HEGLEY ACOUSTIC CONSULTANTS

1/355 Manukau Road
Epsom, Auckland 1023
PO Box 26283
Epsom, Auckland 1344

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

OCEANA GOLD (NEW ZEALAND) LTD

CORONATION NORTH PROJECT

ASSESSMENT OF NOISE EFFECTS

Report No 9480/2

Prepared for:

Oceana Gold (New Zealand) Ltd
Dunedin
3 May 2016

Prepared by: .....

Nevil Hegley

CONTENTS

1 INTRODUCTION

Oceana Gold (New Zealand) Limited (OceanaGold) is proposing an extension to the Macraes Gold Project's existing Coronation Project called the Coronation North Project (the "Project") as shown on Figure 1.

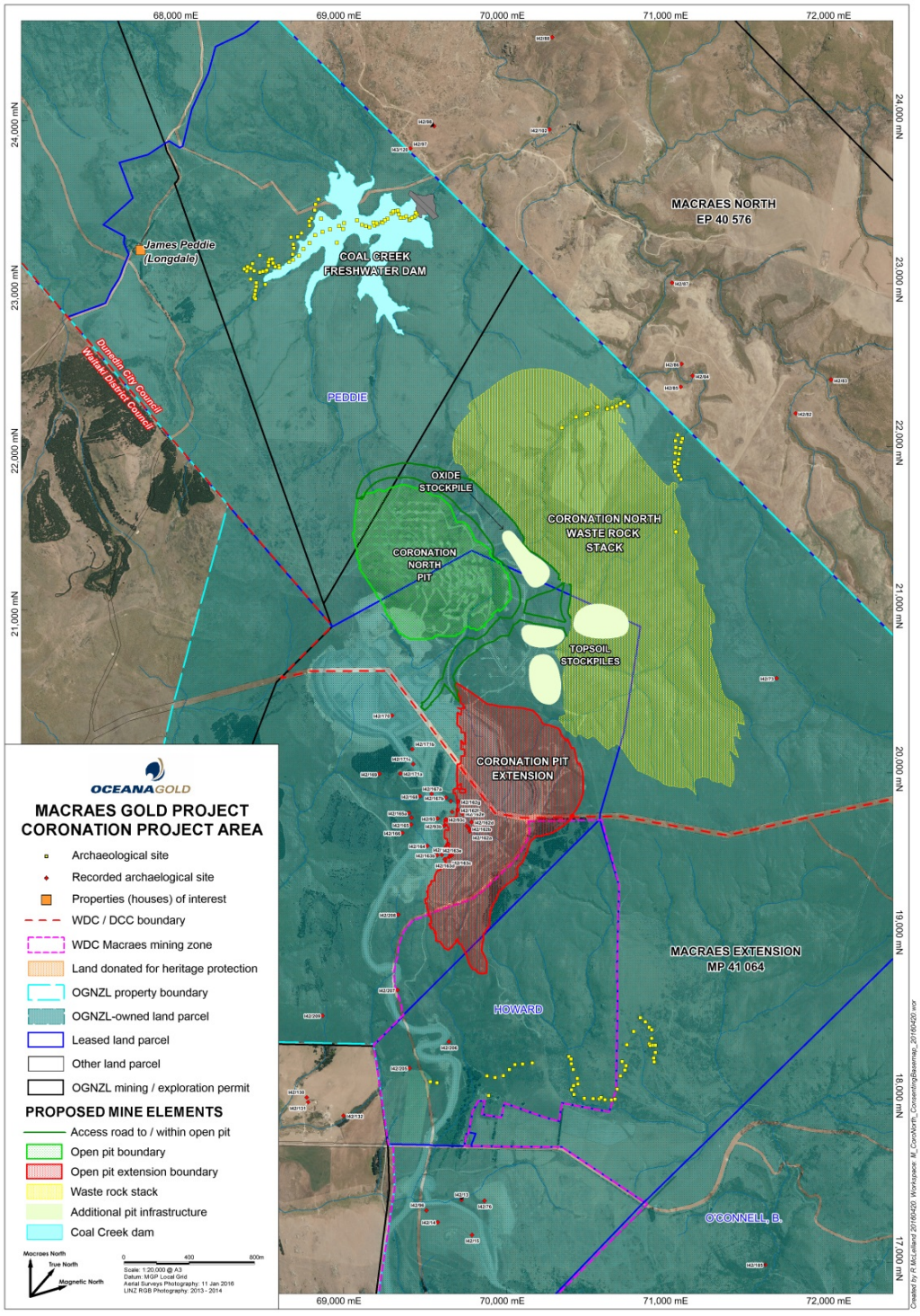

Figure 1. Coronation North Project

This report considers the noise effects of the proposed Coronation North Project on the residential neighbours and how the work will be managed to ensure the noise is controlled to within a reasonable level at all times.

2 DESIGN CRITERIA

To establish if noise from the activity will be within a reasonable level it needs to be determined what levels should be adopted. Condition 8, Noise, of the resource consent Waitaki District Council Reference 201.2013.360 and Dunedin City Council LRC 2013-225 for the Coronation Project states:

8.1 The consent holder shall ensure that all construction and operation activities associated with the mining operations are designed and conducted so that the following noise limits are not exceeded at the locations specified in Condition 8.2

(a) On any day between 7am to 9pm (daytime): 50dB L_{Aeq}; and

(b) On any day between 9.00pm to 7.00am the following day (night-time): 40dB L_{Aeq}; and/or 70dB L_{Amax}.

Measurement Locations

8.2 Noise measurements shall be taken at any point within Macraes Village; or at, the notional boundary of any dwelling not owned by the consent holder in the Rural Scenic Zone.

Note: The notional boundary is defined as a line 20 metres from the exterior wall of any rural dwelling or the legal boundary where this is closer to the dwelling.

Measurement and Assessment

8.3 All noise measurements referred to in Conditions 8.1 and 8.2 above shall be measured in accordance with the provisions of NZS 6801:2008 Acoustics: Measurement of Environmental Sound, and shall be assessed in accordance with the provisions of NZS 6802:2008 Acoustics: Environmental Noise.

8.4 Prior to the commencement of mining, the consent holder shall install double glazing on the dwelling at 406 Horse Flat Road owned by C A and E M Howard. The glazing shall include one layer of 6mm laminated

glass for noise reduction purposes. A mechanical ventilation system shall also be installed in the dwelling that will supply supplementary fresh air ducted from outside to bedrooms and living spaces.

It is noted the above condition adopts the 2008 versions of the Standards while both the Waitaki District Plan, which is expected to be updated during 2016 – 2017, and Dunedin City District Plan, which Plan is currently being updated, adopt the 1991 versions. The main difference between the 1991 and 2008 Standards is that L_{eq} is adopted rather the $L_{10.}$ However, as a general comment, compliance with one Standard will also achieve compliance with the other Standard. The use of the 2008 Standards reflects the preference to adopt the latest versions of the Standards.

Condition 7 of the resource consent Waitaki District Council Reference: 201.2013.360 and Dunedin City Council Reference: LUC-2013-225 state:

7 BLASTING AND VIBRATION

7.1 The consent holder shall ensure that blasting practices minimise air and ground borne vibration. Fly-rock shall be minimised and all blasting procedures shall be carried out so as to ensure the safety of employees and the public. No blasting shall occur when the weather is unsuitable.

7.2 Blasting shall be restricted to within the following hours:

Monday-Friday 9am to 5.30pm

Saturday and Sunday 10am to 4.30pm

7.3 Details of blasting method, strength of the blast and time of blast shall be entered into a record kept for that purpose and shall be available to the Councils on request. This information shall also be included in the monitoring report, required under Condition 9.

7.4 Vibration due to blasting or any other activity associated with the mining operation, when measured at any point within the notional boundary of any dwelling not owned by the consent holder, shall not exceed a peak particle velocity measured in the frequency range 3-12Hz of 5mm/sec provided this level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level shall not exceed 10 mm/sec at any time.

7.5 Airblast overpressure from blasting associated with the mining operation, when measured at any point within the notional boundary of any dwelling not owned by the consent holder shall not exceed a peak non-

frequency-weighted (Linear or flat) level of 115 decibels (dB), provided this level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level shall not exceed 120 dB (Linear peak) at any time. For the purpose of this consent, C-frequency-weighting may be considered equivalent to the Linear or Flat-frequency-weighting.

Note: The notional boundary is defined as a line 20 metres from the exterior wall of any rural dwelling or the legal boundary where this is closer to the dwelling.

In addition, as shown on Figure 2, the site includes a Macraes Mining Project Mineral Zone and Rural Scenic Zone in the Waitaki District plus a Rural Zone High Country Outstanding Landscape Area in the Dunedin City District. In the Dunedin City's proposed Second Generation District Plan (2GP) the site would be within a Rural High Country Zone without any 'outstanding landscape' overlay.

The relevant noise provisions of each of the District Plans are considered below.

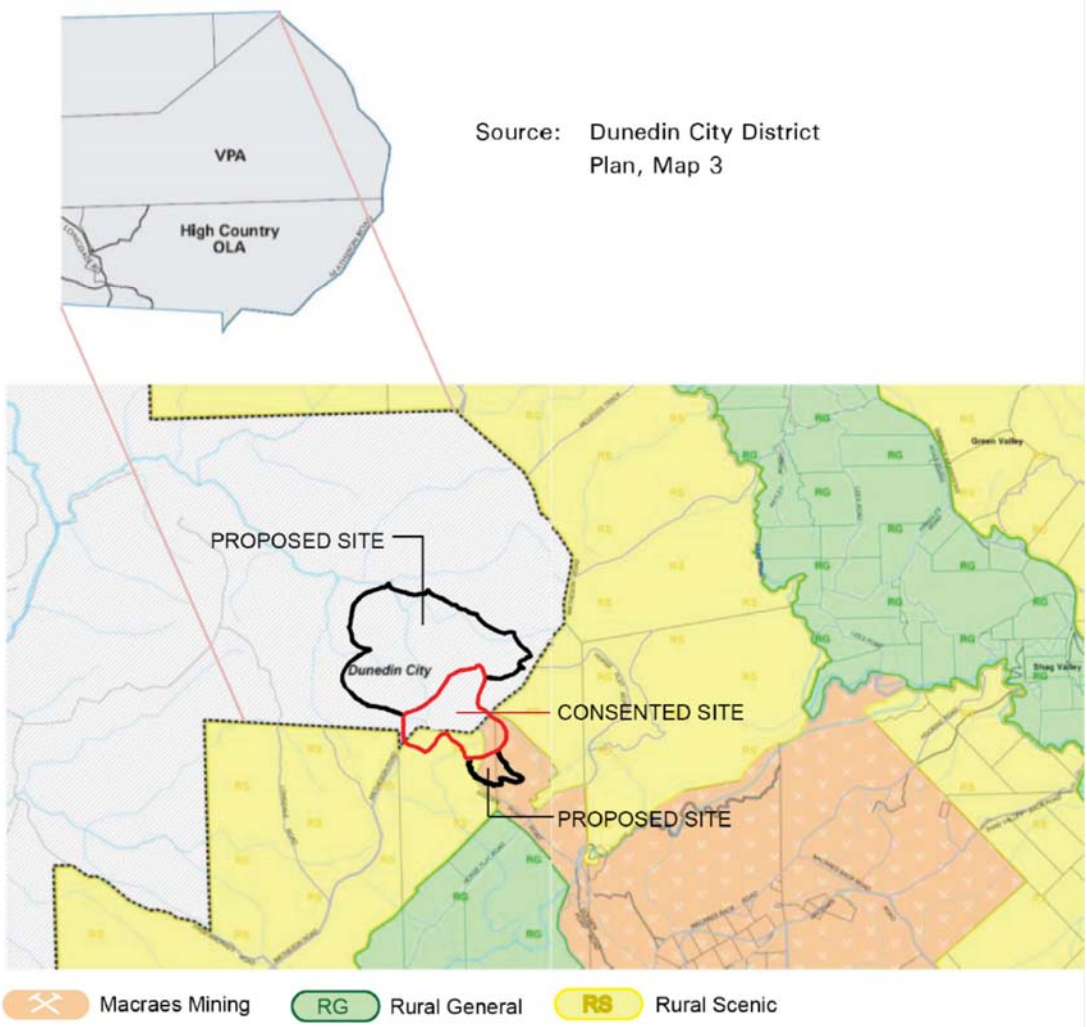

Figure 2. Zoning of the Site

Source: Waitaki District Plan, Maps 30, 31

2.1 Waitaki District Plan

Macraes Mining Project Mineral Zone

The following are the relevant noise rules in the Waitaki District Plan for the Macraes Mining Project Mineral Zone, which covers part of the Coronation North Project site:

6.5.1 Noise

Activities shall be conducted such that the following noise levels are not exceeded at the Macraes Mining Mineral Zone Boundary:

- *during daytime* *55dB $L_{Aeq(15min)}$*
- *during nighttime* *40dB $L_{Aeq(15min)}$*
- *at all times* *75dB L_{AFmax}*

Noise is defined in the District Plan as:

> *means the sound level from an activity is measured and assessed in accordance with NZS 6801:2008 Acoustics – Measurement of environmental sound and NZS 6802:2008 Acoustics – Environmental Noise.*

Daytime is defined in the District Plan as:

> *means 0700 to 2200 hours Monday to Friday and 0800 to 1700 hours Saturday*

Night time is defined in the District Plan as:

> *means 0001 to 0700 and 2200 to 2400 hours Monday - Friday;, 0001 to 0800 and 1700 to 2400 hours Saturday, all Sunday and public holidays..*

Rule 6.5.2 Vibration, sets the following limits for vibration:

> *Activities shall be conducted such that the following ground vibration levels measured either at the Macraes Mining Zone boundary or the boundary of the Golden Point Historic Reserve shall not exceed 10mm per second peak particular velocity measured in the frequency range 3 hertz and 12 hertz.*

Additionally, noise is addressed in the Waitaki District Plan, Rule 6.5.3, Blasting which requires:

> *Activities shall be conducted such that the following air blast peak over sound pressure measured either at the Macraes Mining Zone Boundary or any building within the Golden Point Historic Reserve shall not exceed 128dB linear unweighted. The hours of blasting shall be restricted to the following:*
>
> - *Monday-Friday 9am to 5.30pm*
> - *Saturday and Sunday 10am to 4.30pm*

Rural Scenic Zone

Noise in the Rural Zone is addressed in the Waitaki District Rule 4.5.1, which sets the following noise limits:

> *Activities, shall be conducted such that the following noise limits are not exceeded at any point within the notional boundary of a habitable building on another site, other than the site from which noise generated:*

Monday to Friday 7am – 10pm	*55dB $L_{Aeq(15min)}$*
Saturday 8am – 7pm	*55dB $L_{Aeq(15min)}$*
At all other times and any public holiday	*40dB $L_{Aeq(15min)}$*
Daily 10pm to 7am the following day	*75dB L_{AFmax}*

Exemption:

Noise limits shall not apply to:

(a) residential activities
(b) harvesting, forestry harvesting, bird scarers and any one-off activity not normally anticipated as being required for normal farming activities.
(c) Fire Service and Police

provided that the activity shall comply with the requirements of Section 16 of the Resource Management Act 1991.

Sound levels 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 – Environmental Noise

Section 18 of the Waitaki District Plan, Resource Consent – Assessment Matters sets the following relevant noise criteria in 18.2 (xxiii) Mining Activities and Gravel Extraction - Rural Zones to be considered:

d) The ability of operation to minimise dust, noise, lighting and vibration so that amenity or natural conservation values are not at risk.

By satisfying the relevant noise requirements of the Waitaki District Plan, the existing Macraes Gold Project and Coronation Project Consent Conditions, the requirement of (d) above will be satisfied.

2.2 Operative Dunedin City District Plan

For the area of the mine located within the Dunedin City boundary, as shown on Figure 2, the Dunedin City District Plan Noise Maps do not show the Macraes Gold Project area as having a Noise Map. The index to the Noise Maps states:

> *The Noise Area applying to areas within the Dunedin City Boundary that are not shown on these Noise Maps has a noise limit of 50Dt/40Nt dBA within 50m of a residence.*

Where Dt = Day-time and Nt = Night-time.

Thus, the following noise controls must be complied with within 50m of a residence.

Daytime	*50dBA*
Night time	*40dBA*

Where:

Daytime - means the period between the hours of 7:00 am and 9:00 pm,

Night time - means the period between the hours of 9:00 pm on any night and 7:00 am the following day and includes 24 hours on Sundays and statutory holidays

dBA means A- frequency weighted sound pressure level in decibels relative to a reference sound pressure of 20 micropascals which aims to simulate typical human auditory responses.

Rule 21.6.2 (Noise Measurement and Assessment) of the Dunedin City District Plan states:

> *The noise of an activity shall be measured and assessed in accordance with New Zealand Standard 6801:1991 Measurement of Sound, New Zealand Standard 6802:1991 Assessment of Environmental Sound …*

There are not any specific blast noise requirements in the Dunedin City District Plan with respect to mining in rural areas although Rule 6.5.8(ii) of the District Plan could be considered as guidance on an appropriate level to adopt for the Coronation North Project as they are similar activities that generate the same types of noise. Rule 6.5.8(ii) requires the following condition for Scheduled Permitted Quarrying and Aggregate Processing Activities:

> *(iii) Airblast over-pressure from a blasting event on the site, when assessed at any point within the notional boundary of any residence, shall not exceed a peak non-frequency-weighted (linear or flat) level of 115dB (Peak) at any time*.

2.3 Proposed Second Generation Dunedin City District Plan (2GP)

The operative Dunedin City District Plan is currently being updated, and will be replaced by the 2GP. Submissions have closed on the 2GP, however hearings have not yet commenced so the rules in 2GP may change once the submissions have been heard.

At this stage there is no specific zone for the Coronation North site. OceanaGold has made a submission that a specific zone be created, but at present the Coronation North site is located in the High Country Rural Zone in the 2GP (Section 16).

Rule 16.5.8 states that all land use activities in the Rural Zones must comply with Rule 9.3.6 noise standards. The standards in this rule differ slightly from those in the operative plan.

The Dunedin City District Plan (2GP) City-wide provisions, Public Health and Safety, Rules 9.3.6.2 and 9.3.6.3 include the following relevant noise requirements:

Zoning of receiving property		**Noise level measured at the boundary of the receiving property or the notional boundary of noise sensitive activities in a rural, rural residential or Ashburn Clinic zone**		
		a. 7am to 7pm	**b.7pm to 10pm**	**c. 10pm to 7am**
2.	Rural, rural residential, centres and Ashburn Clinic zones (at notional boundary of noise sensitive activities)	55dB $L_{Aeq(15min)}$	50dB $L_{Aeq(15min)}$	i) 40dB $L_{Aeq(15min)}$; and ii) 70dB L_{AFmax}
3.	Rural, rural residential and Ashburn Clinic zones (at property boundaries, where there are no noise sensitive activities within 20 metres of boundary)	60dB $L_{Aeq(15min)}$	60dB $L_{Aeq(15min)}$	iii) 60dB $L_{Aeq(15min)}$; and iv) 85dB L_{AFmax}

There are no specific noise restrictions on airblasting in the 2GP, although Policy 9.2.2.6 has the effect of allowing mining only where there would be no significant effects from air blast and vibration on people's health and safety, or on surrounding properties.

There is a difference between the existing Macraes Gold Project consent conditions and the two District Plan requirements, with the Waitaki District Plan adopting the boundary of the Macraes Mining Project Mineral Zone and the consent conditions adopting the notional boundary of any dwelling in the Rural Scenic Zone with the notional boundary set at 20m from a dwelling. The Operative Dunedin District Plan also adopts the notional boundary, which is set as the line 50m from the facade of any dwelling, except that, if the dwelling is located closer than 50m to the site boundary the notional boundary is the site boundary. However, the 2GP adopts the notional boundary with an additional control using an increased level at the site boundary.

In summary, the Macraes Gold Project consent conditions adopt 55dB/40dB L_{Aeq} for the day/night limits, the Waitaki District Plan and Dunedin 2GP 55dB/40dB L_{Aeq} for the day/night limits and the Operative Dunedin District Plan 50dBA/40dBA L_{10} within 50m of a residence. In addition 2GP also sets a site boundary level of 60dB L_{Aeq} 24 hours of the day. All conditions include a night time L_{Amax} level although in every case if the L_{10} or L_{Aeq} level is complied with the relevant night time L_{Amax} will also be complied with. As mining is a 24 hours of the day operation the lower night time limit will control the noise levels.

3 THE PROPOSAL

The main features of the Coronation North Project are:

- The Project continues to be located on the ridgeline to the north of Horse Flat Road along the Shag River and Taieri River catchment divide and is situated between the features known as Sister Peaks and Highlay Hill.

- Development will continue to be within the upper reaches of Maori Hen Creek, Maori Burn Creek and Trimbells Gully Creek (Taieri Catchment).

- The Waitaki District Council and Dunedin City Council boundary passes through the Coronation site therefore both authorities will continue to be involved in consenting. The Coronation North waste rock stack and Coronation North Pit will be entirely within the DCC District.

- The Coronation Pit extension will be located in both the Waitaki District and Dunedin City, but largely in Waitaki. The area affected is identified in the operative Waitaki District Plan as within a Rural Scenic Zone and the Macraes Mining Project Mineral Zone.

- The estimated duration of the operation and rehabilitation phases of the Project will be approximately 5 years and the project will add approximately 3 years to the overall Macraes mine life.

- Mining operations will occur 24 hours a day, seven days a week.

- The existing Coronation Pit, which is currently consented to cover an area of 62Ha, will be extended to about 85Ha, which will expand with expected ore recovery from 5MT to approximately 8.5MT (including that which has already been processed). The extension will be primarily to the southern end of the pit, extending from the currently consented edge of the pit. The expanded pit will continue to be opportunistically partially backfilled where practicable and a pit lake, similar to that currently consented, will remain on closure.

- A resource has been identified within the area of the existing consented Waste Rock Stack which will be mined, and a new open pit (Coronation North Pit) will be developed. The Coronation North Pit is estimated to contain approximately 9Mt of ore. The Coronation North Pit will be opportunistically partially backfilled where practicable and closed as a pit lake.

- The ore mining rate for the pits will be approximately 5Mt per annum or 20Mt of material per pit per annum.

- The existing Coronation WRS will not be constructed to the fully consented extent. The total volume of waste rock will reduce from the currently consented 94 Mt (an area of approximately 105Ha). The consented maximum height will remain at 730mRL.

- A new waste rock stack (Coronation North Waste Rock Stack) will be constructed to the North East of the current consented Coronation Waste Rock Stack. The waste rock stack design depicted is capable of containing the total excavated waste material from Coronation North Pit and the Coronation Pit expansion. It is designed to a maximum height of 695mRL. With the potential for opportunistic backfill placement within the Coronation pits the size of the waste rock stacks may reduce proportional to the amount of backfill.

- The existing haul road will be extended by about 2km to the north to reach the North Pit. Ore will be hauled from the pits to the Macraes processing plant via the existing haul road across Horse Flat Road and along the Golden Point Road alignment to the processing plant.

- Mining operations will use the existing fleet of diesel powered mining equipment including: 12 x CAT 789; 2 x Hitachi 3600; 1 x Hitachi 2500; 1 x CAT 5230B; 2 x Montibert 330CL Drills (Grade Control); 2 x D45 KS Dill Techs (waste); and numerous ancillary equipment.

- Mining methods will be similar to those already conducted at Coronation and the wider Macraes Gold Project and will involve drilling and blasting operations similar to that undertaken in the existing pits. Blasting will be restricted to the following hours:
  - Monday-Friday 9am to 5.30pm
  - Saturday and Sunday 10am to 4.30pm.

- The processing rate at the Macraes processing plant of about 6Mt per annum will be unchanged by the Project.

- Distances from the project area to the nearest non-OceanaGold owned residences are 2.0km for the Howard residence, 4.8km for the Vanderley residence (Deepdell Station) and 3.5km for the O'Neil residence.

From this information operating scenarios considered are:

- The stripping of topsoil and transporting the material to the Topsoil Stockpile;

- Mining early in the life of the mine when there is the minimum screening of the mining plant and transporting waste rock to the Coronation North Rock Stack;

- Transferring low grade material to the Low Grade Stockpile; and

- Transporting ore along the haul road to Horse Flat Road.

These areas are shown on Figure 3.

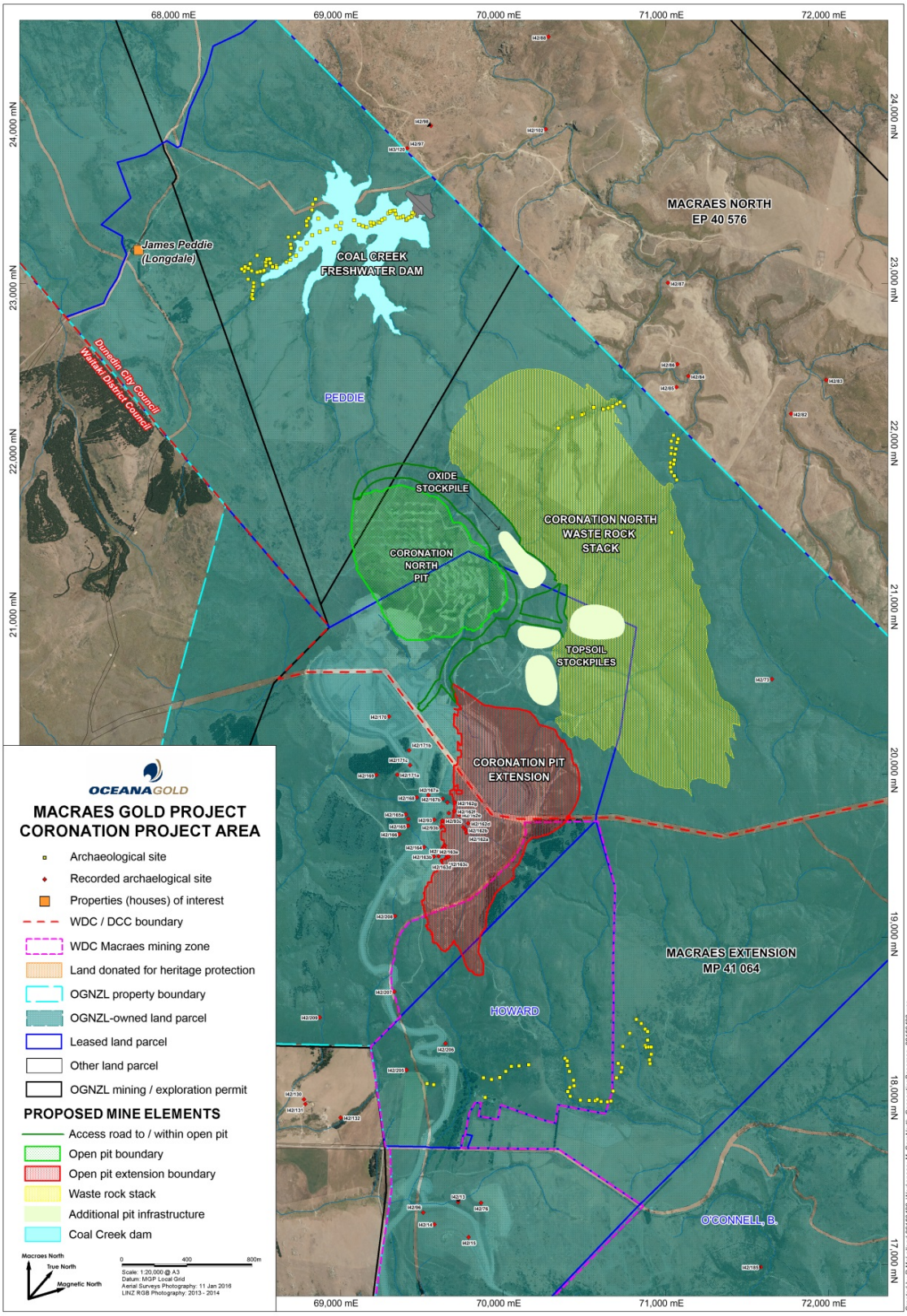

Figure 3. Mining and Disposal Areas

4 EQUIPMENT NOISE LEVELS

To predict the noise from the various mining stages field measurements have been undertaken of the main plant operating at the existing Macraes Gold Project mine and Coronation project.

Figure 4 shows a Cat 5230B excavator loading a Cat 789C dump truck. Figure 5 shows the noise level of the equipment at 78dBA L_{10} when measured at 70m from the excavator.

Figure 4. Cat 5320C Excavator Loading a Cat 789C Dump Truck

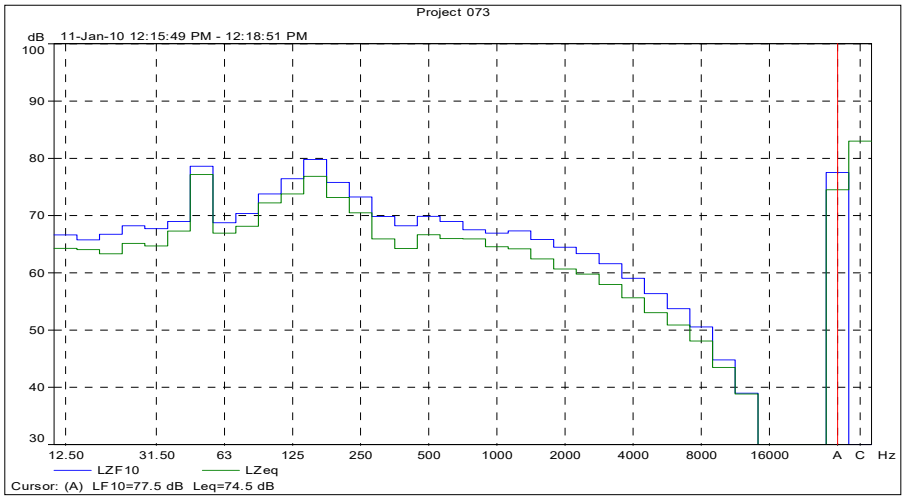

Figure 5. Sound of Cat 5320C Excavator & Cat 789C Dump Truck

Figure 6 shows a Hitachi EX3600 excavator loading a Cat 789C dump truck. Figure 7 shows the noise level of the equipment at 68dBA L_{10} when measured at 130m from the excavator.

Figure 6. HitachiEX3600 Excavator Loading a Cat 789C Dump Truck

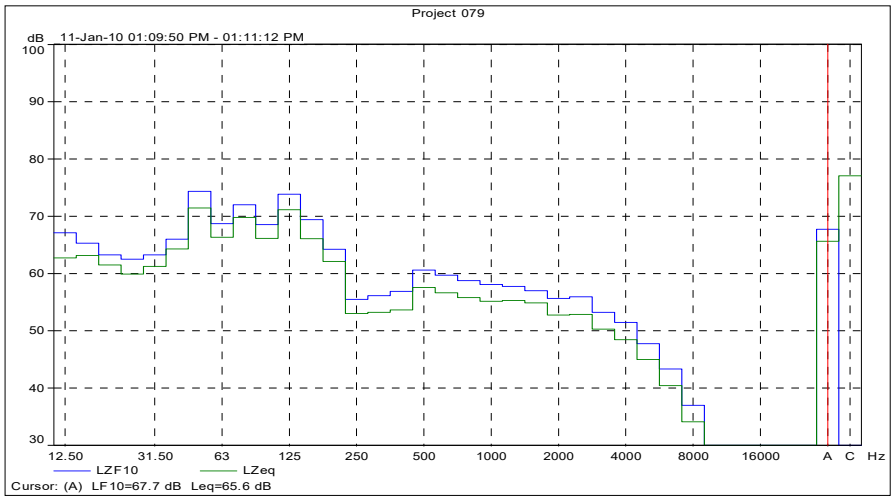

Figure 7. Sound of Cat 5320C Excavator & Cat 789C Dump Truck

Figure 8 shows a Cat 789C dump truck and Figure 9 shows the noise level of the dump truck at 79dBA L_{10} when measured at 26m from the truck.

Figure 8. Cat 789C Dump Truck

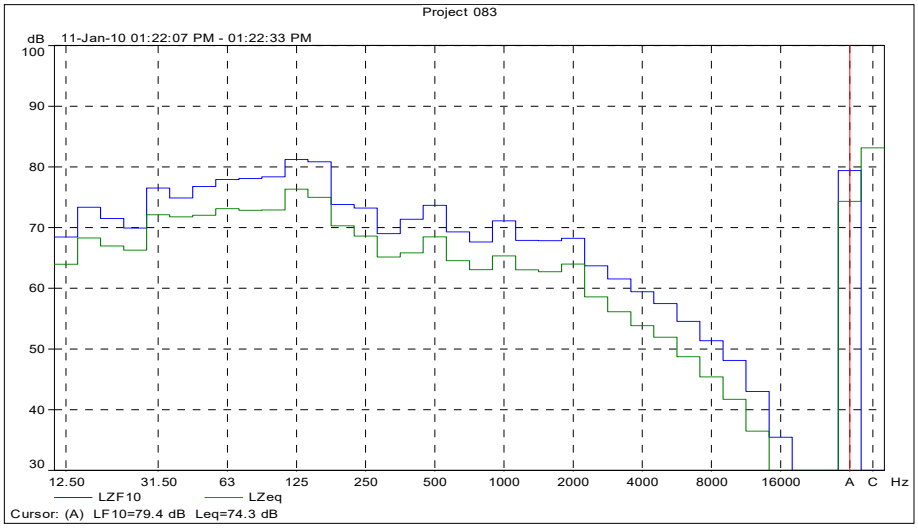

Figure 9. Sound of Cat 789C Dump Truck

Figure 10 shows the rock drill used on site. However, this drill was not operating when the site was visited so the noise from this equipment could not be measured. The noise predictions have therefore been conservatively based on a larger rock drill

as measured at a hard rock quarry at a different site, which had a sound power level of 116dBA.

Figure 10. Rock Drill

It is noted the noise from the various items of equipment is measured at different distances. In each case the location selected was such that the equipment operating controlled the measured level, was representative of the work being undertaken and far enough away from the equipment that the noise was representative of a point source. From these measurements the sound is converted to a sound power level, which is a dimensionless figure used to calculate the noise at any distance in the subsequent calculations.

5 PREDICTED NOISE LEVELS

In order to predict the noise from the proposed Coronation North Project the above noise sources have been located on a digital terrain model with mobile equipment located at the most exposed positions to the notional boundary of the closer neighbours (and identified on Figure 12). The noise has then been predicted using the Brüel & Kjær Predictor v11.0 computer model, which is a noise prediction programme that adopts advanced algorithms to calculate the noise in accordance with the requirements of ISO 9613-1/2 Acoustics – Attenuation of Sound during Propagation Outdoors. For this project, a grid varying between 30 - 120m has been adopted in a digital terrain model with the ground contours varying between 2.5m and 20m intervals. The noise has been calculated at each grid point from which the noise contours have been determined. All calculations have been undertaken assuming a slightly positive meteorological effect at the receiver position. Ground absorption of 0.7 has been used, which is representative of rural land. A receiver height of 1.5m has been adopted for the analysis.

Where a sound has a special audible characteristic, such as tonality or impulsiveness, it attracts a 5dBA penalty in the assessment of that sound. Similarly, if the sound is of limited duration then the sound may be averaged by up to 5dBA. Averaging is not permitted at night time. From field measurements the only equipment on site that has the potential to attract an adjustment due to the type of sound is from the rock drill (Figure 10) and this effect has been included in the analysis.

The noise from the mining has been predicted at the commencement of the mining phase, which is when the equipment is at its highest position and hence the maximum exposure to the neighbours, as shown on Figure 11.

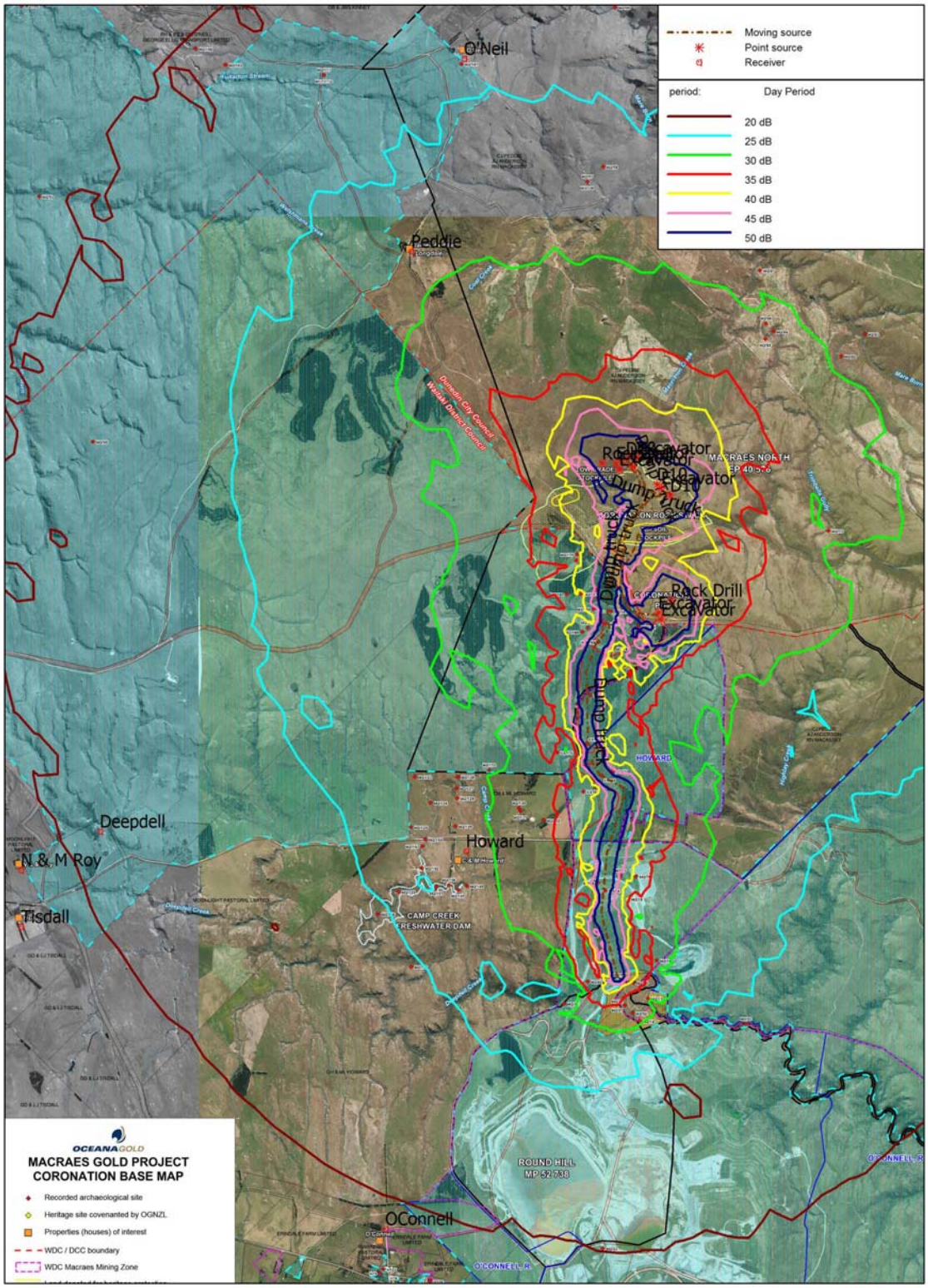

Figure 11. Predicted Noise Contours, dBA L_{10}

In addition, spot levels have been calculated at 1.2m above the ground level at the most exposed notional boundary of each of the closer houses (as shown on Figure 12) around the mine to provide a higher level of accuracy than would be achieved from the contours, which is a smoothing of the levels determined by the selected grid.

The noise level has also been predicted at each of the closer houses not owned by the company as shown on Figure 12. The Howard house is approximately 2km away, O'Neil house 3.5km and the Roy, Tisdale and farm house all just over 5km from the Coronation North Project. The result of these predictions with mining plant at the surface of the area being worked plus the maximum number of trucks on the haul roads, which is the noisiest phase of the project, is:

C & M Howard	29dBA L_{10}
N & M Roy	19dBA L_{10}
Tisdale	19dBA L_{10}
Deepdall Station	21dBA L_{10}
J Peddie (owned by OceanaGold)	28dBA L_{10}
P & D O'Neil	24dBA L_{10}
O'Connell	19dBA L_{10}

From the above it can be seen that the highest predicted noise level experienced at the notional boundary of the closer houses is 29dBA L_{10} with a light temperature inversion present, which is well within the lower night time noise limit of 40dBA L_{10} as set out in the existing Macraes Gold Project and Coronation project consent conditions, the Waitaki District Plan and Dunedin City District Plan. This level of 32dBA L_{10} at the Howard residence, which is the closest dwelling to the haul road, includes the noise effects when assuming the maximum number of trucks along the haul road.

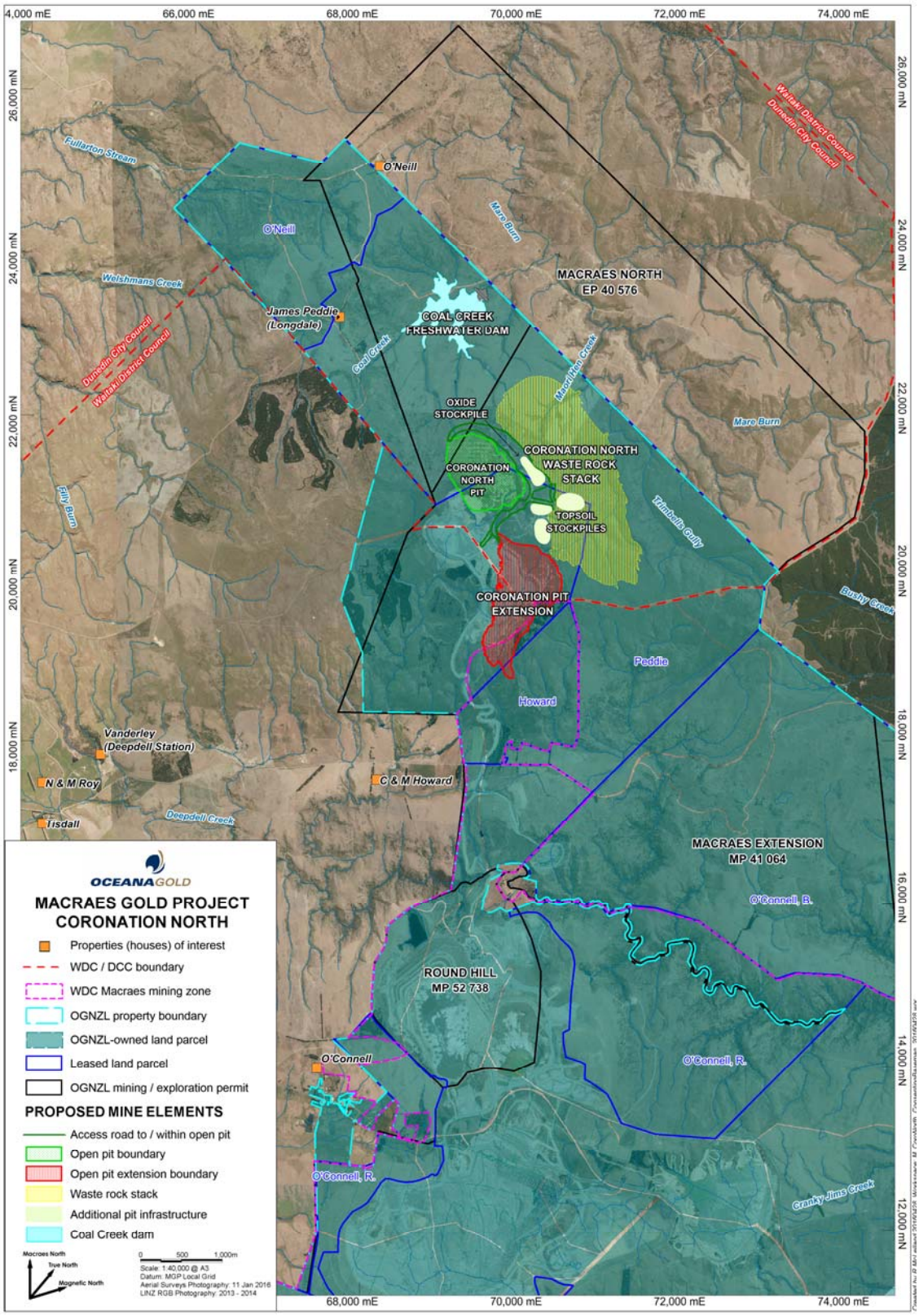

Figure 12. House Locations

Although these levels are all well within the District Plan limits and the existing Macraes Gold Project and Coronation Project consent conditions, the effect on the noise environment prior to mining commencing in the area has also been considered.

From measurements undertaken in 1988 around the Macraes Flat township of the then existing noise environment the background sound (L_{95}) in calm conditions dropped to a low of 27dBA in the afternoon with the lowest L_{10} level during the day at a measured 37dBA. At night time the background sound dropped to a low of 25dBA with the L_{10} down to 28dBA in calm weather conditions. It is noted that the report from the New Zealand Meteorological Service, *'The Climate of the Macraes Flat Area with Respect to Gold Mining at Round Hill*' written by Ron McGann in May 1987, showed there was less than 1% calm conditions and as the wind increased the noise environment quickly increased by 5 – 10dBA or more. That is, except for calm and close to calm conditions the predicted noise from the Coronation North Project will be at or below the original noise environment for the majority of the time.

6 CONCLUSIONS

Noise from the proposed Coronation North Project has been predicted based on all activities occurring at the original ground surface plus the Coronation North Waste Rock Stack at half the height of the final fill. As the Coronation North Pit is excavated and the mining surface goes lower the noise exposure for the neighbours will reduce by 10 – 12dBA, the exact reduction being dependent on how low the plant is operating within the pit. At the same time the Waste Rock Stack height will increase so exposing the equipment operating in this area. However, cumulative noise resulting from equipment on the increased height of the Waste Rock Stack and reduced noise from the equipment lower within the pit will be less than with equipment working at the original ground level.

During busy mining periods of each stage, the noise level at all of the closer houses will remain well within the current Macraes Gold Project consent conditions by a minimum of 8dBA L_{10} at all existing dwellings in the area. As a guide, a reduction of 10dBA is a perceived halving of the noise level.

As the same activities occur during the daytime as adopted in the above analysis, compliance with the night time noise criteria will ensure the daytime levels are complied with by a minimum of a 21dBA L_{10} factor of safety.

Although the noise environment without any effects of mining is relatively low around the Macraes Mine the predicted noise level with the effects of mining is also low. Mining the Coronation North Project may be heard when outside late at night when the background sound is lowest but even under these conditions there will be no adverse noise effects for the neighbours. For the majority of the time the wind is above approximately 2m/s, so the noise from the Coronation North Project will be below the noise environment if all mining noise is excluded from the analysis.

From the above, and in terms of the requirements of the Resource Management Act, the noise effects of the proposed Coronation North Project will be less than minor.

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