken during approved working hours will be approved in writing by the CMO at Wellington City Council

5. Sensitive Receivers

This section of the CNVMP provides an identification of affected houses and other sensitive locations where noise and vibration criteria apply and a list of Noise Sensitive Receivers (as defined in NZS 6803:1999 'Acoustics – Construction Noise').

A site visit was carried out on 22 November 2016 by Marshall Day Acoustics to provide a greater understanding of the topography of the site and to identify the closest potentially affected noise sensitive receivers. The following properties have been identified as the assessment locations:

Adjacent to the upper playing field:

I. **Rolleston Street:** those properties closest to the subject site at the western end of Rolleston Street include numbers 73, and 86 to 102 Rolleston Street. However, all properties fronting on to Rolleston Street are potentially affected as it is proposed that Rolleston Street forms the primary access route for construction vehicles;
II. **Hargreaves Street:** those properties located at the western (top) end of Hargreaves street including numbers 23, 40, 42, 42A, 44 and 46 Hargreaves Street;
III. **Papawai Terrace:** numbers 7 and 8 Papawai Terrace;
IV. **Wright Street**: numbers 26, 34A, 40A and 46B Wright Street.

Adjacent to the lower playing field:

I. **Wright Street:** numbers 40A and 46B Wright Street;
II. **Salisbury Terrace:** numbers 9 to 12;
III. **Salisbury Avenue:** even numbers 2 to 10;
IV. **Westland Road:** uneven numbers 1 to 7.

Overlooking the subject site:

I. **Dorking Road:** properties on the north side of Dorking Road, including numbers 2 to 18;
II. **Asquith Terrace:** uneven numbers 1 to 17.

Other locations in the area may also be subject to noise and vibration from construction activities. However due to their increased distance from these activities, the noise effects will be lesser when compared with those properties identified above.

Figure 4 presents an aerial view of the site and surrounding closest properties potentially affected by construction noise.

Figure 4: View of site and closest surrounding properties. The approximate location of the Reservoir site is shown in red. *(Reference: Rp 001 R05 2016849W –Construction Noise Assessment, Marshall Day Acoustics).*

6. Noise Sources

Construction equipment proposed to be used on the Omāroro Reservoir project is outlined below. At the start of each activity, site noise monitoring will be conducted to adjust this data where necessary. The major plant items likely to be used on this project include:

I. ***Stage 1*** **–** Site Establishment:
   a. 1 to 2 tracked excavators;
   b. Wheeled loader;
   c. Water truck;
   d. Delivery and haul trucks;
   e. On-site trucks.

II. ***Stage 2*** **–** Reservoir Excavation:
   a. Tracked excavators x3;
   b. Static roller;
   c. Vibrating roller;
   d. Wheeled loader;

e. Water cart;
f. On-site trucks;
g. Delivery and haul trucks;
h. Grader;
i. Bulldozer.

III. ***Stage 3 –*** Reservoir Construction
a. Tracked excavators x2;
b. Crane;
c. Concrete pump;
d. Concrete trucks;
e. Concrete vibrators;
f. Dump trucks;
g. Delivery and haul trucks;
h. Wall panel delivery trucks;
i. Occasional low-bed semi-trailer type trucks for large machinery deliveries;
j. Hiab truck;
k. Ramset guns.

I. ***Stage 4 –*** Backfill
a. 1 to 2 tracked excavators;
b. Static roller;
c. Vibrating roller;
d. Wheeled loader;
e. Delivery and haul trucks;
f. Site trucks.

II. ***Stage 5*** – Site Restoration:
a. Tracked excavators x3;
b. Grader;
c. Bulldozer;
d. Static roller;
e. Vibrating roller;
f. Wheeled loader;
g. Water cart;
h. Delivery and haul trucks;
i. Site trucks.

Sound Power Levels

The equipment noise level data for individual items of plant/machinery has been obtained from measurements of similar equipment carried out by Marshall Day Acoustics, and library data in NZS 6803. These levels are presented in Table 4 below.

Reliable estimates of the individual noise levels for each item of equipment can be found through various sources including the NZTA construction noise calculator (reference: *https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/tools/construction-noise-calculator/*).

Table 4: Equipment sound power levels (All Stages)

Equipment	**Sound Power Level (L_w dBA) (per individual item)**
Excavator	103
Static roller	100
Vibrating roller	106
Wheeled loader	107
Water Cart	102
Low bed semi-trailer	110(*)
Trucks	106(*)
Grader	101
Dozer	112
Hydraulic jaw crusher	100
Crane	100
Truck-mounted concrete pump	108
Concrete vibrator	92
Air compressor	100
Powder actuated tools	133 (L_{max})

*Due to the gradient of the Rolleston St, for the purposes of calculating noise from trucks on Rolleston Street, this tabled sound power is increased by an additional +4 dB.

6.1 Noise Predictions Levels

Noise levels have been predicted at the assessment locations in accordance with the methods described in NZS 6803: 1999 and within the Marshall Day Acoustics Construction Noise Assessment.

A 'typical worst case' scenario was utilised for the following reasons:

I. Any screening which may occur from variations in site topography was not taken into consideration;

II. Any noise reduction due to ground effect was not taken into account;
III. An assumption was made that all machinery will operate simultaneously. This is often not the case, with much of the machinery having 'down time' throughout the day.
IV. There are several variables and factors affecting the accuracy of the noise predicted.
V. These factors include the variations in the specific models and individual items of equipment, the exact location of each item, the individual operators and the exact location of the various receiving environments.

The data provided in Table 5 is an estimate of the typical worst-case activity.

	Predicted Noise Levels Leq (dBA)				
Receiver Location	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**
Rolleston St general (construction vehicle noise)	67 to 70	70 to 73	67 to 70	67 to 70	67 to 70
Rolleston St western end	67 to 70	70 to 73	70 to 72	67 to 70	67 to 70
Hargreaves/Papawai/Wright	63 to 70	65 to 72	67 to 72	65 to 70	65 to 72
Salisbury Tce/Salisbury Ave/Westland St	66 to 70	68 to 70	64 to 67	67 to 70	66 to 70
Dorking Road/Asquith Tce	56 to 58	61 to 64	64 to 66	61 to 64	60 to 63

Table 5: Predicted construction noise levels

7. Vibration Sources

The proposed construction methodology does not involve major activities which would typically generate high levels of vibration (such as piling or blasting). As such the vibration limits as set out in Section 3.2 of this CNVMP are not expected to be exceeded. Vibratory compaction (rollers) and concrete vibrators are the main sources of construction vibration associated with the project with the potential for adverse effects.

The Rolleston Street road surface is to be maintained including pothole remedials and even surfaces. This will control vibration received at the houses on Rolleston Street, due to construction traffic using the Rolleston Street site access.

8. Mitigation

Calculations have been made for the main items of equipment based on the construction methodology overview and minimum distances to the nearest neighbours. Table 5 shows that without mitigation measures implemented, construction noise levels at most assessment points are

predicted to be within, or to marginally exceed the NZS 6803 limit for the hours of 0730-1800 (70 dBA Leq) (*reference: Marshall Day Acoustics*). Outside those hours, the exceedance for such activities would be greater, as the relevant noise limits decrease.

The Lmax noise levels for earthworks is expected to be typically 10 dB above the Leq value. Therefore, the 85 dBA Lmax noise limit will be complied with between 0730 and 1800 hours (*reference: Marshall Day Acoustics)*.

Wellington City Council monitoring staff are a key stakeholder for the project. They will be kept up to date with current activities and locations.

8.1 Noise Mitigation

HEB Construction will complete construction activities in accordance with New Zealand Standard 6803:1999 "Acoustics for Construction Noise" - refer Section 3.1. Most of the works will be conducted during daylight hours and will be restricted to the work hours specified in the regulatory permission conditions. In a very limited number of situations, it may be necessary to complete works outside of these hours (0730hrs to 18:00hrs Monday to Friday). The process that HEB Construction will follow to liaise with WCC when this situation is identified is set out in Section 4.2 of this plan. The activities involved most likely include:

- Large scale continuous concrete pours (e.g. for sections of the reservoir floor) where due to the volume of concrete required the beginning of the pour may need to be started prior to 7:30am). This activity would involve concrete delivery trucks and a concrete pump.
- Road pavement connections ("tie-ins") between newly prepared road surfaces and existing roads where in order to complete the work there needs to a temporary road closure the kind of which is not possible to practicably complete during the working day. This activity would involve asphalt spreaders, bitumen/emulsion spray trucks, line marking vehicles, traffic control.

In some instances, there may arise challenges with compliance with noise limits during normal working hours. One example of this includes using rock breakers. Should ground conditions within the bottom of the excavation get hard enough that an excavator "ripping" the surface is not breaking up the material then rock breakers maybe required.

In relation to vehicles HEB Construction will employ where practicable the following construction noise mitigation strategies to reduce the possibility of compliance not being achieved:

Construction Traffic – Rolleston Street

Noise from construction traffic is predicted to be able to comply with the construction noise levels for properties on Rolleston Street. The construction traffic calculations are based on CH2M Beca report "Prince of Wales/Omāroro Reservoir Transport Assessment" (April 2017). This has been supplemented by updated traffic volume predictions, received and produced by Marshall Day Acoustics in September 2017. The predictions are derived by establishing the sound power (dB) for an activity and then calculating the degree to which distance,

environmental factors, and mitigation methods (e.g. barriers) influence the sound at the façade of any particular house.

The method in which the construction traffic is operated can have a noticeable effect on the resulting noise. One method includes lower hourly traffic volumes to reduce the noise levels received at Rolleston Street properties (*Reference: Marshall Day Acoustics*). Other methods associated with vehicle maintenance and equipment/machinery operations include:

A. Vehicle Maintenance

I. All equipment on site shall be checked for efficient exhaust muffler systems.
II. All equipment will be maintained in good working order.
III. Vehicles and equipment will be regularly inspected for any exhaust defects.
IV. All equipment onsite will undergo daily pre-start checks to ensure that they are safe to operate; these checks will identify any repair or maintenance issues that may create additional noise.
V. Fitting / upgrading of engine covers
VI. Any required repair and maintenance work required that will impact on noise levels is to be completed as soon as possible.

B. Equipment, Machinery and Operations

I. All equipment, machinery and vehicles will be operated and maintained in a manner that takes into account noise emissions and excessive noise.
II. Excessive engine revving and excessive use of horns are examples of non-conformance with the obligation to limit the emission of unreasonable noise.
III. Effective silencers to be fitted to power plant and machinery where possible.
IV. Engines and other noise sources have been oriented as far as practical to reduce noise emissions in the direction of sensitive receivers.
V. Truck tailgates will have rubber or other material/mechanism provided to prevent the metal on metal noise generated when tailgates close.
VI. Guidance on loading of trucks – selection of loading and unloading locations where possible away from sensitive receivers and avoiding dumping material from height. Loading rubble onto trucks can provide a significant source of noise. This is particularly the case with the first loads into an empty tray. Careful selection of the location of loader route and loading points is important (away from noise sensitive receivers). Additionally, the material (particularly the first loads) should be carefully placed into the tray, rather than “dumped” from a height above the tray;
VII. All vehicles operating on the site are to be restricted to 50 km/hr or below. Management shall enforce site speed limits in relation to staff and site visitors.
VIII. No exhaust brakes or engine retarders are to be used on the site.
IX. Audible warning devices (such as reversing alarms) are to be limited in terms of sound level and frequency of use, to a practical minimum that satisfies health and safety requirements.
X. Alternatives to the standard tonal reversing alarms of mobile equipment operating on the construction site should be used. Such alternatives include broadband (white noise) reversing alarms (sound from broadband alarms dissipates more readily over distance than tonal alarms), and/or flashing warning lights;
XI. Avoid vibratory rollers and packers near sensitive areas.
XII. Avoid start up, shut down and idling of plant when in close proximity to dwellings.

C. Driver Operating Rules

All staff working on the Project will complete an induction where the following driving related rules will be identified and explained:

I. Take specific considerations when operating vehicles on Rolleston Street to reduce the noise as much as possible.
II. Do not accelerate vehicles unnecessarily;
III. Do not use engine exhaust brakes;
IV. Do not use horns unnecessarily;
V. Adhere to road speed limits at all times;
VI. Do not idle any longer than necessary, and move off the site as soon as practical;
VII. Ensure trucks are maintained to minimise exhaust smoke and odour, and are fitted with effective exhaust silencers and secure tailgates;
VIII. Do not start up, shut down and leave idling plant when in close proximity to dwellings.

Finally, where the above measures relating to maintenance of vehicles, vehicle and equipment operation, and driver rules are found not to be effectively controlling noise, and noise measurements confirm that compliance levels are not being achieved, and the Project has received complaints then works will cease and the following additional mitigation measures will be considered:

Mitigation When Noise Limits are Predicted to be Exceeded:

Due to the proximity to the public and residences, mitigating measures will be required for routine activities that will take place during normal operating hours such as the rock breaking example identified earlier. Alternatively, as identified earlier in this section in a very limited number of situations, it may be necessary to complete works outside of these hours (0730hrs to 18:00hrs Monday to Friday) e.g. long continuous concrete pours. In order to "forecast" the need for mitigation measures for such events the work will be proactively analysed well in advance to establish whether measures are required or should be considered rather than react to a complaint.

Two scenarios have been analysed below as examples of this approach.

The first example is that of the long continuous concrete pour starting at 5:00am and continuing for approximately 8 hours. Prior to 06:30am the permissible L_{eq} is 45dBA. This limitation continues until 06:30am when it increases to L_{eq} 55dBA and finally reaches 70dBA at 0730am. The pour would taken place using a truck mounted concrete pump that has a source power of 108dB. The truck would be positioned inside the excavation and there have, in some situations, a degree of sound barrier created by the wall of the excavation. Figure 5 illustrates Scenario 1 as it relates to 4 separate scenarios in terms of sensitive receivers ("A" closest Hargreaves properties, "B" closest Rolleston properties, "C" closest Dorking properties and "D" closest Salisbury properties).

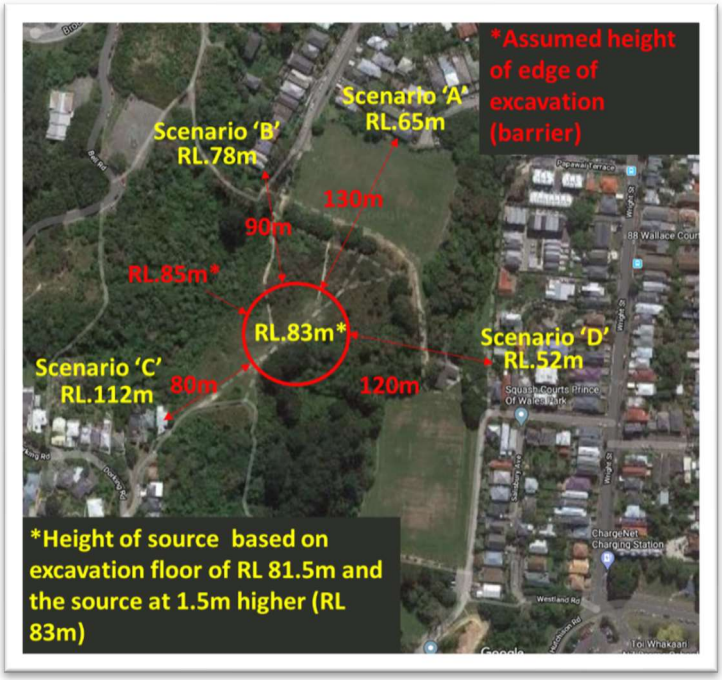

Figure 5: Locations (distance from noise source and relative levels (RL) of 4 examples of sensitive receivers) from the source of noise within the excavation floor (truck mounted concrete pump 108dB).

Using an interactive online "Sound Propagation Level Calculator" (http://noisetools.net/noisecalculator2?display=2) that allows the user to estimate approximate sound levels for receivers and then evaluate the relative effectiveness of barriers in terms of reducing sound levels enables the construction management team to identify whether mitigation measures maybe necessary. For each of the 4 scenarios identified above (A-D) the online calculator was used. The outputs from this modelling showed that for Scenario A and D the need for additional screening will not likely be necessary to comply with the 45dB restriction prior to 06:30am (Refer Figures 6 and 11). However, for Scenario B (Figure 7) the modelling showed that without any additional mitigation the noise would likely not comply with the required standard. Scenario 2 was then amended to include a sound barrier (Refer to Figure 8) and this time the modelling illustrated that compliance could be achieved through the introduction of a barrier. Scenario C (Refer Figure 9) also demonstrated that compliance was unlikely until the introduction of a barrier (Refer Figure 10).

The use of the online calculator to provide an indication of compliance enables the construction management team to proactively address the situation ahead of time. It also enables the construction management team to understand whether at 06:30am (L_{eq} 55dBA) and then at 07:30am (L_{eq} 70dBA) compliance is likely or unlikely with or without barriers. Scenario A and D are already likely to comply. Scenario B is likely to become compliant after 06:30am without the barriers however Scenario C would still likely need barriers until 07:30am. The construction management team will be better positioned to determine whether they will need to employ any of the following considerations is modelling is utilised:

I. **Screening:** A solid barrier that breaks the line of sight from source to receiver can reduce noise levels by up to 10 dB(A). If screens are used, care will be taken to ensure that they do not create problems for other receivers with reflected sound.

II. **Timing:** Avoid noisy work at the most sensitive times where practicable and liaise closely with residents and stakeholders to avoid nuisance and disruption.

III. **Alternate methods:** Consideration will be given to alternative working methods that generate less noise or the use of quieter plant and equipment, avoid unnecessary noisy activities and consider reducing plant and equipment numbers or the length of time that they are left running.

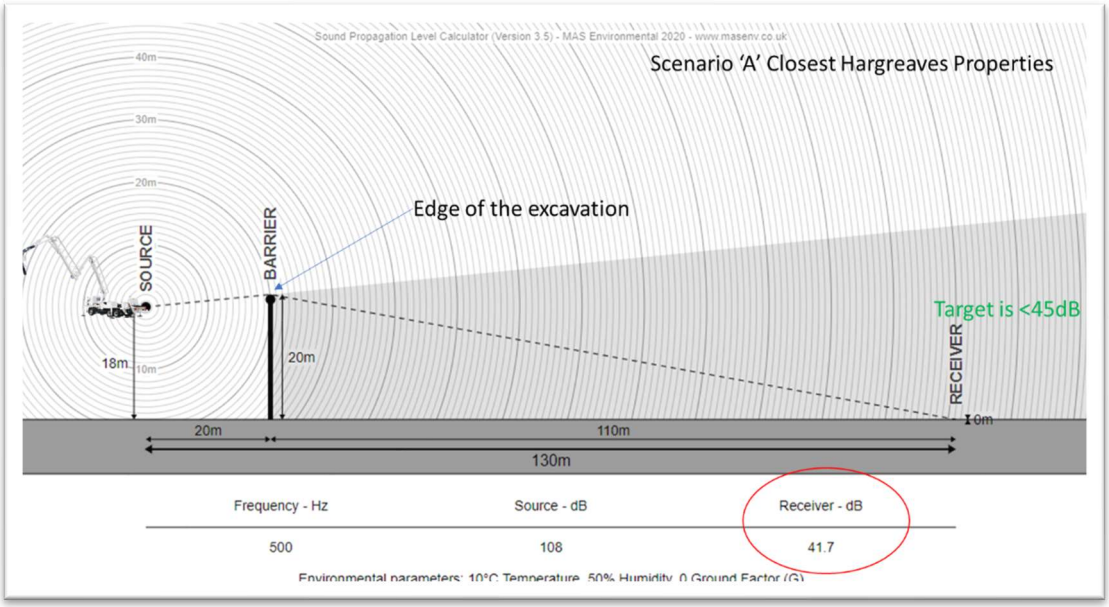

Figure 6: Sound Propagation Modelling of Scenario A.

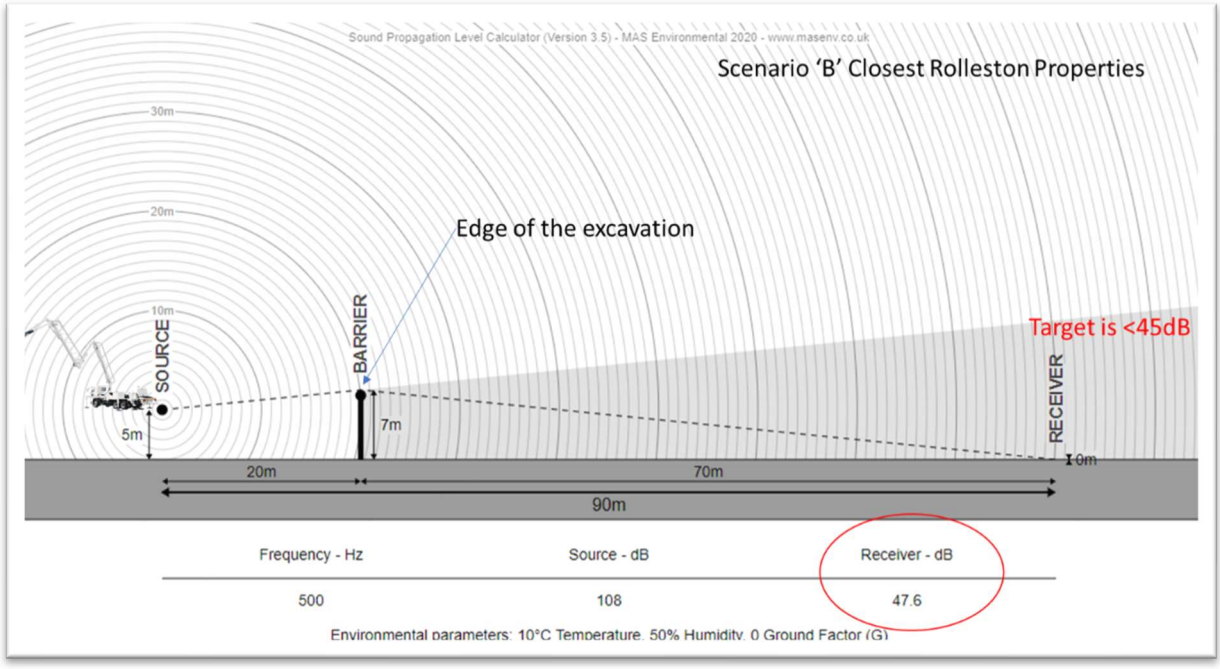

Figure 7: Sound Propagation Modelling of Scenario B.

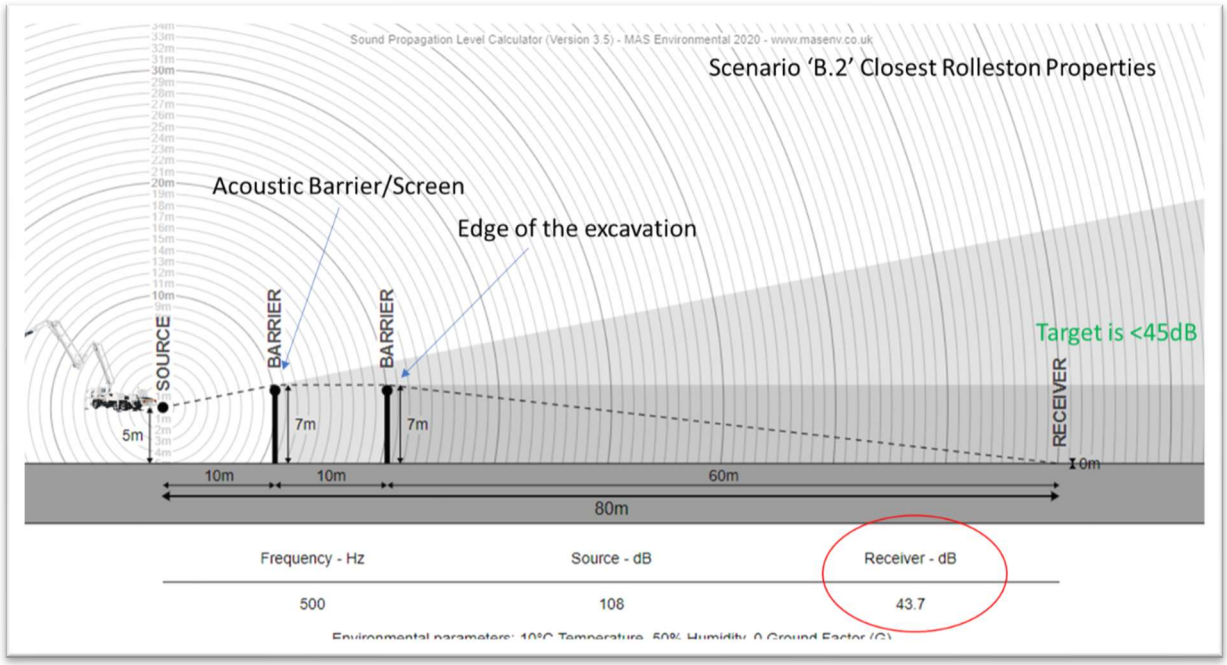

Figure 8: Sound Propagation Modelling of Scenario B.2 (influence of sound barrier)

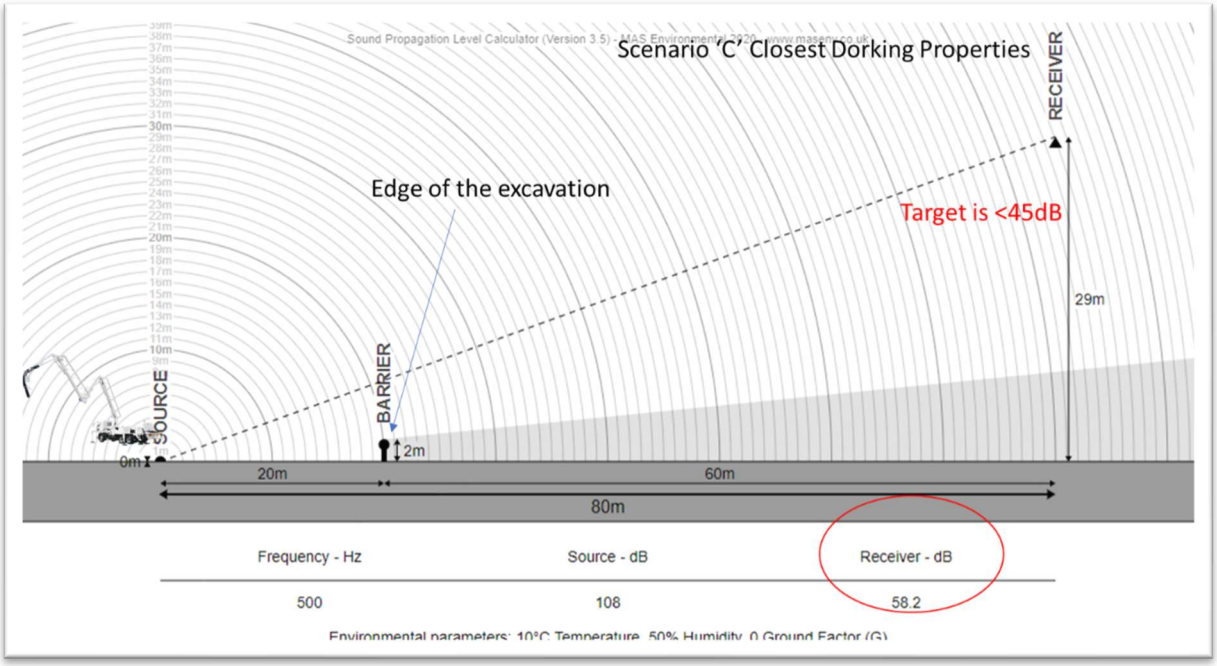

Figure 9: Sound Propagation Modelling of Scenario C

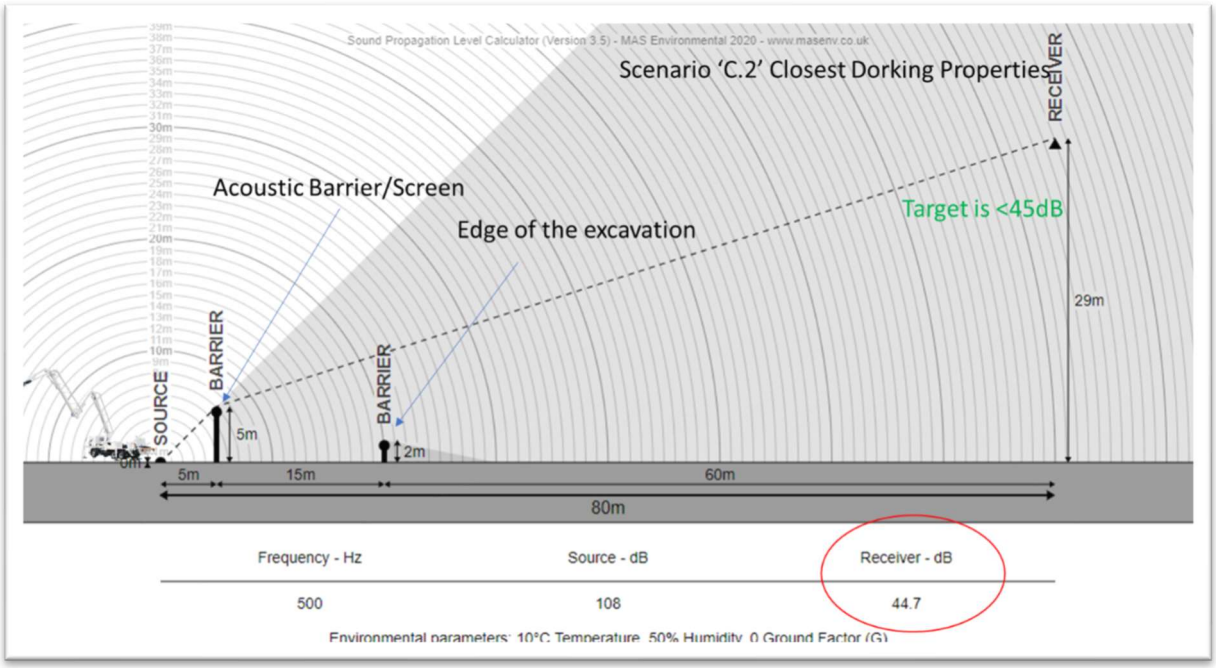

Figure 10: Sound Propagation Modelling of Scenario C.2 (influence of sound barrier)

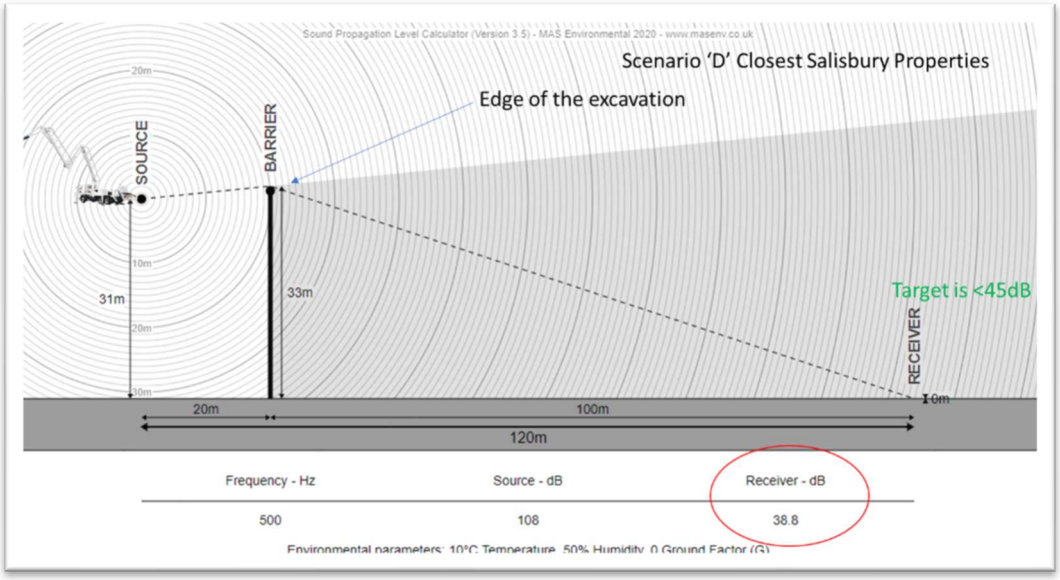

Figure 11: Sound Propagation Modelling of Scenario D

The second suite of scenarios have been developed to address the possible need to employ rock breakers within the floor of the excavation. The difference with these scenarios is that they have a higher sound power level at source (approximately 120dB) and the noise will be generated during normal working hours (07:30am to 17:30pm) when the permissible L_{eq} is 70dBA. Using the same sensitive receivers identified in Figure 5 the situation is modelling to identify if compliance is likely without the need for barriers. Similarly, to previous Scenarios A and D (Figures 12 and 16) compliance is likely. Modelling also suggests that compliance is likely for Rolleston Street - Scenario B (Refer Figure13) without the need for a barrier. Scenario D however again suggests that compliance is borderline without a barrier (Refer Figure 14), however when a barrier is introduced compliance is shown to be likely (Refer Figure 15).

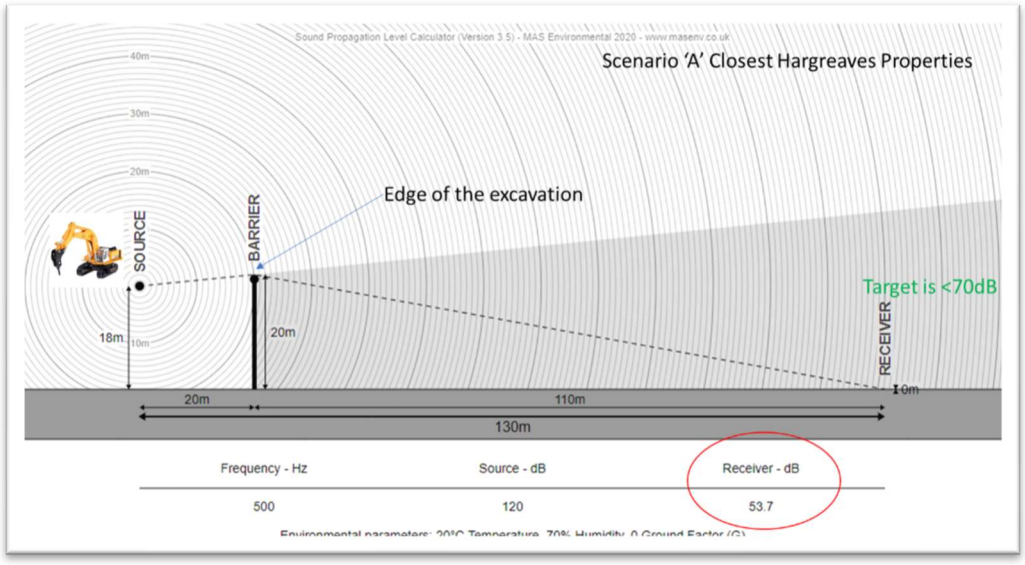

Figure 12: Sound Propagation Modelling of Scenario A

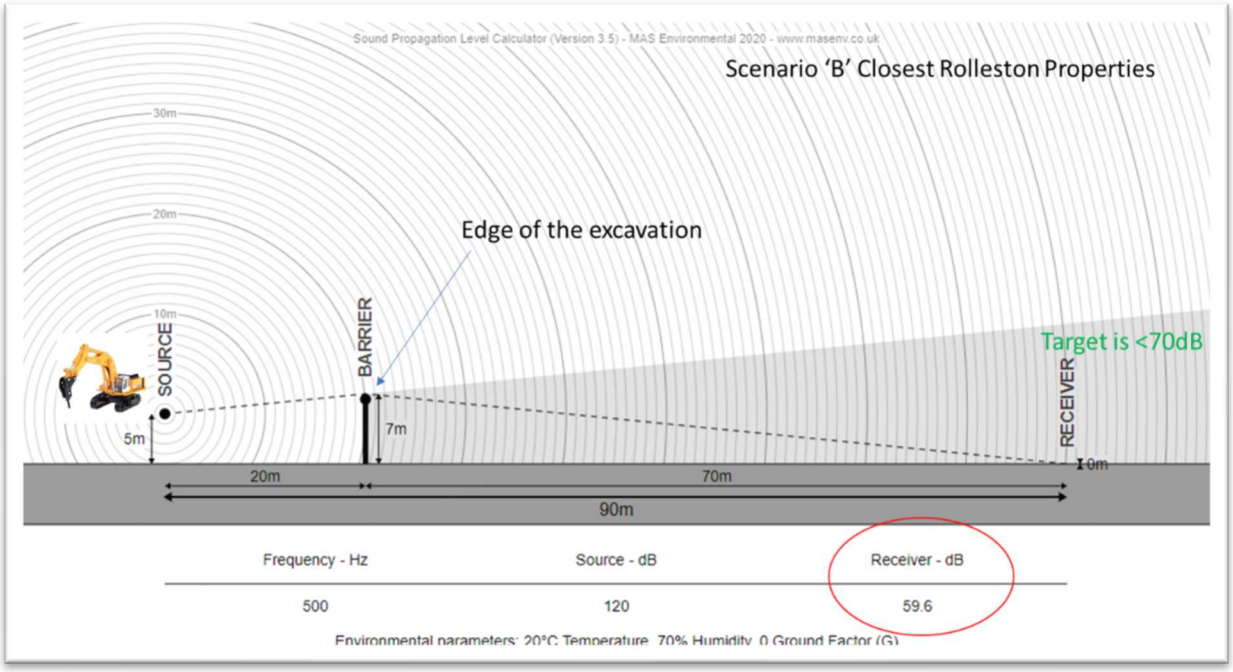

Figure 13: Sound Propagation Modelling of Scenario B

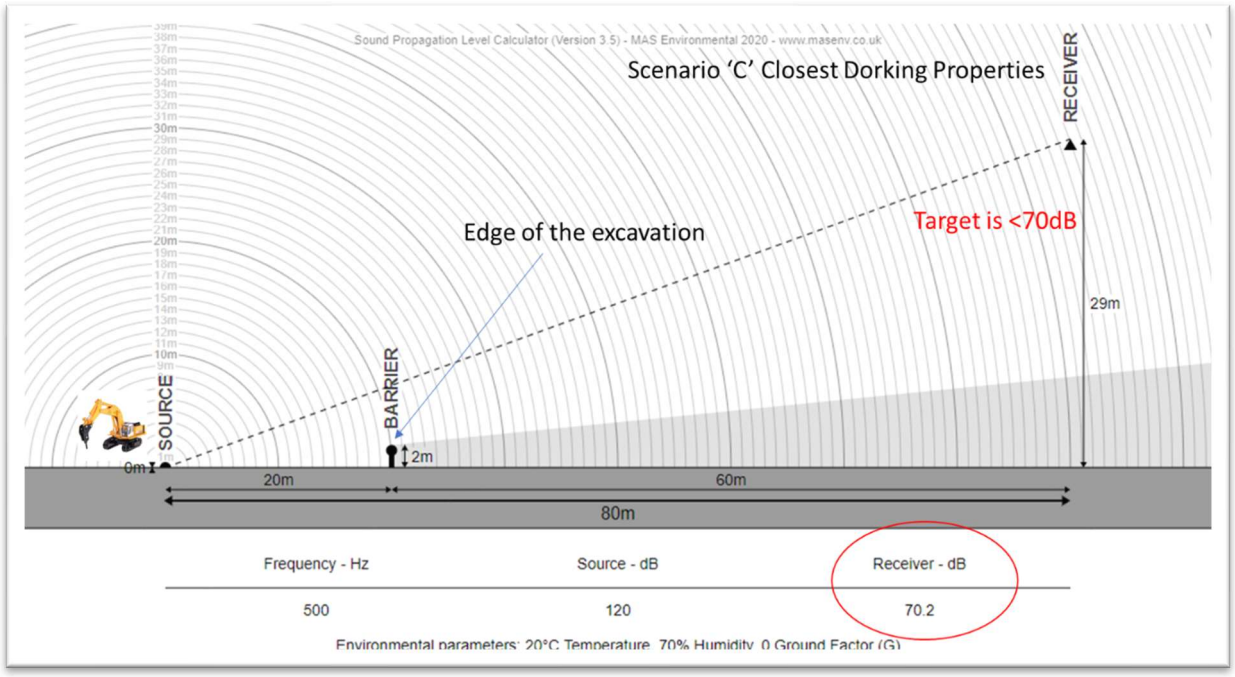

Figure 14: Sound Propagation Modelling of Scenario C

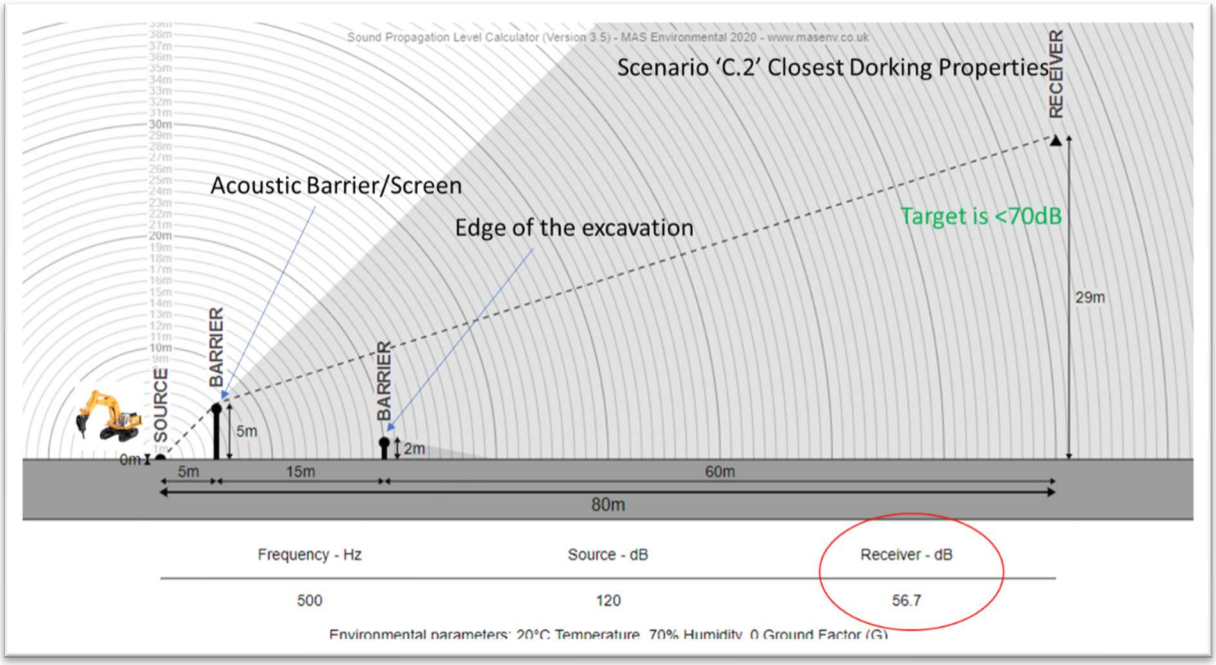

Figure 15: Sound Propagation Modelling of Scenario C.2 (influence of sound barrier)

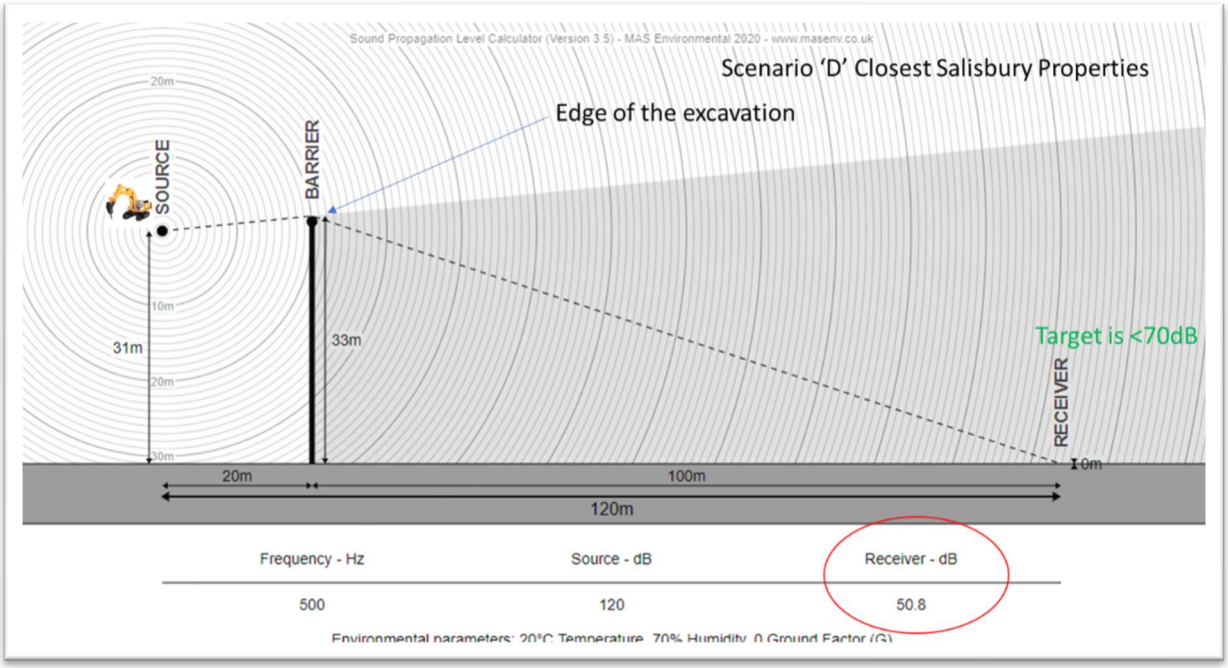

Figure 16: Sound Propagation Modelling of Scenario D

In the event that either of these activities do occur then using data gathered from the machines that will be used on site, along with revised levels for distances and barrier heights the scenarios will be revised and used to help plan and prepare the site to achieve compliance.

8.2 Vibration Mitigation

As specified above, it is not envisioned the vibration limits, as set out in Section 3.2, to be exceeded based on the proposed activities. Staff will be reminded during their induction on to the Project of ways to reduce the risk of vibration becoming a source of complaint. These mitigation procedures are listed below.

I. Do not start up, shut down or leave plant idling when in close proximity to dwellings, and ensure when parking up plant for storage or overnight it is moved as far away from dwellings as possible;
II. Only use required power and size of equipment to carry out the task at hand;
III. Operate equipment in a smooth and efficient manner;
IV. Monitoring and maintenance of the Rolleston Street road including reinstating potholes and levelling surfaces;
V. Consultation and communication with the residents.

If construction vibration monitoring is required on the Project it will be measured in accordance with ISO 8041:2005 “Human response to vibration – Measuring Instrumentation” and ISO 4866:2010 “Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures”.

To assess any vibration damage of buildings closest to the Omāroro reservoir site, pre and post-construction building condition surveys at locations close to activities, with photographic records are required. These are for comparative purposes should any claims arise regarding building vibration damage.

9. Stakeholder Engagement & Complaints

A key component of HEB Construction’s approach to mitigation of the noise is early stakeholder engagement. This approach recognises that while the predicted noise levels are within performance standards/limits residents will most likely find the character of the construction operation noise different and therefore they will be more aware of the sound. Through early and proactive stakeholder engagement HEB Construction will seek to minimise the impact of construction works on potentially affected parties by ensuring residents are forewarned of anticipated construction noise. Prior to the start of work the Project Manager will advise all potentially effected stakeholders of the planned works, duration, timing and who to contact if they have an issue. All communication with stakeholders will be undertaken in conjunction with WWL.

HEB Construction will provide regular updates to ensure residents and businesses can plan, as much as possible, their activities around the construction activities.

HEB construction during consultation will inform residents that the vibration criteria in section 3.2 are the limits to avoid structural damage to buildings and that they may however be able to ‘feel’ vibration at lower levels than these criteria.

Table 6 contains the Complaints related requirements prescribed by the WCC Designation conditions.

Table 6: *Complaints Related Conditions Identified Within WCC Designation.*

Complaints		Associated Management Plan	Specific Section of the Management Plan
DC.9			
a)	At all times during the Works, the Requiring Authority shall maintain a permanent register of any complaints received alleging adverse effects from, or related to, the Works. As far as practicable the register shall include:		
i)	The name and address (where this has been provided) of the complainant		
ii)	The nature of the complaint		
iii)	Location, date and time of the complaint and also of the alleged event		
iv)	Weather conditions at the time of the event and including wind direction and approximate wind strength if the complaint relates to air quality or noise	Construction Noise and Vibration Management Plan (CEMP)	6. Stakeholder Engagement & Complaints

A key aspect of this CNVMP is stakeholder engagement and the handling of complaints. The Construction Environmental Management Plan (CEMP) details how complaints will be handled (Refer Section 10, CEMP).

10. Schedules

Construction noise and vibration management schedules with Site Specific Construction Noise Management Plan (SSCNMP) may be prepared for the construction activities of pavement construction, bulk earthworks or where it is deemed necessary due to very close proximity of a sensitive receiver. In terms of noise the need for a Schedule to be prepared will be triggered in two different ways – firstly where as a result of modelling (of a nature described in Section 8.1 of this Plan) the predicted noise levels are closer than 10% to the Leq for the time period when the work is to be completed. An example might be where during the hours of 07:30am to 18:00pm the predicted noise levels (Leq) generated as a result of modelling is 65dB. Given the Leq is 70dB a schedule would then be developed. The schedules will identify the potentially affected neighbours and confirm the proposed methodology and equipment to be used, along with any specific mitigation to be used. The Schedule will be prepared by the Environmental Manager and conjunction with the Project Manager. The second trigger for a Schedule to be prepared is to address any on-going complaints.

Within the schedule, predictions of construction noise will be made using the interactive online "Sound Propagation Level Calculator" (http://noisetools.net/noisecalculator2?display=2) These calculations will be used to identify where specific mitigation is required and to determine compliance with the Project noise criteria.

A trigger for the need to prepare a Schedule in relation to construction related vibration will include situations where the Project must change construction methodology significantly and that the revised methodology is likely to involve higher levels of vibration. For example, where the need for "rock-breaking" is required to complete the excavation of the Reservoir floor due to very hard ground conditions being encountered. The other situation that would trigger the need to prepare a Schedule will be where the Project is receiving complaints. The preparation of a Vibration Schedule will involve an acoustic vibration specialist. Predictions of vibration will be made using the guidance in NZTA's State Highway Construction and Maintenance Noise and Vibration Guide (August 2013). The schedules will detail any site- specific monitoring or consultation/communication requirements.

Any noise or vibration schedules prepared will be provided to the WCC for review and comment before approval. Once approved they will be read and signed by all site personnel involved in the work, prior to the activity commencing. This will be incorporated into the activity briefing.

11. Monitoring

11.1 Noise Monitoring

HEB Construction will complete noise monitoring throughout the construction programme. Monitoring will be conducted as follows:

I. Onsite monitoring will be completed using a Protech Sound Level Meter, Model QM1598. The unit conforms to Standard IEC61672-1CLASS2 for sound meters. It can measure sound within the range 30dB to 130dB (+/- 1.4dB) and the frequency range 31.5Hz to 8KHz.

II. All monitoring data will be recorded and kept as a matter of record. The monitoring records will be updated and provided to the WCC weekly. Once a month records of noise monitoring will be provided to the CRG for their information.

III. When a new construction activity commences for the first time on site the noise levels of each piece of plant/equipment will be recorded, and a record maintained of the sound power levels (dB) prior to the continuing.

IV. When an activity commences for the first time on site monitoring will be completed to assess the noise levels prior to the activity being carried out adjacent a sensitive receiver. This will enable an assessment of the effectiveness of any proposed noise control measures or mitigation.

V. At regular intervals during the first 6 months of works, at least monthly, to check ongoing compliance with the construction noise criteria noise monitoring will be completed. After 6 months this will continue at 3 monthly intervals until the end of the Project to check compliance.

VI. Noise monitoring will take place in response to construction noise related complaints.

VII. If noise monitoring indicates that Project noise criteria are being exceeded, and that was not anticipated then the management of the area will be reviewed. If breaches of the noise standards continue, then a site-specific Noise Management Plan will be prepared and implemented. A copy of the plan shall be provided to the CMO.

All readings will be recorded, using the HEB Construction ER13 Operational Noise Plan and Monitoring inspection record attached in Appendix 3, and reported to the Environmental Advisor. The inspection record includes external factors, such as location details, environmental conditions, and the presence of other noise sources (e.g. traffic, loud music, barking dogs) to provide context to the readings. Measurements will be taken as 15-minute readings, capturing the LA_{eq} and LA_{max} sound pressure level descriptors.

There may arise occasions when an independent noise assessment is required to either confirm compliance or help provide confidence that monitoring is being completed to the correct standard. If this monitoring is required, the Project Manager will engage Marshall Day Acoustic Specialists.

11.2 Vibration Monitoring

Vibration monitoring will be carried out when it is not practicable to achieve the criteria specified in Section 3.2 of this CNVMP, HEB Construction will engage with a suitably qualified expert to assess and manage construction vibration during the activity that exceed the criteria.

HEB Construction will ensure the continuous and regular monitoring of the Rolleston Street road to minimise vibration and noise related issues. Maintenance will include reinstating potholes and levelling surfaces.

During consultation it is important to inform residents that the above criteria specified in Table 3 (Vibration Units to avoid Building Damage (from DIN 4150-3: 1999), are the limits to avoid structural damage to buildings. People will be able to ‘feel’ vibration at lower levels than these criteria (*Reference: Marshall Day Acoustics*).

11.3 Building Condition Surveys

Vibration damage resulting from construction activity is a potential risk to sensitive receivers and their property/structures.

To assess any vibration damage of buildings closest to the Omāroro reservoir site HEB Construction will carry out pre and post-construction building condition surveys at locations close to activities, with photographic records. These are for comparative purposes should any claims arise regarding building vibration damage. Any pre-construction building condition survey will be undertaken by suitably qualified Surveyor or other suitably qualified personnel.

Property owners will be notified of the requirement to survey their property and an explanation provided as to why. When the owners have agreed to the survey it will be carried out. The survey will consist of a video of the exterior of the structures and written notes. Attention will be paid to the existing wear and tear.

Where a complaint is received relating to possible property damage caused by construction related vibration HEB Construction will manage the complaint in a manner consistent with Section 9 of this CNVMP. At the time of the complaint being received an assessment will be made as to whether a follow up building condition survey is carried out.

12. Documentation

12.2 Reporting and Pre-Construction Requirements

Monitoring of construction noise will be recorded using the HEB ER13 Operational Noise Plan and Monitoring inspection record (Appendix 3) and reported to the Environmental Advisor. These documents will be provided to the WCC weekly when completed.

Pre and post Building conditions surveys will be carried out by a suitably qualified person to provide evidence should any claims arise regarding building vibration damage.

Noise and or vibration complaints will be dealt with in accordance with the methodology specified within Section 10 “Complaints Management” of the CEMP.

At least 15 working days prior to commencement of construction the HEB Construction will submit a CNVMP to the WCC for certification.

Construction shall not commence until HEB Construction has received the written certification of the CNVMP from WCC.

The CNVMP must be modified at the reasonable request of WCC to deal with any deficiencies in its operations.

13. Updates and Review

Changes to the CNVMP are expected through the life of the Project as scope of works change, issues are encountered, and solutions developed. HEB Construction will therefore routinely review the CNVMP. After each review a revised CNVMP will be issued to WCC.

This is ongoing during operation for any unforeseen issue arises not addressed in the initial CNVMP relating to mitigation / communication / measurement/ compliance with the limits in the standard, etc. the CNVMP is updated to address these issues and prevent adverse effects.

Appendix 1: Glossary of Terminology

Noise	A sound that is unwanted by, or distracting to, the receiver.
SPL or L_P	Sound Pressure Level A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 µPa RMS) and expressed in decibels.
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.
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) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
L_{eq}	The equivalent continuous (time-averaged) sound level. This is commonly referred to as the average noise level.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*
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 2: Construction Programme

Appendix 3: HEB ER13 Operational Noise Plan and Monitoring Sheet

Form Name:	Operational Noise Plan and Monitoring	**Form Ref.**	**ER 13**
Project Name:		**Project No.**	

Supervisor:		**Date:**	
Subcontractor:		**Completed By:**	
Job Task Activity:		**Location:**	

Dates / Times of Activity:

Date	Start	Finish

Resources Required: (Tick)

☐ Hand Tools ☐ Power Tools	☐ Excavator ☐ Concrete Saw	☐ Drilling rig ☐ Crane	☐ Mobile Machinery ☐ Other (State)

Action List

Step No:	Description	Done By / Date
1.	**Task Objectives:** Brief description outlining objectives	
2.	**Working Environment:** ☐ Day shift ☐ Night shift Wind Direction (State) Elevation (m)	
3.	**Safety – Hearing Protection Type:** Requirements for specific tasks ☐ Ear Plugs ☐ Ear Muffs ☐ Ear Plugs and Ear Muffs ☐ Noise Booth/baffles	
4.	**Potential Affected Parties:** (E.g. Residents, local businesses – Name) 1. 3. 2. 4.	
5.	**Consultation Undertaken: A** = Letter Drop, **B** = Personal Consultation, **C** = Other (State) 1. 3. 2. 4.	
6.	**Mitigation Measures**: (Describe steps to Eliminate, Isolate or Minimise the Noise Risk)	
7.	**Is Noise Monitoring Required?** ☐ Yes ☐ No If '**Yes**', describe requirements:	

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SITE INFORMATION							
Description of Works on Site: (machinery in use/location etc.)							
Background Sound:							
Sound Meter Type:							
WEATHER							
Wind Speed (m/s)		Wind Direction		Cloud Cover (%)		Rainfall	Temperature
MEASUREMENTS							
Date/Time	**Location**	**Distance from Activity**	**Start/Finish Time**	**Noise reading (dB LAeq(t))**	**Noise Level (dB Lmax(t))**	**Comments**	**Sampler**
The measurement sample time should not exceed one hour, and 15 minutes for constant sound will often be adequate Refer to NZS 6803:1999 Acoustics - Construction Noise							
COMMENTS							
Sampled by:				Signature:			

For each time period there are two noise limits: an average ($L_{Aeq(t)}$) and a maximum (L_{Amax}).
See CNVMP and NZS 6803:1999 Construction Noise - NZS 6803 for guideline noise limits for construction and maintenance works.

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