HEGLEY ACOUSTIC CONSULTANTS

1/355 Manukau Road
Epsom, Auckland 1023

T: 09 638 8414
E: hegley@acoustics.co.nz

WAIKAKA GOLD

ASSESSMENT OF NOISE EFFECTS

Report No 22077v3

Prepared for:

Waikaka Gold

March 2024

Prepared by: .....

Rhys Hegley

CONTENTS

1. INTRODUCTION

Waikaka Gold proposes an alluvial gold mining operation across parts of several farms (the 'Site') that are located to the south east of the intersection of Waikaka Road and North Chatton Road, Waikaka (Figure 1). Hegley Acoustics have predicted the noise from the proposed activity to the surrounding environment, developed mitigation and then assessed the resulting effects in accordance with the requirements of the Gore District Plan ('GDP'). This report provides a summary of the work undertaken.

2. PROPOSED ACTIVITIES

The noise from the proposal can be classed as that resulting from construction or operational activities. The relevance of this distinction is that each is assessed against different provisions of the GDP (section 3). Compared to the operational noise limits, those of construction permit significantly higher levels due to their shorter duration.

The proposed sequence of operations is to begin with activities that can be attributed entirely to construction noise. However, the staging of the proposal would see operational activities commence prior to the completion of construction, with the balance continuing to change until the construction component has been completed. As a further complication, the construction of Process Area 2 would occur part way through operations (from Year 5).

The activities of the proposal can be summarised as follows and as shown in Figure 1:

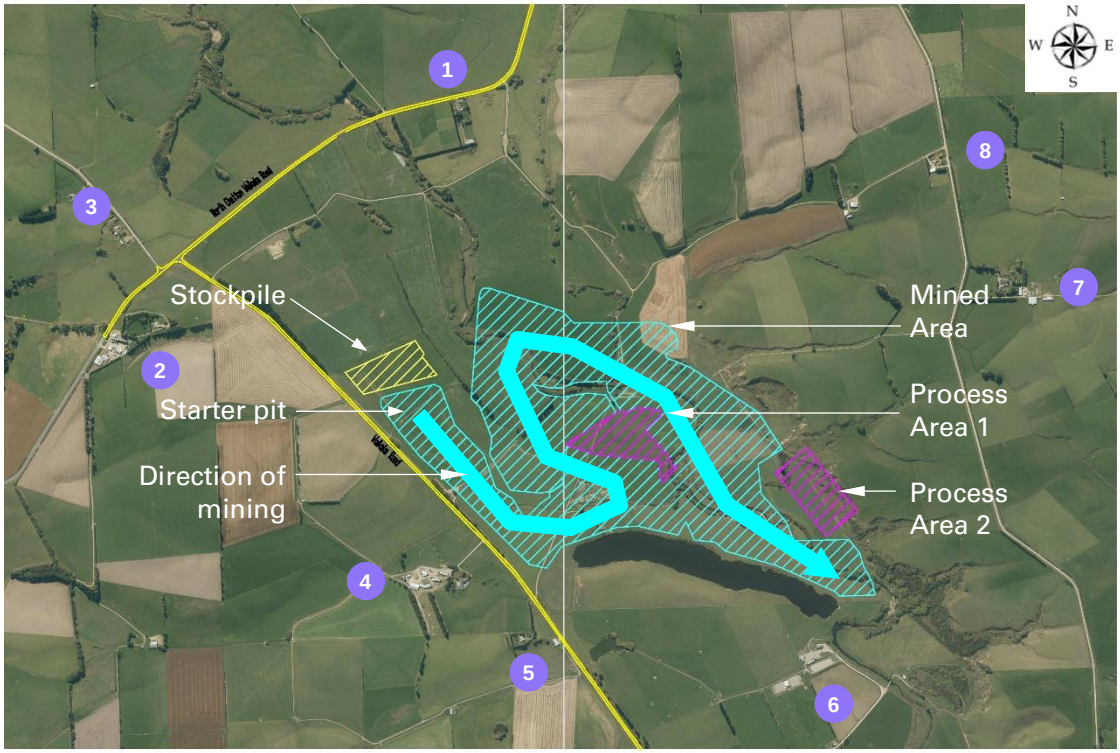

Figure 1. Site Layout and Neighbours

SITE DEVELOPMENT

The processing plant will be initially installed centrally within the Site (Process Area 1, Figure 1) for use from years 1 - 5. The installation involves the creation of settling ponds using an excavator of up to 40t. The excavated material will be transported to Stockpile using the 30 – 40t dump trucks where it will be spread with a D7 bulldozer. Once excavated, hardfill will be imported and compacted using a vibrating roller. In total, this process will take an estimated three months.

At the start of year 5, Process Area 1 will be replaced with Process Area 2, which will be constructed in the same manner as its predecessor.

Mining will begin with the starter pit, positioned at the north western extent of the mine. Topsoil will be removed using a 20t excavator that will commence work from ground level. The topsoil will be transported to dedicated topsoil fill areas that will be placed about the perimeter of the site.

As the site has been mined for gold previously, it will be necessary to remove the overburden that lies beneath the topsoil to get to the underlying unprocessed material ('wash'), which will begin an expected 18 – 38m below the current ground level, depending on the location. This overburden material from the starter pit will be placed in the stockpile with the aid of 100t dump trucks and a bulldozer to place the material.

Once the wash is exposed, it will be removed with excavators and transported and stockpiled adjacent to the processing area with 100t dump trucks using the site haul road.

The excavation rates are expected to vary over time to ensure that the wash is processed at a constant rate. While it is anticipated that the number and the size of the excavators will increase over time, all modelling has been undertaken based on the maximum rate, which will require 2 x 120t excavators. This approach may result in the prediction of noise from the earlier stages being slightly overpredicted.

At the processing area, the wash will be loaded into the processing plant with a 50t front end loader. The processed wash, or tailings, will then be stockpiled.

For the starter pit, the clearing of the top soil is considered a construction activity after which, the activity is considered operational. The construction of the two processing areas is also considered a construction activity. The change in status of the starter pit part way through its life provides unnecessary complications to the assessment, as does the construction of Process Area 2 which, while a construction activity, will occur amidst the operational mining activity. Due to the overlapping nature of construction and operational noise on site, the

assessment was simplified by assessing all activities against the operational noise provisions of the GDP. While not strictly correct, the approach generally provides for a conservative assessment.

OPERATIONS – YEAR 1

With the starter pit complete, the work face will simply push into the next stage of the proposal. The first difference between the starter pit and the subsequent stages is that while the excavation plant will start at ground level for the starter pit, it will begin on a bench that is at least 5m below ground level for the remaining stages. In this manner, the cut face will provide some screening to the excavation equipment.

A second difference between the starter pit and subsequent stages is that rather than carting the overburden to the Stockpile, it will go straight to the previous stage for compaction with a bulldozer.

Generally, when the excavators start the next stage, they will be at the highest elevation (5m below existing ground level) which represents minimum screening and, therefore, the highest level of noise, to neighbours. At the same time, the compaction plant will be beginning work on the previous stage meaning it is at the deepest, and quietest, position. As the mining progresses, the screening of the excavators will increase while the screening of the bulldozer will decrease. As described above, the excavators (which are louder than the bulldozer) have been modelled as 5m below ground level at the start of each stage. While the quieter bulldozer could be modelled as being at the bottom of the excavation, it has been conservatively modelled at that same 5m below existing ground level as the excavators. In this manner, it is intended that the modelling of any stage will represent the highest possible level of noise from that stage and is likely conservative.

A third difference between the starter pit and subsequent stages is that the tailings will be backloaded from the processing area with the dump trucks and 50t front end loader so that they can contribute to the backfilling of the previous stage.

To complete each stage, the topsoil will be spread out with a 30t excavator, dump trucks and bulldozer.

The project involves the temporary relocation of the Waikaka Stream that runs north - south through the center of the Site. A 20t, 40t and 90t excavator will create a new channel for the stream at the eastern extent of the site on an as needed basis. The cut material will be transported via 30 – 40t dump trucks to either the Stockpile or to backfill the previously excavated parts of the site. In both instances, the fill will be placed with a bulldozer. At the same time, road trucks will be importing aggregate to line the new watercourse.

OPERATIONS – YEARS 2 - 9

Subsequent to Year 1, excavation will progress northwards in the same manner as described for Year 1 and following the path indicated in Figure 1. In year 5, it is intended to relocate the processing area.

REHABILITATION

Rehabilitation of the site will largely be a continuation of the backfilling process described above. It will cumulate with soil spreading, removal of infrastructure, pasture cultivation and replacement of farm improvements and will be completed approximately three years after the cessation of extraction. As this stage represents reduced activity on site compared to previous stages, it is not considered specifically.

All work on site will go from 7am – 7pm, Monday to Friday and from 7am – 12 noon on Saturdays.

3. ASSESSMENT OF NOISE

3.1. Predicted Noise Level Assessment

A rating level is the predicted level of mining noise that is then adjusted in accordance with the requirements of NZS 6802[1], the New Zealand Standard for the assessment of noise. These adjustments recognise that the effects from noise are not described by level alone but include consideration of the type of noise and its duration. Section 3.3 below describes the way in which the noise level was determined while section 3.6 describes the adjustments made to determine the rating level.

The provisions of the GDP against which the proposed levels are compared are described in the following section. The provided noise limits are typical of those used for assessing effects on a residential activity and it is considered that compliance with the relevant criteria will result in reasonable levels of noise and effects that can be considered reasonable.

3.2. District Plan Provisions

Within the GDP maps, the Site and all surrounding land is zoned rural. Rule 4.3.1(1) provides the construction noise limits, as follows:

> c) *Construction, maintenance and demolition work provided that it complies with the recommended noise limits set out in NZS 6803:1999.*

NZS 6803 provides noise limits over the entire 24 hour period. The night time limits are set to allow the likes of administrative work but would prohibit excavation. The limits apply 1m from the most exposed facade of residential neighbours. When taking into account the 5dB reduction for the assumed long term duration of the works, the criteria become:

[1] NZS 6802: 2008 Acoustics – Environmental Noise

Table 1. Construction Noise Limits

Time of Week	Time Period	Construction Limit (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

Rule 4.5.1 of the GDP provides the following limits to noise from the proposed activities:

(1) Noise limits for the rural and residential zones

On any day: *7.00 a.m. to 10.00 p.m.* *55dBA L_{eq}*
10 p.m. to 7.00 a.m. *40dBA L_{eq}*
10 p.m. to 7.00 a.m. *75dBA L_{max}*

Measured:

Rural zones *at any point in the notional boundary of any noise sensitive activity*

(6) Methods of measurement and assessment

Unless stated otherwise, sound shall be measured in accordance with the provisions of NZS 6801:1999 Acoustics - Measurement of Environmental Sound and assessed in accordance with the provisions of NZS 6802:1999 Acoustics - Assessment of Environmental Noise.

The GDP defines the notional boundary as:

> *Notional boundary means a line 20 metres from the façade of a building containing a noise sensitive activity, or the legal boundary where this is closer to the building.*

While the GDP uses the 1999 version of NZS 6801 and NZS 6802 it is proposed that the latest editions of each standard be adopted for this project. This approach is consistent with best practice. In reality, there is little difference between the two editions of either standard. The exception is that the 2008 version of NZS 6802 permits averaging, which was excluded from the earlier version used by the GDP. Its omission is widely seen as an error in the standard as averaging of noise over the day time period is a well recognized approach to fully assessing noise effects. As discussed in section 3.6 below, averaging has conservatively been ignored for the assessment but it is noted that its inclusion in the condition proposed below would allow averaging to be used for any compliance monitoring. Again, this would be considered best practice.

As discussed above, the proposal is to undertake both construction and operational activities at the site time. Rather than assess the two activities separately, it is proposed to group them together and assess them all against the operational noise provisions of the GDP.

For this approach to be successful, it will be necessary to exclude a specific construction noise rule from conditions. The reason relates to the different definitions that the construction noise rule and the operational noise rule provide for the day time. For example, an excavator engaged in an operational activity can begin at 7.00am at a level of 55dB L_{Aeq}. Should that excavator be classified as undertaking a construction activity, the limit is lower, at 45dB L_{Aeq} until 7.30am. The same issue occurs at the end of the day when the excavator can continue to operate at 55dB L_{Aeq} until 7.00pm if it is engaged in an operational activity. If the

activity were considered construction, the lower limit of 45dB L_{Aeq} commences at 6.30pm.

Section 3.9 concludes that the effects of the activity occurring between 7am and 7pm, whether it be construction or operation, are reasonable. For this reason, it is proposed that the usual construction noise rule (the intention of which is to permit increased levels) is not adopted for this project.

A suitable construction noise condition that captures the above would be:

x) *Noise from all mining activities on site, including those considered to be related to the construction of the project, shall not exceed the following limits when measured at the notional boundary of any noise sensitive activity on a site other than the proposal:*

On any day:	*7.00 a.m. to 10.00 p.m.*	*55dBA L_{eq}*
	10 p.m. to 7.00 a.m.	*40dBA L_{eq}*
	10 p.m. to 7.00 a.m.	*75dBA L_{max}*

Notional boundary means a line 20 metres from the façade of a building containing a noise sensitive activity, or the legal boundary where this is closer to the building.

Sound shall be measured in accordance with the provisions of NZS 6801:2008 Acoustics - Measurement of Environmental Sound and assessed in accordance with the provisions of NZS 6802:2008 Acoustics - Assessment of Environmental Noise.

The above condition varies the wording of the GDP through the adoption of the latest 2008 editions of NZS 6801 and 6802. This is considered a best practice approach. This introduces the potential for averaging to the assessment, which is discussed earlier in this section.

3.3. Prediction Method

Noise from the proposed activities has been predicted to the surrounding environment using the Predictor noise modelling software. Predictor allows a

full-scale three-dimensional model of the proposal and the surrounding area to be developed using the information as described below.

3.4. Predictor Input Data

The accuracy of Predictor is reliant on the accuracy of the input data. The following was used for modelling:

Ground Contours	The topography of the Site as it currently exists has been provided by the surveyor of the project.
Topography outside of mine	The topography outside of the quarry is important as it defines the height of the neighbouring properties and any intervening landforms, both of which can affect the degree of topographical screening that an individual dwelling receives from the quarry activities. This survey data was obtained from the Gore District Council GIS system.
Ground Type	Given the distance that the neighbouring dwellings are from the quarry, the absorption of sound by the ground becomes relevant. Ground absorption will typically change over time, depending on vegetation and moisture content. Analysis was based on a factor of 0.7, or 70% reflection. This represents relatively hard ground, such as dry earth with little vegetation (summer) to provide the upper level of noise expected from the quarry.
Weather	Meteorological conditions, such as wind strength and direction and the presence of inversions, affect the propagation of sound. In accordance with NZS 6802, predictions adopt slightly positive meteorological conditions.
Receivers	The closest residential neighbours to the proposal have been selected for analysis. These locations are shown in Figure 1.
Base noise levels	Predictor requires base noise data for each mining activity for the calculations. This data has been obtained from measurements of the actual processing

plant that will be used on site. The earthmoving plant proposed is typical of that used elsewhere and measurements of similar plant have been relied upon.

3.5. Quarry Activities and Modelled Scenarios

Section 2 above describes the various activities proposed for the mine. As this plant will move over time, various scenarios have been modelled to represent various stages of the mine's development. The scenarios considered were:

1. The construction activities associated with diverting the stream;

2. The starter pit, where the excavation plant starts at ground level but there is no backfilling of a previous stage;

3. Rather than model noise from every stage of the mine over time, those selected for analysis place the excavation or backfilling closest to one of the eight surrounding houses. Of all the operational noise levels calculated, only the uppermost to each of the eight sites is reported below. Put another way, noise over the duration of the project will typically be below the levels contained within this report.

3.6. Averaging and Special Audible Characteristics

For the assessment of operational noise, NZS 6802 describes the adjustment of the predicted level of noise for its durations and for the type of sound. These two adjustments are described below, noting they do not apply to construction noise.

Noise that is not present all day is generally considered to have less effect than noise that is present all day. The proposed 2008 version of NZS 6802 accounts for this through the provision for averaging whereby noise for a limited duration over the daytime can be averaged with the period of no noise. All plant has been assumed to operate continuously throughout the day and the resulting levels have not been averaged. This is a slightly conservative assumption and results in a minor overprediction of the levels.

NZS 6802 also recognises that by their nature, some sounds are more annoying than others and allows an adjustment of + 5dB to the predicted level of noise for an activity considered to have a special audible characteristic. Of the activities undertaken within the mine site, only the noise from tonal reversing alarms fitted to the mobile equipment is considered to have the potential to result in noise with a special audible characteristic. The use of audible reversing alarms can often be removed by laying the site out so that there is no need for reversing, or restricting people in areas such as the pit or fill area to the operators and requiring them to stay in their machinery while work is being undertaken. Where neither of the above is practicable, the tonal reversing alarms can be replaced with broadband alarms. Analysis has assumed that tonal reversing alarms will not be used on site and, as such, the predicted levels do not allow for a special audible characteristic.

3.7. Mitigation

The mitigation required for compliance with the GDP levels is provided through the separation of the activity from its neighbours and the excavation plant operating below ground level with the cut face acting as an acoustic screen.

As discussed above, removing the tonal reversing alarms is a mitigation method proposed for the site.

3.8. Predicted Rating Levels

The rating levels resulting from all activities when calculated as described above, are as follows:

Table 2. Operational Rating Levels

Site (Figure 1)	Rating Level, dB L_{Aeq}
	Night Time
1	54
2	48
3	43
4	55
5	55
6	53
7	38
8	37

Table 2 shows full compliance with the 55dB L_{Aeq} daytime limit of the GDP noise rules.

3.9. Assessment of Noise Effects

In assessing the effects of noise from the proposal, consideration has been given to compliance with the GDP rules, a comparison to the ambient sound and an assessment against the permitted baseline, each of which is described below.

3.9.1. Comparison to GDP Noise Rule

Noise from the proposed activities will comply with the operational limits of (Rule 4.5.1(1)) of the GDP.

As discussed above, the predicted noise levels represent the most exposed case where mining equipment is operating close to the particular receiver and at maximum elevation (minimum screening). As such, levels will typically be below the reported levels.

Based on this, it is concluded that the predicted levels are reasonable and that the resulting effects are appropriate.

3.9.2. Ambient Sound

To demonstrate how the operational noise from the proposal will compare to the current environment, the ambient sound was measured at Sites 2 and 4. To describe the ambient sound, the L_{eq} and L_{90} metrics are reported. The L_{eq} matches that used by the GDP and generally correlates to how an observer would describe the sound. The L_{90} is the sound level that is exceeded 90% of the time, or nearly all of the time. This is used to describe the background sound, or the level that is nearly always present. When the L_{eq} and L_{90} are similar in level, the sound they are describing is tending towards constant (such as ventilation). When there is a large difference between the L_{eq} and L_{90} metrics, the sound environment consists of discrete noises that are elevated above the background sound. An example would be infrequent traffic.

Sites 2 and 4 were selected for measurement as Site 2 is considered representative of the ambient sound that the northern sites will experience (Sites 1, 2 and 3) while Site 4 is considered representative of the southern sites (4, 5 and 6). Table 2 shows that the remaining Sites 7 and 8 will receive the lowest levels of noise from the proposal meaning no ambient sound measurement was considered necessary. For both measurements, the loggers were placed with line of sight to the proposal and in locations that were considered representative of the notional boundary. The weather varied over the measurement period but, for the reported results, conditions were generally fine with winds not exceeding to 3 – 4m/s.

Figure 3 shows the measured noise level (every 15 minutes) plotted against time for the Site 2 measurement. The measurement represents the 24 hour period beginning in the afternoon of Tuesday 19 July 2022. Marked on the Figure is the range of operational noise levels reported in Table 2 for the northern Sites 1, 2 and 3.

When reading Figures 2 and 3, it should be remembered that the floor of the logger, which is the lowest level that the logger is capable of measuring, is

approximately 30dBA. If the ambient sound falls below the logger floor, the logger reports the floor.

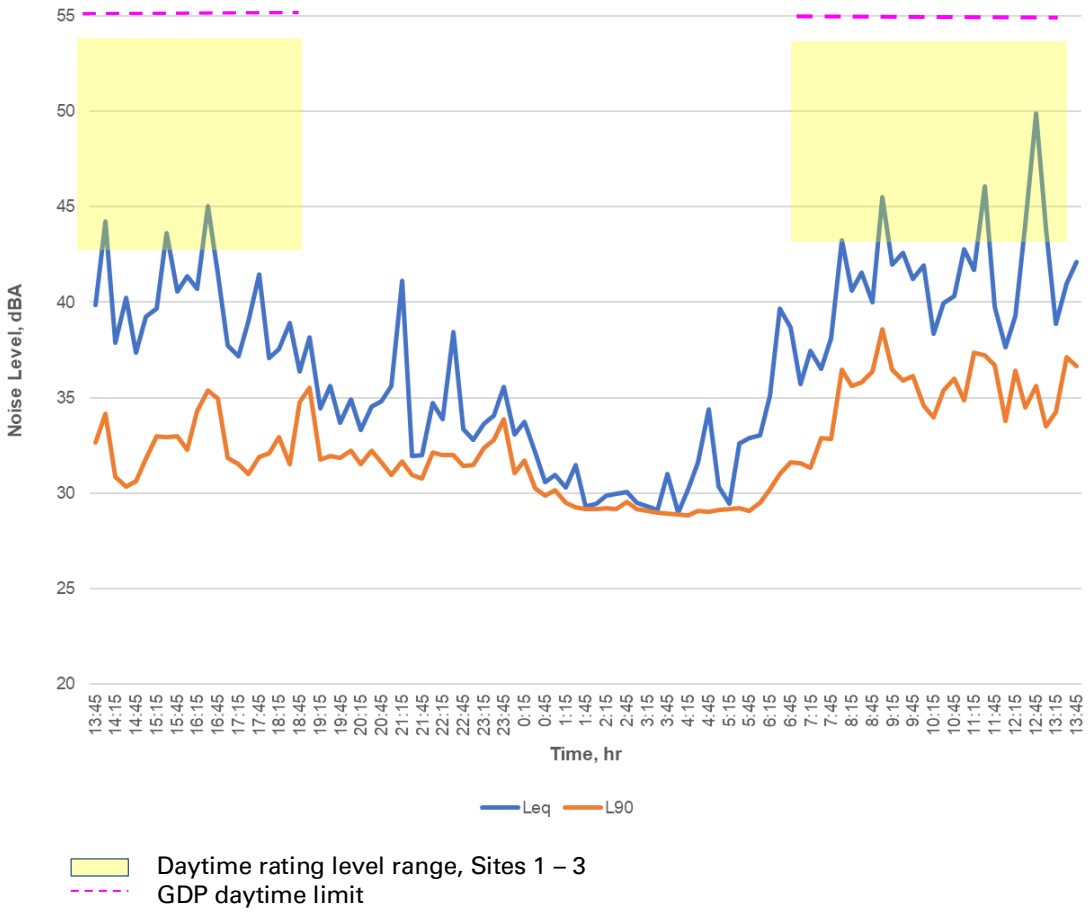

Figure 2. Ambient Sound Measurement at Site 2

The measurement at Site 4, which represents two, 24 hour periods beginning on the afternoon of Wednesday 20 July 2022 is shown below.

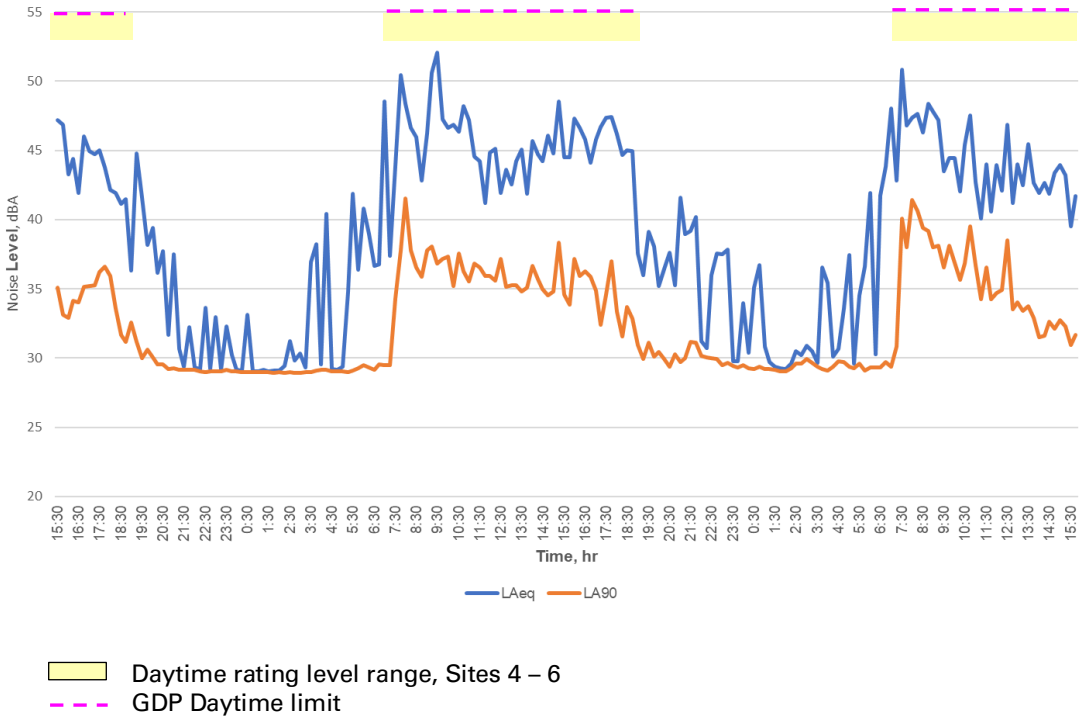

Figure 3. Ambient Sound Measurement at Site 4

Figures 2 and 3 show that the ambient sound at each measurement position was similar. The L_{eq} noise levels were typically within the 40dBA range during the daytime reducing to below 30dBA at night. The background sound was typically in the 30dBA range during the daytime falling to below this at night. Both measurements describe a reasonably quiet environment that is regularly punctuated with discrete sounds.

Both Figures 2 and 3 show that the predicted rating levels from the proposal would be at, or above the current ambient L_{eq} during the day time period when the proposal operates and when the excavation plant is in its most exposed location. The Figures also show that the predicted rating levels will be noticeably above the current background level. In practice, this means that the proposal would generally be quite apparent when compared to the ambient sound indicating that there would be an effect from the proposal. However, when

viewed in the context of compliance with the GDP limits, the magnitude of that effect can be considered small.

3.9.3. Permitted Baseline Assessment

The permitted baseline is an assessment approach that allows decision makers the discretion to disregard the effect of an activity on the environment if the GDP permits an activity with that effect. Such an approach therefore relies on defining the noise effect permitted by the GDP. The effects of noise are well documented in literature as being a function of the level of noise, its duration, and any particular feature of the noise that requires particular consideration. Conversely, determining effects through a definition of activities is not considered useful. For example, the effect of noise from a truck operating is related to the level of truck noise, its duration, and any particular features of the noise (such as a tonal reversing alarm) but is unrelated to the reason why the truck is engaged in those activities. An issue with using a description of activities to define the permitted baseline is that, in the rural zone, rule 4.5.1(2)(c) excludes *"... normal production or forestry activities*" from compliance with noise rule 4.5(1). If one were to use a description of activities as a definition of the permitted baseline, this exclusion could indicate to those living in the rural zone that there are instances when they should have no expectations on the noise environment that they could be exposed to.

If a first principles approach is to be used to describe the noise effects that an occupant of the rural zone could expect, it is considered that the GDP noise rule is appropriate. The rule sets a noise limit that takes account of the duration of the noise (through averaging) and provides consideration of the type of noise (through the provision of special audible characteristics). In doing so it is considered that the GDP rules can be used to fully describe the noise that those in the rural zone could expect from a neighbouring activity and, therefore, the permitted noise baseline.

By complying with the GDP noise limits it is concluded that the activity is within the permitted baseline for noise in the rural zone.

4. CONCLUSION

It is proposed to mine gold from the site to the south east of the intersection of Waikaka Road and North Chatton Road, Waikaka. This report describes the noise modelling and assessment that was undertaken for the project. It demonstrates that operational noise levels will comply with the noise provision of the Gore District Plan to the neighbouring properties.

The conclusion of this report is that by complying with the GDP limits, the resulting effects will be both appropriate and reasonable and that they fall within the permitted baseline.

*****