acoustic engineering services

www.aeservices.co.nz
office@aeservices.co.nz
Auckland +64 9 917 0369
Wellington +64 4 890 0122
Christchurch +64 3 377 8952

Report Number: AC22071 – 05 – R4

OceanaGold Frasers Macraes Phase 4 project

Assessment of Environmental Noise Effects

Prepared for:
OceanaGold Corporation
Macraes Flat
EAST OTAGO 9483

Issued:
8 March 2024

ACENZ

Association of Australasian Acoustical Consultants

Revision History

Reference	Status	Date
AC22071 – 05 – R1	DRAFT	9 February 2024
AC22071 – 05 – R2	DRAFT	26 February 2024
AC22071 – 05 – R3	FINAL	8 March 2024
AC22071 – 05 – R4	FINAL	11 March 2024

Document Acceptance

Author	Signature
Oliver Hutchison *BA (Hons), MArchSci* Acoustic Engineer	
Reviewer	**Signature**
Clare Dykes *MBSc, MASNZ* Senior Acoustic Engineer	
Reviewer and Approver	**Signature**
Dr Jeremy Trevathan *Ph.D. B.E.(Hons.) Assoc. NZPI® MASNZ* Managing Director	

Table of Contents

This page has been left intentionally blank.

1.0 BACKGROUND

Acoustic Engineering Services (AES) have been engaged by OceanaGold (New Zealand) Limited (the Applicant) to provide acoustic engineering advice in relation to an application for Resource Consent for the Macraes Phase 4 Project (MP4) in Macraes Flat, Otago. The Applicant requires an assessment of the environmental noise emitted by the activities, with regard to section 104 (1) of the Resource Management Act 1991 (RMA), which requires the actual and potential effects of the activity on the environment to be considered.

This report should be read in conjunction with the Resource Consent application documentation, and is based on information received by email and file share, including terrain contours, identification of neighbouring properties, and description of the activity. Other documentation used in the development of this report is as follows:

- Email titled *MP4 Scope Change: Project Descriptions and Information*, as sent by Dean Fergusson (OGL) to AES on the 17th of August 2023.
- Scope change summary report, titled *MP4 Project – Openpit Extensions & FTSF, Project scope changes*, as prepared by OceanaGold Limited, and dated the 17th of August 2023.
- Memorandum titled *Coronation Stage 6 Open Pit – Project Description*, as prepared by OceanaGold Limited, and dated the 16th of August 2023.
- Memorandum titled *IM Open Pit – Project Description*, as prepared by OceanaGold Limited, and dated the 16th of August 2023.

We understand that a blasting noise and vibration assessment has been carried out for this project by TechNick Consulting, as outlined in the report titled *MP4 Project Stage 3 Blasting Vibration and Airblast effects assessment OGNZL Macraes New Zealand*, dated the 26 October 2023. We note that due to its impulsive nature, noise from blasting does not fit in well with the noise criteria discussed below, and as such blasting noise is typically assessed by different parameters. It is therefore appropriate to assess noise from blasting separately than the other noise sources outlined below. We have therefore excluded an assessment of blasting from this report.

The MP4 project will extend the OceanaGold Macraes Life of Mine Plan to approximately 2030. This involves the expansion of existing and previously mined areas in the wider Macraes Gold Project area, including:

- Further development of the proposed Frasers Pit Tailings Storage Facility.
- Extensions to Golden Bar (GB), Coronation (CO), and Innes Mills (IM) open pits and associated waste rock disposal.
- The operation of the Processing Plant and other consented mining operations will continue throughout the mine life. Tailings disposal location will change from TTTSF to FTSF in approximately Q1 2026.

It is noted that the MP4 project scope excludes the expansion and extension of GPUG, an initial stage of tailings disposal at FTSF, and a minor extension of IM8 stripping through 2025 to the early part of 2026. Noise effects have been previously assessed for these mining activities by AES and were the subject of separate Resource Consent applications in October and December 2023. AES provided Assessment of Environmental Noise Effects for these projects, respectively:

- Report titled *OceanaGold Golden Point Underground Mine – Variation to mine plan Assessment of Environmental Noise Effects* (AES file reference: AC19259 – 03 – R3), dated the 11th of April 2023.

- Report titled *OceanaGold Frasers Tailings disposal and IM Stage 8 pit expansion, Macraes Flat, Otago* (AES file reference: AC22038 – 06 – R3), dated the 15th of December 2023

This present study assesses noise from all other MP4-related activity. Cumulative assessment of all MP4 noise, including noise from the above GPUG, IM8, and Frasers tailings disposal activities and noise from other consented (non-MP4) mining activity, is also addressed.

A summary location plan for the MP4 project is shown in figure 1.1 below.

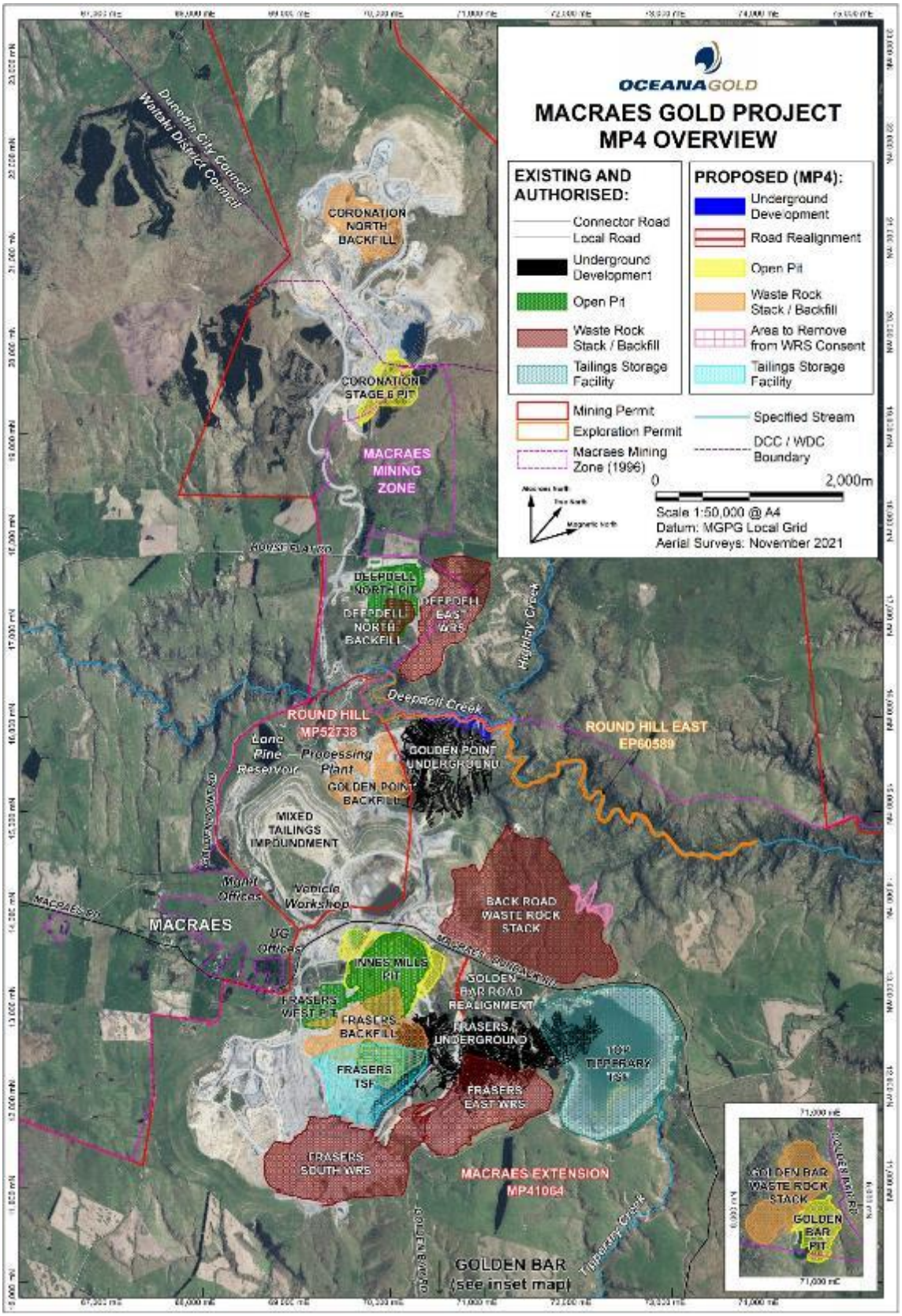

Figure 1.1 – Summary location plan

1.1 Site and surrounding area

The OceanaGold site currently contains a number of operating and previously mined open pits and associated waste rock stacks, underground mines and a Processing Plant. The proposed activity is located mostly within the Macraes Mining Project Mineral Zone (MMPMZ) as defined in the Waitaki District Plan. The MMPMZ adjoins the Rural General Zone to the west of the site. To the north, east, and south, the MMPMZ adjoins the Rural Scenic Zone.

The Coronation and Coronation North mining areas are located within the Dunedin City Council High Country OLA/Rural zone.

The extent of the Macraes site, and MP4 activity areas are shown in figure 1.2 below.

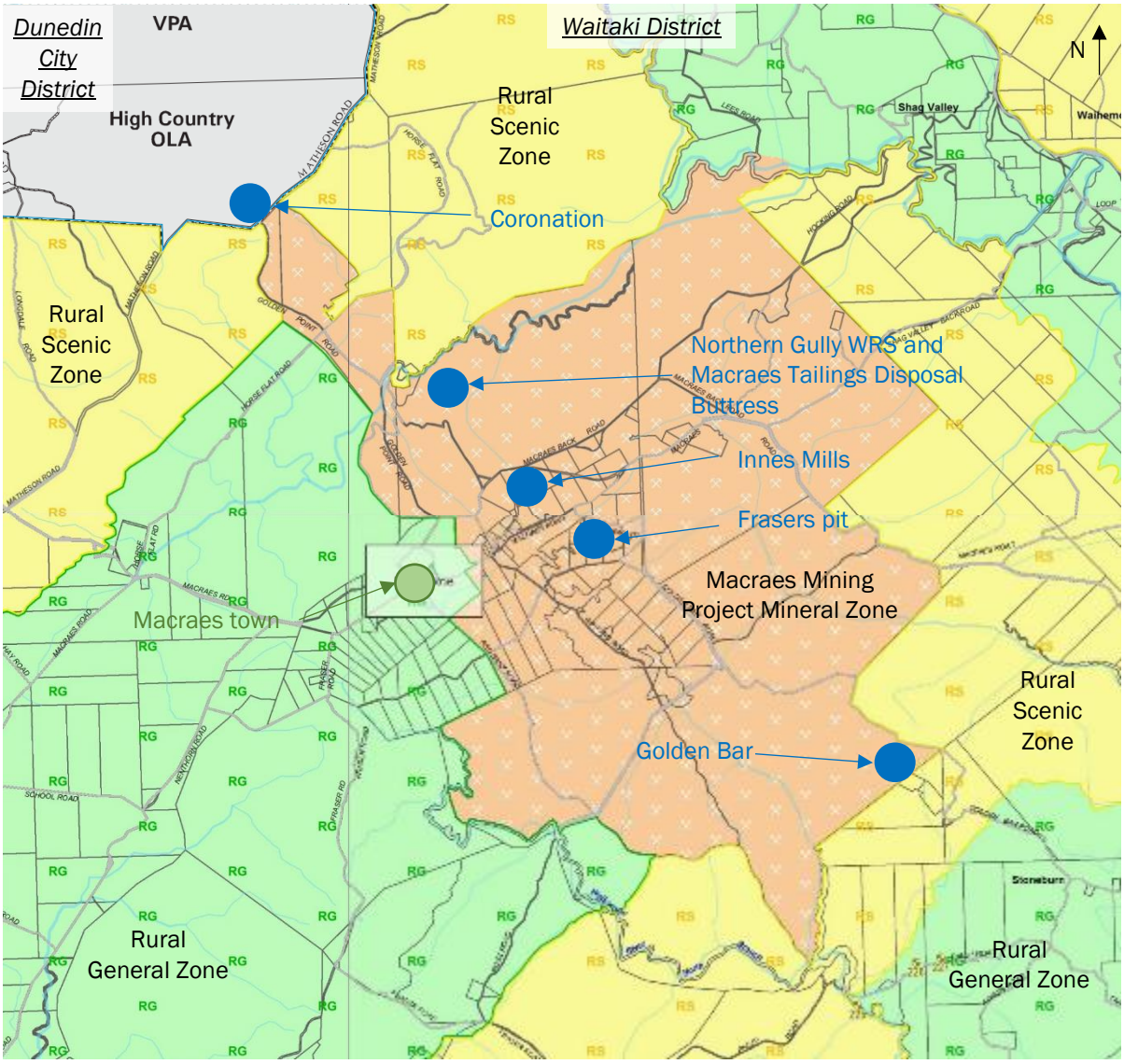

Figure 1.2 – District Plan zones with relative location of proposed MP4 activity areas

There are a number of residential dwellings within and around the MMPMZ which are in relatively close proximity to existing and proposed mining areas (particularly concentrated around the Macraes town area). However, many of these dwellings are owned by OceanaGold. We have identified three key residential

properties which are not owned by OceanaGold, and which may be affected by the proposed activity. Figure 1.3 below indicates with yellow dots the position of these nearby dwellings relative to key locations on the project site.

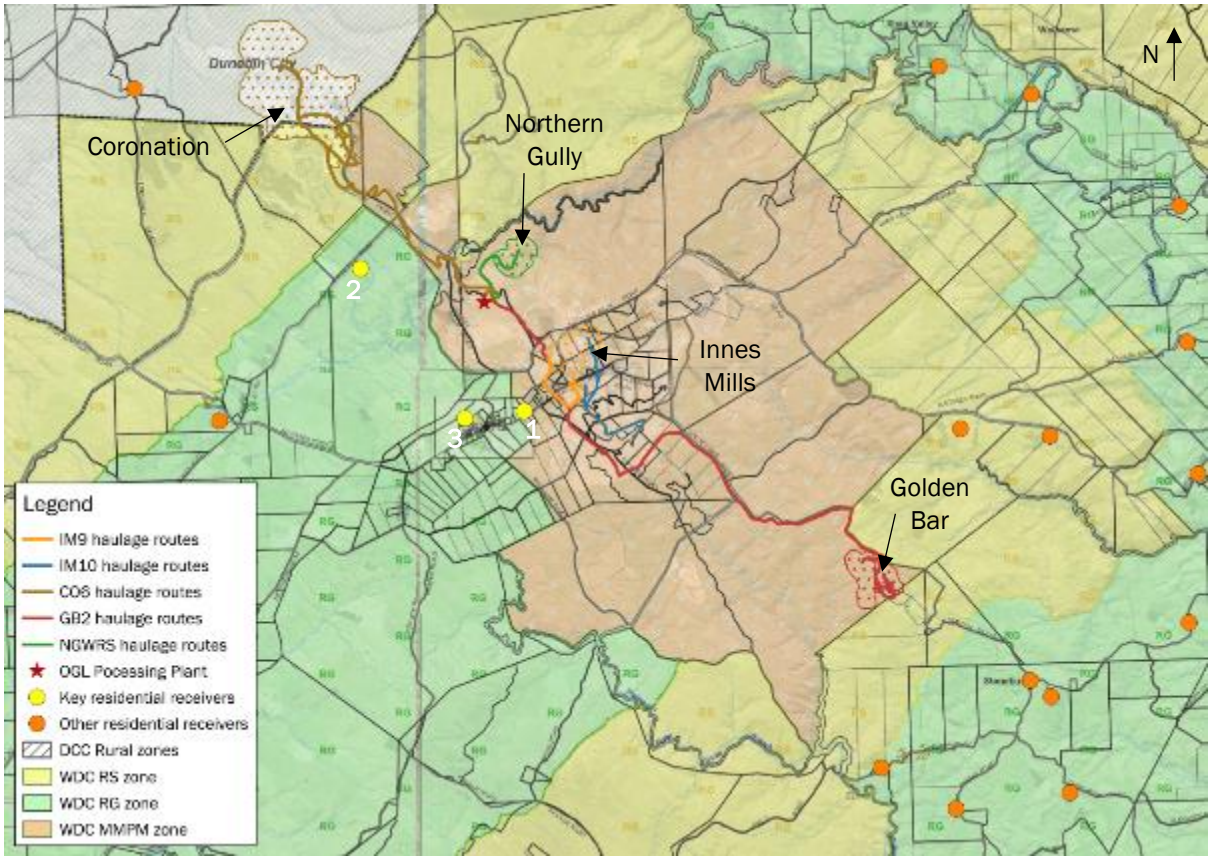

Figure 1.3 – Location of privately-owned (non-OGL) residential properties relative to the proposed activity

Orange dots in figure 1.3 above indicate the location of other non-OGL owned residential properties that are at further distances from the project site. These dwellings have been included in our modelling for completeness, but we do not expect noise levels at these sites to be appreciable, and they have therefore not been discussed further.

Table 1.1 below shows distances to the three key residential dwellings from locations of proposed MP4 activity.

Table 1.1 – Nearby dwellings and distances to the proposed activity

Receiver	Dwelling	Owner	Approximate distance to (metres)	
			Closest point on the MMPMZ boundary	Closest point on a proposed haulage route
1	1668 Macraes Road, Macraes	Private	10	650
2	406 Horse Flat Road, Macraes	Private	1,100	1,280
3	47 Hyde Street, Macraes	Private	600	1,250

1.2 Proposed activity

1.2.1 Open cast pit extensions

There are planned expansions of the existing open cast mining activities at the Golden Bar, Coronation, and Innes Mills pits. Current and proposed mining is planned to take place between Q3 2024 and Q2 2029.

Waste rock from the various stages of the MP4 project is planned to be disposed in five waste rock disposal locations: Frasers Backfill (FRBF), Frasers South Backfill / Waste Rock Stack (FSBF/WRS), Golden Bar Waste Rock Stack (GBWRS), Coronation North Back Fill (CNBF), and the Golden Point Backfill (GPBF). Noise from operating, consented pits has been included in the cumulative noise effects assessment in section 5.0.

Table 1.2 below summarises the proposed open cast pit extensions as part of the MP4 project, including the duration of each stage, and the waste rock disposal location.

Table 1.2 – Proposed open cast pit extensions

Mining area	Stage	Start date	End date	Total ore (Mt)	Total waste (Mt)	Waste rock disposal location
Innes Mills	9	Q1 2026	Q3 2028	2.28	17.23	▪ FSBF/WRS ▪ FRBF
	10	Q2 2027	Q2 2029	1.07	22.32	▪ FSBF/WRS ▪ FRBF
Golden Bar	2	Q2 2026	Q4 2027	1.49	27.94	▪ GBWRS
Coronation	6	Q3 2024	Q1 2027	1.99	31.55	▪ CNBF

In addition to the above, a total of 5.4Mt of waste is planned to be moved from the Northern Gully Waste Rock Stack (NGWRS) to GPBF in early 2027 and again in 2029-30.

Typically, drill and blast is to be used to fracture and loosen the overburden before excavation. Drill and blast operations are conducted Monday to Friday between 9:00 am and 5:30 pm. Loading out of the waste rock to haulage trucks will be undertaken using excavators. The CAT 789D haul trucks have a nominal rated payload of 194 tonnes. Haulage of ore from the Golden Bar Pit (GB2) to the Processing Plant is proposed to be undertaken using CAT 773D trucks, or similar. These trucks have a nominal rated payload of 55 tonnes. Waste disposal will primarily be by end tipping into the various waste rock disposal locations described above, supplemented with spreading of the unloaded waste with a dozer and/or a grader. The mining, loading, hauling, and unloading activity is expected to operate 24 hours a day, 7 days a week.

2.0 ACOUSTIC CRITERIA

The Resource Management Act (1991) requires consideration of the significance of any adverse effects associated with the proposal. Guidance as to the significance of any adverse noise effects may be obtained from several sources.

2.1 Waitaki District Plan noise limits

As stated above the site is mostly located within the Macraes Mining Project Mineral Zone, with the nearest neighbouring properties located within the Rural General Zone under the current District Plan.

The noise limits which apply to the Macraes Mining Project Mineral Zone are outlined in section 6.5 of the Waitaki District Plan, and are as follows:

> *Noise*
>
> *Activities shall be constructed such that the following noise levels are not exceeded at the Macraes Mining Mineral Zone Boundary:*
>
> | | |
> |---|---|
> | *During daytime* | *55 dB $L_{Aeq\ (15min)}$* |
> | *During night-time* | *40 dB $L_{Aeq\ (15min)}$* |
> | *At all times* | *75 dB L_{AFmax}* |
>
> *Daytime is defined as 0700 to 2200 hours Monday to Friday & 0800 to 1700 hours Saturday. Night-time is all other times and any public holiday.*

The noise limits which apply within the Rural General Zone and Rural Scenic Zone are outlined in section 4.5 of the Waitaki District Plan, and are as follows:

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

The Waitaki District Plan defines the notional boundary as a line 20 metres from any side of a dwelling building, or the legal boundary where this is closer to the dwelling building.

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 provision of NZS 6802:2008 *Acoustics – Environmental Noise*.

Objective 4 for the Rural Zone within the Waitaki District Plan relates to Rural Amenity, and states:

> *A level of rural amenity that is consistent with the range of activities anticipated in the rural areas, but which does not create unacceptably unpleasant living or working conditions for the District's residents and visitors, nor a significant deterioration of the quality of the rural environment.*

2.2 Dunedin City District Plan (2006) noise limits

A part of the MP4 project area is located within the Dunedin City District. Under the Dunedin City District Plan, the project site is included in the High Country OLA zone.

The noise limits which apply to noise generated within the High Country OLA zone are outlined in Rule 21.5.1 *Performance Standard: Noise Limits - General Levels*, and on the *Index to noise maps* document.

The following noise limits apply at the notional boundary of residences:

Day time	*50 dB L_{A10}*
Night time	*40 dB L_{A10} and 75 dB L_{AFmax}*

Day time is defined as 0700 to 2100 hours Monday to Saturday. Night-time is all other times and any public holiday.

The Dunedin City District Plan (2006) defines the notional boundary as a line 50 metres from any side of a residence.

Sound levels shall be measured in accordance with the provisions of NZS 6801:1991 *Acoustics – Measurement of Environmental Sound* and assessed in accordance with the provision of NZS 6802:1992 *Acoustics – Environmental Noise*.

2.3 Dunedin City 2nd Generation District Plan (2GP) noise limits

Under the Dunedin City 2GP District Plan, the project site is included in the High Country Rural zone.

The noise limits which apply to noise generated within the High Country Rural zone are outlined in *Section C – City-wide provisions, 9 Public Health and Safety, 9.3 Performance Standards 9.3.6 Noise*.

The following noise limits apply at the notional boundary of residences:

Day time (0700 to 1900 hours)	*55 dB $L_{Aeq\ (15\ min)}$*
Evening (1900 to 2200 hours)	*50 dB $L_{Aeq\ (15\ min)}$*
Night time (2200 to 0700 hours)	*40 dB $L_{Aeq\ (15\ min)}$ and 70 dB L_{AFmax}*

The Dunedin City 2GP District Plan defines the notional boundary as a line 20 metres from any side of a residential building, or the site boundary where this is closer to the residential building.

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 provision of NZS 6802:2008 *Acoustics – Environmental Noise*.

2.4 New Zealand Standard 6802

NZS 6802:2008 *Acoustics – Environmental Noise* outlines a guideline day time limit of 55 dB $L_{Aeq\ (15\ minute)}$ and a night time noise limit of 45 dB $L_{Aeq\ (15\ minute)}$ for "the reasonable protection of health and amenity associated with the use of land for residential purposes".

If there are no timeframes otherwise specified, then NZS 6802:2008 suggests that the day time period is 0700 to 2200 hours, and the night time period 2200 to 0700 hours.

NZS 6802 defines the notional boundary as a line 20 metres from any side of a dwelling, or the legal boundary where this is closer to the dwelling.

The Standard also describes how a -3 dB adjustment may be applied to sound received for less than 50 % of the day time period, and a -5 dB adjustment may be applied to sound received for less than 30 % of the day time period.

2.5 World Health Organisation

Guidelines for Community Noise[1], a document produced by the World Health Organisation (WHO) based on extensive international research recommends a guideline limit of 55 dB $L_{Aeq\ (16\ hours)}$ to ensure few people are seriously annoyed in residential situations. A guideline limit of 50 dB $L_{Aeq\ (16\ hours)}$ is recommended to prevent moderate annoyance. A guideline night time limit of 45 dB L_{Aeq} is recommended to allow occupants to sleep with windows open.

The day time guidelines relate to ongoing noise at the stated level over a 16-hour period with no distinction between days of the week.

2.6 Approved Resource Consents for existing mining activity on the site

As stated above, there are other areas of ongoing mining activity on the site, which have had their noise effects considered during their respective consenting processes. Two examples of noise-related conditions attached to granted Resource Consents are reproduced below.

2.6.1 Macraes Phase 3 Project

We have reviewed the approved conditions of the Macraes Phase 3 (MP3) land use consent (Consent number 201.2011.35/2), which authorises open pit mining, including at Frasers and Innes Mills pits. Parts of the MP4 proposal will occur in similar locations to the activities authorised by the MP3 land use consent. The noise related conditions of consent are outlined in Condition 9 and are as follows:

9. NOISE

Noise limits

9.1 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 9.2:

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

b) On any day between 9.00 pm on to 7.00 am the following day (night-time): 40 dBA L_{eq}; and/or 70 dBA L_{max}

Measurement Locations

9.2 Noise measurements shall be taken at any point within Macraes Village; or at, the notional boundary or 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

9.3 All noise measurements referred to in Conditions 9.1 and 9.2 above shall be measured in accordance with the provisions of NZS 6802:2008 Acoustics: Measurement of Environmental

[1] Edited by Berglund, B *et al. Guidelines for community noise.* World Health Organization 1999.

Sound, and shall be assessed in accordance with the provisions of NZS 6802:2008 Acoustics: Environmental Noise

2.6.2 Golden Point Underground Mine (GPUG)

We have also reviewed the approved conditions of consent for the Golden Point Underground Mine (Consent number 201.2020.1514), which has noise generating activity occurring in similar locations to parts of the proposed activity. The location of the GPUG activity in relation to the proposed activity can be seen in figure 1.1 above. The noise related conditions of consent are outlined in Conditions 31 through 33 and are as follows:

31. 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:

a. On any day between 7 am to 9 pm (daytime): 50 dBA LAeq; and

b. On any day between 9.00 pm to 7.00am the following day (night-time): 40dBA LAeq; and/or 70 dBA LAmax.

32. Noise measurements shall be taken at any point within Macraes Township; or at the notional boundary of any dwelling not owned by the consent holder in the Rural General or Rural Scenic Zone except that condition 31 shall not apply to any property or site that is owned by the consent holder.

Advice 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.

33. All noise measurements referred to in Conditions 31 and 32 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.

2.7 Discussion regarding appropriate noise levels

As outlined above, in order to fully comply with the Waitaki District Plan noise limits noise would need to be assessed at the MMPMZ boundary. With regard to noise effects, all other relevant guidance (including the Dunedin City District Plan noise limits, and previous Resource Consent conditions discussed in section 2.4 above) consider it appropriate to assess noise levels at the notional boundary of neighbouring dwellings not owned by the Applicant. As the dwellings are the nearest noise sensitive locations in the vicinity, we again consider the notional boundary (20 metres from a dwelling) to be the appropriate measurement location for this Consent.

As the proposed MP4 activities may operate continuously throughout the day and night time period it is the noise emitted during the night time period that has the potential to have the greatest effect on the neighbouring properties.

Overall, ideally noise levels from the MP4 activities would be managed so that they were less than 40 dB L_{Aeq} at the notional boundary of privately owned neighbouring dwellings during the night time period, in line with the previous consent conditions. However, we note that the recognised guidance discussed above actually recommends a maximum external noise level of 45 dB L_{Aeq} at a bedroom window to ensure occupants can still sleep with windows open. Noise levels exceeding 40 dB L_{Aeq} may therefore be acceptable from time to time, with effects which are only minor.

3.0 NOISE GENERATED BY THE ACTIVITY

SoundPLAN computational noise modelling based on ISO 9613 *Acoustics – Attenuation of sound outdoors – Part 2: General method of calculation* has been used to calculate the propagation of noise from the site, taking into account the topography of the area, and sound power levels for each of the noise sources.

This modelling considers enhanced propagation representative of either moderate downwind conditions (up to 5 m/s) in every direction (which would not occur in reality), or moderate ground-based temperature inversions to represent what can occur on a clear, calm night. Noise levels predicted under these conditions are taken as being at the upper limit of the 'meteorological window' described in NZS 6801:2008 and NZS 6802:2008 where valid compliance assessments are possible.

3.1 Sound power of equipment

Clare Dykes of AES conducted a series of noise measurements on mining plant, equipment, and heavy machinery operating at the existing Coronation North Pit, between 1300 and 1600 hours on the 8th of February 2018. Measurements were made under neutral weather conditions in general accordance with NZS 6801:2008 *Acoustics – Measurement of Environmental Sound*.

The purpose of these measurements was to acquire data which could be used for predicting the expected noise levels at the notional boundaries of the neighbouring residential dwellings, for a given worst-case scenario in each of the proposed activity areas.

3.1.1 Main mining equipment

Based on previous measurements and analysis undertaken by AES, the assumed worst-case sound power levels of the noise generating equipment which is associated with the operation are shown in table 3.1 below. The measured noise levels are in line with the reference levels provided in the relevant standards. This data has been used to calculate the noise expected at the nearest neighbouring dwellings due to the machinery operating.

Table 3.1 – Equipment sound power levels

Equipment or Machinery	Sound level dB L_{wA}	Notes
Drill	119	1.
Excavator	115	2.
Dozer / Loader	116	2.
Grader	115	2.

1. Based on measurements undertaken of drill and blast drilling rig on site.

2. Measured typical levels on site and referenced against the British Standard BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*.

3.1.2 Haulage trucks

The noise level emitted by haulage trucks is more difficult to determine as the noise output of a truck varies with load, terrain, and operation.

Given the changing gradient of the haulage route, the trucks emit varying levels of noise as they travel up / down the road. To determine the relative noise source level of the trucks as they travel on the haulage route, we have calibrated our model using the results from attended noise monitoring undertaken by OceanaGold

at the dwelling at 1668 Macraes Road on Tuesday the 21st of May 2019. Results from this measurement showed that noise from two loaded haulage truck passes on the haulage road under neutral weather conditions measured 37 dB $L_{Aeq\ (15\ mins)}$ at the 1668 Macraes Road dwelling. Both trucks measured were the CAT 789D type which has a nominal rated payload of 194 tonnes, and which are owned and operated by OceanaGold.

We note that this value may be increased if the truck movements happened to occur at a time during enhanced propagation which still fell within the meteorological window outlined in NZS 6802:2008, such as during a temperature inversion condition.

We have therefore considered trucks as a line source along the haulage road, scaled to the measurements above, with an adjustment for enhanced propagation.

The model of truck used for the Golden Bar ore haulage activity, CAT 773D (nominal rated payload of 55 tonnes), is a significantly smaller truck than the CAT 789D (nominal rated payload of 194 tonnes). We have not had the opportunity to undertake measurements of the CAT 773D trucks, though from information made available by the manufacturer, external noise emissions from 773D trucks are in the order of 5 dB less than that emitted by the CAT 789D model (which we have measured as described above).

3.2 Predicted noise levels – Temporary surface level operations

With open cast mining, the majority of noise generating activity (excepting truck haulage) will occur within the pits, which typically occurs below the surrounding ground level. During the initial stages of open pit mining there will be some noise generating activity, such as drilling and excavation, which occurs at the existing surface ground level. As the pit excavation progresses and the pit deepens, screening is provided by the enclosing pit walls. Surface level operations are therefore considered to be a worst-case scenario for drilling and excavation equipment, and this would only occur for a limited period of time.

We have analysed scenarios below for temporary surface level drilling and excavation activities.

3.2.1 Drilling holes for blasting

We understand that for typical drill and blast operations, it takes approximately 6 minutes to drill the holes, and the drill will only stop for a short amount of time between holes to relocate to the next hole, and to allow a sample of cuttings to be taken. Drilling operations typically occur during the day time period (between 0700 to 2200 hours), and typically last for 1 – 2 days in any given week.

We have modelled a variety of scenarios with a drill operating at the existing surface level at many different locations around the whole perimeter of each pit extension area, including IM6 – 10, GB2, and C06. The drill in our model was configured as a single drill operating continuously for a 15-minute period, though we note this is a conservative approach (there will be periods of lower noise emissions during a typical 15-minute period, as the drill is repositioned etc.). Furthermore, we understand that, in practice, material in the upper bench is likely to be softened by weathering processes and hence easier to excavate (free dig, or lower powder factor) and therefore drilling cycles may be shorter at the top layers of the pits.

Based on this analysis, our modelling shows that noise associated with drilling at existing ground level on the proposed MP4 extension mine areas is expected to result in noise levels of 37 dB L_{Aeq} or less at the notional boundary of all nearby dwellings. This readily complies with all relevant acoustic criteria.

3.2.2 Surface level excavation

As noted above, excavation equipment is likely to operate at surface level during the initial stages of open pit mining operations on new / expanded pit areas.

As with drilling above, we have modelled a variety of scenarios with excavation equipment operating at the existing surface level at many different locations around the whole perimeter of each pit expansion area,

including IM9-10, GB2, and CO6. We assumed a worst-case scenario with three excavators operating simultaneously and continuously in each location for a 15-minute period.

Based on this analysis, our modelling shows that noise associated with excavation at existing ground level on the proposed MP4 expansion mine areas is expected to result in noise levels of less than 35 dB L_{Aeq} or less at the notional boundary of all nearby dwellings. This complies with all relevant acoustic criteria.

3.3 Predicted noise levels – Ongoing activity

In the following sub-sections we have analysed various scenarios of noise-generating activity that is expected to be ongoing throughout the lifespan of the MP4 project. These scenarios consider that most noise sources associated with each mining stage will be located within the pit shells for the vast majority of the time. Trucks used for haulage of extracted rock out of the pit are the notable exception, as these travel between pits, waste rock stacks and, in the case of ore, the Processing Plant, and therefore noise generated by these trucks can occur above ground level for parts of the haulage routes.

The intensity of activity within each mining area on any given day can depend on a variety of factors including scheduled truck numbers, the nature of the haulage routes, weather conditions, etc. The scenarios analysed in this section are intended to reflect a reasonable peak level scenario for concurrently operating noise sources during a worst-case 15-minute period in each quarterly period of the MP4 project lifespan. Generally speaking, for the majority of the time, noise levels from MP4 mining activity is expected to be less than the levels predicted in this section. However, the predicted levels could be expected to occur from time to time.

Our modelling was based on quarterly data for haulage truck movements, and annual data for other equipment. For brevity we have reported annual results only – being the maximum level expected at the dwelling in any quarter of a given year.

3.3.1 Removal of extracted rock – Innes Mills (IM) stages 9 – 10

For the majority of the time, the only activity in the IM mining area will be the excavation and haulage of waste rock. This activity will comprise of periodic drill and blast, excavators loading the material into haul trucks and the trucks transporting waste rock to FSBF/WRS, FRBF, and GPBF, with a smaller number of trucks transporting ore to the Processing Plant. We have modelled quarterly projected mining activity data from OceanaGold for the duration of the IM project stages 9, and 10 (IM9 – IM10). Based on this analysis, we have considered the peak operation could consist of the following during a worst-case 15-minute period:

- IM9 – Up to 1.7 trucks in a 15-minute period on the haul road travelling between the IM pit and permanent waste rock storage in the FRBF or FSBF/WRS facilities, or to the Processing Plant.
- IM10 – Up to 3.2 trucks in a 15-minute period on the haul road travelling between the IM pit and permanent waste rock storage in the FSBF/WRS or FRBF facilities, or to the Processing Plant.
- Up to three excavators operating simultaneously in the base of the mine
- One drill operating around the base of the mine
- One dozer operating in each waste rock storage area
- One grader operating in each waste rock storage area

With respect to truck haulage of ore from both IM9 and IM10 pits to the Processing Plant, the route taken by haul trucks depends on the stage of mining in the pit. We have modelled ore trucks based on a worst-case south-westerly route, which passes near Macraes town. In reality, most ore haulage is likely to take a more direct north-westerly route from IM9 / IM10, which is further from Macraes town. Therefore, our modelling of noise from ore truck haulage is conservative.

The expected noise levels from the above scenario at the worst affected nearby dwellings not owned by the Applicant are outlined in table 3.2 below. Levels exceeding the Rural General Zone and Rural Scenic Zone night time limit in the Waitaki District Plan (40 dB L_{Aeq}) have been highlighted.

Table 3.2 – Expected noise levels from ongoing operations associated with IM9 – IM10 activity

Rec.	Location (notional boundary of the dwelling)	Maximum expected noise level (dB L_{Aeq})			
		2026	2027	2028	2029
1	1668 Macraes Road, Macraes	43	43	41	39
3	47 Hyde Street, Macraes 9483	37	38	35	33

Only dwellings where the predicted noise level is higher than 35 dB L_{Aeq} during at least one quarterly period of operation have been reported in the table. Noise levels from IM ongoing operations at the notional boundaries of all other dwellings are expected to be lower than 35 dB L_{Aeq}.

The analysis above indicates that noise associated with the ongoing operations as part of the proposed IM9 – IM10 activity is expected to result in levels of less than 40 dB L_{Aeq} at the notional boundaries of most nearby residential properties. There is potential for levels of 41 to 43 dB L_{Aeq} to be received from time to time at the notional boundary of the private dwelling at 1668 Macraes Road during 2026-2028. This is primarily due to trucks on the haul road between the IM pit and FRBF and FSBF/WRS facilities.

The predicted worst-case noise level at this one dwelling exceeds the WDP night time limit (40 dB L_{Aeq}). However, it does not exceed the WHO / NZS6802:2008 recommendations to allow occupants to sleep with windows open for ventilation (45 dB L_{Aeq}). We would therefore not expect the noise effects to be more than minor at this location.

3.3.2 Removal of extracted rock – Golden Bar stage 2

For the majority of the time, the only activity in the Golden Bar mining area will be the excavation and haulage of waste rock. This activity will comprise of periodic drill and blast, excavators loading the material into haul trucks and the trucks transporting waste rock to the nearby Golden Bar Waste Rock Stack (GBWRS), which is immediately to the north west of the Golden Bar pit. A small number of trucks will transport ore a distance of 12.1 km via the existing haul road to the Processing Plant. We have modelled quarterly projected mining activity data from OceanaGold for the duration of the Golden Bar stage 2 (GB2). Based on this analysis, we consider the peak operation could consist of the following during a worst-case 15-minute period:

- GB2 – Up to 2.3 trucks in a 15-minute period on the haul road travelling between the GB pit and existing ore processing facility.
- GB2 – Up to 7.7 trucks in a 15-minute period on the haul road travelling between the GB pit and permanent waste rock storage in the GBWRS facility.
- One excavator operating in the base of the mine
- One drill operating around the base of the mine
- One dozer operating in the waste rock storage area
- One grader operating in the waste rock storage area

The expected noise levels from the above scenario at the worst affected nearby dwellings not owned by the Applicant are outlined in table 3.3 below.

Table 3.3 – Expected noise levels from ongoing operations associated with GB2 activity

Rec.	Location (notional boundary of the property)	Maximum expected noise level (dB L_{Aeq})	
		2026	2027
1	1668 Macraes Road, Macraes	39	39

The only dwelling where the predicted noise level is higher than 35 dB L_{Aeq} during at least one quarterly period of operation has been reported in the table. Noise levels from GB ongoing operations at the notional boundaries of all other dwellings are expected to be lower than 35 dB L_{Aeq}.

The analysis above indicates that noise associated with the ongoing operations as part of the proposed GB1 activity is expected to result in noise levels of less than 40 dB L_{Aeq} at the notional boundaries of all nearby residential properties.

3.3.3 Removal of extracted rock – Coronation stage 6

For the majority of the time, the only activity in the Coronation mining area will be the excavation and haulage of waste rock. This activity will comprise of periodic drill and blast, excavators loading the material into haul trucks and the haul trucks transporting the ore to the Processing Plant, and waste rock from CO6 to CNBF. A small number of trucks will transport ore a distance of 8.5 km via the existing haul road to the Processing Plant. We have reviewed quarterly projected mining activity data from OceanaGold for the duration of the Coronation stage 6 project (CO6). Based on this analysis, we have considered the peak operation could consist of the following during a worst-case 15-minute period:

- CO6 – One truck in a 15-minute period on the haul road travelling between the CO6 pit and existing ore processing facility – note that this truck is in addition to existing truck haulage movements associated with consented stages of the Coronation pit activity.
- CO6 – Up to 1.8 trucks in a 15-minute period on the haul road travelling between the CO pit and permanent waste rock storage in the CNBF facility.
- Up to two excavators operating simultaneously in the base of the mine
- One drill operating around the base of the mine
- One dozer operating in the waste rock storage area
- One grader operating in the waste rock storage area

The expected noise levels from the above scenario at the worst affected nearby dwellings not owned by the Applicant are outlined in table 3.4 below. Levels exceeding the Rural General Zone and Rural Scenic Zone night time limit in the Waitaki District Plan (40 dB L_{Aeq}) have been highlighted.

Table 3.4 – Expected noise levels from ongoing operations associated with CO6 activity

Rec.	Location (notional boundary of the property)	Maximum expected noise level (dB L_{Aeq})			
		2024	2025	2026	2027
2	406 Horse Flat Road, Macraes	43	43	43	42

The only dwelling where the predicted noise level is higher than 35 dB L_{Aeq} during at least one quarterly period of operation has been reported in the table. Noise levels from CO ongoing operations at the notional boundaries of all other dwellings (including all dwellings in the Dunedin City District Plan area) are expected to be lower than 35 dB L_{Aeq}.

There is potential for a level of 43 dB L_{Aeq} to be received at the notional boundary of the private dwelling at 406 Horse Flat Road, primarily due to trucks on the haul road between the CO pit and the existing ore Processing facility.

As discussed in section 2.0, the predicted worst-case noise level is still lower than the WHO and NZS6802:2008 recommendations to allow occupants to sleep with windows open for ventilation. We would therefore not expect the noise effects to be more than minor in this location.

3.3.4 Moving of waste rock – Northern Gully Waste Rock Stack (NGWRS)

As noted above, a small quantity of waste rock is planned to be shifted from the existing NGWRS to the GPBF. This activity will comprise of excavators loading the material into haul trucks and the trucks transporting waste rock to Golden Point Backfill. We have modelled quarterly projected waste rock disposal activity data from OceanaGold for the duration of the NGWRS haulage activity. Based on this analysis, we have considered the peak operation could consist of the following during a worst-case 15-minute period:

- Up to 4 trucks in a 15-minute period on the haul road travelling between the NGWRS and permanent waste rock storage in the GPBF.
- One excavator operating in the NGWRS area
- One dozer operating in the GPBF area
- One grader operating in the GPBF area

Our analysis indicates that noise associated with the ongoing operations as part of the proposed NGWRS haulage activity is expected to result in noise levels of 40 dB L_{Aeq} or less at the notional boundaries of all nearby residential dwellings.

3.4 Overall ongoing noise levels from all MP4 activity

Section 3.3 above has discussed noise levels expected to be associated with general mining operations in each mining area as part of the MP4 project.

In this section, we present the overall MP4 noise levels, being the sum of all activities discussed in section 3.3.1 to 3.3.4. Table 3.5 below outlines the predicted levels at the notional boundaries of dwellings. Levels exceeding the Rural General Zone and Rural Scenic Zone night time limits in the Waitaki District Plan (40 dB L_{Aeq}) have been highlighted.

Table 3.5 – Expected overall noise levels from MP4 activity

Rec.	Location (notional boundary of the property)	Maximum expected noise level (dB L_{Aeq})						
		2024	2025	2026	2027	2028	2029	2030
1	1668 Macraes Road, Macraes	23	23	44	45	41	33	26
2	406 Horse Flat Road, Macraes	43	43	43	42	21	15	32
3	47 Hyde Street, Macraes 9483	26	26	39	40	35	30	28

Only dwellings where the predicted noise level is higher than 35 dB L_{Aeq} during at least one quarterly period of operation have been reported in the table. Noise levels from MP4 ongoing operations at all other dwellings are expected to be lower than this level.

This analysis indicates that overall noise associated with the ongoing operations as part of the proposed MP4 activity is expected to result in noise levels of less than 40 dB L_{Aeq} at most nearby residential dwellings, with the following exceptions:

- At the notional boundary of the dwelling at 1668 Macraes Road, Macraes, there is potential for:
    - Levels of 44 to 45 dB L_{Aeq} received during 2026-2027, primarily due to concurrent operation of the IM9 and IM10 operations with the ore haulage trucks on the haul road between the GB2 pit, and the Processing Facility.
    - Levels of up to 41 dB L_{Aeq} received during the years 2028.
- At the notional boundary of the private dwelling at 406 Horse Flat Road, there is potential for levels of up to 43 dB L_{Aeq} to be received in 2024-2027, primarily due to ore haulage trucks on the haul road between the CO6 pit, and the Processing Facility.

As discussed in section 2.0, where predicted noise levels are 45 dB L_{Aeq} or less, this is still consistent with the WHO and NZS6802:2008 recommendations to allow occupants to sleep with windows open for ventilation. As noted previously, the levels predicted in this section are based on reasonable worst-case operational scenarios and are not expected to be present all the time. Based on this we would therefore not expect the noise effects to be more than minor in these locations.

4.0 VARIATION IN NOISE LEVELS

We expect the noise levels predicted above to be a reasonable worst-case representation of the noise associated with the proposed new mining activity, and provide an appropriate basis to assess the effects of the activity. However, this does not mean higher noise levels may not be experienced from time to time. Examples of situations where increased noise levels may be experienced include:

- Unusual meteorological conditions – such as extreme temperature inversion and cloud cover.
- Equipment undertaking temporary non-typical activity on the mining site or the haul road.

However, our assessment has been undertaken in accordance with NZS 6801:2008 *Acoustics – Measurement of Environmental Sound*, and NZS 6802:2008 *Acoustics – Environmental Noise*, which provide the following guidance:

- NZS 6801:2008 states that 'measurements may be made under a range of meteorological conditions described as the meteorological window. This includes upwind conditions which result in reduced propagation from the source to the receiver, and down-wind conditions and temperature inversions which enhance propagation. However, uncommon meteorological conditions producing enhanced propagation shall be excluded.'
- NZS 6802:2008 Appendix A A1.3 states 'the situation to be considered should be that which produces the highest sound level from a typical occurrence of the specific sound during the prescribed time frame. This representative level is not necessarily the highest measured LEQ during a noise survey.'

AES has previously reviewed noise monitoring data for existing OceanaGold mining activity in Macraes. The results of this review were outlined in our report titled *Oceana Gold Mining Activity, Macraes Flat: Review of unattended noise monitoring data* (AES file reference: AC17347 – 12 – R2, and dated the 21st of November 2018). This review was conducted with respect to noise from the Coronation North mine area received at the dwelling at 406 Horse Flat Road during the night time period, however the findings in general are expected to be a representative example of the typical variation in noise levels at nearby residential receivers. Results from our review indicated that for most nights in the measured sample, noise levels received were typically in the order of 25 to 35 dB L_{Aeq} (5 – 10 dB lower than predictions for those scenarios would likely have suggested). However, for a possible three 15-minute periods out of the full measurement period (six weeks), noise levels were up to 7 dB higher, due to noise likely associated with mining activity. These three high noise periods appeared to be due to a combination of the factors described above.

We would expect the situation to be similar under MP4. For the vast majority of the time noise levels will be below those predicted. However, occasional short duration periods of higher noise levels may be experienced during conditions which are uncommon or due to activity which is not representative in the context of NZS 6801:2008 and NZS 6802:2008 (and therefore not appropriate for conducting compliance assessments).

5.0 CUMULATIVE NOISE LEVELS

In this section, we analyse cumulative noise from proposed MP4 activities, together with noise from known existing and consented OceanaGold activity on the Macraes site.

5.1 Innes Mills Stage 8 Continuity Consent Project (CCP) – extension mining activity

A proposed extension to the Innes Mills mine is currently planned to occur between 2024 and 2026. We understand that consent for this work being sought separately, to provide for continuity of mining operations, while the MP4 consent is being processed.

We have recently completed an Assessment of Environmental Noise Effects report for IM8 CCP activity (AES file reference AC22038 – 06 – R3 and dated the 15th of December 2023). We have therefore based our assessment of cumulative noise from the IM8 CCP extension and MP4 activities on the levels outlined in this previous report.

5.2 Frasers tailings disposal activity

Based on discussion with OceanaGold, we understand that an initial stage of Frasers wet tailings disposal is planned to occur during the MP4 project lifespan (currently scheduled to take place between Q1 2025 and Q1 2026).

We have previously completed an Assessment of Environmental Noise Effects report for the wet tailings disposal activity (AC22038 – 06 – R3 and dated the 15th of December 2023). We have based our assessment of cumulative noise from the FRCD and MP4 activities on the levels outlined in this previous report.

5.3 Frasers Underground (FRUG) mining activity

We understand that consented activity within the FRUG mine is currently scheduled to continue in 2024, and thus may occur concurrently with proposed MP4 activities.

We have previously completed an Assessment of Environmental Noise Effects report for the FRUG activity (AES file reference AC20036 – 01 – R3 and dated the 29th of April 2020). We have based our assessment of cumulative noise from the FRUG and MP4 activities on the levels outlined in this previous report.

5.4 Golden Point Underground (GPUG) extension and expansion mining activity

As noted in section 2.4.2 above, a proposed extension and expansion to the GPUG mine (beneath Deepdell Creek) is currently scheduled to occur as part of the MP4 project between 2024 and 2030.

We have previously completed an Assessment of Environmental Noise Effects report for the existing, consented GPUG activity (AES file reference AC19259 – 01 – R4 and dated the 12th of February 2020). We have also recently completed an updated assessment for a variation to the mine plan (AES file reference AC19259 – 03 – R3 and dated the 11th of April 2023). We have therefore based our assessment of cumulative noise from the GPUG extension and expansion and MP4 activities on the levels outlined in these previous reports.

5.5 Expected cumulative noise levels

Based on the above, we have assessed cumulative noise effects from ongoing noise generating activity during concurrent operation of the proposed MP4, CCP (IM8 and Frasers Tailings disposal), FRUG and GPUG during the overlapping years of each mining project. The expected worst-case cumulative noise levels from concurrent activities during the night time period are given in table 5.1 below. Levels exceeding the Rural General Zone and Rural Scenic Zone night time limit in the Waitaki District Plan (40 dB L_{Aeq}) have been highlighted.

Table 5.1 – Expected cumulative noise levels during the night time period

Rec.	Location (notional boundary of the dwelling)	Maximum expected noise level (dB L_{Aeq})						
		2024	2025	2026	2027	2028	2029	2030
1	1668 Macraes Road, Macraes	45	44	45	45	41	34	30
2	406 Horse Flat Road, Macraes	43	43	43	43	36	36	37
3	47 Hyde Street, Macraes 9483	40	40	40	40	35	30	28

This analysis shows that:

- At the notional boundary of the private dwelling at 1668 Macraes Road, Macraes, there is potential for levels of up to 45 dB L_{Aeq} received during 2024, and 2026-2027. Levels of up to 44 dB L_{Aeq} may be received during 2025, and up to 41 dB L_{Aeq} in 2028.

- There is potential for levels of up to 43 dB L_{Aeq} to be received at the notional boundary of the dwelling at 406 Horse Flat Road during 2024-2027.

As discussed in section 2.0, where predicted noise levels are 45 dB L_{Aeq} or less, this is still consistent with the WHO and NZS6802:2008 recommendations to allow occupants to sleep with windows open for ventilation. As noted previously, the levels predicted in this section are based on reasonable worst-case operational scenarios and are not expected to be present all the time. Based on this we would therefore not expect the noise effects to be more than minor in these locations.

6.0 COMPLIANCE AT THE MMPMZ BOUNDARY

As noted in section 2 above, we consider that assessment of noise levels at the notional boundaries of residential dwellings is most appropriate for determining noise effects from mining activity on the OGL Macraes site. However, the Waitaki District Plan also includes noise limits at the MMPMZ boundary.

We note that some MP4 and existing consented mining activity occurs in very close proximity to the MMPMZ boundary, and in some locations (Coronation pit, Coronation North pit, Golden Bar pit) occurs outside the MMPMZ boundary. Therefore, the noise limits outlined for the Macraes Mineral Mining Zone will not be met regardless of the proposed level of the activity, as equipment will be driving back and forth over (or directly alongside) the MMPMZ boundary (as is already the case with existing consented activity in a number of locations).

We have modelled noise levels at all locations around the MMPMZ boundary during all years of the proposed MP4 operation. Modelling has been based on the cumulative levels for all OGL activity (proposed MP4 and existing consented activity) discussed in section 5 above.

Figure 6.1 below shows, with red lines, locations along the MMPMZ boundary where the Waitaki District Plan boundary night-time noise limit (40 dB $L_{Aeq\ (15min)}$) is expected to be exceeded at some point during the MP4 project life span and a technical non-compliance would occur. Properties (land) adjacent to areas of exceedance at the boundary have been indicated (excluding OGL owned titles), and these are discussed further in table 6.1 below.

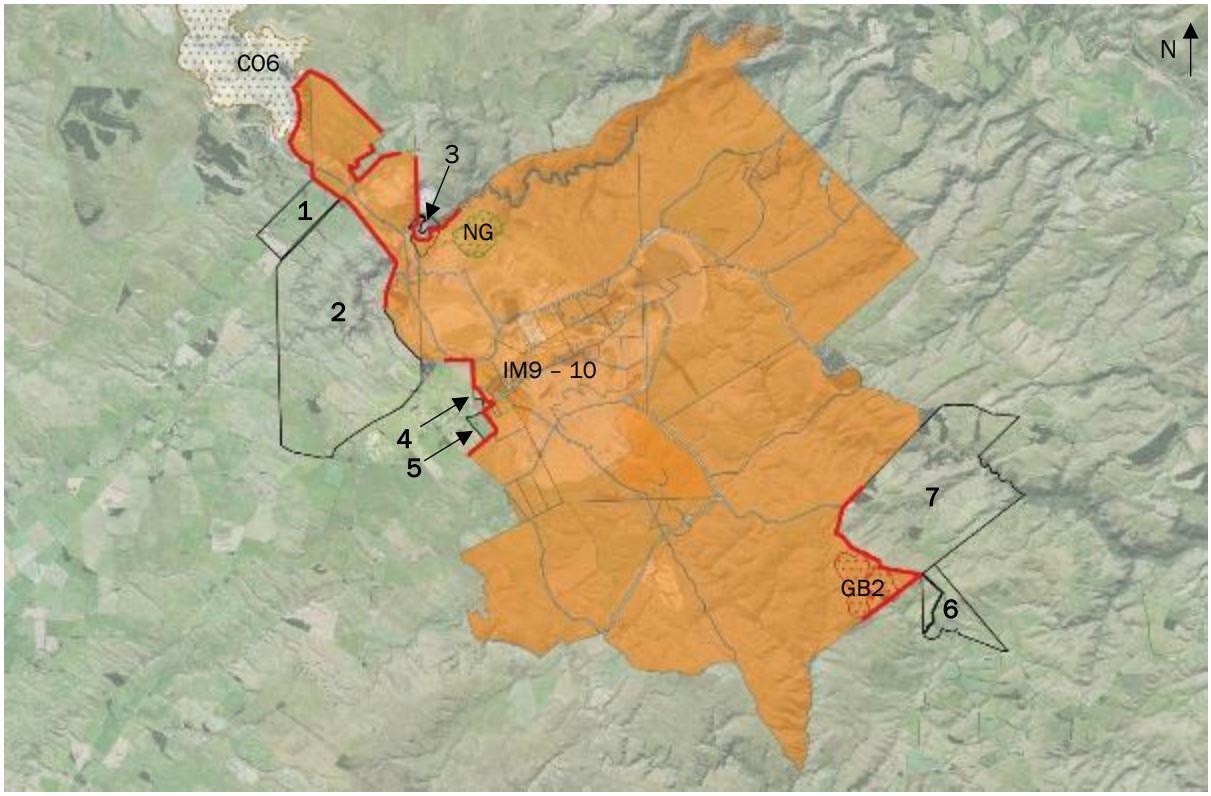

Figure 6.1 - Compliance at the MMPMZ boundary

We note the technical non-compliances referred to above are based on exceedance of the WDP night-time noise limit (40 dB $L_{Aeq\ (15min)}$). During the daytime, given the higher noise limit at the MMPMZ boundary (50 dB $L_{Aeq\ (15min)}$), the overall areas of exceedance will be smaller. Nevertheless, some exceedance in the same general locations is still expected, and is inevitable based on the location of activity.

Table 6.1 below outlines the non-OGL owned properties identified in the figure above where technical non-compliances would be expected.

Table 6.1 – Non-OGL owned sites adjacent to the MMPMZ boundary where a technical non-compliance is expected

Reference (from figure 5.1)	Site	Description
1 & 2	Owner: *Private* Titles: *OT14C/1088 and OT14C/1089*	Exceedances may be expected along parts of the MMPMZ boundary during some periods of MP4 operation, mainly during 2024-26. These exceedances are primarily due to ore haulage trucks travelling between the C06 pit and the Processing Plant, which travel along part of the MMPMZ boundary.
3	Owner: *Crown (Golden Point Reserve)* Titles: *OT17D/1098 and OT420/92*	Exceedances may be expected along parts of the MMPMZ boundary during some periods of MP4 operation, mainly during 2024-26. These exceedances are primarily due to ore haulage trucks travelling between the C06 mine and the Processing Plant, and waste haulage trucks transporting waste from the NGWRS to permanent waste rock storage in the GPBF.
4 – 5	Owner: *Private* Title: *OT16B/853*	Exceedances) may be expected along parts of the MMPMZ boundary during some periods of MP4 operation, mainly during 2026-28. These exceedances are primarily due to activity in the IM9 and IM10 areas.
6	Owner: *Private* Title: *OT10D/121*	Exceedances may be expected along parts of the MMPMZ boundary during some periods of MP4 operation, mainly during 2026-27. These exceedances are due to activity in the GB2 area.
7	Owner: *Private* Title: *OT14C/205*	Exceedances may be expected along parts of the MMPMZ boundary during some periods of MP4 operation, mainly during 2026-27. These exceedances are due to ore haulage trucks travelling between the GB2 pit and the Processing Plant, which travel along part of the MMPMZ boundary.

It should be noted that the technical non-compliances generally all occur in remote rural locations (with the exception of Reference 4) which are far from any residential receivers. Therefore, we do not expect any adverse noise effects from these exceedances.

References 4 & 5 are closer to the Macraes Township, and reference 4 is the site containing the 1668 Macraes Road residential dwelling (discussed previously in this report). In this case, while a noise level of up to 46 dB $L_{Aeq\ (15min)}$ may be expected along parts of the MMPMZ boundary in this area, the more relevant observation is that at the notional boundary of the dwelling on the site, noise levels are not expected to exceed 45 dB L_{Aeq} (as also described in section 5.4 above).

7.0 CONCLUSION

Noise from a range of sources expected to be associated with the proposed MP4 project mining activities has been considered.

As the haulage activity may operate continuously throughout the day and night time period it is the noise emitted during the night time period that will have the most effect on the nearby residential properties. Based on a review of the Waitaki and Dunedin City District Plans, previous consents, and other relevant guidance, ideally noise levels from the MP4 projects would be managed so that they were less than 40 dB L_{Aeq} during the night time period when received at the notional boundary of dwellings. However, we note that recognised guidance suggests noise levels of up to 45 dB L_{Aeq} would still allow occupants to sleep with windows open. Noise levels exceeding 40 dB L_{Aeq} may therefore be acceptable from time to time, and only have a minor effect.

Our calculations predict that noise levels associated with the MP4 project will comply with the relevant WDP, DCDP, and DC2GP night time criteria at the notional boundaries of most nearby residential dwellings not owned by the Applicant, with the following exceptions:

- At the notional boundary of the dwelling at 1668 Macraes Road, Macraes, there is potential for levels of up to 45 dB L_{Aeq} received during some years of the MP4 operation, when assessed cumulatively with other known, consented, noise generating activity within the OceanaGold Macraes mine area.

- There is potential for levels of up to 43 dB L_{Aeq} to be received at the notional boundary of the dwelling at 406 Horse Flat Road, during some years of the MP4 operation, when assessed cumulatively with other known, consented, noise generating activity within the OceanaGold Macraes mine area.

Cumulative noise levels of 40 dB L_{Aeq} or less are expected at all other notional boundaries of all other neighbouring dwellings not owned by the OceanaGold.

Where predicted noise levels are 45 dB L_{Aeq} or less, this is still consistent with the WHO and NZS6802:2008 recommendations to allow occupants to sleep with windows open for ventilation. As noted previously, the levels predicted in this section are based on reasonable worst-case operational scenarios and are not expected to be present all the time. Based on this we would therefore not expect the noise effects to be more than minor in these locations.

Overall, we expect the noise effects associated with the proposal will not create unacceptably unpleasant living conditions for the neighbours, and would not cause a significant deterioration of the quality of the rural environment of the nearby Macraes township environment.