Oceana Gold – Macraes Gold Project - Air Quality Technical Assessment

Life of Mine Extension MP4 Stage 3

Prepared for Oceana Gold (New Zealand) Limited
Prepared by Beca Limited

5 March 2024

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Revision History

Revision Nº	Prepared By	Description	Date
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4	Rhys Kevern	Revision following site scope change	18 October 2023
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Document Acceptance

Action	Name	Signed	Date
Prepared by	Rhys Kevern		5 March 2024
Reviewed by	Mathew Noonan and Graeme Jenner		5 March 2024
Approved by	Graeme Jenner		5 March 2024
on behalf of	Beca Limited		

Executive Summary

Oceana Gold (New Zealand) Limited (**OGNZL**) operates large open cast and underground gold mines in Otago, northwest of Palmerston and northeast of Middlemarch (referred to as the Macraes Gold Project (MGP)). OGNZL is seeking a resource consent for the discharges to air from mine extensions at the Coronation Pit (Stage 6), back filling Coronation North Pit to the north; backfilling in Golden Point Open Pit (GPOP), extension of Innes Mills Pit (Stages 9-10), backfilling of Frasers and Innes Pits (FRBF) and development and operation of Frasers Tailings Storage Facility (FRTSF) all in the main central mine area; and extension of Golden Bar Pit (Stage 2) and associated waste disposal to the south. These mine extensions and associated waste and tailings disposal features will increase the life of the mine by approximately three years and are collectively called the Macraes Phase 4 Stage 3 development project (**MP4**).

The project generally involves mining of waste rock and ore, the transportation of material and the disposal of waste rock in stacks or backfilling of retired and active pits. The mining operations will move around the site and the mining machinery will be redeployed in new locations as required. Only one additional excavator is planned, therefore the level of mining activity from the whole site will remain the same, just occur in different locations.

The predominant discharges to air from the proposed activity will be dust, or particulate matter, from the handling and transport of waste rock or ore. The primary environmental concern is the potential nuisance effects that these discharges may have on neighbouring residents.

Combustion-related emissions (i.e. sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO) and carbon dioxide (CO_2)) will also be emitted from the operation of machinery and vehicles. However, these emissions will be comparatively small, will not increase in scale compared to those currently occurring on site and will actually be less due to the introduction of an electric excavator. Therefore, vehicle emissions are highly unlikely to have an adverse effect beyond the site boundary.

The effects of discharges of dust and particulates from diffuse sources (such as waste rock and tailings storage), are not easily quantifiable by modelling techniques. Therefore, this assessment of environmental effects has been based on the results of current monitoring and mitigation processes for similar activities at the Macraes Mine site, in accordance with the Ministry for the Environment's "*Good Practice Guide for Assessing Discharges to Air from Industry"* and *"Good Practice Guide for Assessing and Managing Dust".*

The results of ambient air quality monitoring and the complaints history for the wider MGP site demonstrates that any increases above background concentrations of deposited dust, total suspended particulate (TSP), fine particles (PM_{10}) and silica, measured at sites in the vicinity of the previous and current mining operations, are small and well below the relevant standards and guidelines recommended by the Ministry for the Environment. They are also within the concentration limits set by current resource consent conditions for the site.

An assessment of the potential for dust effects to occur at the nearest sensitive receptors (private dwellings) noted above has been undertaken where the frequency, intensity, duration, offensiveness and location of the discharges (FIDOL factors) have been considered. The distances to the closest non OGNZL-owned dwellings to the different mining activities are presented in Table 1.

Table 1. Distances from mining activities to nearby non OGNZL owned residential dwellings (R)

Mining Activity	Distance to residential dwellings
Coronation Pit	R4, Four Mile Road 3.6 km NW of Coronation North backfill; R5, 406 Horse Flat Road 2.2 km S of Coronation pit.
Innes Mills	R9 Macraes resident (1668 Macraes - Dunback Rd) 1 km SW of Innes Mills West.
Golden Bar	R6 Residence 593 Macraes - Dunback Road 3.0 km north northeast of GB expanded pit, R7 Residence 659 Richie Road 3.9 km northeast of GB expanded pit, R8 Residence 800 Stoneburn Road 3.2 km southeast of GB expanded pit

Based on an assessment using the guidance provided by the UK Institute of Air Quality Management (IAQM), the risk and level of potential effects of the proposed project activities at these nearby dwellings is mostly classified as “negligible”, or in some situations, a “slight adverse effect”.

All other identified sensitive receptors are located further than the three identified properties and are not expected to experience any adverse effects from dust.

The concentrations of contaminants including particulate matter (PM_{10}), respirable crystalline silica, nitrogen oxides (NO_2 and NO) and carbon monoxide are expected to remain well within the National Environmental Standards for Air Quality (NESAQ), guideline/standard values and current consent limits, beyond the boundary of the project.

Providing the mitigation measures currently carried out by OGNZL are continued as described in the Macraes Site Dust Management Plan (DMP), the risk of dust generated by the proposed project activities causing adverse effects beyond the OGNZL property boundary or at residential dwellings, to the extent that the dust is offensive or objectionable, is considered to be negligible. Overall, it is our opinion the effects of MP4 will be less than minor.

1 Introduction

1.1 Background

Oceana Gold (New Zealand) Limited (**OGNZL**) operates several large open cast mines and one underground gold mine in Otago, northwest of Palmerston and northeast of Middlemarch, referred to as the Macraes Gold Project (**MGP**).

As part of the proposed Macraes Phase 4 Stage 3 project (**MP4**), OGNZL is proposing to expand several of the currently consented open pits, backfills and waste rock stacks (WRS). The MP4 Stage 3 project includes the following:

- Mining extensions for Coronation Pit (Stage 6), Innes Mills Pit (IM 9-10), Golden Bar Pit (GB 2), and
- Backfilling of Golden Point Pit, and Innes Mills/Frasers Pit (FRBF), and
- Storage of tailings in Frasers Pit Tailings Storage Facility (FTSF Stage 2).

The following are excluded from Stage 3:

- An initial stage of tailings storage in FTSF is the subject of a separate consent (Consent Continuity Project).
- Expansion and extension of GPUG is the subject of a separate resource consent application.

OGNZL is seeking a discharge permit to allow discharges to air of dust and other contaminants from the proposed MP4 Stage 3 project. This report provides a technical assessment of the discharges to air from Stage 3 of MP4.

1.2 Discharges to Air

The predominant discharge to air from the proposed activity is dust, or particulate matter, from the handling and transportation of waste rock and ore. The primary environmental concern is the potential nuisance effects that these discharges may have on neighbouring residents.

Combustion-related contaminants (e.g. sulphur dioxide (SO_2), nitrogen oxides (NO_x) and carbon monoxide (CO) and carbon dioxide (CO_2)) will also be emitted from the operation of machinery and vehicles. However, these emissions will be comparatively small and are unlikely to have adverse effects on neighbours.

1.3 Existing Consents

OGNZL currently holds air discharge permits associated with different aspects of the MGP site as listed in Table 1-1.

Table 1-1. Existing air discharge consents currently held by OGNZL.

Consent Number	Details
Discharge Permit 96785_V5	To discharge contaminants from mining operations and post-mining rehabilitation to air in the vicinity of Macraes Flat (all of the mine site except features associated with Macraes Phase III and Coronation).
Discharge Permit 2006.689	To discharge contaminants to air for the purpose of ventilating Frasers Underground Mine.
Discharge Permit 2007.511	To discharge contaminants to air for the purpose of carrying out mining activities and post mining rehabilitation (Golden Bar Pit, Rock Stack, Silt Ponds and Infrastructure).

Consent Number	Details
Discharge Permit RM10.351.52.V1	To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations (Macraes Phase III expansion).
Discharge Permit RM12.378.15	To discharge contaminants from mining operations and post-mining rehabilitation to air for the purpose of undertaking mining operations (Coronation Waste Rock Stack, Coronation Pit and associated haul roads, utility areas and stockpiles).
Discharge Permit RM16.138.19.V1	To discharge contaminants from mining operations and post-mining rehabilitation to air for the purpose of undertaking mining operations.
Discharge Permit RM20.024.12	To discharge contaminants from mining operations and post-mining rehabilitation to air for the purpose of undertaking mining operations.
Discharge Permit RM20.130.01	To discharge contaminants to air for the purpose of ventilating the Golden Point Underground Mine (Golden Point Underground Mine – Macraes).

1.4 Purpose of Report

OGNZL has commissioned Beca Limited (Beca) to prepare a technical assessment of the effects of air discharges from the proposed MP4 project activities to accompany an Assessment of Environmental Effects (AEE) for a resource consent application. This technical report has been prepared in accordance with relevant international, national and regional standards, guidelines and plans.

This report contains the following information:

- A brief description of the site and receiving environment,
- A brief summary of the proposed activities where they relate to discharges to air,
- A description of the nature of the discharges to air resulting from the existing and proposed activities,
- A consideration of the National Environmental Standards for Air Quality (NESAQ) and other relevant air quality criteria,
- An assessment of the receiving environment in terms of the potential influences on the environmental effects of the emissions to air from the site,
- A description of the effects assessment methodology,
- An assessment of the potential effects of the proposed changes on air quality, and
- A summary of conclusions and findings of the investigation.

The effects of discharges of particulate matter including diffuse dust sources (such as open pit mines and waste rock disposal areas), are not easily quantifiable by modelling techniques. Therefore, this assessment of environmental effects has been based on the results of current monitoring and mitigation processes at the Macraes Mine site, in accordance with the Ministry for the Environment's "*Good Practice Guide for Assessing Discharges to Air from Industry"* (2016) and "*Good Practice Guide for Assessing and Managing Dust*" (2016).

1.5 Limitations

This report has been prepared by Beca for OGNZL. Beca has relied upon the information provided by OGNZL in completing this document. Unless otherwise stated, Beca has not sought to independently verify this information as provided. This report is therefore based upon the accuracy and completeness of the information provided and Beca cannot be held responsible for any misrepresentations, incompleteness, or inaccuracies provided within that information. Should any new or additional information become available, this report will need to be reviewed accordingly.

2 Project Description

2.1 Project Overview

2.1.1 Components of MP4 Stage 3

The components of MP4 Stage 3 (MP4), which are relevant to the discharges to air, include the following mining extensions and associated waste rock stacks (WRS):

- Coronation Pit Stage 6 (CO6),
- Innes Mills Stages 9 & 10 (IM9-10),
- Golden Bar Stage 2 (GB2).
- Frasers Tailings Storage Facility (Stage 2), and
- Rehandling some of the Northern Gully WRS to partially backfill Golden Point Open Pit (also referred to as Round Hill Open Pit)

A layout of the Macraes Gold Project site is shown in Figures 2-1 and 2-2. Figure 3-1 shows the boundary of OGNZL land and the mine locations. The relevant components of MP4 Stage 3 are discussed in Sections 2.1 to 2-4 of this report.

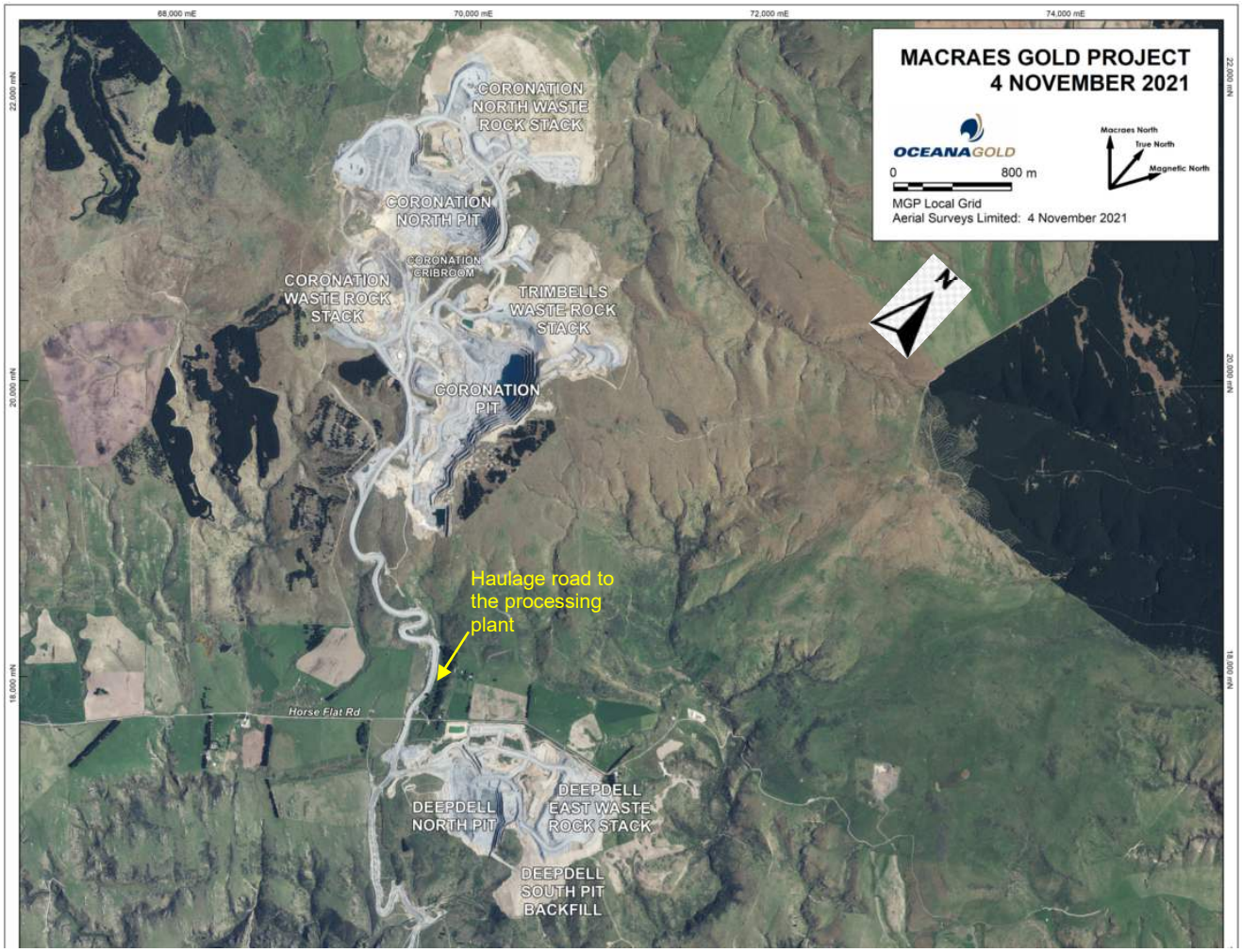

Figure 2-1. Layout of the northern part of OGNZL mine site (Coronation and Deep Dell)

Figure 2-2. Layout of the central part of the OGNZL mine site (Golden Point to Frasers Pits and WRS).

2.1.2 MP4 Project development

The MP4 project is expected to be developed over an approximate seven-year period, between 2024 and 2030, in a series of pit extensions continuing from previous mined limits. The proposed mining of ore and waste rock, and waste rock disposal schedules, over the project period, is presented by location in Table 2-1.

Table 2-1. Pit mining and waste schedules for MP4 Stage 3 (OGNZL)

MP4 Pit Mining Schedule

	Pits	Stage	2023	2024	2025	2026	2027	2028	2029	2030	2031
MP3	DN5	Stage 5									
	GT	Stage 4									
	IM	Stage 6									
		Stage 7									
MP4		Stage 8									
		Stage 9									
		Stage 10									
	CO	Stage 6									
	GB	Stage 2									
	NG WRS										
	Total										

Note: DN5 = Deep Dell North underground stage 5, GT = Gay Tan Pit, IM = Innes Mills Pit, CO = Coronation Pit, GB = Golden Bar Pit, NG WRS = North Gully Waste Rock Store.

MP4 WRS Dumping Schedule

	WRS/BackFill		2023	2024	2025	2026	2027	2028	2029	2030	2031
MP3	DDWD1										
	DN3BF										
	FEWD										
	FSBF/FSWRS										
	FWBF										
	FRBF										
MP4	CNBF										
	GBWRS										
	GPBF										
	Total										

Note: DDWD1 = Deep Dell Waste Dump, DN3BF = Deep Dell backfill, FEWD = Frasers East Waste Dump, FSBF/FSWRS = Frasers South backfill/Frasers South Waste Rock Store, FWBF = Frasers West backfill, FRBF = Frasers Backfill (part of the new Tailings Storage Facility – FTSF), CNBF = Coronation North backfill, GBWRS = Golden Bar Waste Rock Stack, GPBF = Golden Point backfill.

2.1.3 Mining equipment

A summary of the trucking which will be employed over the MP4 timeline is presented in Table 2-2. The maximum number of trucks used at Macraes from 2024 is 19. Truck numbers decline steadily after this. The number of trucks per excavator varies according to the truck cycle time but is typically in the range 4- 5. Longer hauls necessitate increasing the trucks per excavator to maintain productivity. The number of excavators required is presented in Table 2-3. The main change to the number of current mining equipment on-site for the MP4 Stage 3 project is the addition of an electric excavator. The existing equipment is deployed into different areas as required to meet annual waste and ore production targets.

Table 2-2. Projected numbers of Cat 789D trucks required per pit for MP4 Stage 3

Pit	2023	2024	2025	2026	2027	2028	2029	2030	2031
IM6	15	6							
IM7	11-19	7-38	3-11						
IM8		3-5	9-18	11-15					
IM9				5-7	2-7	2			
IM10					4-16	4-8	2-3		
GT4	7-10								
DN5	22								
GBWRS				20-31	8-21				
GBOre*				9	9				
CO6		6	6-7	6	5				
NGWRS					14			14-16	

*GB ore transport to the Processing Plant uses a Caterpillar 773D truck (or similar)

In some years, there will be an overlap of trucks, for example if a pit is mined out - the digger and trucks from that pit will move on to the next pit. This is also reflected in the digger numbers presented in Table 2-3 for 2024 – 2026 and 2028.

Table 2-3. Digger requirements over the project period [1]

Pit	2023	2024	2025	2026	2027	2028	2029	2030	2031
EX2500	1	1	1	1	1				
EX3600 Diesel	3	3	3	2	2	1	1	1	1
EX3600 Electric	1	1	1						

Note EX3600 = a Hitachi 360 t excavator and EX2500 = 250 t Hitachi excavator.

From 2023 to 2027, there will be 6 bulldozers in the pits, 3 graders maintaining the haul roads and 3 water trucks. The mining method will always be drill & blast followed by Load-Haul-Dump.

2.1.4 Sequence of operations

The sequence of operations allows for the staged movement of material around the site. A significant part of the mining process involves moving 'waste' rock (overburden) to access ore. Where in-pit storage space permits, the waste rock typically is back filled into the pit. However, where the required space is not available, it is hauled out of the pit to nearby prepared disposal areas (WRSs).

The processing plant is used to extract gold. Here the plant crushes the ore to a silt (fine sand) consistency to help liberate gold. The waste material from this process, called tailings, is piped as a slurry to a tailings storage facility (TSF) to allow the solids to settle and then the decanted water is returned to the plant to allow for more material to be slurried.

The slurried tailings are currently being deposited in Top Tipperary Tailings Storage Facility (TTTTSF). This tailings storage facility will reach consented capacity around mid-2024. A separate consent application has been made to cover increasing the height of TTTSF to RL570 m to provide a further 8-9 months more capacity while a new TSF at Frasers Pit (FTSF) is consented and prepared for receiving tailings from the processing plant, (expected to start in Q1 2025).

[1] One dig fleet = 1 Hitachi EX3600 excavator (362 t, 21 m^3 bucket) and a number of Caterpillar 789D Mining Trucks (324 t, 194 t nominal load) as noted in Table 2-2. EX2500 = 250 t Hitachi excavator.

2.2 Coronation Mining Extension

2.2.1 Overview

The currently consented pit areas (green) and waste rock stack areas (WRS) (orange) for the northern mining part of OGNZL's operations (Coronation area) are presented in Figure 2-3.

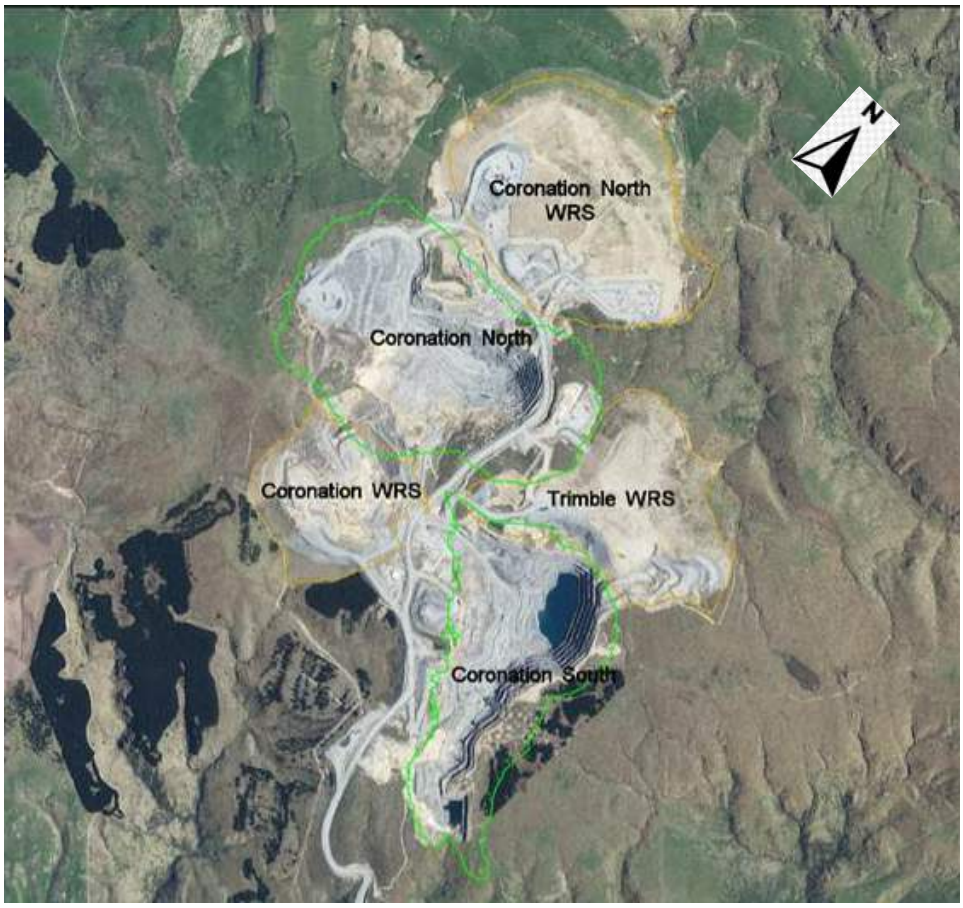

Figure 2-3. Currently consented mining areas at Coronation (Pits are green, WRS are orange)

The proposed extension of the Coronation Pit, referred to as Coronation Pit Stage 6[2] (CO6), will involve an approximately 250 m expansion of the pit to the southeast as shown in Figure 2-4. The expanded footprint of the pit will extend over previous pine forest and pasture. Waste rock will be used to infill the Coronation North Pit.

[2] This expansion is number 6 for the Coronation Pit.

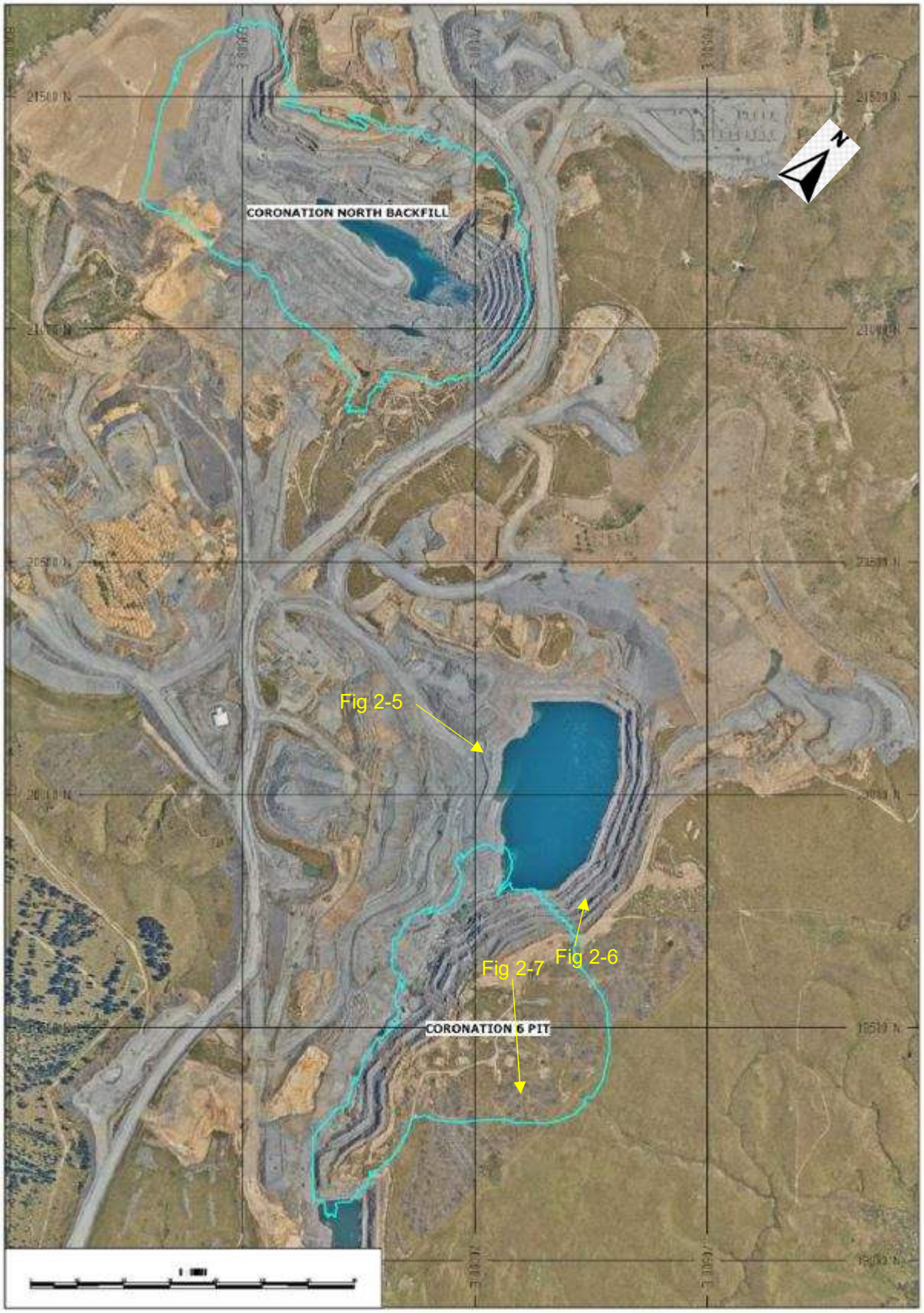

Figure 2-4. Proposed Coronation Pit expansion CO6

Figures 2-5 to 2-7 present the views around the Coronation Pit area.

Figure 2-5. View of Coronation Pit looking to the east

Figure 2-6. View of Coronation Pit from the southeast side looking to the north

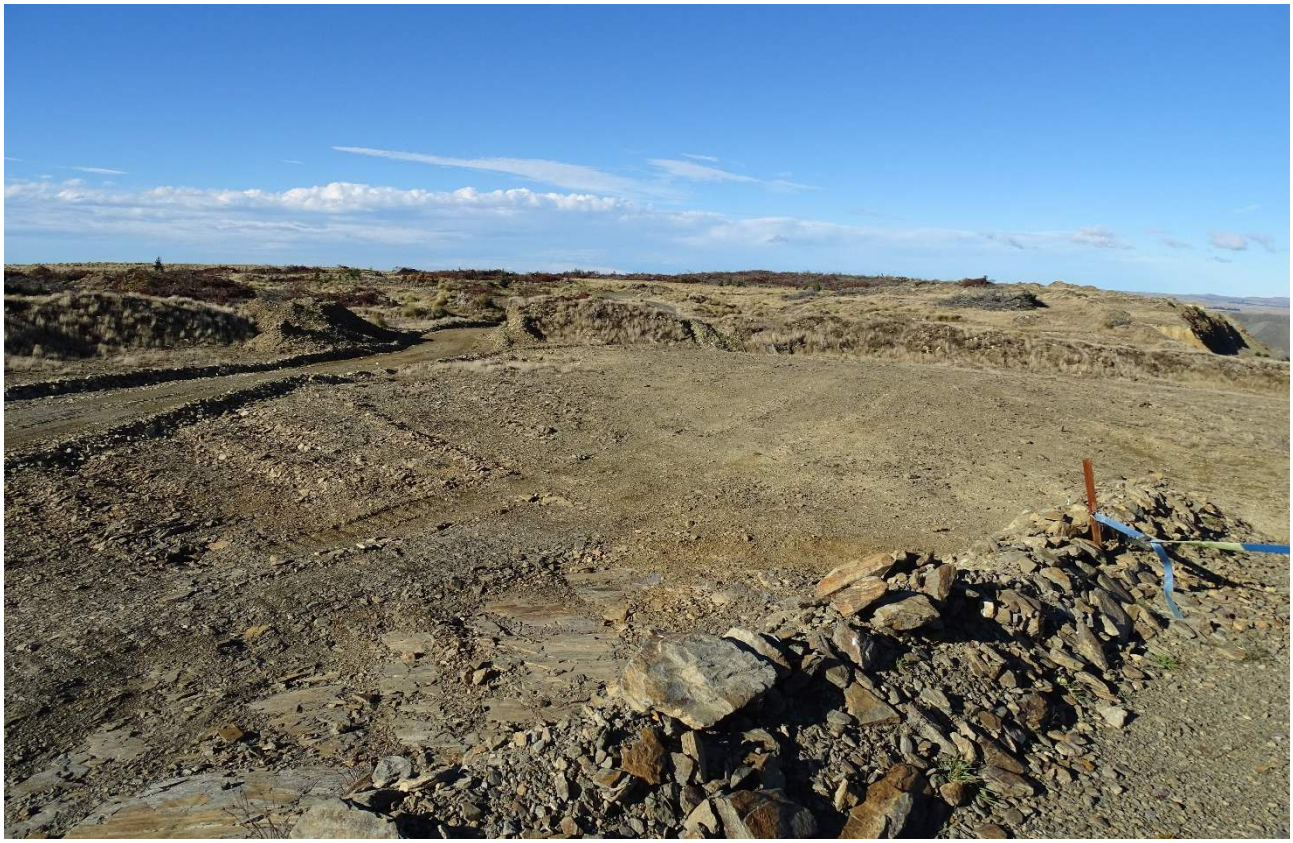

Figure 2-7. View of the Coronation Pit expansion area looking to the southeast.

2.2.2 Mining plan

An estimated 32 Mt of waste rock will be removed to access approximately 2 Mt of ore in the Coronation South Pit. The waste rock will be used to backfill the existing Coronation North Pit (Stage 5) as shown in Figure 2-4. The excavated ore will be transported to the processing plant by mine trucks using the existing haul road as shown on Figure 2-1.

The equipment required is listed in Tables 2-2 and 2-3. Truck numbers will increase over time as the pit deepens and the backfill increases in height - but be around 5-6 trucks. Supporting equipment will be required (drills, grader, tracked bulldozer, watercart, fuel truck and a pit pump). This fleet will operate 24 hours per day and 7 days per week.

The indicative Project Timeline for the proposed CO6 expansion is as follows:

- 2024-26 Mining phase, including ore transport to the process plant
- 2027 Commence full site rehabilitation.

2.2.3 Water management

The current Coronation South Pit is used as a water storage reservoir. This sump will be emptied of water prior to mining the new area for use elsewhere on the site. Operational water from stormwater runoff or groundwater ingress will be used for either dust suppression or pumped into the WRS runoff system, as per the current Coronation water quality management plan.

2.2.4 Project closure

The expanded area of the Coronation pit will not be backfilled and will become a pit lake at closure. The Coronation North Backfill (CNBF) slopes will be shaped to a suitable landform and revegetated progressively

using Macraes standard site rehabilitation methods. Likewise, site establishment areas and haul roads will also be rehabilitated using standard site rehabilitation methods.

2.3 Innes Mills Mining Extension

2.3.1 Overview

The currently consented pit areas (green) and waste rock stack areas (WRS) (orange) for the central part of OGNZL's open pit mine operations (Frasers, IM and GPOP) are presented in Figure 2-8.

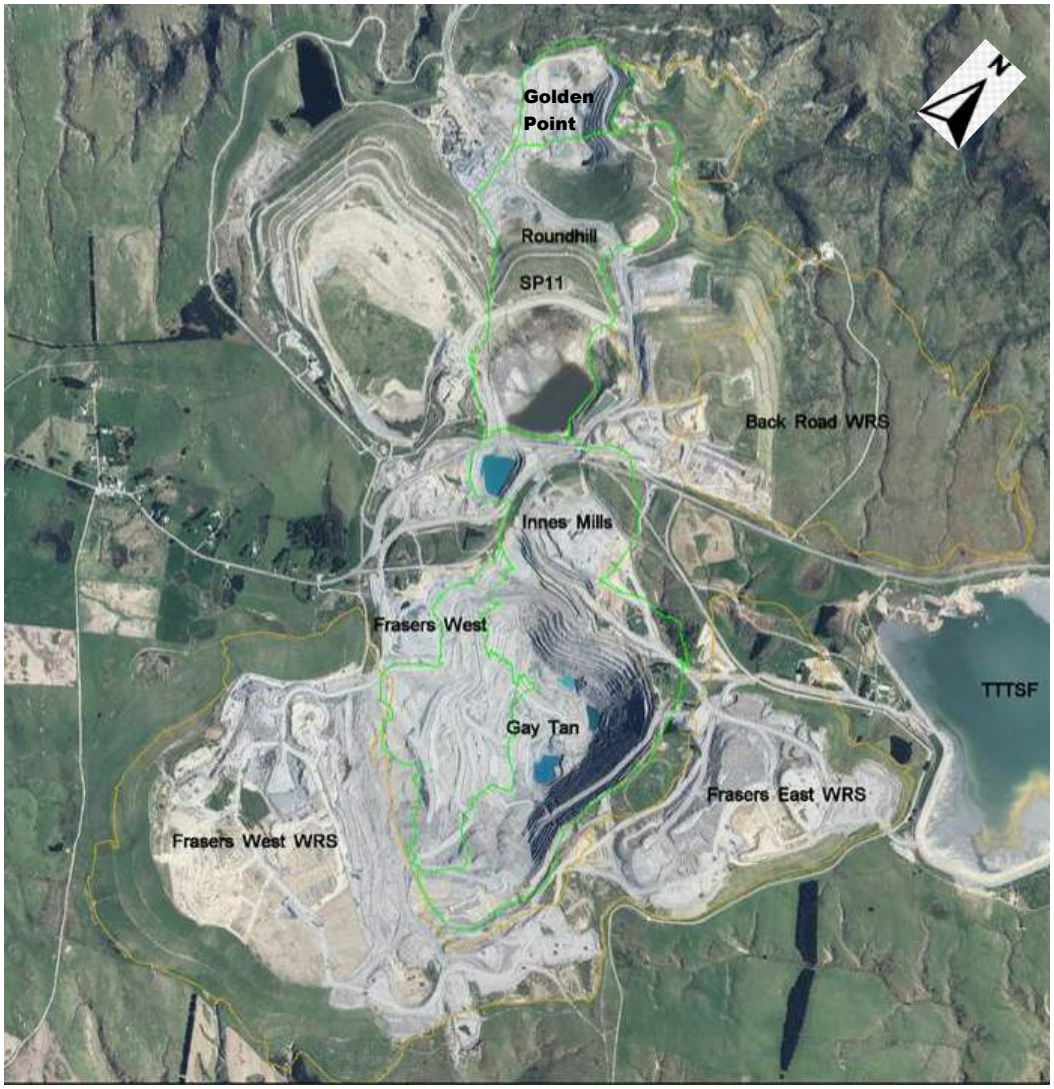

Figure 2-8. Consented central mine pit areas and waste rock stacks

2.3.2 Mining plan

The proposed IM extension involves an approximate 200 m increase to the east and approximately 150 m increase to the west of the currently consented pit. Figure 2-9 shows a view of the current IM area looking south from Golden Bar road close to the Macraes - Dunback Road and Figure 2-10 shows a view of Innes Mills area south from the bridge on Macraes - Dunback Road. The mine extension will involve Stages 9-10 extending over existing mine haul roads and mine land shown in brown areas on the lower part of Figure 2-11. Golden Bar Road will need to be realigned to the east prior to IM10 mining being undertaken.

The total amount of waste rock to be removed from the Innes Mills stages 9-10 will be ~40 Mt, to be able to remove 3.35 Mt of ore.

The mining and transport mobile plant requirements for waste rock and ore for each of the stages is presented in Tables 2-2 and 2-3. Supporting equipment will be required (drills, grader, track dozer, water cart, fuel truck, pit pumps). This fleet will operate 24 hrs / 7 days per week.

Most of the waste material from Innes Mill Pit will be disposed of at the consented Frasers WRS (Figure 2-12). Once mining at the Gay Tan Pit (located inside Frasers Pit) has been completed, the Frasers Backfill (FRBF) in the northern part of Frasers Pit (Figure 2-13) will be used as a preferred disposal area of mine waste material. Backfilling of Golden Point Pit will also use waste material from IM and later rehandled waste rock from the Northern Gully WRS.

The indicative Project Timeline for the proposed IM expansion is as follows:

- 2024-28 Mining phase, including ore transport to the process plant
- 2030 Full site rehabilitation.

Figure 2-9. View of Innes Mills looking south from the north side

Figure 2-10. View to the south from the Highway bridge of the Innes Mills and Frasers Pits

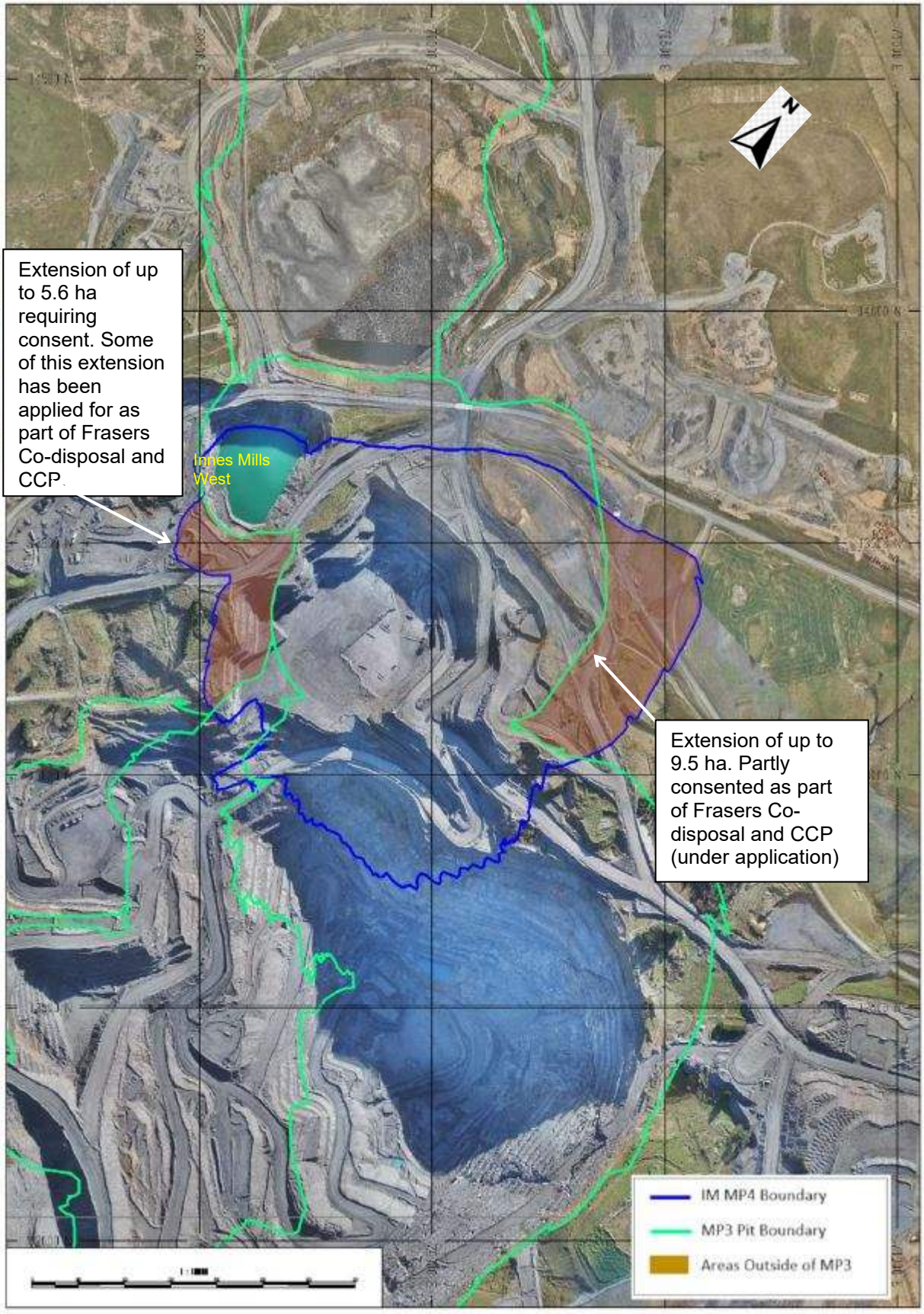

Figure 2-11. Existing consented and proposed expansions of the Innes Mill (IM) pit

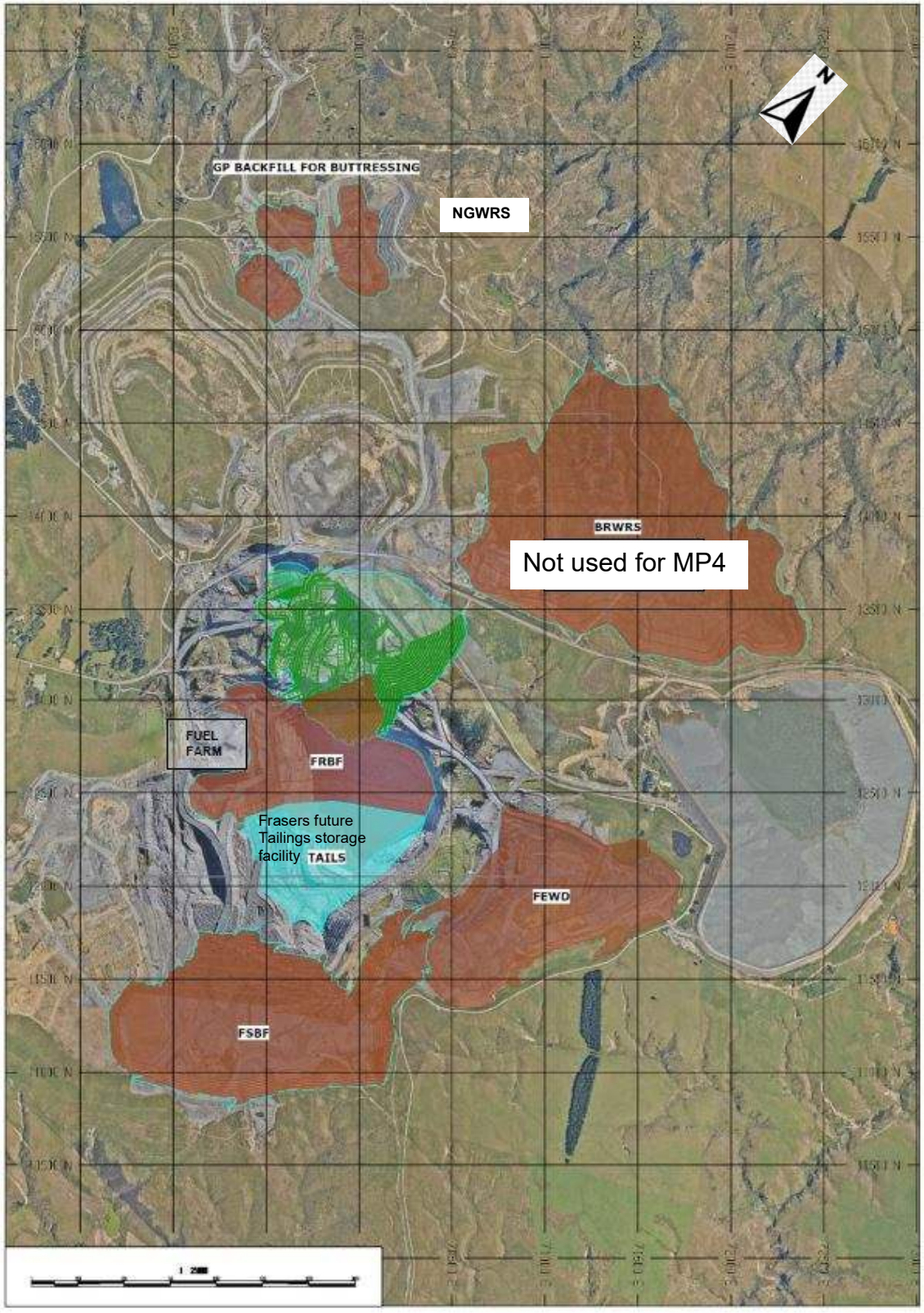

Figure 2-12. Final MP4 Stage 3 central open pit configuration. [3]

[3] GPBF = Golden Point backfill, BRWRS = Back Road Waste Rock Stack (not used for MP4 stage 3), FRBF = Fraser's backfill, FSBF = Frasers South Waste Rock backfill, FEWD = Frasers East Waste Dump

Figure 2-13. Frasers Pit looking to the backfill/WRS area near Gay Tan from Innes Mills

Water management

Innes Mills West (IMW) pit is currently being used as a water storage reservoir as shown in Figure 2-11. This will need to be emptied prior to IM Stage 9 mining commencing, to allow backfill for haul road construction to be placed within the IMW void.

This water is intended to be pumped back to the Frasers Pit for use in the processing plant, or as part of the tailings re-mining activities.

Operational water from stormwater runoff, or groundwater ingress will be dealt with as per Frasers' Pit water (dust suppression or pumped into the Frasers West WRS runoff system). Water management during operations would require pumping of stormwater runoff (primarily) out of the pits and into the existing surface water ponds/sumps located within existing disturbed areas.

2.3.3 Project closure

Frasers and IM Pits will be partly backfilled (FRBF) creating an embankment for the impoundment of tailings at the FTSF. Following mining, the IM void will fill with water to become a pit lake that will join the Frasers Tailings Storage Facility. The Golden Point Pit will be partially backfilled and will partially fill with water to become a shallow pit lake. Waste disposal (Backfills and WRSs) slopes will be shaped and revegetated progressively, using standard site rehabilitation techniques. Site establishment areas and haul roads will be rehabilitated using standard site techniques.

2.4 Golden Bar Pit

Figure 2-14 shows the various elements of the proposed Golden Bar Pit expansion. The red mining permit (MP) boundary is essentially on the boundary of OceanaGold (NZ) Ltd owned land. The pit will be expanded approximately 200 m to the north.

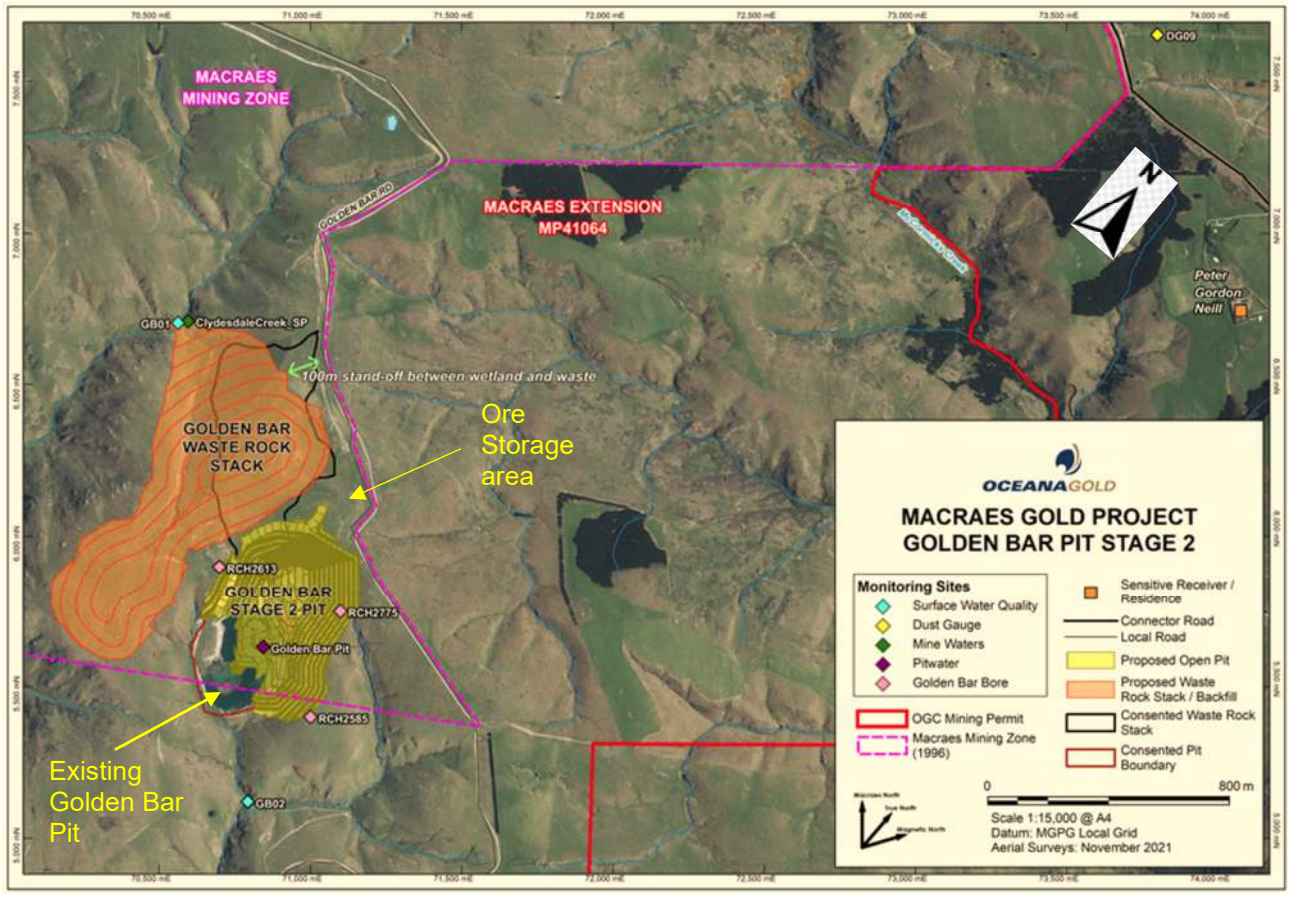

Figure 2-14. Proposed Golden Bar Mine and WRS expansion

Much of the footprint of the expansion incorporates land which has been previously disturbed during the first stage of mining at Golden Bar in 2004-2006. Following stage 1 mining, the Golden Bar Waste Rock Stack, mining equipment park-up area and crib facilities area had been subsequently rehabilitated to pasture. Figure 2-15 shows Golden Bar mine when viewed from the SE direction and Figure 2-16 shows the Golden Bar area when viewed from the NW.

Figure 2-15. View of the southern edge of Golden Bar from the southeast side looking to the northwest

Figure 2-16. View towards Golden Bar Pit from the northwest side including Golden Bar Road

The highest point of the proposed pit expansion will be approximately 580 mRL. The current mine plan will locate the pit crest near to the current Golden Bar Road. A further iteration of the pit design may be required once the geotechnical assessment has been completed to provide for a safe standoff distance from the road.

An estimated 28 Mt of waste rock will be removed to gain access to approximately 1.5 Mt Ore. Mining equipment required for this pit is presented in Table 2-2. Supporting equipment will be required (i.e. drills, grader, track dozer, water cart, fuel truck, pit pump). This fleet will operate 24 hrs/7days per week.

Ore from the mine trucks will be stockpiled adjacent to the WRS (Ore Store on Fig. 2-14). This ore will then be transported to the processing plant by smaller off-road dump trucks (probably Cat 773 dump trucks). The trucks will be loaded by a wheeled front-end loader (e.g. Cat 988). The route to the processing plant will be via the existing 11 km private haul road located adjacent to the public Golden Bar Road. The haul road will be maintained by grading and a water cart used to dampen the road surface to minimise dust emissions.

This fleet is expected to commence operations on a single shift basis but then proceed to operate 24 hrs/ 7 days per week as the mine increases in size.

The existing WRS will be expanded in the western and southerly directions to accommodate the extracted waste rock. The final WRS will extend up to the new silt pond (see Figure 2-14). Most of the footprint is the rehabilitated previous WRS, but there is new disturbance for the southward extension and along the flanks where the currently rehabilitated faces abut natural ground.

The south extension provides a cap above the gently sloping existing topography and does not extend below the level where the topography gets steeper. The top level of the WRS will be 620 mRL, or approximately 70 m higher than the current WRS.

The current indicative mining timeline is as follows:

- 2026 - 2027 Mining phase, including ore transport to the process plant
- 2030 Site rehabilitation.

2.4.1 Water management

The current GB pit and WRS water will be discharged to nearby streams or, in the case of pit lake water, pumped back to Frasers Pit. Stormwater and groundwater within the pit are intended to be pumped initially for use in dust suppression.

2.4.2 Project closure

Golden Bar Pit will not be backfilled and therefore it will be left as a pit, albeit larger. The pit void will eventually fill with water and spill over to the southeast, as it does currently.

Site establishment areas, WRS and haul roads will be rehabilitated using Macraes standard methods in line with the environmental management plan and consent requirements.

3 Site and Locality Description

3.1 Site Description

The Macraes Gold Project site lies approximately 30 km to the northwest of Palmerston, Otago. Key features of the Macraes Gold Project include:

- Active and inactive open pits,
- The Frasers (inactive) and Golden Point underground mines,
- Several waste rocks stacks (WRS) (both active and rehabilitated),
- A network of haul roads,
- An ore Processing Plant,
- Tailings storage facilities (TSF) (both active and rehabilitated), and
- A comprehensive network of water management infrastructure.

A layout of the Macraes Gold Project site (excluding Golden Bar) is shown in Figure 2-1 and 2-2.

3.2 Site Boundary

OGNZL owns a number of properties which incorporates the mining activity and the surrounding area. Figure 3-1 shows the properties currently owned by OGNZL.

3.3 Locality and Description of Surrounding Land Use

The MP4 Stage 3 project incorporates mining operations throughout the OGNZL owned land. The predominant land-use surrounding the project sites is either other mining activities, or low intensity farming. There are some rural residential dwellings, mainly associated with pastoral uses and the Macraes township, located approximately 1.7 km away from Innes Mills. The Macraes township includes approximately 20 houses, a school and an historic hotel.

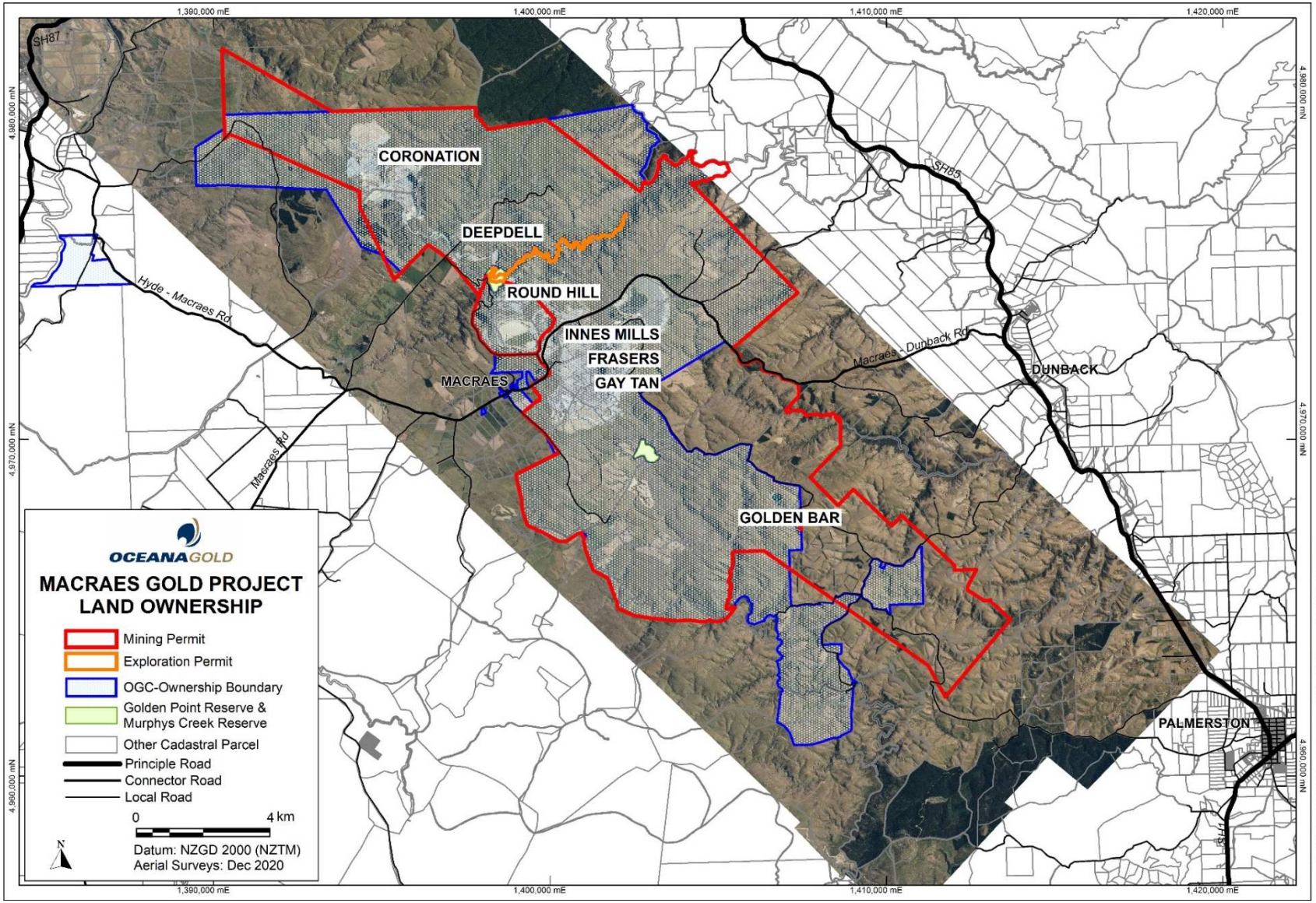

Figure 3-1. Mine site boundary and land owned by OGNZL (Source: OGNZL)

3.4 Sensitivity of Receiving Environment

The sensitivity of locations to dust depends on the characteristics of the land use, including the time of day and the reason that people are at a particular location. The Ministry for the Environment's *Good Practice Guide for Assessing and Managing Dust (GPG Dust)*[4] provides guidance on the sensitivity of different receiving environments to dust.

The GPG Dust notes that in rural areas, a low population density means there is a decreased risk of people being adversely affected by dust and that people living and visiting rural areas generally have a high tolerance for rural activities but may have a "*moderate to high*" sensitivity to other activities such as industrial activities, especially if they are exposed at all times of the day and night.

In accordance with the GPG Dust, the rural areas which surround the Macraes site are considered to have a "*low*" sensitivity to nuisance dust. These areas can also be expected to have a low occupancy, particularly at night.

However, higher sensitivity can be expected for rural dwellings. At these locations, a relatively high level of air quality amenity would be expected by residents. Similarly, people may be present at these locations for 24 hours per day. The GPG Dust classifies rural residential properties as having a *moderate to high* sensitivity to nuisance dust.

Table 3-1 summarises the locations of sensitive receptors to the proposed Stage 3 activities.

Table 3-1. Relative location of nearby sensitive receptors from proposed activities.

Receptor No.	Receptor	Sensitivity to Dust	Zoning	Approximate distance from nearest project activity
R9	Residential dwelling at 1668 Macraes - Dunback Road	Medium - High	Rural General	1.0 km southwest of IMW 0.84 km west of FRBF
R1	Residential dwelling at 1700 Macraes - Dunback Road	Medium - High	Rural General	1.1 km southwest of IMW 1.0 km west of FRBF
R2	Holiday house (previously a Church) at 1726 Macraes Rd	Medium - High	Rural General	1.5 km southwest of IMW 1.5 km west southwest of FRBF
A	Coronation Hall at 1750 Macraes - Dunback Road	Medium - High	Rural General	1.7 km southwest of IMW 1.7 km west southwest of FRBF
B	Macraes Moonlight School	High	Rural General	1.8 km southwest of IMW 1.8 km west southwest of FRBF
C	Cricket Pavillion at 16 Hyde Street	Medium - High	Rural General	1.8 km southwest of IMW 1.9 km west of FRBF
R3	Residential dwelling at 47 Hyde Street	Medium - High	Rural General	2.0 km southwest of IMW 2.1 km west of FRBF
R4	Residential dwelling Four Mile Road	Medium - High	Rural General	3.6 km northwest of CNBF

[4] Ministry for the Environment (2016) *Good Practice Guide for Assessing and Managing Dust*

Receptor No.	Receptor	Sensitivity to Dust	Zoning	Approximate distance from nearest project activity
R5	Residential dwelling 406 Horse Flat Road	Medium - High	Rural General	2.2 km south of Coronation Pit 3.9 km northwest of IMW
D	Golden Point Reserve – historical landmark	Medium	Rural Scenic	2.9 km southeast of Coronation Pit 2.4 km northwest of IMW
E	Callery's Battery – historical landmark	Medium	Rural Scenic	2.9 km southeast of Coronation Pit 2.4 km northwest of IMW
R6	Residence 593 Macraes - Dunback Road	Medium - High	Rural General	3.0 km north northeast of Golden Bar expanded pit
R7	Residence 659 Richie Road	Medium - High	Rural General	3.9 km northeast of Golden Bar expanded pit
R8	Residence 800 Stoneburn Road	Medium - High	Rural General	3.2 km southeast of Golden Bar expanded pit

Most nearby dwellings are clustered near Macraes township and approximately 1.7 km from Innes Mills West or FRBF.

The Macraes Moonlight Primary School (6 Hyde Street) is also located in the Macraes township. This school is located approximately 1.8 km from Innes Mills Pit. The GPG Dust classifies schools as having a *high* sensitivity to dust nuisance effect.

The township also includes several historical buildings including the Stanley's Hotel and the Macraes stables, which are both owned by OGNZL. These receptors are not considered further in this assessment.

The Golden Point Reserve and Callery's Battery historic landmarks are located to the northwest of Golden Point Pit. However, both landmarks are more than 2.4 km from IMW and 2.9 km from Coronation South Pit. Therefore, any dust emitted from the proposed activities is highly unlikely to have any adverse effect at these locations. These historic landmarks are considered to have a *moderate* level of sensitivity.

Figures 3-3 to 3-8 show the location of nearby sensitive receptors (excluding dwellings located on land owned by OGNZL). IAQM[5] guidance categorises receptors between 200 – 400 m from a mine extraction activity to be 'distant' with regards to potential for the dust generated from the activity to have an adverse nuisance or health effect. To put IAQM distances in context of the proposed activities, the distances of 200 m and 400 m from the areas, for which resource consents are being applied, are shown in the Figures 3-2, 3-4 and 3-5 as blue and red dotted lines respectively.

[5] Institute of Air Quality Management "*Guidance on the Assessment of Mineral Dust Impacts for Planning"* May 2016.

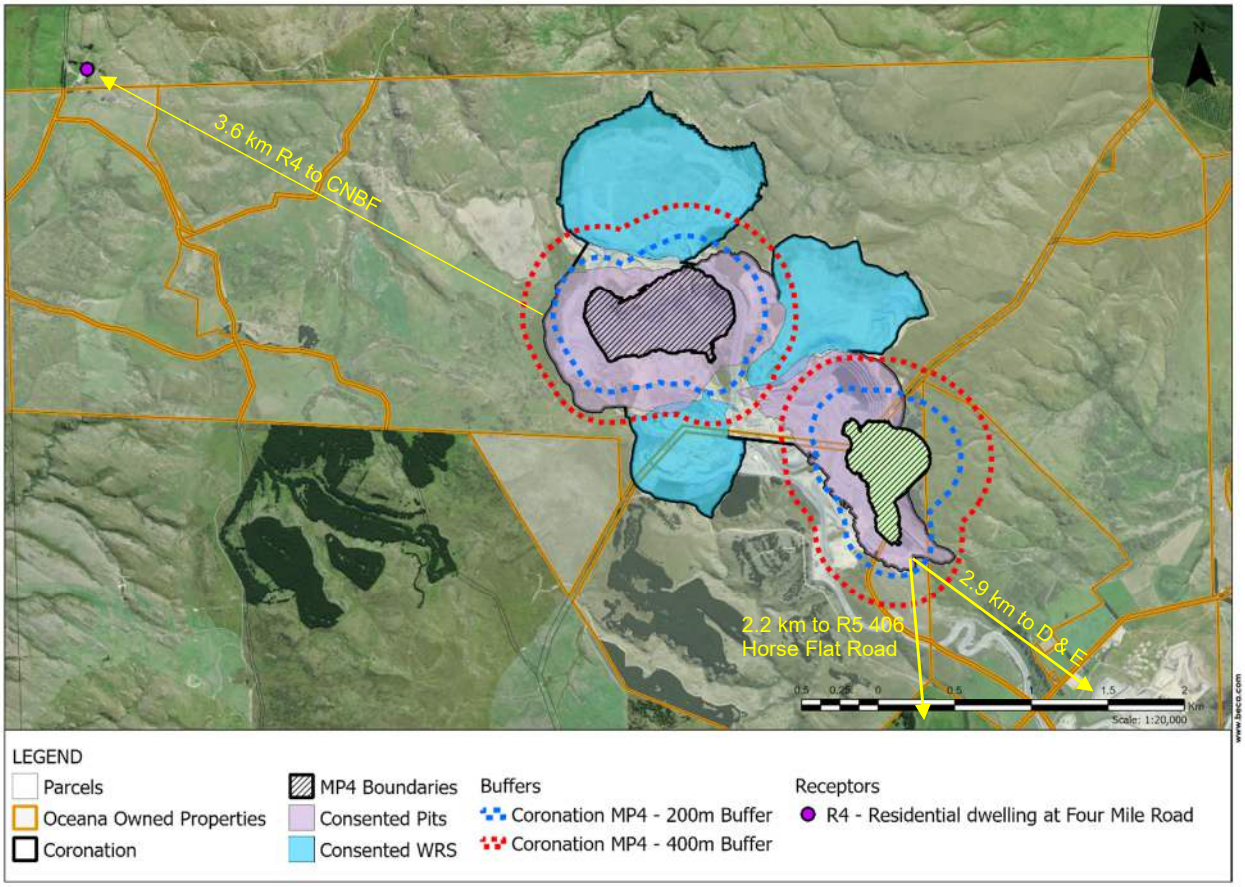

Figure 3-2. Coronation Pit sensitive receptors

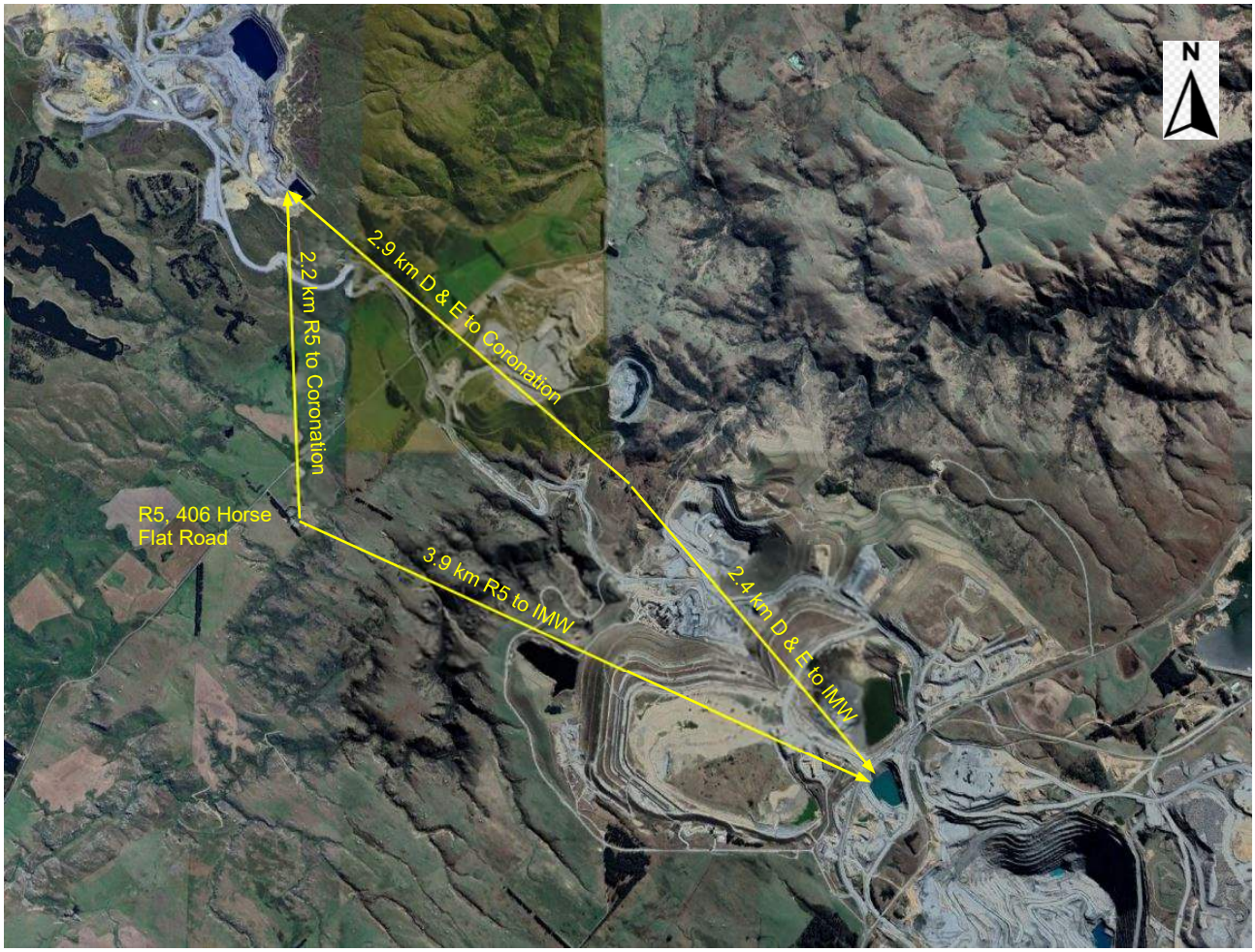

Figure 3-3. Receptor R5, D & E separation distances

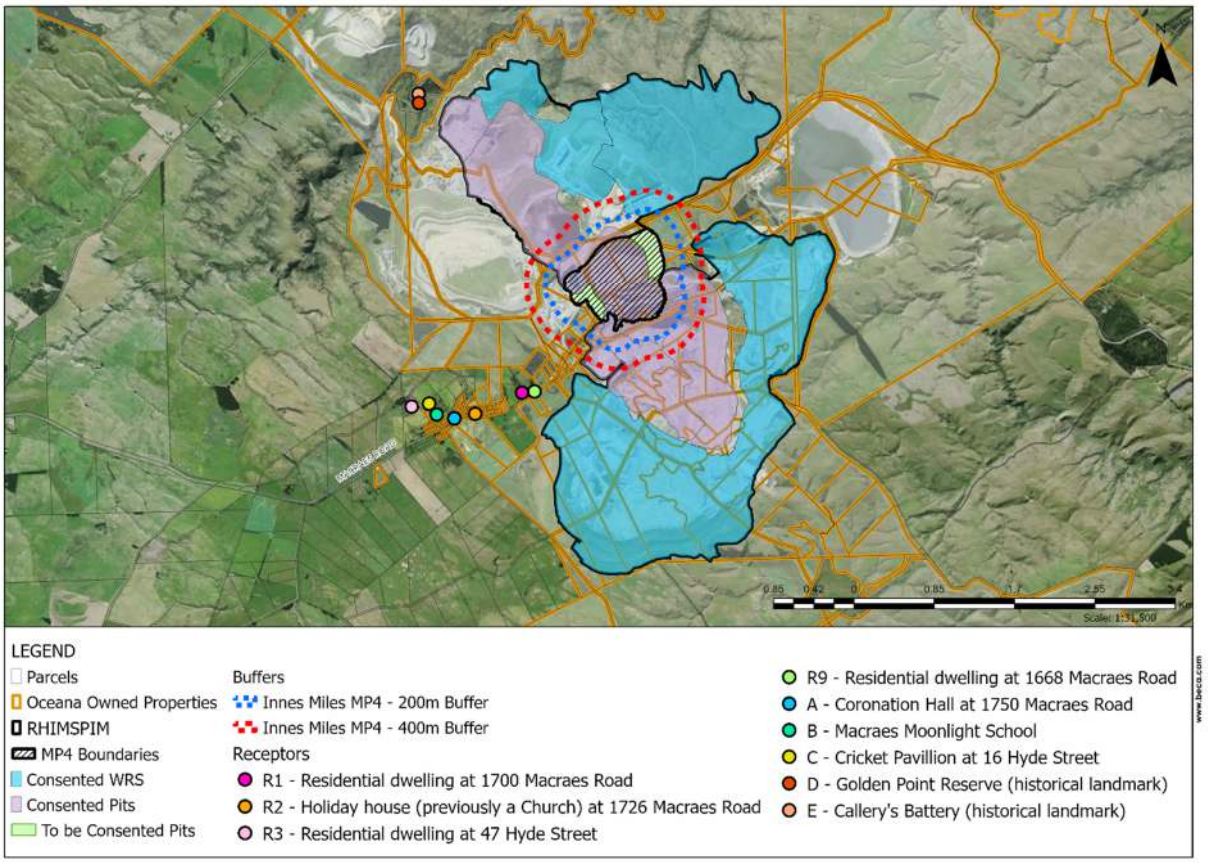

Figure 3-4. IM and Frasers Pit sensitive receptors

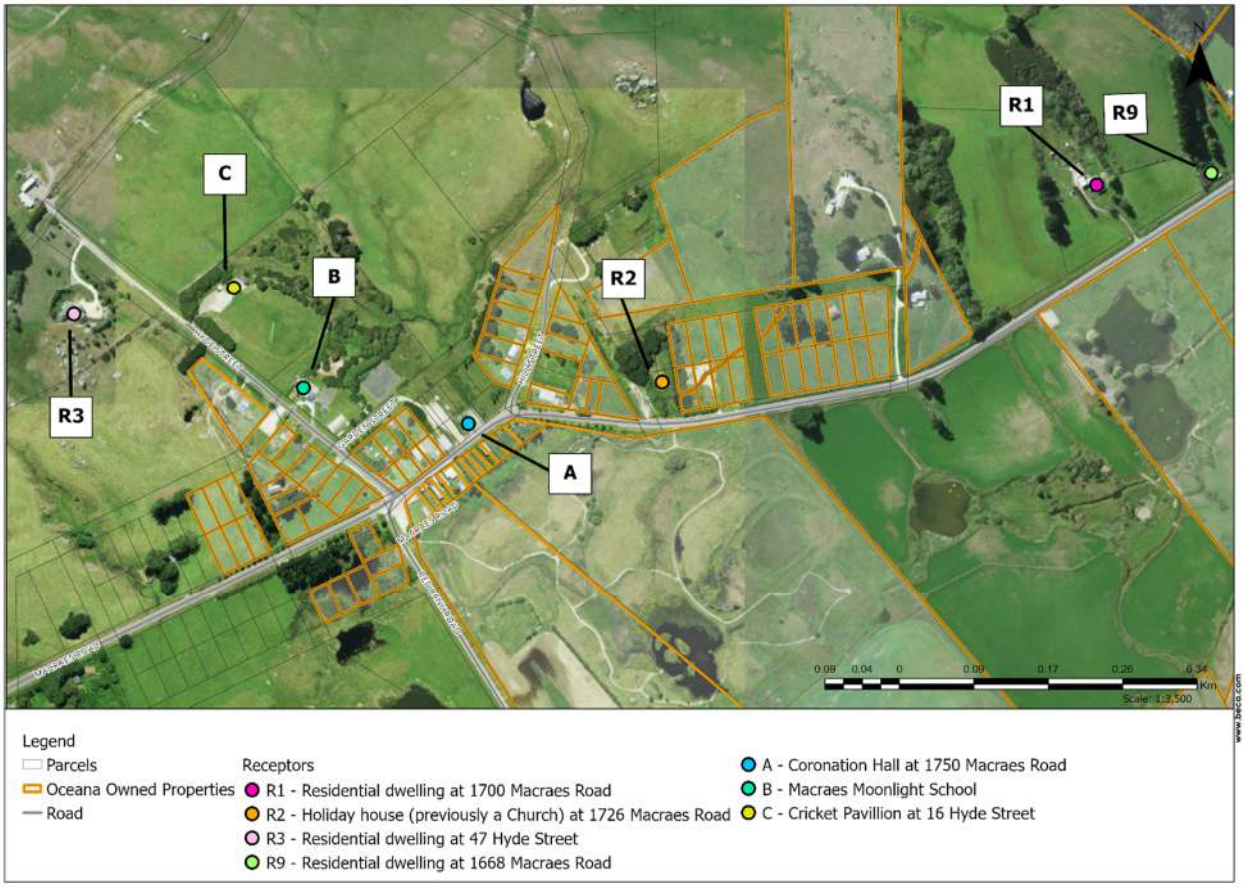

Figure 3-5. Location of Macraes township sensitive receptors

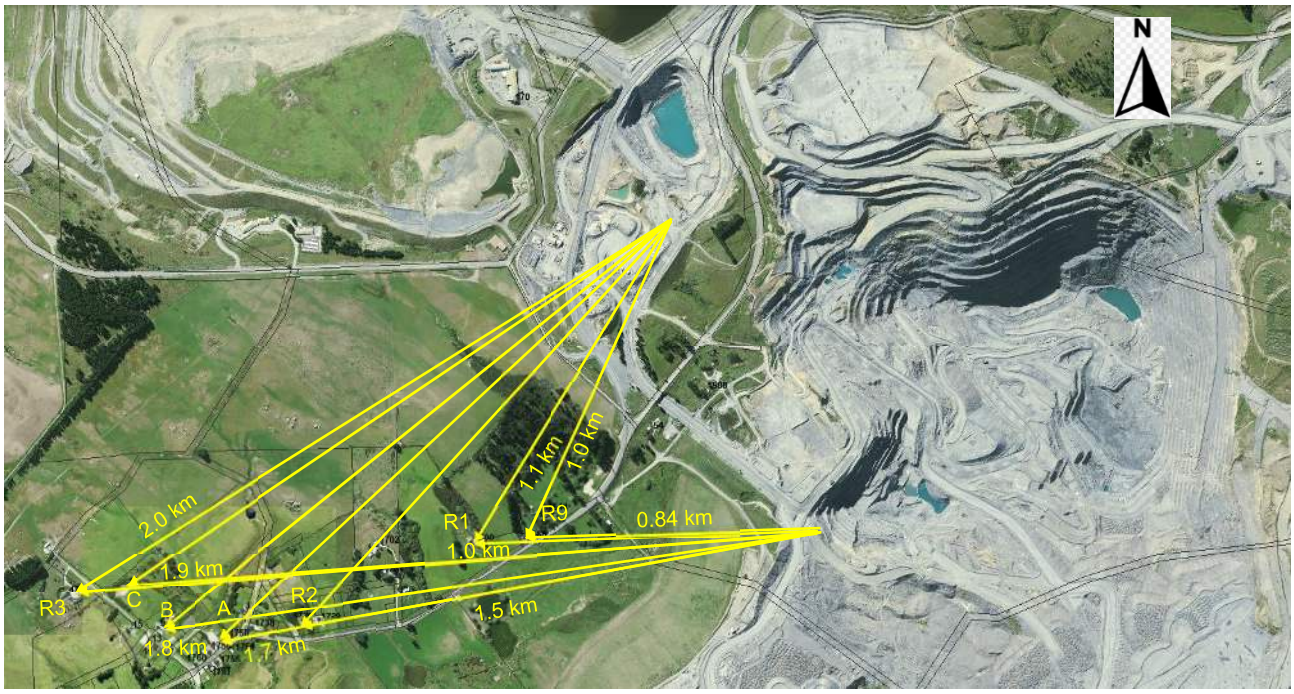

Figure 3-6. Macraes Village Receptor Separation distances

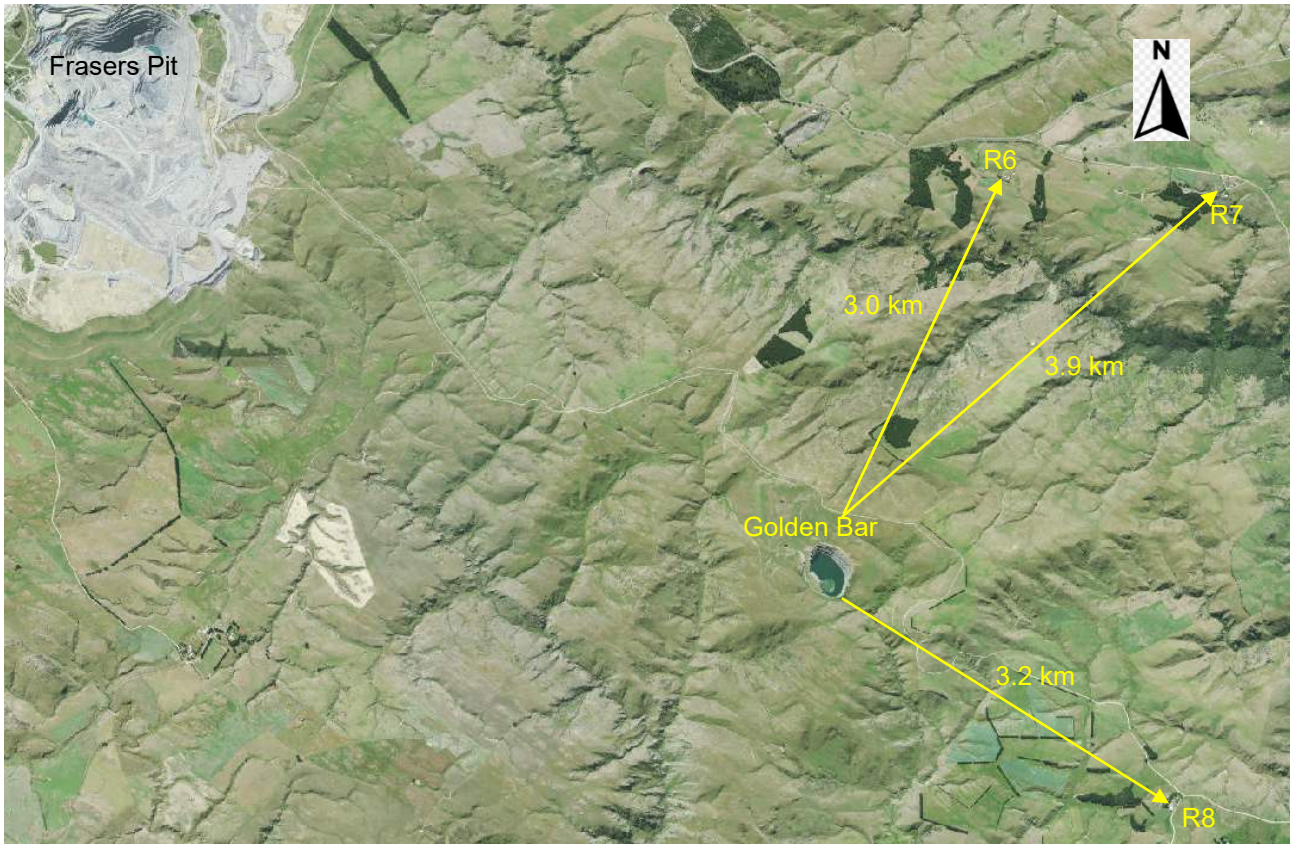

Figure 3-7. Location of non OGNZL owned residential properties near Golden Bar

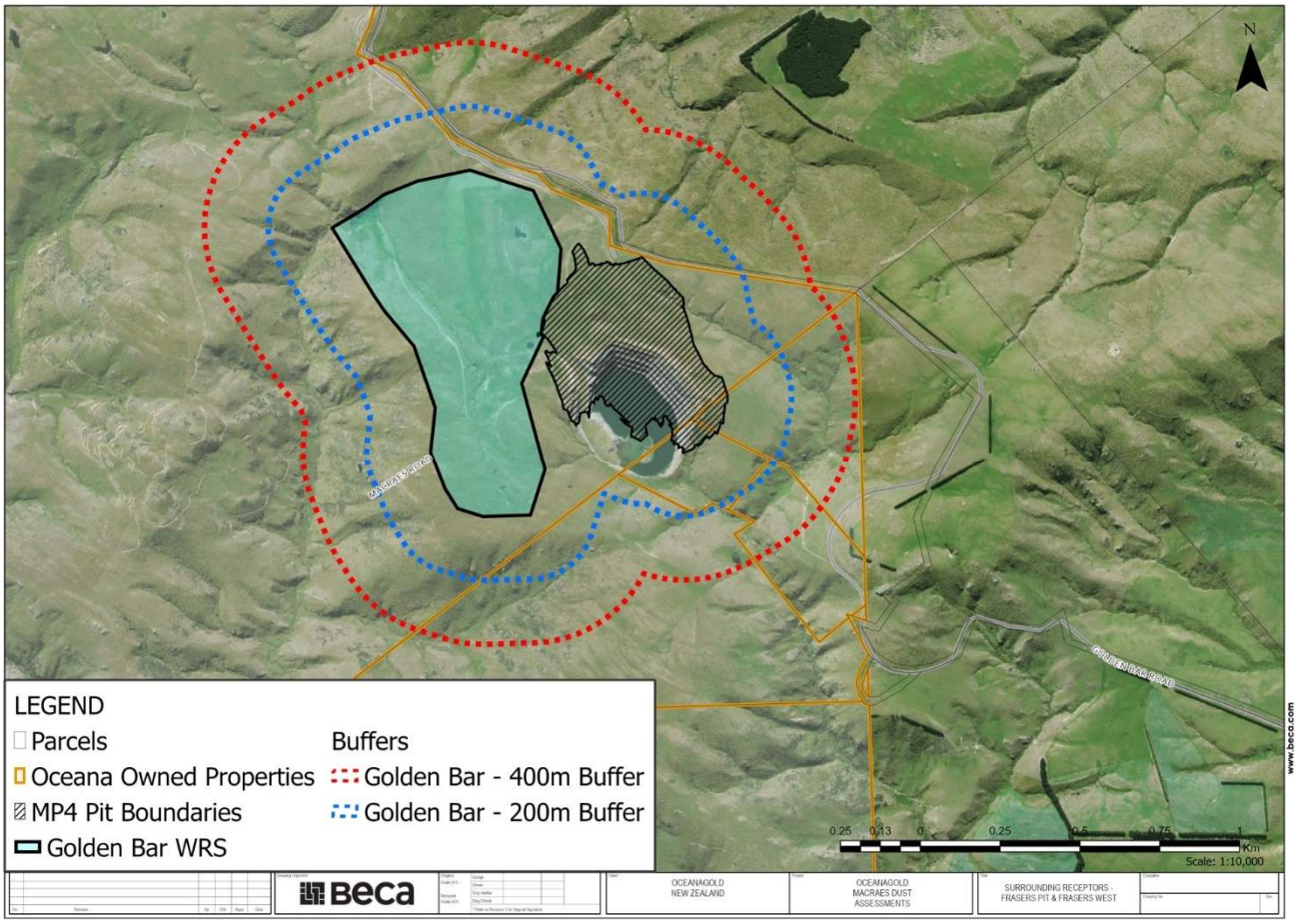

Figure 3-8. Golden Bar buffer zones

3.5 Air Shed Status

The Otago Regional Council (ORC) has gazetted three airsheds in Otago. Macraes is located within Air Zone 3 under the ORC Air Plan and under Airshed 5 gazetted with the Ministry for the Environment (MfE). Airshed 5 currently complies with the National Environmental Standards for Air Quality (NESAQ) for particles less than 10 µm diameter (PM_{10}).

The proposed project activities are not expected to result in any significant increases in PM_{10} concentrations in the airshed. Hence, there is no impediment to granting the consent application under Regulation 17 of the NESAQ.

3.6 Background Air Quality

The predominant land-use in the vicinity of the proposed mine and waste rock stack extensions is other mining activity. Low intensity pastoral farming and some residential dwellings are also present beyond site boundaries.

Possible sources of air contaminants typical of rural areas include unsealed roads, agricultural activities, dry unvegetated fields and domestic heating. During periods of low rainfall and strong winds, background dust concentrations may increase due to the natural and agricultural sources in the area.

The GPG Dust describes typical background concentrations of deposited dust for different environments. Deposited dust concentrations range from 4–8 g/m^2/30 days in the vicinity of specific industrial sources such as timber mills, quarries, mines, steel mills, port operations and abrasive blasting operations.

There is only a limited amount of data available relating to ambient concentrations of total suspended particulate (TSP) levels in New Zealand. The GPG Dust notes that background TSP levels in general industrial areas are about 50-100 µg/m^3. TSP concentrations in the vicinity of the mine pits, WRS and hauls roads are expected to be of this order, as there are no other large sources of particulate such as industries or urban developments. TSP and deposition monitoring undertaken on-site is discussed in Section 6 of this report.

4 Discharges to Air and Mitigation Methods

4.1 Overview

The predominant air discharge contaminant from the project activities is larger settleable particulate matter in the form of dust. However, the products of combustion, such as sulphur dioxide (SO_2), nitrogen oxides (NO_x) and carbon monoxide (CO), will also be discharged from the operation of machinery and vehicles.

The dust generated from the proposed project activities is predominantly made up of larger size fractions (i.e. greater than 10 microns (µm)) and is commonly referred to as total suspended particulate matter (TSP). Some finer particulates (particulate matter less than 10 µm (PM_{10}) and 2.5 µm ($PM_{2.5}$)) will be discharged from vehicles and combustion-based equipment. However, these emissions will be well dispersed prior to reaching sensitive receptors and would be unlikely to exceed any of the relevant health-based air quality criteria (refer Section 5.1). The assessment of effects of the discharges to air from the proposed project activities focuses primarily on the effects of TSP.

4.2 Sources of Dust Emissions

There are several potential sources of dust discharges from the project activities which include the following:

- Loading and unloading of mined waste rock and ore,
- Vehicle movements on unpaved haulage roads and site areas,
- Wind action on dry exposed surfaces.

Dust from exposed surfaces can come from different potential sources including bare surfaces of Pits and WRSs that may be disturbed and subsequently exposed during excavation or stockpiling, dump trucks generating dust as they drive along the haul road and the movement of dry material by machinery at WRSs. Any fresh material dug from more than 10-30 m below the ground is typically damp and therefore unlikely to produce dust during movement by trucks.

4.3 Factors which Influence Dust Generation

The major factors that influence dust emissions from the project activities are:

- Wind speed across the surfaces of exposed soil, excavations or material stockpiles – the critical wind speed for pickup of dust from surfaces is 5 m/s; above 10 m/s loose material pickup increases rapidly,[6]
- The percentage of fine particles in the material on the surface,
- Moisture content of the material and on the surfaces,
- The area of exposed surfaces,
- Mechanical disturbances such as traffic movements, excavation, loading and unloading of materials including drop height, and
- Vehicle speeds.

Systems for controlling dust emissions need to include methods that modify the condition of the materials so that it has a low tendency to lift with the wind or from disturbances such as vehicle movements, and methods that reduce the velocity of the wind at the surface.

The greater the area of exposed material, the greater the potential there is for dust emissions. The smaller the particle size on an exposed surface, the more easily the particles can be picked up and entrained in the wind.

[6] Air and Waste Management Association "*Air Pollution Engineering Manual*" 2nd edition edited by Wayne T Davis, 2000.

Watering of exposed surfaces and materials that may be disturbed is a primary method of control. Moisture binds particles together preventing them from being disturbed by wind or vehicle movements. As a general guide, the typical water requirements for most parts of New Zealand are up to 1 litre per square metre per hour (GPG Dust).

This application rate does not need to be applied over every square metre of ground/material for every hour of the day, but sufficient water is required to be available to effectively suppress dust where and when required.

4.4 Loading and Unloading of Materials

The loading and unloading of materials are potential sources of dust due to the turbulence induced by dropping materials from a height. Examples of loading and unloading operations are shown in Figures 4-1 & 4-2. OGNZL controls dust from these activities by:

- Using water sprays on the falling materials if required,
- Minimising drop heights as far as practicable (e.g. Figure 4-1), and
- Undertaking loading and unloading activities below ground level as far as practicable (which for most Stage 3 pit extensions will be the norm).

Figure 4-1. Example of loading operations

Figure 4-2. Unloading of waste rock by end tipping at Frasers West WRS

4.5 Vehicles, Roads and Yard Areas

Heavy mine vehicles travelling over exposed surfaces (i.e. haul roads) tend to pulverise the surface particles. Particles are lifted and dropped from rolling wheels and the surface. Dust is also sucked into the turbulent wake created behind moving vehicles. An example of dust from vehicle movements is shown in Figure 4-3.

Figure 4-3. Example of dust generated by vehicle movements (note the hauled material being damp is not generating dust)

OGNZL controls dust from these activities by:

- Minimising traffic movements and controlling vehicle speeds to a maximum of 60 km/h on haul roads,
- Adhering to load sizes to avoid spillages,
- Minimising travel distances through appropriate site layout and design,
- Keeping tailings impoundment, pit and haul road maintenance up to date, such as repair of potholes and the laying of fresh gravel or surfacing material, and
- Keeping haul road and exposed surfaces damp during dry conditions with water carts or fixed sprinklers.

The controls above are in line with the GPG Dust except for the requirement to use tarpaulins to cover loads and wheel washes at exits. As the material being hauled is damp, dust is not generated from the load and therefore tarpaulins are not required or practical for mine operations. The trucks operate on internal mine roads and therefore will not track dust out of the site onto public roads.

The GPG Dust makes the following comment on vehicle wind speeds:

"Dust emissions due to vehicles can be minimised with the following controls:

- *limiting vehicle speeds. Industrial sites in New Zealand commonly apply a speed limit of 10–15 kilometres per hour. Additional speed control measures such as judder bars (speed humps) are used along with a speed limit……*

Speed controls on vehicles have an approximately linear effect on dust emissions. This means that a speed reduction from 30 to 15 kilometres per hour will achieve about a 50 per cent reduction in dust emissions."

A large Mine such as Macraes is different to other industrial sites as it has a much larger buffer to neighbours than commercial premises in cities and the transport is internal to the site. If the controls listed above are implemented consistently, especially watering the haul roads, the limiting of vehicle speeds to very slow speeds at the site is also not required.

The vehicles travelling on the access roads and within the site will also discharge products of combustion. The concentrations of contaminants (including GHG) generated will be comparable to traffic emissions from other rural roads with a similar traffic density. To minimise exhaust emissions, vehicles under OGNZL control are kept well maintained.

4.6 Dust from Exposed Surface Sources

The primary means of controlling dust from exposed surfaces is keeping surfaces damp and minimising the quantity of fine particles on the surfaces exposed to wind. An example of dust emissions from exposed surfaces is presented in Figure 4-4.

The methods used by OGNZL to minimise the generation of dust from exposed surfaces includes the following:

- Keeping operational areas around the pits, stockpiles, Processing Plant and haul roads damp using water carts or sprinklers when required; and
- Using windrows, screens and fences in dust prone areas to reduce wind speeds and subsequently, the generation and migration of dust.

The DMP is reviewed at least annually and updated as required. Discharges to air from the proposed expanded mine and WRS operations will also be managed in accordance with the DMP.

Figure 4-4. Example of dust generated from exposed surfaces by winds (Frasers West Pit)

4.7 Dust Management Plan

Dust emissions from the MGP site are managed in accordance with the DMP. The DMP has been prepared in accordance with Discharge Permits 96785_V5, RM10.351.52, RM12.378.15, RM16.138.19 and RM20.024.12. A copy of the current DMP is provided in **Appendix A**.

5 Assessment Criteria and Guidelines

5.1 National Environmental Standards and Guidelines for Ambient Air Quality

5.1.1 Overview

Ambient air contaminant concentrations may be compared with relevant criteria to assess the potential for adverse health and environmental effects to occur. The MfE *Good Practice Guide for Assessing Discharges to Air from Industry* (GPG Industry)[7] sets out the order of priority for the use of various air quality assessment criteria as follows:

- Air quality standards contained in the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (NESAQ)
- New Zealand Ambient Air Quality Guidelines (AAQG) published by the MfE (2002)
- Regional Plan objectives (unless more stringent than above criteria)
- World Health Organisation (WHO) guideline concentrations (where appropriate)
- California Office of Environmental Health Hazard assessment (OEHHA) reference exposure levels (REL) (acute and chronic) and the US EPA inhalation reference concentrations and unit risk factors (chronic).

The NESAQ Regulations set out ambient air quality standards for a number of contaminants including PM_{10}, SO_2, CO and NO_2 for the protection of public health. The NESAQ and the AAQG are intended to apply where people are likely to be exposed for the relevant averaging period. The NESAQ and AAQG include both concentration limits and the specified number of occasions that these concentrations may be exceeded within any year. The Regional Ambient Air Quality Guidelines described in the Regional Plan: Air for Otago, are consistent with the AAQG and are not more stringent than the NESAQ or the AAQG.

5.1.2 PM_{10}

The National Environmental Standards for Air Quality (NESAQ) came into force on 1 September 2005 and have since been revised with the latest revision coming into effect in 2011. The NESAQ standards are designed to protect public health and the environment of New Zealand by, among other things, setting concentration limits for criteria air pollutants. The contaminant relevant to this application is PM_{10}.

5.1.3 NESAQ Regulations 13 and 17, PM_{10}

Regulation 13 sets a standard for PM_{10} that allows a maximum of one exceedance per year of a PM_{10} concentration of 50 µg/m^3 (24-hour average).

Regulation 17 restricts the granting of resource consent for discharges of PM_{10} if the following apply:

- The discharge would be likely to increase 24-hour average PM_{10} concentrations in a “polluted” airshed by more than 2.5 µg/m^3; and
- The PM_{10} emissions to be authorised by the proposed consent exceed those authorised by an existing consent for the same activity.

The site is not located within an airshed that is classified as a “polluted” airshed under Regulation 17. Therefore, Regulation 17 does not apply to this application.

[7] Ministry for Environment (2016) *Good Practice Guide for Assessing Discharges to Air from Industry*

5.1.4 $PM_{2.5}$

There is currently no NESAQ limit for ambient concentrations of $PM_{2.5}$. There is, however, a reporting guideline of 25 µg/m^3 (24-hour average).

In February 2020, the MfE released a consultation document on some proposed amendments to the NESAQ which includes a recommendation for a new daily average standard for $PM_{2.5}$ of 25 µg/m^3 (three or fewer exceedances allowed in a 12-month period) and an annual average standard for $PM_{2.5}$ of 10 µg/m^3. The amendments are still within the consultation stage and have no legal effect at present.

5.1.5 Respirable Crystalline Silica

There are no New Zealand ambient air quality standards or guidelines for respirable crystalline silica (RCS). In the absence of local guidance, the MfE recommends the use of international guidelines. The annual guideline threshold concentration for RCS provided by the California OEHHA is 3 µg/m^3.

The OEHHA chronic REL for RCS and the NESAQ and AAQG standards that are relevant to this project are summarised in Table 5-1.

Table 5-1 Relevant air quality assessment criteria

Contaminant	Averaging period	Threshold concentration µg/m^3	Number of permitted exceedances	Source
PM_{10}	24-hour	50	1	NESAQ
	Annual	20	-	AAQG
CO	1-hour	30	-	AAQG
	Running 8-hour	10	1	NESAQ
NO_2	1-hour	200	9	NESAQ
	24-hour	100	-	AAQG
RCS	Annual	3	-	OEHHA

5.2 Dust Guidelines

There are no New Zealand environmental standards or guidelines for deposited dust or TSP. However, the GPG Dust recommends “trigger” levels which are intended to be used for proactive management of dust on a site. These trigger levels are not intended for enforcement because exceedance of these levels does not necessarily infer an adverse effect offsite[8]. The trigger levels are intended to apply beyond the site boundary.

5.2.1 Deposited Dust

The recommended “trigger value” for deposited dust is 4 g/m^2/30 days above background concentrations. The GPG Dust notes that deposition rates of more than this value above background levels, in some industrial and sparsely populated areas may not cause nuisance, but conversely in sensitive residential areas, dust levels in the order of 2 g/m^2/30 days above background levels may cause nuisance.

The area in the vicinity of the project activities is not densely populated, or likely to be especially sensitive to dust. Hence, the limit applied in the existing air discharge consent of 3 g/m^2/30 days above background concentrations (refer Table 6-2) is considered to be appropriate.

[8] Ministry for the Environment (2016) *Good Practice Guide for Assessing and Managing Dust*

5.2.2 Total suspended particulate matter (TSP)

Similarly, there are no New Zealand-specific ambient air quality standards or guidelines for total suspended particulates (TSP). The GPG Dust recommends "trigger" levels for TSP concentrations (24-hour average) of 60 µg/m^3 (24-hour average) for sensitive areas, 80 µg/m^3 for moderate sensitivity and 100 µg/m^3 (24-hour average) for insensitive areas such as sparsely populated rural areas. Rural residential/countryside living is classified in the GPG Dust as moderate to high sensitivity. Hence, assessment criteria of 80 µg/m^3 (24-hour average), in the vicinity of the houses and school and 100 µg/m^3 (24-hour average) for rural areas are considered appropriate.

The Otago Regional Council air consent reviewer[9] has indicated that the TSP limits of 80 µg/m^3 24 hour average and 250 µg/m^3 in the more recent consent RM20.24.12 and consent RM10.351.52.V1 are likely to be imposed in future consents instead of the limit of 120 µg/m^3 24 hour average in the other consents.

The GPG Dust also recommends a short term 5-minute average trigger level for TSP of 250 µg/m^3 for areas with a high sensitivity such as residences, or the school.

Consent RM20.024.12 includes a TSP trigger level of 250 µg/m^3 1-hour average and a 24-hour average trigger level of 80 µg/m^3 requiring the consent authority to be notified of these elevated levels within 10 days of the exceedance of the trigger.

The GPG Dust recommends "trigger" levels for TSP for various time-averaging periods and sensitivities of the receiving environment. The "trigger" levels included in the GPG Dust for TSP are shown in Table 5-2.

Table 5-2. GPG Dust TSP trigger levels

Trigger	Averaging Period	Sensitivity of receiving environment		
		High	Moderate	Low
Short term	5-minute	250µg/m^3	n/a	n/a
Short term	1-hour	200 µg/m^3	250 µg/m^3	n/a
Daily[10]	24-hour rolling average	60 µg/m^3	80 µg/m^3	100 µg/m^3
Consents RM16.138.19, RM10.351.52, 96785 and RM12.378.15 Limit at DG15	24-hour average	-	-	120 µg/m^3

The GPG Dust also provides guidance on the sensitivity of different receiving environments. For rural areas such as those surrounding the project site, the GPG Dust classifies the sensitivity to dust as "low" for rural activities but "moderate" to "high" for other activities such as industrial activities. Hence, in assessing the effects of dust the residential dwellings near the proposed project activities will be recognised as being more sensitive to such effects on the basis that the dust comes from a non-rural activity source.

[10] * For managing chronic (i.e., long term) dust only.

6 Air Quality Monitoring

6.1 Overview

Under air discharge consents 96785_V5, RM10.351.52.V1, RM12.378.15, RM16.138.19.V1 and RM20.24.12, the following air quality monitoring is currently undertaken:

- Dust deposition rates at monthly intervals at 16 sites,
- Real time total suspended particulate (**TSP**) concentrations at monitoring site DG07 Horse Flat Road, site DG11 Macraes Road (short term programme) and site DG15 Macraes Township (ongoing),
- Continuous meteorological monitoring at two representative locations (i.e. sites DG03 mixed tailings dam/offices and DG15 Macraes township),
- Daily record kept of water used for dust suppression.

In addition to the resource consent monitoring, OGNZL monitors weather forecasts, the condition of potential dust generating areas and undertakes additional dust deposition and total suspended particulate monitoring. The monitoring limits for dust deposition and TSP applied to more recent current consents are considered to be suitable for on-going activities at the mine considering the lack of off-site effects.

Table 6-1 summarises the current air quality monitoring programme. The location of the site meteorological, deposition dust and TSP monitoring sites are shown in Figure 6-1.

The current monitoring programme will continue to operate during the site changes associated with the MP4 Phase 3 project and is considered to be adequate to determine compliance with consent limits.

Table 6-1. Air Quality Monitoring Programme

Monitoring Activities	Frequency
Check weather forecasts for strong winds and send electronic alerts to key personnel.	Daily
Observe weather conditions, wind via observations (Beaufort Scale).	Daily and as conditions change.
Inspect all haul road surfaces for dampness and general condition.	Daily and as conditions change
Inspect all exposed surfaces for dampness and to ensure that surface exposure is minimised.	Daily and as conditions change.
Inspect tailings impoundment surfaces for dampness.	Daily and as conditions change.
Inspect tailings impoundment dust suppression systems.	Twice daily during extended periods of no deposition of tailings
Monitor dust deposition rates in 16 gauges surrounding the mine site.	Monthly
Monitor real time Total Suspended Particulate (TSP) at Site DG07, DG11 & DG15 using a Nephelometer.	Continuously
Monitor meteorological conditions at Sites DG03 and DG15.	Continuously

6.2 OGNZL Air Quality Monitoring Sites, Purpose and Parameters

Table 6-2 provides a summary of the air quality monitoring sites, their purpose and parameters recorded. The locations of these sites are shown in Figure 6-1.

Table 6-2. Macraes Mine air quality monitoring locations, purpose and parameters recorded

Site Number	Location of Monitor	Monitoring Purpose	Parameters Recorded
DG02	Back of Macraes	Consent compliance	Dust deposition
DG03	South of Mixed Tailings Dam beside a gravel section of Golden Point Road	Monitoring	The consent requires monitoring of wind speed, wind direction, air temperature at 2 heights, rainfall and solar radiation. Relative humidity is also monitored. Dust deposition is monitored in addition to consent requirements
DG07	Howard's farm	Consent compliance	Dust deposition, TSP
DG09	Control 7 km ex H/W 85	Background levels – control site	Dust deposition
DG10	Control 3.25 km ex Macraes	Background levels – control site	Dust deposition
DG11	Expansion drilling site, across from 1,700 Macraes Rd	Consent compliance for consent RM10.351.52.V1	Dust deposition, TSP
DG13	Red Bank Rd	Non-Consent Monitoring	Dust deposition
DG15	Behind 1757 Macraes - Dunback Road, Macraes across from Stanley's Hotel	Consent compliance	Dust deposition TSP Wind speed, wind direction, temperature and rainfall
DG17	Horse Flat Rd	Consent compliance RM20.24.12 Background levels – control site for DG02, DG07, DG11, DG15, DG20 and DG21	Dust deposition
DG18	North of Top Tipperary Tailings Storage Facility	Non-Consent Monitoring	Dust deposition
DG19	East of Top Tipperary Tailings Storage Facility	Non-Consent Monitoring	Dust deposition
DG20	East of Frasers East Rock Stack	Consent compliance	Dust deposition
DG21	East of Frasers South Rock Stack	Consent compliance	Dust deposition
DG22	North of Coronation	Consent compliance	Dust deposition
~~DG23~~	North of Coronation	Consent compliance (**removed** in April 2017)	Dust deposition
DG24	East of Coronation	Background levels- control site	Dust deposition
DG25	North of Coronation North Pit	Consent compliance (installed in April 2017) to replace DG23	Dust deposition

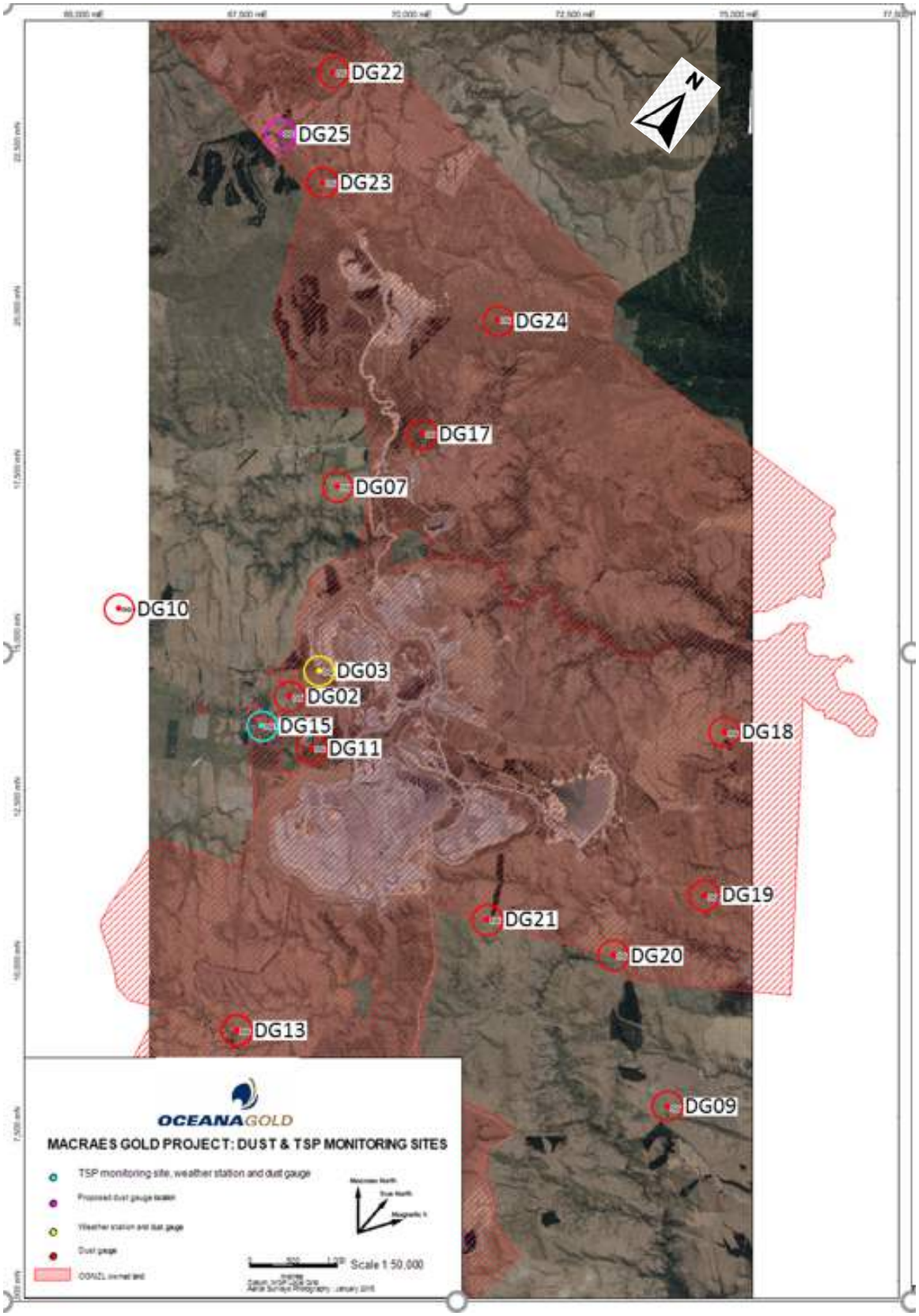

Figure 6-1. Locations of OGNZL meteorological stations, deposited dust and TSP monitoring.

6.3 Meteorological Monitoring

6.3.1 Overview

The main features of the Macraes climate are the low rainfall and the moderately strong average wind speed. Both these factors can contribute to the generation of dust. OGNZL records weather data including wind speed and direction and rainfall at a climate station on Golden Point Road on the driveway to the offices (site DG03 – refer to Figure 6-1) and site DG15 across from Stanleys Hotel in Macraes Village. Site DG03 is located approximately 1.0 km W of IMW and site DG15 is 1.8 km SW of Innes Mills Pit.

Site DG03 Mixed Tailings Dam

The meteorological parameters recorded at site DG03 are:

- wind direction at 6 m above ground level,
- wind speed at 6 m above ground level,
- rainfall at ground level,
- temperature at 1.75 m and 6.0 m above ground level,
- solar radiation at 1.75 m, and
- relative humidity at 6.0 m.

Site DG15 Macraes Village

Meteorological parameters recorded at site DG15 are:

- wind direction at 6 m above ground level,
- wind speed at 6 m above ground level,
- rainfall at ground level,
- temperature at 1.5 m above ground level, and
- Total Suspended Particulate Matter.

6.3.2 Wind Conditions

Figure 6-2 shows the distribution of hourly wind speeds and wind directions recorded at monitoring sites DG03 and DG15 between 2018 and 2022. The windrose shows that winds are predominantly from the east and northeast and west and northwest directions. The strongest winds come from the south to west directions.

The average hourly wind speed measured at site DG03 between 2018-2022 was 3.77 m/s and maximum hourly wind speed reached 21.9 m/s. Calm conditions (wind speeds <0.5 m/s) occurred for 0.1% of the time.

The average hourly wind speed measured at site DG15 between 2018-2022 was 2.88 m/s and maximum hourly wind speed reached 14.2 m/s. Calm conditions (wind speeds <0.5 m/s) occurred for 0.2% of the time.

Winds that exceed 5 m/s, which is the critical wind speed for the lifting of dust from unconsolidated surfaces, occur for approximately 24.6% and 15.1% of time from 2018-2022, for sites DG03 and DG15 respectively. Figure 6-3 shows the distribution of wind flows at sites DG03 and DG15 when wind speeds are greater than 5 m/s. Table 6-3 and Table 6-4 provide the wind frequency distribution at sites DG03 and DG15. At site DG03, wind speeds greater than 5 m/s are predominantly from the west-southwest and west direction (and occur for approximately 10.4% of the time). At site DG15, wind speeds greater than 5 m/s are predominantly from the southwest and west-southwest direction (and occur for approximately 7.7% of the time).

Similar wind direction patterns are also observed during the day and night (refer to **Appendix B**), although average wind speeds tend to be higher during the day. The average wind speed for site DG03 during the daytime from 2018-2022, was 4.3 m/s compared to the night average wind speed of 3.2 m/s. For site DG15,

the average wind speed during the daytime, for 2018-2022, was 3.3 m/s compared to the night average wind speed of 2.4m/s.

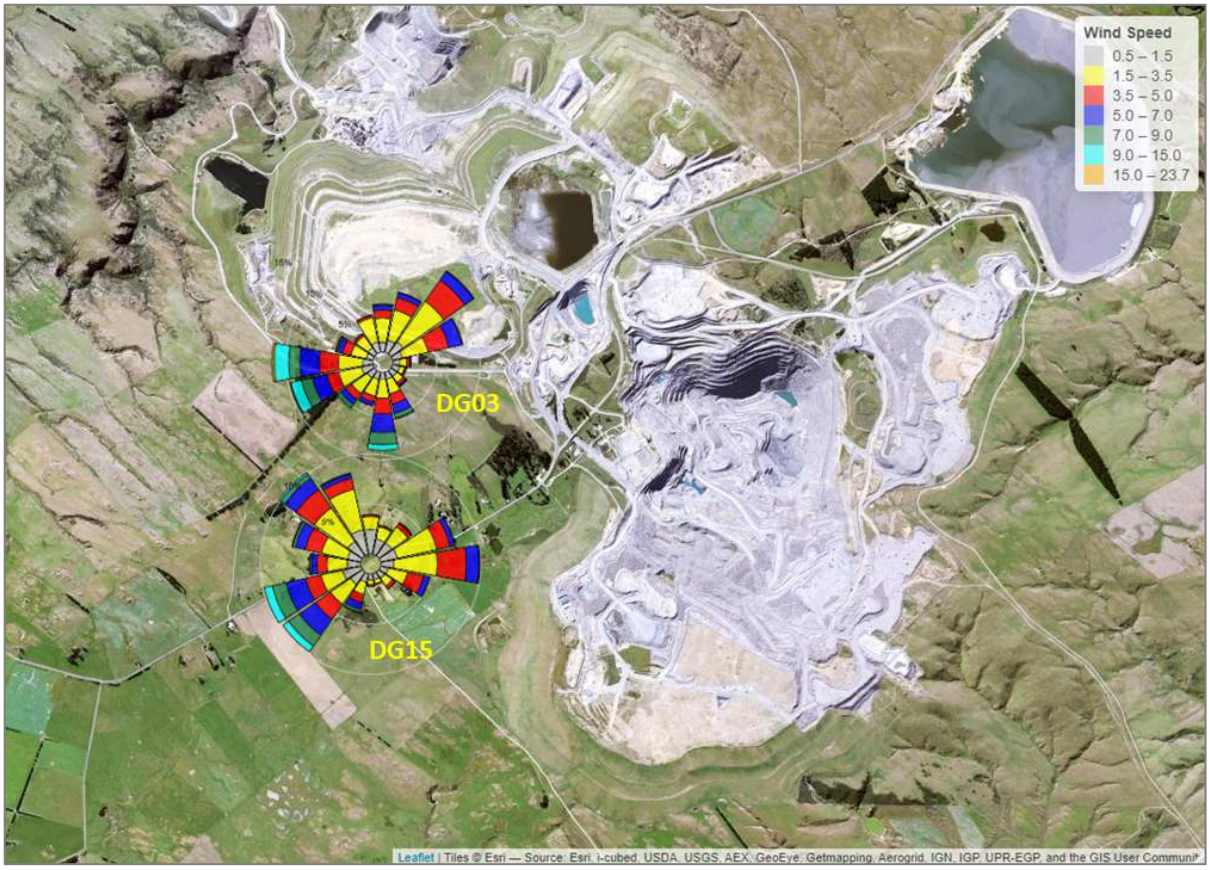

Figure 6-2. Sites DG03 and DG15 windroses (hourly averages) from 1 January 2018 – 31 December 2022 (Met data provided by OGNZL).

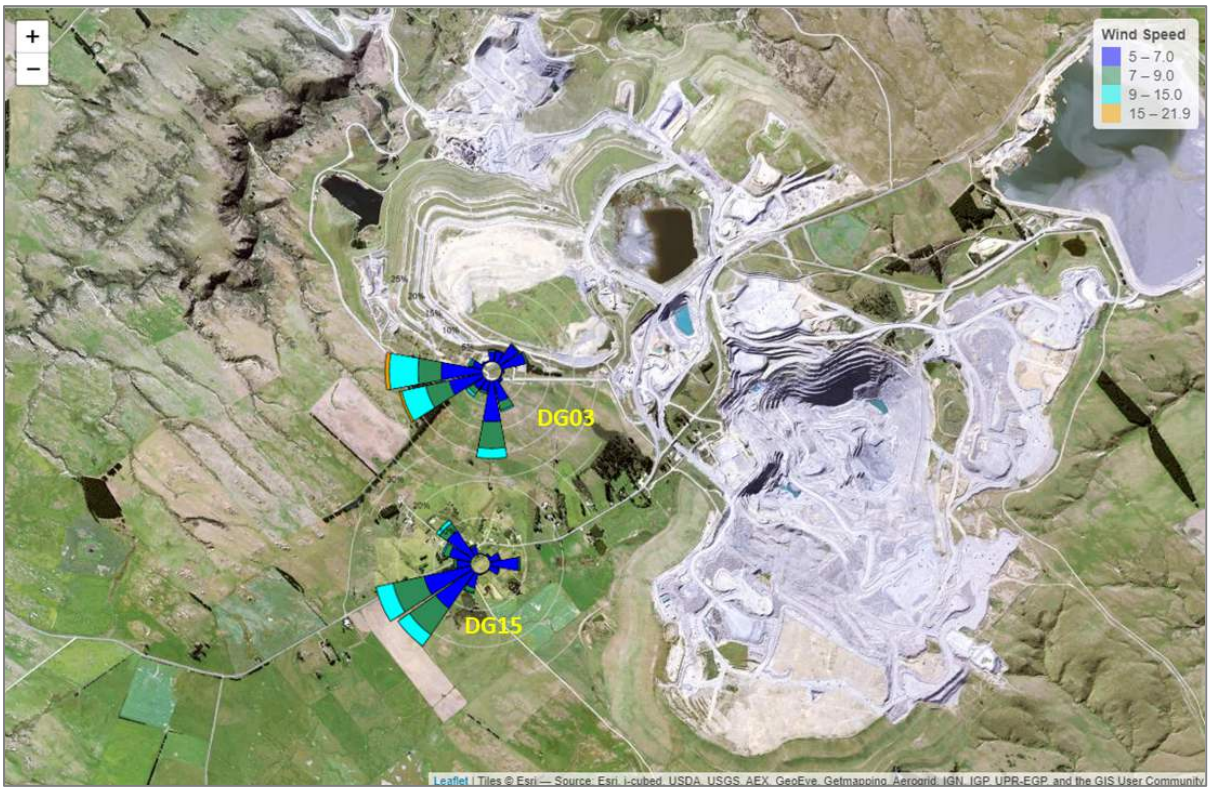

Figure 6-3. Sites DG03 and DG15 wind roses (hourly averages) of wind speeds >5m/s from 1 January 2018 – 31 December 2022(Met data provided by OGNZL).

Table 6-3. Wind frequency distribution (%) for site DG03 from 1 January 2018 – 31 December 2022 (Met data provided by OGNZL).

Wind Direction	0 – 0.5 m/s	0.5 – 1.5 m/s	1.5 – 3 m/s	3 – 5 m/s	5 – 8 m/s	8 -10 m/s	> 10 m/s	Total (%)	Total (> 5 m/s) (%)
N	0.15	1.41	2.59	1.40	0.63	0.06	0.01	6.25	0.70
NNE	0.15	1.65	2.77	1.81	0.65	0.03	0.00	7.06	0.68
NE	0.13	1.69	4.18	4.74	1.26	0.02	0.00	12.01	1.28
ENE	0.13	1.11	1.82	2.69	1.19	0.02	0.00	6.95	1.21
E	0.09	0.88	0.57	0.45	0.12	0.01	0.01	2.13	0.13
ESE	0.11	0.77	0.42	0.25	0.06	0.01	0.00	1.63	0.07
SE	0.09	0.73	0.60	0.49	0.19	0.01	0.01	2.11	0.20
SSE	0.09	0.73	1.35	1.84	1.61	0.25	0.05	5.94	1.92
S	0.11	0.80	1.64	2.49	3.45	1.06	0.31	9.86	4.82
SSW	0.13	0.90	1.78	1.49	0.74	0.03	0.00	5.06	0.78
SW	0.07	1.05	1.84	1.34	0.87	0.19	0.09	5.45	1.15
WSW	0.10	1.03	2.09	2.09	2.71	1.15	1.21	10.38	5.07
W	0.11	0.95	2.12	3.26	3.01	1.02	1.36	11.82	5.39
WNW	0.10	0.77	1.45	1.64	0.73	0.16	0.07	4.92	0.96
NW	0.07	0.99	1.80	0.75	0.13	0.01	0.00	3.74	0.14
NNW	0.13	1.19	2.35	0.68	0.07	0.01	0.00	4.42	0.08
Total	1.75	16.65	29.35	27.42	17.42	4.02	3.13		

Table 6-4. Wind frequency distribution (%) for site DG15 from 1 January 2018 – 31 December 2022 (Met data provided by OGNZL).

Wind Direction	0 – 0.5 m/s	0.5 – 1.5 m/s	1.5 – 3 m/s	3 – 5 m/s	5 – 8 m/s	8 -10 m/s	> 10 m/s	Total (%)	Total (> 5 m/s) (%)
N	1.28	2.58	1.36	0.36	0.03	0.00	0.00	5.61	0.03
NNE	0.70	1.81	1.15	0.26	0.02	0.00	0.00	3.93	0.02
NE	0.52	1.65	1.80	0.70	0.11	0.00	0.00	4.79	0.12
ENE	0.43	1.53	2.98	2.18	0.49	0.01	0.00	7.62	0.50
E	0.30	1.29	3.61	4.56	1.46	0.02	0.00	11.24	1.49
ESE	0.22	0.84	1.44	2.20	0.54	0.00	0.00	5.24	0.55
SE	0.26	0.69	0.65	0.54	0.05	0.00	0.00	2.20	0.05
SSE	0.18	0.47	0.33	0.13	0.03	0.00	0.00	1.14	0.03
S	0.16	0.53	0.38	0.22	0.04	0.00	0.00	1.34	0.04
SSW	0.25	0.72	0.72	0.90	0.56	0.06	0.00	3.21	0.62
SW	0.49	1.29	1.77	2.35	2.71	0.85	0.29	9.75	3.85
WSW	0.71	1.57	1.57	2.09	2.69	0.86	0.30	9.78	3.85
W	0.60	1.52	1.67	1.40	0.53	0.03	0.00	5.75	0.57
WNW	0.63	1.60	1.94	2.12	0.94	0.09	0.01	7.33	1.04
NW	0.77	2.03	3.21	3.19	1.56	0.25	0.08	11.09	1.89
NNW	1.13	2.56	2.99	1.44	0.34	0.03	0.01	8.50	0.38
Total	8.60	22.70	27.56	24.63	12.12	2.22	0.71		

6.3.3 Rainfall

Ten-minute average rainfall is recorded at sites DG03 and DG15 weather stations. Table 6-5 presents the percentage of 'rain days'[11] per year. Based on the rainfall data collected from 2018 – 2022, the annual rainfall for 2022 was the lowest in the five-year monitoring period measured at both the site DG03 and DG15 weather stations. Daily rainfall is presented in Figure 6-4.

Table 6-5. Rainfall measured at sites DG03 and DG15 2018-2022

Year	DG03		DG15	
	No. of Days above 1 mm Rain	% Rain days over a year	No. of Days above 1 mm Rain	% Rain days over a year
2018	108	29.9	103	28.2
2019	104	28.5	94	25.8
2020	91	24.9	82	22.5
2021	101	27.7	94	25.8
2022	78	21.4	78	21.4

[11] A rain day is classified as a day with total rainfall exceeding 1 mm over a 24-hour period.

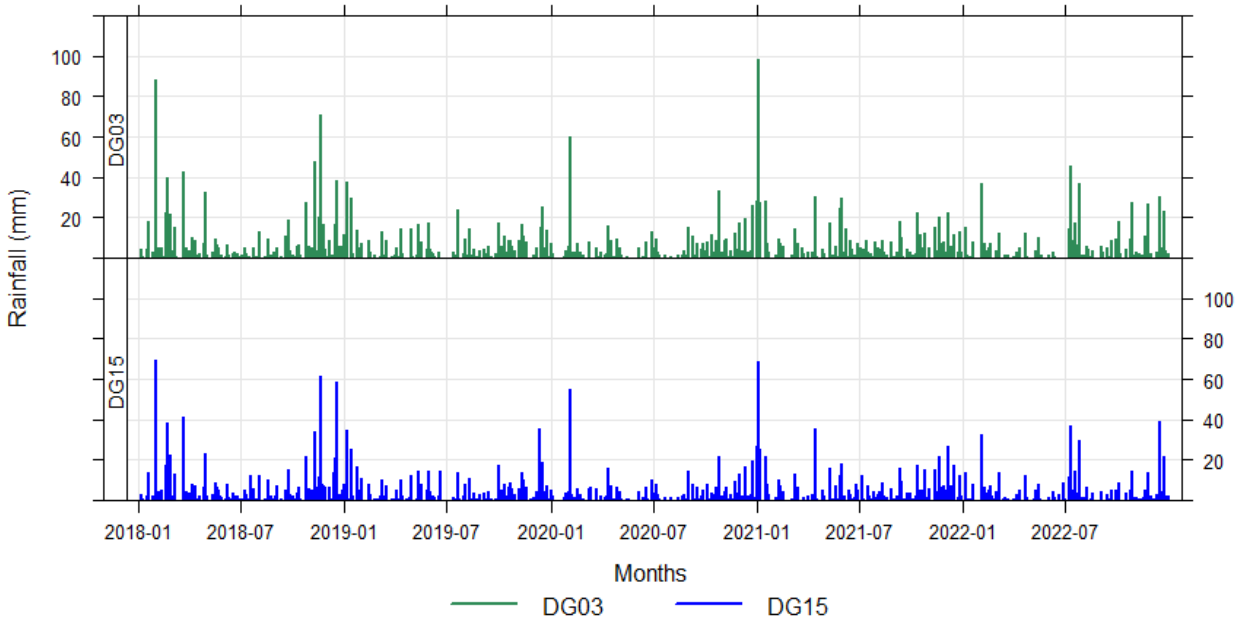

Figure 6-4. Daily Rainfall measured at sites DG03 and DG15 from 2018 – 2022

6.4 Deposited Dust Monitoring

6.4.1 Overview

Deposited dust is comprised of soluble and insoluble dust fractions. The soluble fraction is only relevant downwind of sources that produce water-soluble emissions, such as milk powder from a dairy factory. For OGNZL, the only emissions of any significance are crustal dust particles which are insoluble in rainwater.

Deposited dust is any dust that falls out of suspension in the air. Deposited dust monitoring is carried out using dust fall deposit gauges as a requirement of current air discharge consent conditions (Consent 96785_V5, Consent RM10.351.52.V1, Consent RM12.378.15, Consent RM16.138.19.V1 and Consent RM20.024.12).

Dust deposition rates are measured at the monitoring sites using dust gauges in accordance with draft ISO Standard ISO/DIS 4222.2, *("Air Quality Measurement of Atmospheric Dustfall – Horizontal Deposit Gauge Method" 1980*).

Table 6-6 summarises the existing air discharge consent conditions with regards to dust deposition rates. Collectively, the consent conditions require that insoluble dust deposition rates at sites DG02 and DG15 do not exceed 3 g/m^2/30 days above background levels at any time, and insoluble dust deposition rates at sites DG07, DG11, DG17, DG20, DG21, DG22 and DG25 do not exceed 3 g/m^2/30 days above background levels more than twice in any calendar year.

For compliance monitoring purposes, background dust deposition rates are considered to be the average of the insoluble dust deposition rates measured at sites DG09, DG10, and DG24 (background A) and for some sites, the average of sites DG09, DG10 and DG17) (background B).

Sites DG03, DG13, DG18 and DG19 are used for monitoring purposes only (i.e., not for consent compliance). No monitoring is required at Golden Bar Pit.

Table 6-6. Summary of Consent Dust Monitoring Requirements and Criteria

Consent Number	Cond. No	Insoluble Dust Deposition sites	Dust Limit, g/m^2/30 days above background
96785_V5 most of site	7	DG07, DG20 and DG21	≤3 for no more than twice per year
	8	DG02 and DG15	≤3
	8a	DG09, DG10 and DG24 averaged	Background A
RM10.351.52.V1 Frasers Pit	6	DG07, DG11, DG20 and DG21	≤3 for no more than twice per year
	7	DG02 and DG15	≤3
	8	DG09, DG10 and DG17 averaged	Background B
RM12.378.15 Coronation	4	DG07, DG20, DG21, DG22 and DG23	≤3 for no more than twice per year
	5	DG02 and DG15	≤3
	6	DG09, DG10 and DG24 averaged	Background A
RM16.138.19.V1 Coronation	4	DG07, DG20, DG21, DG22 and DG25	≤3 for no more than twice per year
	5	DG02 and DG15	≤3
	6	DG09, DG10 and DG24 averaged	Background A
RM20.24.12 Deep Dell	7	DG07 and DG17	≤3 for no more than twice per year
	9	DG09, DG10 and DG24 averaged	Background A

6.4.2 Results of monitoring

Figure 6-5 and 6-6 show the annual average insoluble dust deposition rates above background levels at compliance monitoring sites for the years 2018 – 2022. These results show that dust deposition rates recorded at these sites are, on average, lower than the 3 g/m^2/30 days consent limit.

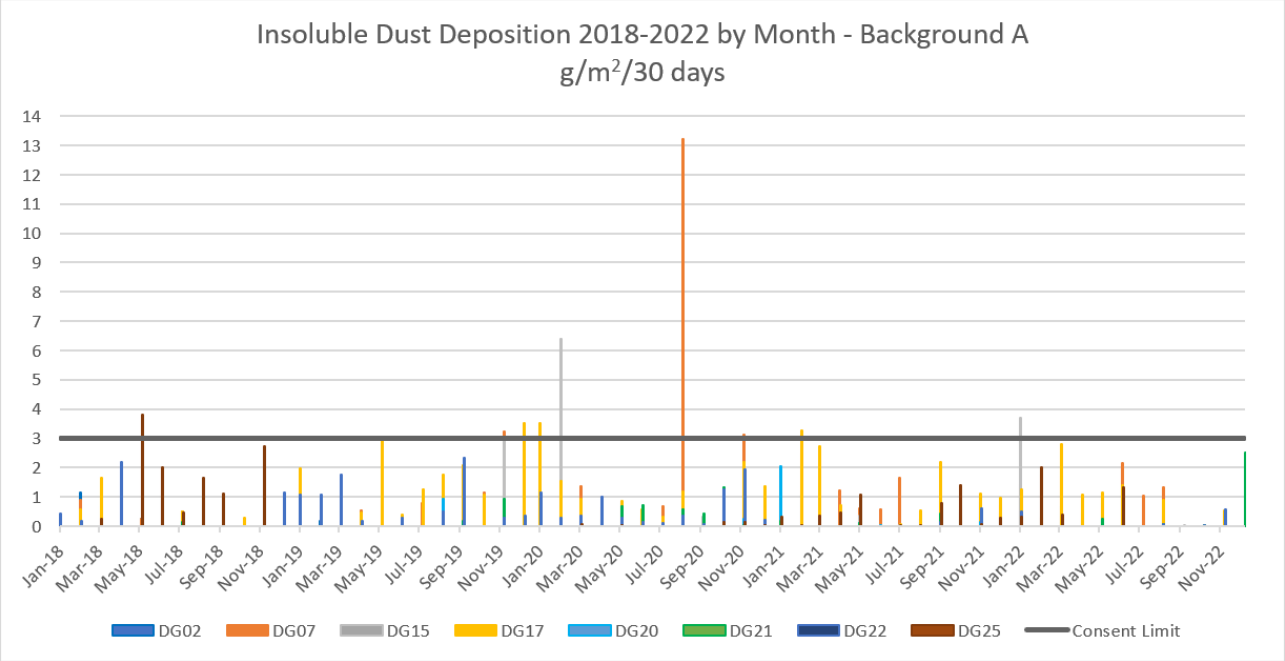

Figure 6-5. Historic insoluble deposited dust deposition 2018 – 2022, most consents background.

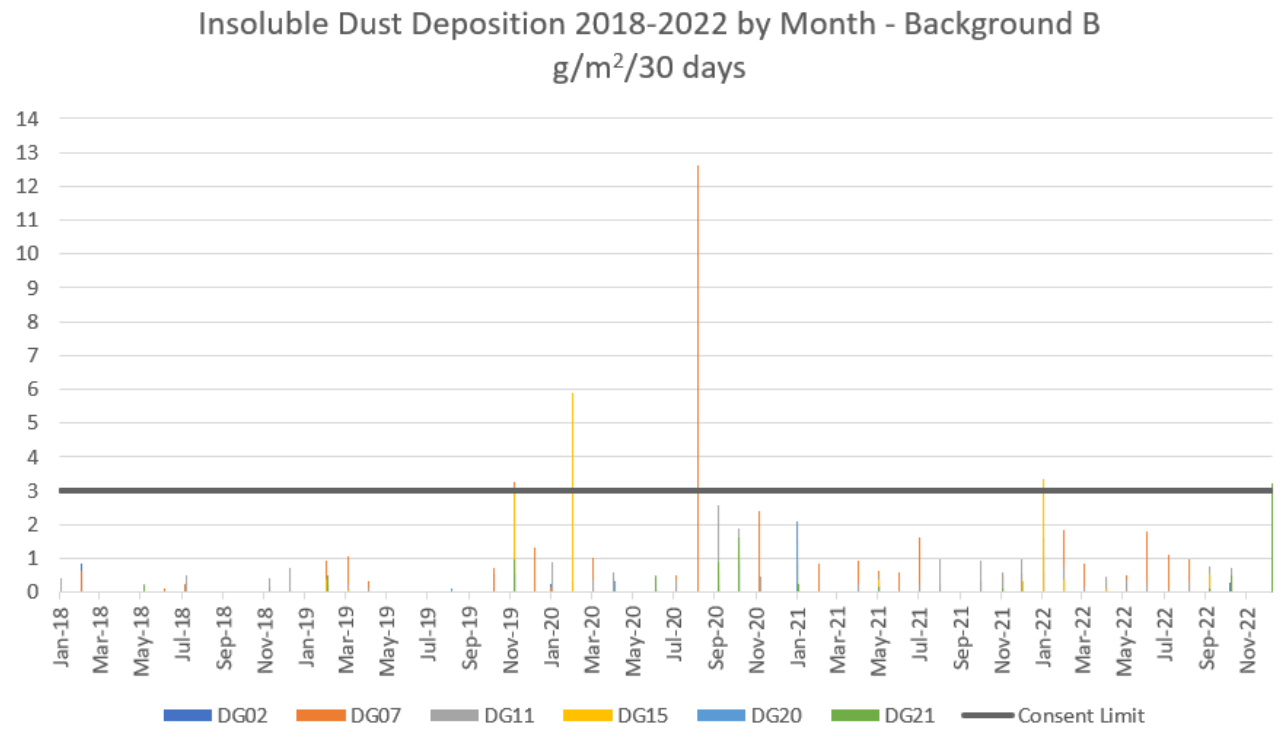

Figure 6-6. Historic Insoluble Deposited Deposition Monitoring 2018 – 2022, consent RM10.351.52.V1 background.

The monitoring sites that are most relevant to the proposal are sites DG02, DG11, and DG15 due to their proximity to the sensitive receptors which would potentially be most impacted by the proposed MP4 Stage 3 project activities.

Site DG15 is in the Macraes township (at 1756 Macraes - Dunback Road), site DG02 is located approximately 0.8 km to the north of the township and site DG11 is located approximately 0.9 km to the east of the township. Sites DG02 and DG15 are both consent compliance monitoring sites.

Figure 6-7 shows the monthly insoluble deposited dust above background concentration (A) at sites DG02 and DG15 between 2018 – 2022. The monthly insoluble deposited dust above background concentration (B) at sites DG02, DG11 and DG15 between 2018 – 2022 is shown in Figure 6-8. The results show that 95% of the deposition rates at sites DG02, DG11 and DG15, between 2018 and 2022, were less than 0.9, 1.5 and 1.6 g/m^2/30 days above background limit respectively, or between approximately 33 and 50% of the consent limit.

However, two exceedances of the consent limit were recorded at site DG15 in February 2020 and January 2022. The February 2020 exceedance was likely to be attributed to non-mining activities, such as the spreading of urea in the nearby paddock[12]. The exceedance at site DG15 in January 2022, for background A and B, related to bird droppings being present in the gauge.

The results of the deposited dust monitoring show a high level of compliance with the consent limit at all three of the monitoring sites. Emissions from the proposed expansions of current mining area would not be expected to have a significant effect on dust deposition rates, outside the site boundary, due to the separation distances between the activities and these monitoring sites. Consequently, the dust deposition rates cumulatively from the whole site activities would still be expected to comply with existing consent conditions.

[12] *Macraes Mine – Summary of Ambient Air Monitoring Results for 2020* prepared by Beca Limited on 20 July 2020

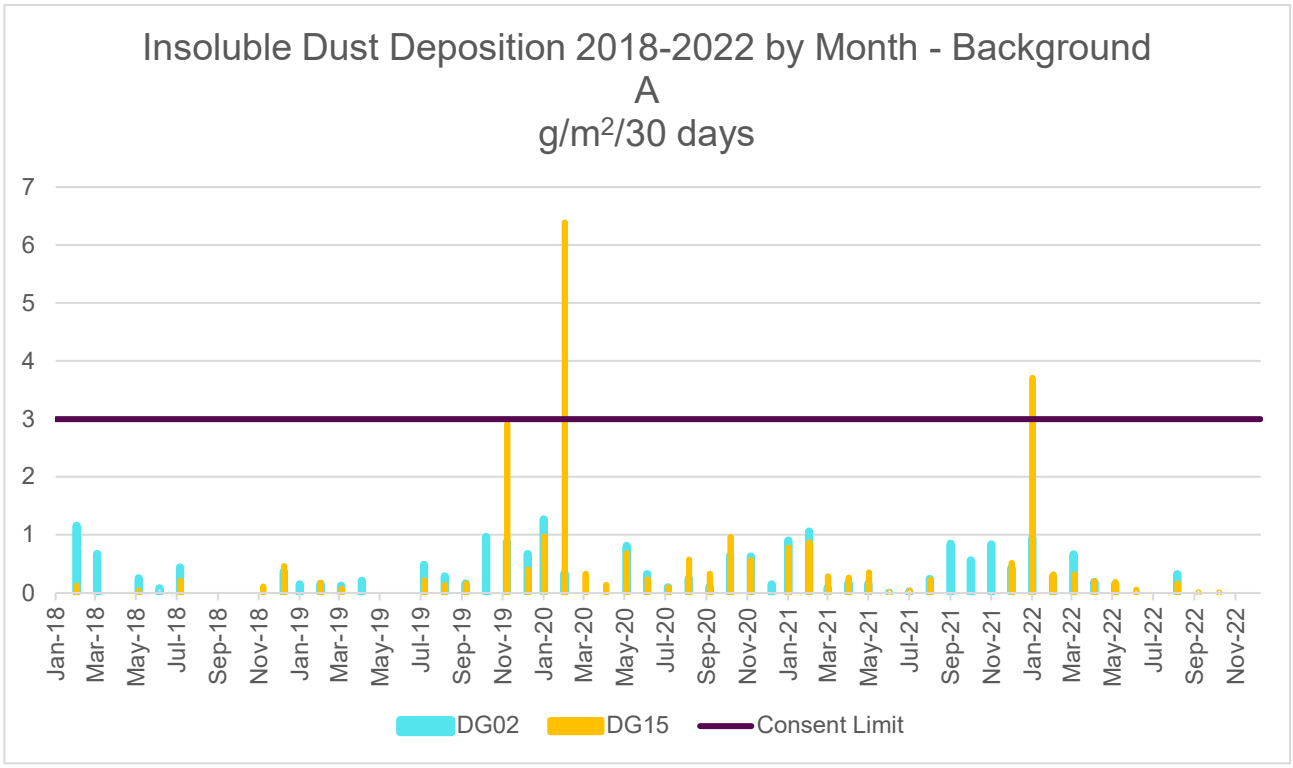

Figure 6-7. Monthly insoluble deposited dust above background concentration A 2018 – 2022 at sites DG02 and DG15

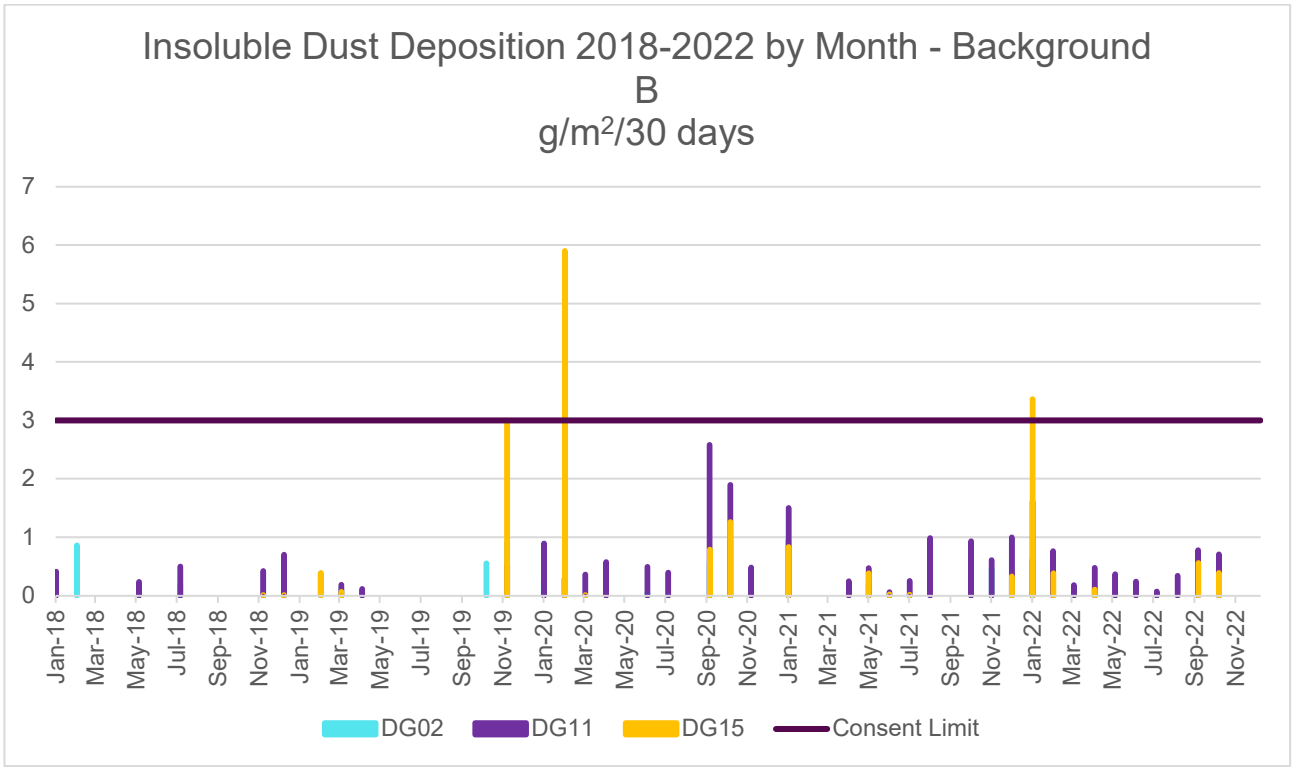

Figure 6-8. Monthly insoluble deposited dust above background concentration B 2018 – 2022 at sites DG02, DG11 and DG15

The proposed Coronation and Golden Bar component of the project are both located in relatively isolated areas. The closest monitoring stations to Coronation Pit site are DG17 and the background monitoring station, site DG24. The closest monitoring site to Golden Bar is background monitoring site DG09 which is located more than 3 km to the north of the pit.

A summary of monthly insoluble deposited dust above background concentration 2018 – 2022 at site DG17 is shown in Figure 6-9. The monitoring results show that deposition rates, have on occasions (more so during Summer- Autumn), exceeded 3 g/m^2/30 days over the past five years, but in the main were typically lower than the consent limit.

The average insoluble dust deposition rates observed at the background monitoring stations, sites DG09 and DG24, between 2018 and 2022 were 0.55 g/m^3/30 days and 0.68 g/m^2/30 day, respectively. The 95th percentile deposition rate at these sites is approximately 1.5 g/m^2/30 days. The results indicate that background dust deposition rates are comparatively low in the vicinity of these sites.

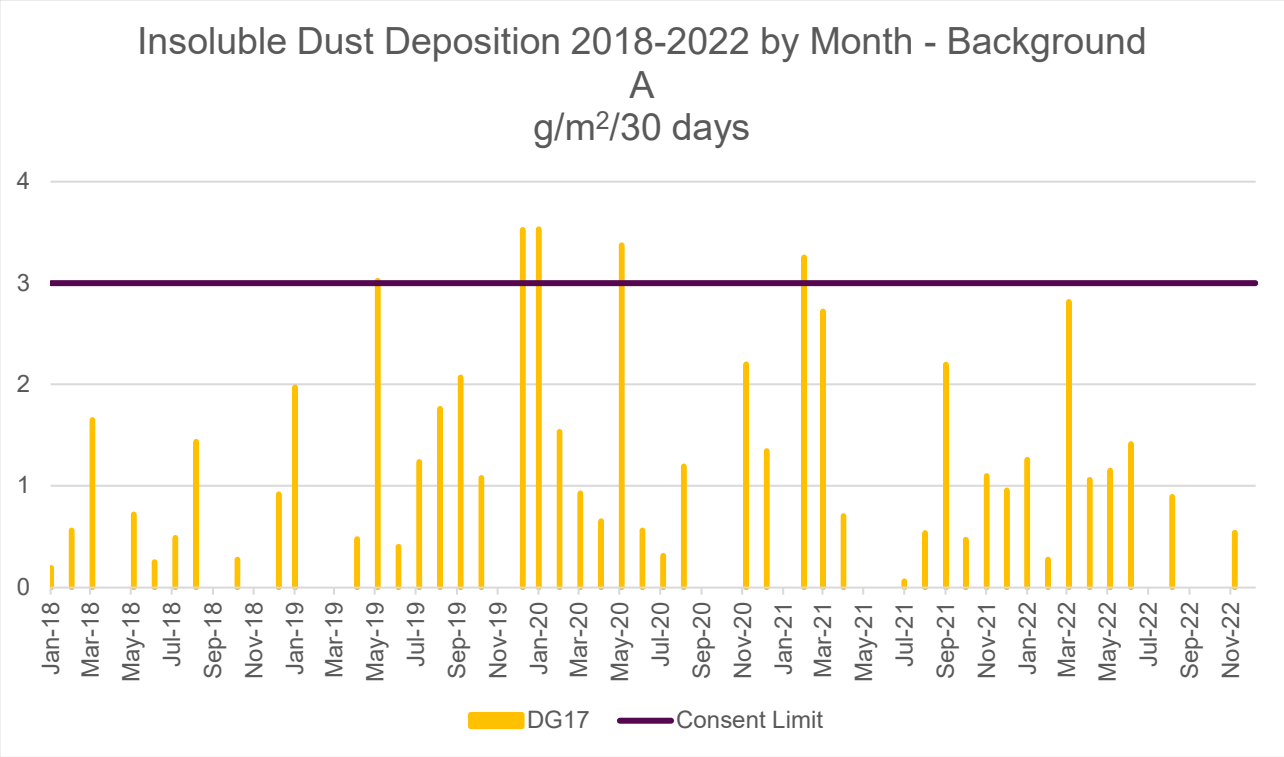

Figure 6-9. Monthly insoluble deposited dust above background concentration 2018 – 2022 at site DG017

6.5 Total Suspended Particulate Monitoring

A summary of the site TSP monitoring requirements in each consent is presented in Table 6-7. The monitoring is undertaken using a nephelometer[13] or similar.

Table 6-7. Site TSP Monitoring Requirements

Consent Number	Cnd No	TSP sites	Dust Limit and Averaging Period
96785_V5 most of site	9 and 12c	DG15	120 µg/m^3 24hr average

[13] Nephelometer- measures the density of suspended particulates in the air using a source light beam and detector

RM10.351.52.V1	6a	DG11	80 µg/m^3 24hr average, 250 µg/m^3 1 hourly
	9 and 12c	DG15	120 µg/m^3 24hr average, no limit 1 hourly
RM12.378.15	7 and 10c	DG15	120 µg/m^3 24hr average, no limit 1 hourly
RM16.138.19.V1	7 and 10c	DG15	120 µg/m^3 24hr average, no limit 1 hourly
RM20.24.12 Deep Dell	5c	DG07 Howard Res[14]	80 µg/m^3 24hr average, 250 µg/m^3 1 hourly
	10 and 13b	DG15	120 µg/m^3 24hr average, no limit 1 hourly

Figure 6-10 shows the 24-hour average TSP concentrations observed at sites DG07, DG11 & DG15 between 2018 and 2022. Limited monitoring occurred in 2021 due to a malfunction of the monitoring equipment, which could not be repaired due to Covid-19 site visit restrictions.

The results show that there were two exceedances of the 24-hour consent limit of 120 µg/m^3 in 2017 and five exceedances in 2021. The TSP levels at site DG15 were otherwise well below the consent limit.

In the latest consent, the 24-hour consent TSP limit was 80 µg/m^3. During the five-year monitoring period (2018 – 2022), there were 33 exceedances of this consent limit.

The monitoring results show that most higher TSP concentrations observed at the monitoring station occurred during periods of fog in the area. As the nephelometer uses an optical monitoring method, TSP concentrations during these events are likely to have been over-estimated, as the airborne water aerosols would be measured by the instrument as TSP.

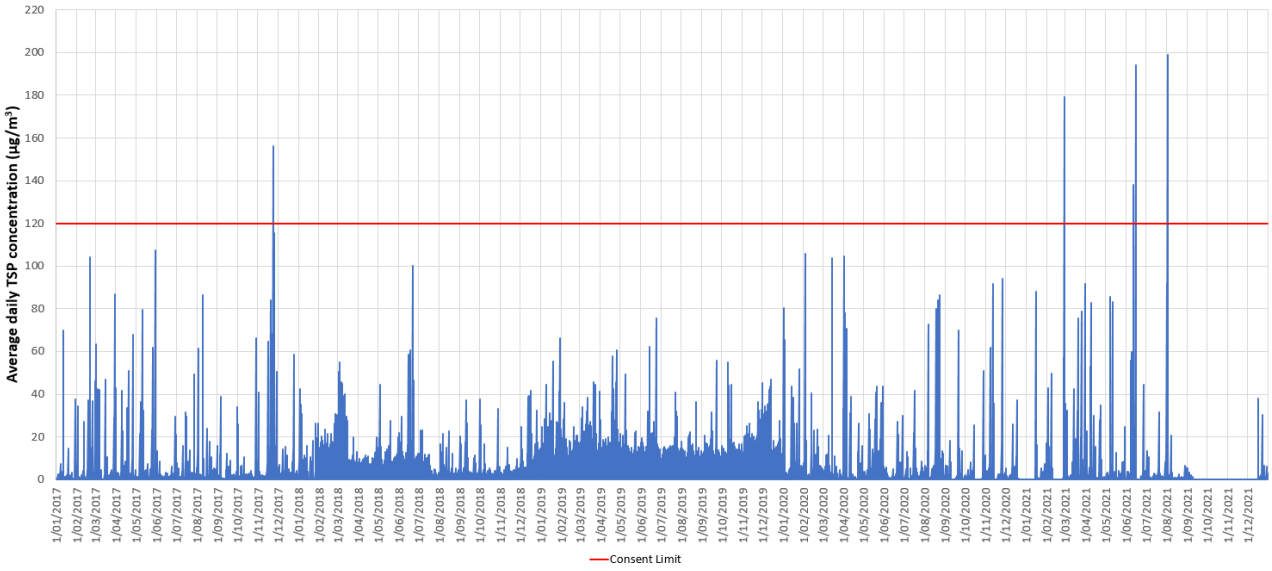

Figure 6-10. 24-hour average ambient TSP concentrations recorded at Site DG15 from years 2018 - 2022.

[14] 406 Horse Flat Road

7 Effects of Discharges to Air

7.1 Potential Adverse Effects of Discharges to Air

7.1.1 Overview

The potential adverse effects from the discharge of dust (particulate matter) include:

- Health effects generally associated with exposure to contaminants associated with dust,
- Health effects from exposure to inhalable dust (PM_{10} and $PM_{2.5}$ as these finer particles can penetrate the nose and mouth if inhaled and can enter the lungs and respiratory tract),
- Nuisance effects generally associated with deposited dust and the coarser fraction of TSP such as soiling, effects on amenity and visibility, and
- Effects on ecosystems.

Dust discharges from mine activities typically produce larger particle sizes, generally referred to as 'deposited particulates'. As a class of material, deposited particulates have only minimal physical health impacts (due to limited penetration into the respiratory tract). However, they may cause nuisance or amenity effects in sensitive areas due to soiling of clean surfaces, or reduced visibility.

7.1.2 Potential for dust generation associated with project activities

Dust particles generated by mine activities generally fall into the larger size fractions, with an aerodynamic diameter of 100 micrometres (0.1 mm) or greater. The larger the particle size, the less distance it will travel in light to moderate winds. The GPG Dust states:

> *"When dust particles are released into the air, they tend to fall back to ground at a rate proportional to their size. This is called the settling velocity. For a particle 10 micrometres in diameter, the settling velocity in calm conditions is about 0.5 cm/sec, while for a particle 100 microns in diameter it is about 45 cm/sec in still air. To put this into a practical context, consider the generation of a dust cloud at a height of one metre above the ground. Any particles 100 microns in size will take just over two seconds to fall to the ground, while those 10 microns in size will take more than 200 seconds. In a 10-knot wind (5 m/sec), the 100 micrometre particles would only be blown about 10 metres away from the source while the 10 micrometre particles have the potential to travel about a kilometre. Fine particles can therefore be widely dispersed, while the larger particles simply settle out in the immediate vicinity of the source".*

In steady wind conditions, with average wind speeds of less than 10 m/s (typical of most areas in New Zealand), and without vehicle movements, 100 µm particles would travel only a few tens of metres from the source. However, this theoretical calculation takes no account of re-entrainment of dust, or of the effects of turbulent airflow over unsealed surfaces.

As a rule, based on the discussion regarding particles size in the GPG Dust and the results of research into dust entrainment, dust deposition is unlikely to occur to any significant degree beyond a distance of approximately 100 - 200 m from significant dust sources in most circumstances. Dust nuisance is more likely to occur within such proximity of a significant dust source.[15] IAQM[16] considers receptors located more than 200 m to 400 m from a dust source has as being "Distant" (which is the farthest separation distance category).

[15] Etymezian V et al "*Deposition and Removal of Fugitive Dust in the Arid Southwestern United States: Measurements and Model Results",* Journal of the Air & Waste Management Association, Volume 54 September 2004

[16] Institute of Air Quality Management "*Guidance on the Assessment of Mineral Dust Impacts for Planning"* May 2016.

Local environmental conditions may influence the potential range of dust deposition. High average wind speeds, a high frequency of strong winds or complex local topography may increase the potential range over which dust deposition occurs. The degree of vegetative cover in the area will also have an impact on the distance dust is likely to travel. Vegetation such as trees act as an effective dust barrier and filter, thus reducing the distance dust can travel downwind.

The terrain in the area surrounding the project site is predominantly flat, which may increase the potential for some dust deposition to occur at greater distances. However, dust impacts will occur mainly within 200-400 m of sources, even at the dustiest sites [17].

The closest sensitive receptor (dwelling) in the vicinity of the project is more than 1 km from Innes Mills (refer Figure 3-6). Sensitive receptors in other areas are more than 2.2 km from the Coronation Pit and Golden Bar Pit. Therefore, provided the dust mitigation methods specified in the site DMP are implemented, any dust emitted from the proposed activities project is expected to be well dispersed before reaching these receptors.

7.2 Assessment of Potential for Dust to Cause Adverse Effects

7.2.1 Introduction

Dust deposition is the settling of dust onto surfaces. The effects of dust deposition can be subjective and is dependent on the sensitivity of the receiving environment. Some people will not be annoyed by dust, others will be annoyed, and some may find it objectionable or offensive. Dust fallout on a road or rural farmland may not be a nuisance even at relatively high deposition rates.

Typically, the most common areas of concern from dust deposition arise at residential properties (or similar sensitive locations such as retail premises or schools) and include the visible soiling of clean surfaces such as cars, window ledges and household washing as well as dust deposits on vegetation.

7.2.2 FIDOL Factors

The GPG Dust notes that the potential for a dust discharge to cause an objectionable or offensive effect depends on the following characteristics of the dust fallout:

- The **f**requency of dust nuisance events,
- The **i**ntensity of events, as indicated by dust quantity and the degree of nuisance,
- The **d**uration of each dust nuisance event,
- The **o**ffensiveness of the discharge having regard to the nature of the dust, and
- The **l**ocation of the dust nuisance, having regard to the sensitivity of the receiving environment.

These factors are known as the FIDOL factors and are used to consider whether a dust discharge will cause an offensive or objectionable effect. Essentially, whether a dust discharge leading to dust deposition causes an offensive or objectionable effect depends on how frequent it is, the sensitivity of the receiving environment and how much dust is deposited.

7.2.3 IAQM Risk Assessment

The IAQM has developed a risk assessment method based on the FIDOL factors, which uses a series of semi-quantitative matrices to estimate the likelihood of dust reaching receptors based on the distance between the source and the receptor and the frequency of winds which blow in the direction of the receptor. These are combined with the scale of the operation and the sensitivity of the receptor to produce an estimate of the potential risk of adverse effects arising. A risk assessment of the potential nuisance effects of dust from the

[17] Institute of Air Quality Management "*Guidance on the Assessment of Mineral Dust Impacts for Planning"* May 2016.

proposed project activities using the IAQM method has been carried out for the closest sensitive receptors to the proposed project activities. The results of the risk assessment are summarised in the following sections. The risk assessment matrices are included in **Appendix C**.

7.2.4 Assessment methodology

To assess the potential effects of dust on the closest residences to the project activities, a combination of the FIDOL factors and the IAQM risk assessment methods have been used.

7.3 Overall MP4 Stage 3 Project Pathway Effectiveness Assessment

The IAQM assessment first requires the determination of the dust pathway effectiveness based on the IAQM dust risk categories, with respect to distance from the pit extension and the frequency receptors are downwind of the pit during wind speeds greater than 5 m/s. As noted in earlier sections, dust can be picked up from consolidated surfaces when wind speeds are greater than 5 m/s.

All of the receptors for the whole MP4 Stage 3 project are classified by the IAQM as being "Distant" (which is the farthest separation distance category), as they are located more than 200 m to 400 m from a dust source.

Winds above 5 m/s in the direction of receptors for the whole MP4 Stage 3 project occur for less than 5% of time for all wind directions, except for WSW which is marginally over this threshold at 5.07% of the time. Most wind directions are therefore classified by IAQM as being “infrequently” downwind of the respective operations with the WSW direction only, receiving winds >5 m/s for marginally more often than 5% of the time. Consequently, the IAQM dust pathway effectiveness is classified as “ineffective” for all the receptors for the MP4 Stage 3 project activities. The risk assessment assumes some mitigation is already in place, but if the conclusion of the assessment is there is likely to be a significant effect, further mitigation would be required.

Therefore, emissions of dust from the proposed activities can be expected to be well dispersed and diluted before reaching these receptors. The larger dust particles would also be deposited to the ground over the separation distance. Consequently, the contribution (intensity) of the emissions from the proposed project activities to air quality amenity, at the nearby sensitive receptors, would be minimal and unlikely to be considered offensive, provided the current mitigation procedures documented in OGNZL Site Dust Management Plan are implemented.

Assessment of individual parts of the project are discussed in Sections 7.4 to 7.6 of this report.

7.4 Potential Dust Effects at Nearby Sensitive Receptors to Coronation Pit

Receptors with a moderate to high sensitivity to dust nuisance effects, in the vicinity of the proposed Coronation Pit extension, are summarised in Table 7-1. Receptor R5 is the closest residential dwelling to Coronation Pit (on land not owned by OGNZL). Table 7-1 shows that winds above 5 m/s in the direction of Coronation Pit receptors occur for less than 0.7% of time. This means those receptors are classified by IAQM as being “infrequently” downwind of the proposed Coronation Pit extension during adverse wind conditions. The dust effectiveness pathway for Coronation Pit receptors is therefore “ineffective”.

Table 7-1. Receptor IAQM Pathway Effectiveness Assessment for Sensitive Receptors - Coronation Pit

Receptor	Location relative to nearest dust source	Distance from Source category	Frequency downwind in winds >5 m/s	Frequency Downwind category	Dust Pathway Effectiveness category
R4 Four Mile Road	3.6 km northwest of Coronation North Backfill.	Distant	0.2% SE	Infrequent	**Ineffective**
R5 406 Horse Flat Road	2.2 km south of Coronation Pit ext	Distant	0.7% N	Infrequent	**Ineffective**
D Golden Point Reserve	2.9 km southeast of Coronation Pit ext	Distant	0.1% NW	Infrequent	**Ineffective**
E Callery's Battery	2.9 km southeast of Coronation Pit ext	Distant	0.1% NW	Infrequent	**Ineffective**

Based on the IAQM Guidance document, the risk and level of potential effects of the proposed project activities on local receptors are summarised in Table 7-2. The proposed pit expansion has been classified as being a "large" dust source.

For "large" sources with an "ineffective" pathway the risk of dust impacts is classified as "low". The closest receptor to Coronation Pit, which has a high sensitivity to dust nuisance, is located more than 2.2 km from the Coronation Pit extension. This receptor may experience a slight adverse effect. The Golden Point Reserve and Callery's Battery historical landmarks are located approximately 2.9 km southeast of Coronation Pit and are considered to have a medium sensitivity to dust effects. These receptors have been assessed as being negligibly adversely affected.

The IAQM considers "slight adverse effects" to be "not significant". Provided appropriate dust control procedures are implemented, potential impacts are considered to be appropriately mitigated and therefore less than minor.

Table 7-2. IAQM Assessment of Magnitude of Dust Effects for Sensitive Receptors – Coronation Pit

Receptor	Location relative to nearest dust source	Residual source emissions	Pathway effectiveness	Dust impact risk	Receptor sensitivity	Likely Magnitude of dust effect
R4 Four Mile Road	3.6 km northwest of Coronation North Backfill.	Large	Ineffective	Low risk	High	**Slight adverse effect**
R5 Resident 406 Horse Flat Road	2.2 km south of Coronation Pit	Large	Ineffective	Low risk	High	**Slight adverse effect**
D Golden Point Reserve	2.9 km southeast of Coronation Pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
E Callery's Battery	2.9 km southeast of Coronation Pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**

Given the separation distance between Coronation Pit, the Coronation North backfill and these receptors, any dust emission from the Pit extension, or other existing operations further away from the receptors, would be expected to have negligible impact on air quality amenity at these receptors. The wider site activities will be in

operation during the project and therefore be a potential continuous source of dust. However, taking into consideration the FIDOL factors and site dust management techniques used on site, emissions from the project are not expected to have an adverse effect outside the site boundary (OGNZL owned land) which is at least 1 km from the operations. The proposed project would also not be expected to have a noticeable impact on TSP concentrations and dust deposition rates which are currently observed at these locations, due to the amount of site equipment essentially remaining constant throughout the project.

All other identified sensitive receptors are located further away than the receptors listed in Table 7-2 and therefore, it is very unlikely they would be adversely affected by dust. Further explanation of the IAQM assessment is included in **Appendix C.**

7.5 Potential Dust Effects at Nearby Sensitive Receptors to IM

Receptors with a moderate to high sensitivity to dust nuisance effects in the vicinity of the Central Mine area proposed works (IM and FRBF) are summarised in Table 7-3. Receptor R9 is the closest residential dwelling to the project (on land not owned by OGNZL). Table 7-3 shows that winds above 5 m/s in the direction of IM and FRBF receptors occur for less than 1.3% of time. This means those receptors are classified by IAQM as being “infrequently” downwind of the proposed pit extensions during adverse wind condition conditions. The dust effectiveness category for IM and FRBF receptors is therefore “ineffective”.

Table 7-3. Receptor IAQM Pathway Effectiveness Assessment for Sensitive Receptors – IM & FRBF

Receptor	Location relative to nearest dust source	Distance from source category	Frequency downwind in winds >5 m/s	Frequency downwind category	Dust Pathway Effectiveness category
R9	0.84 km west of FRBF 1.0 km southwest of IMW	Distant	0.13% E 1.3% NE (IM & FRBF)	Infrequent	Ineffective
R1	1.0 km west of FRBF 1.1 km southwest of IMW	Distant	0.13% E 1.3% NE (IM & FRBF)	Infrequent	Ineffective
R2	1.5 km west southwest of FRBF 1.5 km southwest of IMW	Distant	1.2% ENE 1.3% NE (IM & FRBF)	Infrequent	Ineffective
A	1.7 km southwest of FRBF 1.7 km west southwest of IMW	Distant	1.3% NE 1.2% ENE (IM & FRBF)	Infrequent	Ineffective
R5	3.9 km northwest of IMW	Distant	0.2% SE	Infrequent	Ineffective
D	2.4 km north northwest of IMW	Distant	0.03% SSE	Infrequent	Ineffective
E	2.4 km north northwest of IMW	Distant	0.03% SSE	Infrequent	Ineffective

Based on the IAQM Guidance document, the risk and level of potential effects of the proposed project activities on local receptors are summarised in Table 7-4. The proposed pit expansions are considered to be “large” emission sources. The risk of adverse dust impacts is classified as “low” for all the receptors.

The closest receptors to the IM expansions, which have a high sensitivity to dust nuisance, are located more than 840 m from the Innes Mills Pit extension. The three residences on Macraes - Dunback Road in Macraes village are considered to have a high sensitivity to dust effects. The receptors are located to the southwest of Innes Mills Pit and may experience a slight adverse effect.

The other medium sensitivity receptors have been assessed by the IAQM method as being “negligibly” adversely affected. As discussed in Section 7.4, the IAQM considers “slight adverse effects” to be “not significant”.

Table 7-4. IAQM Assessment of Magnitude of Dust Effects for Sensitive Receptors – IM & FRBF

Receptor	Location relative to nearest dust source	Residual source emissions	Pathway effectiveness	Dust impact risk	Receptor sensitivity	Likely Magnitude of dust effect
R9	0.84 km west of FRBF 1.0 km southwest of IMW	Large	Ineffective	Low risk	High	**Slight adverse effect**
R1	1.0 km west of FRBF 1.1 km southwest of IMW	Large	Ineffective	Low risk	High	**Slight adverse effect**
R2	1.5 km west southwest of FRBF 1.5 km southwest of IMW	Large	Ineffective	Low risk	High	**Slight adverse effect**
A	1.7 km southwest of FRBF 1.7 km west southwest of IMW	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
R5	3.9 km northwest of IMW	Large	Ineffective	Low risk	High	**Slight adverse effect**
D	2.4 km north northwest of IMW	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
E	2.4 km north northwest of IMW	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**

Given the separation distance between IM and FRBF and these receptors, any dust emissions from operations would be expected to have negligible impact on air quality amenity at these receptors. The wider site activities will be in operation during the project and therefore, be a potential continuous source of dust. However, taking into consideration the FIDOL factors and site dust management techniques used on site, emissions from the project are not expected to have an adverse effect outside the site boundary. The proposed project would also not be expected to have a noticeable impact on TSP concentrations and dust deposition rates, which are currently observed at these locations, due to the amount of site equipment essentially remaining constant throughout the project.

All other identified sensitive receptors are located further away than the receptors listed in Table 7-4 and therefore, it is very unlikely they would be adversely affected by dust. Further explanation of the IAQM assessment is included in **Appendix C.**

7.6 Potential Dust Effects at Nearby Sensitive Receptors to Golden Bar Pit

Receptors with a moderate to high sensitivity to dust effects in the vicinity of the proposed Golden Bar project are summarised in Table 7-5. Receptor R6 is the closest residential dwelling to the project (on land not owned by OGNZL).

Table 7-5 shows that winds above 5 m/s blow in the direction of receptors less than 3.9% of the time, which is classified as “infrequent” in the IAQM assessment. The dust effectiveness pathway for “distant” receptors, that are “infrequently” downwind to experience dust, is classified as “ineffective”.

Table 7-5. Receptor IAQM Pathway Effectiveness for Sensitive Receptors Golden Bar

Receptor	Location relative to nearest dust source	Distance from source category	Frequency downwind in winds >5 m/s	Frequency Downwind category	Dust Pathway Effectiveness category
R6 Residence 593 Macraes - Dunback Road	3.0 km north northeast of GB expanded pit	Distant	0.6% SSW	Infrequent	Ineffective
R7 Residence 659 Richie Road	3.9 km northeast of GB expanded pit	Distant	3.9% SW	Infrequent	Ineffective
R8 Residence 800 Stoneburn Road	3.2 km southeast of GB expanded pit	Distant	1.9% NW	Infrequent	Ineffective

Based on the IAQM Guidance document, the risk and level of potential effects of the proposed project activities on local receptors are summarised in Table 7-6. The proposed pit expansion has been classified as being a “large” dust source.

For “large” sources with an “ineffective” pathway, the risk of dust impacts is classified as “low”. All the residences in the vicinity of the Golden Bar pit are considered to have a medium sensitivity to dust effects as they are located more than 3 km from the edge of the pit. These receptors have been classified as being negligibly adversely affected.

The IAQM considers “slight adverse effects” to be “not significant”. Provided appropriate dust control procedures are implemented, potential impacts are considered to be appropriately mitigated.

Table 7-6. IAQM Assessment of Magnitude of Dust Effects for Sensitive Receptors - Golden Bar

Receptor	Location relative to nearest dust source	Residual source emissions	Pathway effectiveness	Dust impact risk	Receptor sensitivity	Magnitude of dust effect
R6	3.0 km north northeast of GB expanded pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
R7	3.9 km northeast of GB expanded pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
R8	3.2 km southeast of GB expanded pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**

Given the separation distance between Golden Bar Pit and these receptors, any dust emission from operations would be expected to have negligible impact on air quality amenity at these receptors. Taking into

consideration the FIDOL factors and site dust management techniques used on site, emissions from the project are expected to have less than minor adverse effects outside the site boundary.

All other identified sensitive receptors are located further away than the receptors listed in Table 7-6 and therefore it is very unlikely they would be adversely affected by dust. Further explanation of the IAQM assessment is included in **Appendix C.**

7.7 Potential Effects of Dust from the Haul Road on Nearby Residences

The closest residential dwelling to the haul road beside Innes Mills is located approximately 650 m from the road. The separation distance is such that any dust generated from vehicle movements is highly unlikely to have any adverse effect at that receptor. Other sensitive receptors are located much further away and therefore, it is very unlikely they would be adversely affected by dust from the haul road.

OGNZL will continue to use standard dust mitigation methods to minimise the tracking of debris onto the road from truck wheels and the generation of dust from truck loads. Haul roads are maintained and graded, and a water cart used to dampen the road during potentially dusty conditions.

Any adverse effects resulting from dust emissions from the road are expected to be negligible.

7.8 FIDOL Summary

Overall:

- There are infrequent winds above 5 m/s in the direction of sensitive receptors.
- There is a significant distance to neighbours which allows for particulate drop-out and therefore a low intensity of dust at sensitive receptors.
- The operation is continuous but, as discussed above, the frequency of higher winds in the direction of receptors is low so the duration of dust events is also low.
- The dust from the mine originates from soil and sand and is therefore similar to other dust experienced in a rural area.
- There is a low population of sensitive receptors in the area around the mine due to it being a rural area.

7.9 Potential Health Effects from Inhalable Particulate Matter

A proportion of the particulate matter generated by the project activities will be fine particulate matter (PM_{10} and $PM_{2.5}$) and this is likely to contain a proportion of crystalline silica. Fine particulate matter and crystalline silica particles that are small enough to be inhaled deep into the lungs (RCS)[18], have the potential to cause adverse health effects if people are exposed to concentrations above recommended standards and guideline concentrations for extended periods of time (refer Section 5.1).

Ambient air concentrations of PM_{10}, $PM_{2.5}$ and RCS were measured at Macraes township by OGNZL during the summer months between 1998 and 2000[19]. Monitoring undertaken at the three TSP monitoring sites plus an additional site located to the north of the Golden Point Pit used two high volume samplers at each site, one fitted with a PM_{10} head and the other fitted with a $PM_{2.5}$ head. The particulate collected on the $PM_{2.5}$ filters

[18] Inhalable silica particles are known as respirable crystalline silica or RCS

[19] Beca Infrastructure Ltd (2011) "*OceanaGold NZ Ltd Phase III Development – Assessment of Environmental Effects of Air Discharges";* report prepared for OceanaGold

was analysed for respirable crystalline silica concentrations. Samples were taken once a month at each site in November through to March 2000.

Measured PM_{10}, $PM_{2.5}$ and RCS concentrations were found to be well below guideline values for the protection of human health and therefore further monitoring was not considered to be warranted.

The major sources of fine particulates from the project activities will be vehicle exhausts and the abrasion of surface materials on roads by vehicle movements.

The discharge of fine particulates and other products of combustion from vehicle exhausts on the site will be spread across a large area and the contaminants will be well dispersed and diluted prior to reaching the closest dwelling. Any effects resulting from exhaust emissions from vehicles operating on the site, on the health of nearby residents, are therefore expected to be negligible.

The mitigation measures undertaken by OGNZL to control larger particles of dust from the proposed project activities will also effectively control the discharge of finer particulates. Providing these mitigation measures are carried out effectively, it is expected that any health effects resulting from the discharge of fine particulate matter and RCS will be negligible and concentrations of PM_{10}, $PM_{2.5}$ and RCS will not exceed the relevant standards and guideline values at locations where people are likely to be exposed.

7.10 Potential Effects on Vegetation

Excessive dust has the potential to adversely affect vegetation by interfering with plant photosynthesis, promoting weed or disease occurrence and impacting on the efficient application of pesticides or fertilisers. Excessive dust can also make pasture unpalatable to stock. The nature and degree of effects of dust deposition on plants is dependent on the chemical characteristics of the dust, the particle size of the dust and the species of plant. However, there is very little quantitative information available on the levels of dust deposition that may lead to adverse effects on vegetation.

The vegetation surrounding the proposed project activities is predominantly pasture and pine trees. Both the IAQM and the GPG Dust consider that farmland and pines have a low sensitivity to dust. Providing OGNZL carries out the dust mitigation measures described in the Site Dust Management Plan, any adverse effects on vegetation beyond OGNZL owned land are expected to be negligible.

7.11 Dust Complaints Register

Any air quality (including dust-related), complaints received are recorded in a register by OGNZL and are presented in Table 7-7. Between 2012 and 2023, four complaints were received which attribute nuisance dust events to mine operations. On average, the number of complaints received is less than 1 every two years, which is low for an activity of the scale of the Macraes mining operation.

Although dust complaint records are not conclusive indicators of the presence or absence of dust nuisance, they provide a broad indication of the nuisance dust effects which are experienced in the vicinity of a site. Overall, the small number of complaints indicate dust levels in the vicinity of the Macraes Gold Project site are generally acceptable to the community and dust emissions are effectively controlled by the existing mitigation methods.

It should be noted that complainants who have reported nuisance dust events are located more than 1.1 km from the mine activities. Table 7-7 also shows the distance of these complainants to other activities within the mine operation. Due to the separation distance between these receptors and the proposed project activities, any emissions of dust from the project are highly unlikely to have an adverse effect at these locations.

Table 7-7. Summary of dust nuisance complaints received by OGNZL

Year	Complaint Date	Location	Details	Action Taken
2012	None	NA	NA	NA
2013	None	NA	NA	NA
2014	None	NA	NA	NA
2015	None	NA	NA	NA
2016	None	NA	NA	NA
2017	None	NA	NA	NA
2018	28 September 2018	Coronation Project, approximately 2.2 km south of Coronation Pit extension and 1.1 km southwest of the haul road to Coronation Pit. The residential dwelling is 200 m southwest of unsealed Horse Flat Road.	The complaint was received from a resident located on Horse Flat Road. Excessive dust was observed on 15 September. The complainant was concerned about the dust as they had two children with asthma. The Horse Flat Road resident is approximately: 2.2 km south of Coronation Pit 3.9 km northwest of IMW	Video footage overlooking the Process Plant did not indicate excessive dust was being generated at site during the incident. One of the water trucks used for dust suppression was not in operation at the time of the incident. OGNZL staff considered this may have been the main contributing factor to the incident. However, meteorological conditions at time of the incident were also identified as a potential contributing factor.
2019	06 August 2019	Coronation North Project Area, approximately 2.3 km south of Coronation Pit extension	The complaint was received from a resident located on Horse Flat Road. Excessive dust was observed and suspected to be impacting the residents with asthma.	Water trucks were not in operation at the start of the day due to the risk of the water icing up the roads.
	31 October 2019	Coronation Project Area, approximately 2.2 km south of Coronation Pit	The complaint was received from a resident located on Horse Flat Road. The resident raised concerns associated with dust emitted from the hauling of material from Coronation Pit to the Process Plant.	The dust incident was attributed by the OGNZL staff to a delay in getting a water truck used for dust suppression to the site of operations.
2020	31 August 2020	Top Tipperary Tailings Storage Facility (TTTSF), 1.3 km northeast of Frasers Pit	Excessive dust blowing from the TTTSF surface (high winds) and an area of the tailings surface had dried out due to an infrastructure upgrade and maintenance.	The source of the dust observed at the east end of the TTTSF was attributed by OGNZL staff to construction activities being undertaken in this area.

Year	Complaint Date	Location	Details	Action Taken
2021	None	NA	NA	NA
2022	None	NA	NA	NA
2023	None	NA	NA	NA

7.12 Greenhouse Gases

7.12.1 Background

The Resource Management Amendment Act 2020 repeals several sections of the Resource Management Act 1991 and lifts the restrictions on consent authorities to consider greenhouse gases in discharge permit applications. This change took effect from 1 December 2022. The Ministry for the Environment promulgated the Resource Management (National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat) Regulations 2023 (NES-IGHG) on 27 July 2023. These standards set out nationally consistent rules for specific greenhouse gas emitting activities from industrial process heat. As vehicle emissions are not related to industrial process heat, these regulations do not apply to OGNZL activities.

The activities at the Macraes site have involved the operation of diesel vehicles and machinery for a long period. As there is a small level of variation in mining fleet numbers as the wider mining activities progress, the activities described in this application will not significantly increase the overall vehicle emissions from the site as shown in Tables 2-1 and 2-2. OGNZL is also proposing the introduction of an electrical excavator which is part of a site emissions reduction plan (see below).

Greenhouse gases include carbon dioxide (CO_2) which has the potential to retain heat emitted from the Earth's surface with the consequential effect of climate change, potential sea level rise and global temperature rise. Carbon dioxide emissions from vehicles and machinery for the Macraes site are expected to remain approximately the same as current operations, due to the mining machinery moving from one active area to another as the site operations progress. OGNZL has also implemented a GHG mitigation plan[20] aimed at minimising emissions from site. The key GHG reduction options are discussed in Section 7.12.2.

7.12.2 GHG mitigation plan

Options to reduce energy usage and GHG emissions were identified in the March 2021 Beca Energy Transition Acceleration (ETA) study prepared for OGNZL. With a rapid acceleration in technology development to improve energy efficiency and reduce GHG emissions, it is likely that the effectiveness and relative cost of abatement options will reduce over time. With this in mind, an alternate proposed plan by OGNZL has been constructed to balance economic and environmental outcomes. Table 7-8 below provides a consolidated view of the projects to be undertaken at the Macraes site as part of this plan at an expected capital cost of $3.204M and increased operational costs of $0.198M per annum.

Macraes purchased, and are planning to commission, the planned electric shovel (prime mover for overburden) in the near future.

[20] *Macraes Energy and Greenhouse Gas Emissions Management Plan*, 29 December 2021.

Table 7-8. Feasible greenhouse gas reduction options at Macraes site

Primary activities	GHG emissions reduction (annual tonnes)	Capital Investment ($M)	Operational cost impact per annum,(E$M)	Marginal abatement cost ($/tonne CO2e)
Purchase of certified renewable electricity	23,430	0.000	0.300	16
Electrification of one overburden excavator	3,000	2.560	-1.500	-192
Electric water heating of the processing plant	890	0.390	-0.080	-5
Plant heat recovery	440	0.034	-0.140	-178
Totals / Weighted average marginal abatement cost	**27,760**		**-1.455**	

The baseline scenario involves none of these initiatives and sees annual CO_2-e emissions rising from 92,520 t in 2019 to about 113,000 t by 2027 and continuing to 2030 due to deeper pits and longer hauls. The planned reduction of 27,760 t represents a 14% reduction in cumulative CO_2-e emissions (based on the 2019 baseline) and 20% reduction in cumulative emissions (based on the business-as-usual scenario).

The following secondary options will also be considered, based on economic viability, with potential to increase the potential reduction in cumulative GHG emissions by 20% from 2019 baseline (and a 29% reduction in cumulative emissions from a business-as-usual scenario) gross emissions:

- Introduce a second electrical excavator (dependent on the success of the first unit).
- Offset the increased emissions associated with deepening the mine through the procurement and use of sustainably produced biodiesel (or through use of other emerging technology, such as hydrogen or LNG).

This plan is being updated annually with agreed actions incorporated into Life of Mine (LOM) Plans to enable new opportunities to be considered, modelling to be updated and the action plan to be adapted.

7.13 Summary of Effects

7.13.1 Dust Discharges

The potential nuisance effects from dust deposition from the proposed MP4 Stage 3 Project have been assessed to be “negligible” due to the infrequency of winds which exceed 5 m/s in the direction of the most sensitive receptors and the large distances between sensitive receptors and the proposed project activities.

The potential health effects of discharges of PM_{10}, $PM_{2.5}$ and RCS, on the residents of the nearby dwellings, have been assessed as being negligible.

Any adverse effects of dust deposition on vegetation surrounding the proposed project activities are expected to be negligible.

Monitoring undertaken by OGNZL indicates that site dust emissions typically comply with consent limits at the boundary. The proposed activities would not be expected to have any substantial additional impact on site emissions, or offsite contaminant concentrations. Consequently, future dust emissions would also be expected to comply with existing consent conditions which remain fit for purpose.

In summary, providing OGNZL continues to proactively manage dust within the locations of proposed project activities, using the methods described in this report and the Dust Management Plan, any dust from the site can be adequately avoided and mitigated such that discharges beyond the property boundary will not be

offensive or objectionable and any adverse effects, including health effects, will be minimal and the relevant standards and guidelines will not be exceeded.

7.13.2 Greenhouse Gases

Carbon dioxide emissions from vehicles and machinery for the Macraes site are expected to remain approximately the same as current operations, due to the mining machinery moving from one active area to another as the site operations progress. OGNZL has also implemented a GHG mitigation plan[21] aimed at minimising emissions from site.

7.13.3 Consent

The current air discharge consents contain very similar conditions and monitoring limits and these conditions are appropriate and supported for this consent.

[21] *Macraes Energy and Greenhouse Gas Emissions Management Plan*, 29 December 2021.

8 Conclusion

Providing the mitigation measures currently carried out by OGNZL are carried out as described in this report, the risk of dust generated by the proposed project activities causing adverse effects beyond the OGNZL property boundary, to the extent that the dust is offensive or objectionable, is considered to be less than minor.

A

Appendix A – Dust Management Plan

Macraes Operation

Dust Management Plan

November 2020

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Revision History

Date	Revision No.	Issued for	By
04Mar11	A	Initial Draft	Debbie Clarke
18Mar11	B	Amendments to Draft A	Jenny Autridge
01May13	C	Plan Review	Patrick Windsor
09Jul14	D	General Review and Update to include Coronation	Debbie Clarke
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10Aug16	F	Plan Review	Lauren Arnold
23Jan17	G	Review and update to include Coronation North	Lauren Arnold
14 May 19	H	Review and update to include Frasers West	Gavin Lee
23 Nov 20	I	General Review and Update to include Deepdell North Stage III and Frasers West.	Charlotte Boyt

1 BACKGROUND

1.1 Air Discharge Consents

This Dust Management Plan (DMP) covers the area of the original mining operation at Macraes (up until May 2012), the Macraes Phase III mine expansion area, the Coronation Project area and the Coronation North Project area. The most recent permit being Deepdell North Stage III project area. The plan has been prepared to fulfil the requirement for a DMP which is a resource consent condition in four air discharge consents held by Oceana Gold (New Zealand) Limited (OceanaGold). A fifth air discharge consent is held for the ventilation of the Frasers Underground mine. Details of the consents are summarised in Table 1.1.

Table 1.1: Air Discharge Consents held by OceanaGold

Consent Number	Details
Discharge Permit 96785_V5	To discharge contaminants from mining operations and post mining rehabilitation to air in the vicinity of Macraes Flat. (all the minesite except features associated with Macraes Phase III and Coronation).
Discharge Permit 2006.689	To discharge contaminants to air for the purpose of ventilating Frasers Underground Mine.
Discharge Permit RM10.351.52	To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations (Macraes Phase III expansion).
Discharge Permit RM12.378.15	To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations (Coronation Waste Rock Stack, Coronation Pit and associated haul roads, utility areas and stockpiles).
Discharge Permit RM16.138.19	To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations.
Discharge Permit RM20.024.12	To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations.

Discharge Permit 96785_V5, RM10.351.52, RM12.378.15, RM16.138.19 and RM20.024.12 include conditions requiring a DMP. Relevant conditions are reproduced below.

"Prior to the exercise of this consent, the consent holder shall submit a Dust Management Plan to the Consent Authority. The Dust Management Plan shall include, but not be limited to, the following:

(a) A description of potential dust sources and the factors influencing dust generation;

(b) Dust mitigation measures and procedures including, but not limited to:

i) Minimising the areas of disturbed ground;

ii) Watering, with water trucks and fixed sprinklers;

iii) Avoiding as far as possible, ground disturbance when wind may cause dust nuisance;

iv) Taking wind conditions into account in planning and carrying out work to minimise dust dispersion;

v) Ensuring materials being moved are kept in a coarse state;

vi) Covering materials; and

vii) Replanting disturbed ground as soon as possible, including temporary planting if necessary.

(c) A description of dust monitoring equipment and procedures, including methods of analysis and details of the method used for the calculation of background dust concentration should values from one or all of the background sites be unavailable;

(d) Procedures for managing and addressing air quality or odour related complaints; and

(e) Key responsibilities, consultation and reporting, including details of the annual review and independent consultant used as required by Condition 18 of this consent."

"The consent holder shall review the Dust Management Plan annually taking into account the following:

(a) The outcomes of reviews completed in accordance with Condition 10 and 18 of this consent; and

(b) Whether management practices are resulting in compliance with the conditions of this consent.

Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan for the Macraes Gold Project site. The consent holder shall provide the Consent Authority with any updates of the Dust Management Plan within one month of any update occurring."

1.2 Purpose

The purpose of this DMP is:

To facilitate the avoidance, remediation and mitigation of any adverse effects of dust discharges generated from mining activities and to promote proactive solutions to the control of dust discharges from the site.

The DMP includes information on the following:

- The sources of dust at Macraes Gold Project;
- Dust mitigation and prevention measures;
- Monitoring methods;
- Mechanisms for remediation of adverse effects (should this be required);
- Methods for managing complaints regarding dust and keeping records related to compliance; and
- Key responsibilities, consultation and reporting.

The DMP is intended to be a working document and is to be reviewed annually. Any updates made to the DMP must be forwarded to the Otago Regional Council within one month of the update occurring.

1.3 Objectives

The objectives of this management plan are:

- To describe current and proposed dust management methods and procedures;
- To enable OceanaGold to operate in full compliance with resource consent requirements; and
- To describe the dust monitoring regime and reporting of results.

2 SITE OVERVIEW

2.1 Description of Mine Areas

The key features of the Macraes Gold Project up until November 2020 are:

- The Deepdell South, The Deepdell North, Golden Point, Round Hill, Innes Mills, Frasers, Golden Bar, Coronation, Coronation North and Frasers West Open Pits;
- Pit Backfilling in Deepdell North, Coronation, Coronation North and Frasers Pit;
- The Mixed Tailings, Southern Pit 11 and Top Tipperary tailings storage facilities;
- The Deepdell, Northern Gully, Western, Back Road, Frasers West, Frasers East, Golden Bar, Coronation, Coronation North and Trimbells Waste Rock Stacks;
- A processing plant;
- Various offices, workshops and ancillary buildings;
- The Lone Pine Fresh Water Reservoir; and
- All Haul road, light vehicle access roads, assorted silt ponds, topsoil stockpiles, oxide stockpiles and low grade stockpiles.
- Works associated with road realignments of Macraes Dunback Road and Golden Bar Road.
- Construction of dams in Camp Creek and Coal Creek.

2.2 Description of Site and Local Environment

Macraes sits within a rural upland landscape of fluvially dissected rolling hills of moderate relief and with characteristic broad ridge crests; being the coastal extent of Central Otago' s basin and range topography. Prominent regional landscape features include the Nenthorn Valley, Taieri Ridge, Taieri Valley and the Rock and Pillar Range, which lie to the south1 and west, the Shag Valley and Horse Range to the east and the coastal hills and extinct volcanic cones of Palmerston and Waikouaiti to the south.

Pastoral farming is the broad land use in the area, followed by gold mining; the latter has a history in the area that goes back to the nineteenth century. Macraes is on the eastern edge of the schist country and the broader historic goldfields of Central Otago. The presence of the relatively large scale Macraes Gold Operation is a noticeable and culturally interesting element in the current landscape. The Macraes Gold Operation is the modern 'face' of open pit gold mining and its presence and effect relative to landscape change is now a major feature contributing to the local landscape character.

The long term, focal and cultural landscape feature of Macraes Flat is the Macraes village with its hotel, school, churches, cemeteries and small clusters of houses and various outbuildings and shelterbelts. The village sits in splendid isolation within 'the flat' and various local roads lead to even more isolated farms and homesteads. Scattered and isolated habitation is a feature of the open, rolling, landscape on the edge of basin and range topography that expands through to the upper Taieri and the Maniototo.

[1] As noted at Footnote 1, the orientation of the geographic features in the broader landscape are given relative to 'Macraes North'

2.2.1 Macraes Gold Project

Macraes Gold Project has been operational since 1990.The existing mining area extends to the north and south of Macraes-Dunback Road. Initially the mining operations were all to the north of Macraes-Dunback Road and include the Golden Point and Round Hill Pit, and the now backfilled Southern Pit. The Deepdell complex of pits (north and south) lie to the across Deepdell Creek. Since 2000, mining has been developed to the south of the road into Frasers Pit and Golden Bar Pit. Mining has been completed at Golden Bar, whilst mining further mining development in Frasers is planned at Frasers West, Frasers Slip and the Innes Mills Pit backfill.

Waste rock is stored around the Frasers Pit in the Frasers South, Frasers West and Frasers East Waste Rock Stacks as shown in Figure 2.1. A consented but yet to be used area to the north of Frasers Pit – Fraser North Waste Rock Stack is also indicated in Figure 2.1. Waste rock stacks are also located in Northern Gully Waste Rock Stack and to the south at the Backroad Waste Rock Stack, to the east and north east of the Round Hill/Golden Point Pit.

Deepdell North Pit is currently backfilled with Waste Rock, whilst Deepdell South Pit remains a pit lake. Plans are currently being developed to backfill this lake with a cutback in the Deepdell North Pit backfill.

The Coronation and Coronation North projects commenced in 2015 and 2017 respectively and are located on the Taieri Ridge. Mining consists of the Coronation and Coronation North Pits and associated waste rocks stacks. Coronation and Coronation North are linked to the Process Plant via a haul road and a culvert crossing across Deepdell Creek. They are located on the, in the headwaters of; Camp Creek (Shag River catchment),
The Top Tipperary Tailings Storage Facility is located to the east of the present mining activity and is the current operational facility for deposition of tailings. The Mixed Tailings Impoundment and the Southern Pit 11 tailings storage are currently in the process of being rehabilitated, whilst also providing some water storage.

The processing plant is central located on the south side of Deepdell Creek and below the Southern Pit and Mixed Tailings facilities.

The Deepdell Pits, Round Hill/Golden Point Pit, the associated waste rock stacks, the Southern Pit 11 and Mixed Tailings Storage Facilities and sections of Coronation Pit and Waste Rock Stack lie in the Deepdell Creek Catchment. Whilst the Frasers Pit and associated rock stacks lie predominantly in the North Branch of the Wakouaiti River catchment. The Top Tipperary Waste Rock Stack and a small portion of Frasers East Waste Rock Stack lies in the Tipperary Creek Catchment. Coronation North Pit and Waste Rock Stack and sections of Coronation Pit and Waste Rock Stack lie in the Maori Hen Creek and Trimbells Gully Creek (tributaries of the Mare Burn in the Taieri River catchment).

The mine site occupies an area of approximately 1500 hectares.

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Figure 2-1 Macraes Gold Project Mine Elements

2.2.2 Local Environment

The land in the vicinity of the Macraes Mine is rural and is of a similar character to the land surrounding the existing mine. The topography of the area is dominated by the large waste rock stacks and mine pits. Rehabilitated waste rock stacks have been shaped so that their profile, contours, skylines and transitions blend with the surrounding natural landforms. The land to be mined is all owned by OceanaGold with the exception of the Camp Creek Reservoir site.

Figure 2.2 shows the areas of land in the vicinity of the mine which are owned by OceanaGold, including areas of land leased and the boundaries of land owned by neighbours. The map also shows the locations of the existing and proposed mine activities and demonstrates the distances from the mining activities to the boundaries with neighbouring properties.

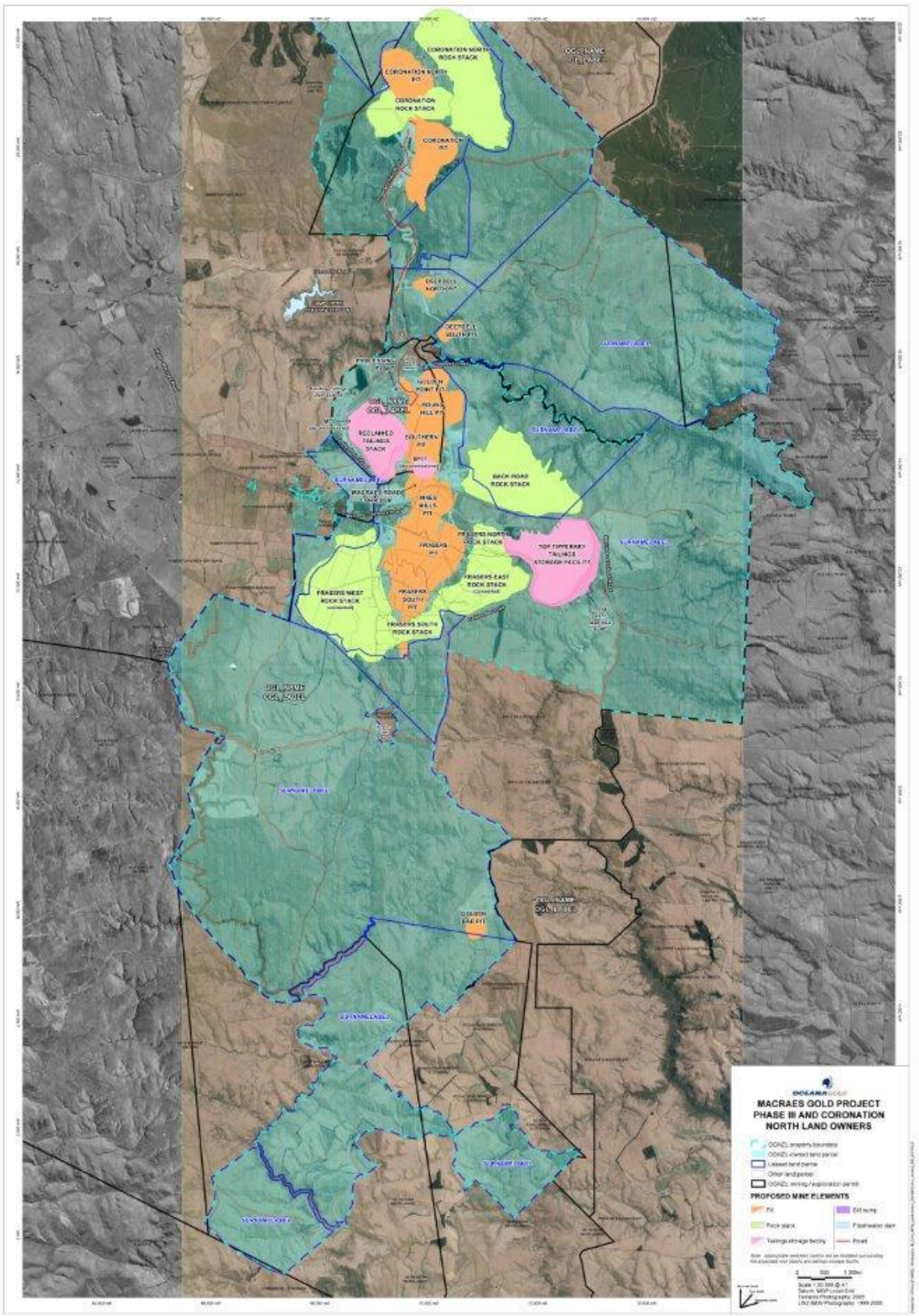

Figure 2-2: Land Owned and Leased by OceanaGold and Locations of Neighbouring Landowners

2.2.3 Site Weather Conditions

The main features of the Macraes Flat climate are the relatively low rainfall (site average annual rainfall is 634mm) and the moderately strong average wind speed of 5.5m/s[2]. Both of these features can contribute to the generation and transport of dust. OceanaGold measures wind speed and wind direction at a climate station located on Golden Point Road and at a second site adjacent to dust monitoring site 15 near the Macraes Village. A typical windrose for the years 2000-2006 is shown in Figure 2.4. Winds tend to blow predominantly from the south and west. The strongest winds also come from these quarters. Winds from the northerly and easterly quarters tend to be lighter and less frequent.

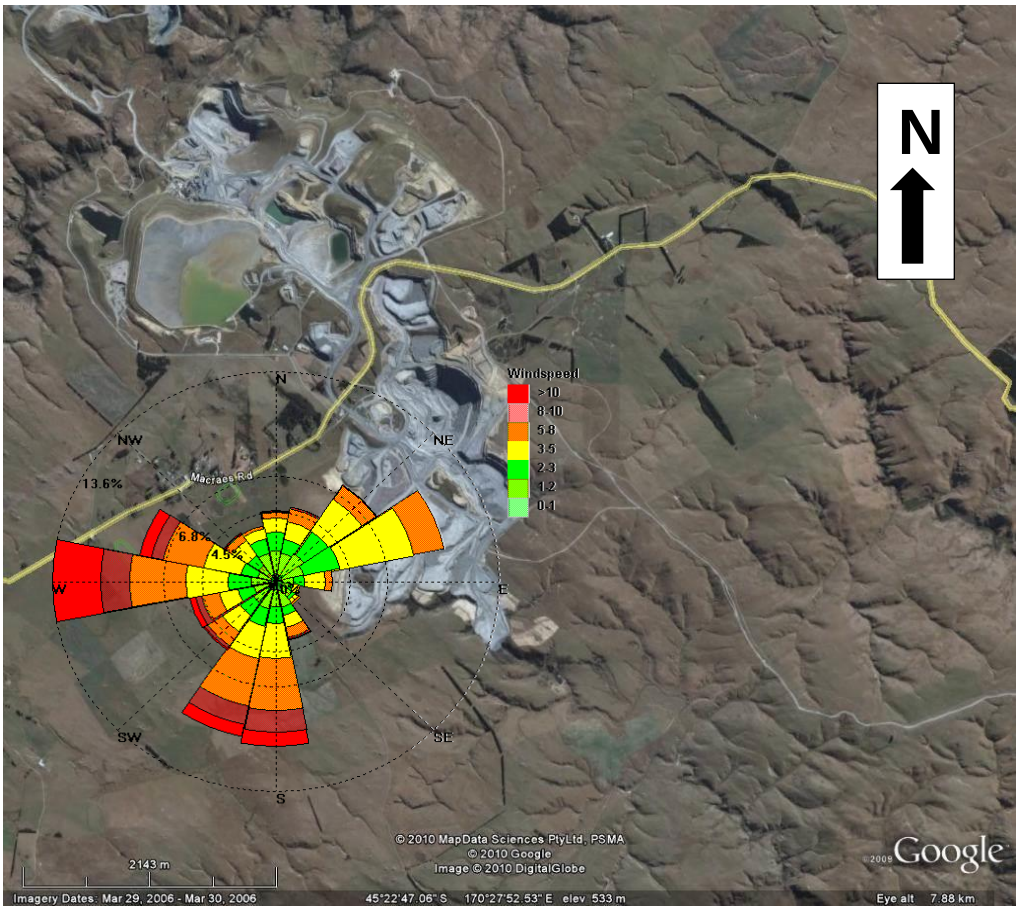

Figure 2-3: Macraes Windrose based on Data from the Golden Point Weather Station 2000 to 2006

[2] Macraes Mining Company Ltd. Macraes Gold Project Discharges to Air Assessment of Environmental Effects December 1996.

3 DUST SOURCES AND GENERATION

3.1 Potential Dust Sources

The following activities have the potential to generate dust:

- Blasting of rock;
- Excavation, including stripping of overburden and topsoil;
- Vehicle movements on unpaved surfaces (i.e. haul roads);
- Loading and unloading of materials;
- Wind generated dust from dry exposed surfaces such as stockpiles, tailings impoundment surfaces and non-rehabilitated surfaces; and
- Crushing of materials.

Dust emissions from exposed surfaces generally increase with increasing wind speed. However, dust pick up by wind is only significant at wind speeds above 5m/s. The smaller the particle size of the material on an exposed surface, the more easily the particles are able to be picked up and entrained in the wind. Moisture binds particles together preventing them from being disturbed by winds or vehicle movements. Similarly vegetated surfaces are less prone to wind erosion than bare surfaces. The larger the areas of exposed surfaces the more potential there will be for dust emissions.

Vehicles travelling over exposed surfaces (i.e. haul roads) tend to pulverise any surface particles. Particles are lifted and dropped from rolling wheels and the surface. Dust is also sucked into the turbulent wake created behind moving vehicles.

The discharge of dust from haul roads has the potential to have effects on two scales. The first is individually from a source where the effects are localised in the immediate area surrounding the activity. Secondly, cumulative effects may be observed where the dust generated from all of the nearby dust sources (such as machinery operating in the pit and adjacent haul roads) combine to affect the air quality of the area as a whole. Therefore, it is important that all dust sources be minimised as far as practical, including those well separated from sensitive locations, as all dust generated will have an effect on the overall air quality in the area.

3.2 Factors Influencing Dust Generation

There are five major factors which influence the potential for dust to be generated from the site. These are:

- Wind speed across the surface;
- The percentage of fine particles in the material on the surface;
- Moisture content of the material;
- The area of exposed surface;
- Disturbances such as traffic, excavation, loading and unloading of materials and blasting.

Systems for controlling dust emissions need to include methods that modify the condition of the materials so that it has a lesser tendency to lift with the wind or disturbances such as vehicle movements, and methods that reduce the velocity of the wind at the surface.
Watering of exposed surfaces and materials that may be disturbed is a primary method of control. As a general guide, the typical water requirements for most parts of New Zealand are up to 1 litre per square meter per hour.

The dust prevention methods detailed in Section 4 are the methods that have been found to be effective over the last 20 years of operation at the Macraes mine site. They can be used alone or in combination depending on the circumstances.

4 DUST MITIGATION MEASURES AND PROCEDURES

The following measures and procedures are implemented as necessary. Where relevant, the measures and procedures are also incorporated into contractor's responsibilities.

Unpaved Surfaces (haul roads, waste rock stacks, tailings impoundment surfaces, pits)

- Limit the area of exposed surfaces.
- Retain as much vegetation as possible.
- Keep tailings impoundment, pit and haul road maintenance up to date, such as repair of pot holes and the laying of fresh gravel or surfacing material.
- Keep haul road and exposed surfaces damp during dry conditions with water carts or fixed sprinklers.
- Cover exposed fine fill materials with coarse materials where practicable.

Vehicles (light vehicles, dump trucks, earthmoving machinery)

- Minimise traffic movements and control vehicle speeds to a maximum of 60km/h on haul roads.
- Adhere to load sizes to avoid spillages.
- Minimise travel distances through appropriate site layout and design**.**

Stockpiles (topsoil, brown rock, waste rock)

- Limit the height and slope of stockpiles to reduce wind entrainment.
- Orientate stockpiles to maximise wind sheltering.
- Minimise drop heights.
- Vegetate stockpiles of any materials that are to be left undisturbed for more than three months.
- Maximise shelter from winds as practicable.

Miscellaneous

- Revegetate exposed soil with appropriate vegetation as soon as practical.
- Install wind fences or barricades where practicable and appropriate.
- Minimise the area of surfaces covered with fine materials.
- Remove topsoil and loose material covering rock prior to blasting.
- Schedule potentially dusty operations where possible to avoid times of the day and year when conditions are likely to be particularly dry and windy.
- Schedule blasts to take into account wind conditions.

In addition to the above measures, specific dust mitigation methods exist for the tailings impoundment surfaces. These mitigation methods are detailed in the *Southern Pit 11 Tailings Impoundment, Mixed Tailings Impoundment and Top Tipperary Tailings Storage Facility Dust Control Manual presented in Appendix B*. Specifically, the measures outlined in the Tailings Dust Control Manual include:

Tailings Discharge

- Tailings deposition to be sequentially moved around the dam, restricting the likelihood of windborne dust generation created by the tailings beach drying out.

Rock Mattress Cover

- If feasible mitigate dust generation from the tailings beach via construction of a rock mattress. A rock mattress to be laid out over the outer 120m of the tailings beach for the Mixed Tailings and 90m for the Southern Pit 11 Tailings Impoundments.

- Rock mattress construction will commence as soon as practicable after cessation of tailings deposition for impoundments constructed using upstream construction methods.

Tailings Wetting System

- For impoundments constructed using upstream construction methods a tailings wetting system is to be established following rockfill mattress construction to enable distribution of either water or tails onto the inner surface of the impoundment surface not covered by the rock mattress.

- Tailings wetting systems are to have the capacity to be operational at all times when the impoundment is not active or resting.

- Limit traffic on the tailings surface when the impoundment is inactive in order to preserve the crust.

- Ensure tailings wetting system can be mobilised to other areas of the impoundment where necessary to mitigate dust generation.

5 MONITORING

OceanaGold currently holds five air discharge consents: RM10.351.52 (Macraes Phase III), 96785_V5 (covering general mining and processing operations in all areas not covered by Macraes Phase III), RM12.378.15 covering the Coronation area and RM16.138.19 covering the Coronation North area, RM20.021.12 covering Deepdell Stage III as well as Consent No 2006.689 for the purpose of ventilating the underground mine. Copies of these consents are presented in Appendix A.

Under air discharge consents 96785_V5, RM10.351.52, RM12.378.15, RM16.138.19 and RM20.021.12 the following monitoring is currently undertaken:

- Dust deposition rates at monthly intervals at 16 sites
- Real time total suspended particulate concentrations at site DG15. The ORC gave permission for the concurrently operated High Volume Sampler to be disestablished in May 2015);
- Continuous meteorological monitoring of conditions at two representative locations (Sites DG03 and DG15); and
- Daily record kept of water used for dust suppression.

In addition to the resource consent monitoring OceanaGold has a process of checking weather forecasts and advising key operational personnel if strong winds are forecast. This process is set out in the *Tailings Storage Facilities Dust Control Manual*, included as Appendix B.

To ensure that controls are implemented and are effective in minimising dust emissions, OceanaGold monitors weather conditions, the condition of potential dust generating areas and undertakes depositional dust and total suspended particulate monitoring.

Table 5.1 below outlines the current dust monitoring programme.

Table 5.1: Existing Dust Monitoring Programme

Monitoring Activities	Frequency
Check weather forecasts for strong winds and send electronic alerts to key personnel.	Daily
Observe weather conditions, wind via observations (Beaufort Scale)[3].	Daily and as conditions change.
Inspect all haul road surfaces for dampness and general condition.	Daily and as conditions change
Inspect all exposed surfaces for dampness and to ensure that surface exposure is minimised.	Daily and as conditions change.
Inspect tailings impoundment surfaces for dampness.	Daily and as conditions change.
Inspect tailings impoundment dust suppression systems.	Twice daily during extended periods of no deposition
Monitor dust deposition rates in 16 gauges surrounding the mine site.	Monthly
Monitor real time Total Suspended Particulate (TSP) at Dust Site 15 using a Nephelometer.	Continuously
Monitor meteorological conditions at Dust Sites 3 and 15.	Continuously

The locations of the depositional and total suspended particulate monitoring sites are shown on Figure 5.1.

[3] A description of the Beaufort Scale can be found in Appendix C

5.1 Monitoring Equipment Specifications

Specifications of the equipment used to undertake these monitoring activities can be found in Tables 5.2 to 5.4 below.

Table 5.2: Monitoring Equipment at Site DG15

Monitor Type	Monitor Specifications
Nephelometer (real time total suspended particulate monitoring)	Met One E-Sampler-9800.
Atmospheric monitoring site	Temperature sensor: Campbell Scientific 107 Anemometer: Vector A101M Wind Vane: Vector W200P Rain Gauge: TB3-0.2/P
Dustfall Gauge	Standard Dust Deposition Gauge. Dust gauges are analysed using the Horizontal Deposit Gauge Method.

Table 5.3: Monitoring Equipment at Site DG03

Monitor Type	Monitor Specifications
Atmospheric Monitoring Site	Temperature Sensor: Campbell Scientific 107 Temperature and RH Sensor: Viasala HMP50Y Anemometer: Vector A101M Wind Vane: Vector W200P Rain Gauge: Ota Keiki Seisakusho 34-T Solar Radiation: Apogee SP110 Pyranometer
Dustfall Gauge	Standard Dust Deposition Gauge. Dust gauges are analysed using the Horizontal Deposit Gauge Method.

Table 5.4: Other Dust Monitoring Locations

Monitoring Type	Specifications
Dustfall Gauge	Standard Dust Deposition Gauge. Sixteen gauges are positioned in various locations around site (see Figure 5.1 for locations). Dust gauges are analysed using the Horizontal Deposit Gauge Method.

5.2 Data Analysis and Reporting

5.2.1 Dustfall Gauge Data

Data from dustfall gauges is collected, analysed and reported on a monthly basis by Environmental Standards Limited. Dustfall gauges are analysed using the Horizontal Deposit Gauge method. This method is detailed in the Draft International Standard ISO/DIS 4222.2 ('*Air Quality Measurement of Atmospheric Dustfall – Horizontal Deposit Gauge Method"* 1980).

Depositional dust results are included in the Quarterly Monitoring Reports supplied to the Otago Regional Council.

5.2.2 Atmospheric and Total Suspended Particulate Data

Watercare Services Limited (WSL) undertakes data analysis and reporting for the nephelometer, and atmospheric monitoring station. A monthly summary report is produced once all the data has been collected and analysed. Details of the methods for data analysis can be found in Section 5 of their latest monthly report, which can also be found in Appendix D of this plan.

Total suspended particulate results are included in the Quarterly Monitoring Reports supplied to the Otago Regional Council.

5.3 Compliance Limits

Under resource consent RM10.352.52 (Macraes Phase III) and 96785_V5, the following compliance limits apply:

- Insoluble dust deposition rates at sites DG07, DG20 and DG21 must not exceed 3g/m^2/30days of insoluble dust above background more than twice in any calendar year;
- Insoluble dust deposition rates at sites DG02 and DG15 must not exceed 3g/m^2/30days of insoluble dust above background; and
- 24 hour average total suspended particulate at Site DG15 must not exceed 120ug/m^3.

Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24. In the event that a result for one of these sites is unavailable, the background concentration will be calculated by averaging the remaining sites.

Under resource consent RM12.378.15 (Coronation), the following compliance limits apply:

- Insoluble dust deposition rates at sites DG07, DG20, DG21, DG22 and DG23 must not exceed 3g/m^2/30days of insoluble dust above background more than twice in any calendar year;
- Insoluble dust deposition rates at sites DG02 and DG15 must not exceed 3g/m^2/30days of insoluble dust above background.
- 24 hour average total suspended particulate at Site DG15 must not exceed 120ug/m^3.

Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24. In the event that a result for one of these sites is unavailable, the background concentration will be calculated by averaging the remaining two sites.

Development of the Coronation North Project results in DG23 needing to be decommissioned and a new site being established (DG25). An application to vary resource consent RM12.378.15 to reflect this change will be submitted in the first quarter of 2017.

Under resource consent RM16.138.19 (Coronation North), the following compliance limits apply:

- Insoluble dust deposition rates at sites DG07, DG20, DG21, DG22 and DG25 must not exceed 3g/m^2/30days of insoluble dust above background more than twice in any calendar year.
- Insoluble dust deposition rates at sites DG02 and DG15 must not exceed 3g/m^2/30days of insoluble dust above background.
- Twenty-four hour average total suspended particulate at site DG15 must not exceed 120µg/m^3.

Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24. In the event that a result for one of these sites is unavailable, the background concentration will be calculated by averaging the remaining two sites.

Under resource consent RM20.024.12 (Deepdell North Stage III), the following compliance limits apply:

- Insoluble dust deposition rates at sites DG07 and DG17 must not exceed 3g/m^2/30days of insoluble dust above background more than twice in any calendar year.
- Insoluble dust deposition rates at sites DG02 and DG15 must not exceed 3g/m^2/30days of insoluble dust above background.
- Twenty-four hour average total suspended particulate at site DG15 must not exceed 120µg/m^3.

Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24. In the event that a result for one of these sites is unavailable, the background concentration will be calculated by averaging the remaining two sites.

5.4 Exceedance of a Compliance Limit

If a consent limit for depositional dust or total suspended particulate is exceeded, OceanaGold will undertake an immediate review to determine the likely cause of the exceedance. The Otago Regional Council will be notified within a 24 hour period of the exceedance becoming apparent and depending on the nature of the incident, a report detailing the findings of the investigation will be forwarded to the Otago Regional Council within one month, or follow up comment will be made in the Quarterly Monitoring Report (in the event of clear indication that the exceedance is not a result of OceanaGold operational activities) . If it is found that activities of OceanaGold were the cause of the exceedance then dust mitigation measures shall be reviewed by an independent consultant and a report prepared summarising the cause of the exceedance and recommending measures to improve dust mitigation so the exceedance does not occur again. The report will be forwarded to the Otago Regional Council within two months of the exceedance being identified.

5.5 Annual Dust Review

An annual summary of the ambient air monitoring results is to be forwarded to the ORC by 30th April each year. This report reviews and assesses the results for the previous calendar year and is to be undertaken by a suitably qualified independent reviewer. OceanaGold engage Prue Harwood from Beca Infrastructure Ltd for this report. Her qualifications and experience can be found in Appendix B of *"OceanaGold Macraes Mine – Summary of Ambient Air Monitoring Results for 2015".*

The report shall include the following:

(a) The name, qualifications and experience of the reviewer;

(b) The methods used and the investigations undertaken for the review;

(c) Interpretation of the monitoring data reviewed;

(d) An assessment of the quality of the monitoring data;

(e) An assessment of the monitoring regime;

(f) A description and evaluation of each of the dust mitigation measures used;

(g) Recommendations on whether:

i) The monitoring of dust is adequate or should be changed, and if changed the changes that are recommended;

ii) The dust mitigation measures used by the consent holder are adequate, or should be changed, and the changes that are recommended; and

iii) Any changes that should be made to the conditions of this consent.

(h) Any other matters that the reviewer considers should be drawn to the attention of OceanaGold or the Otago Regional Council.

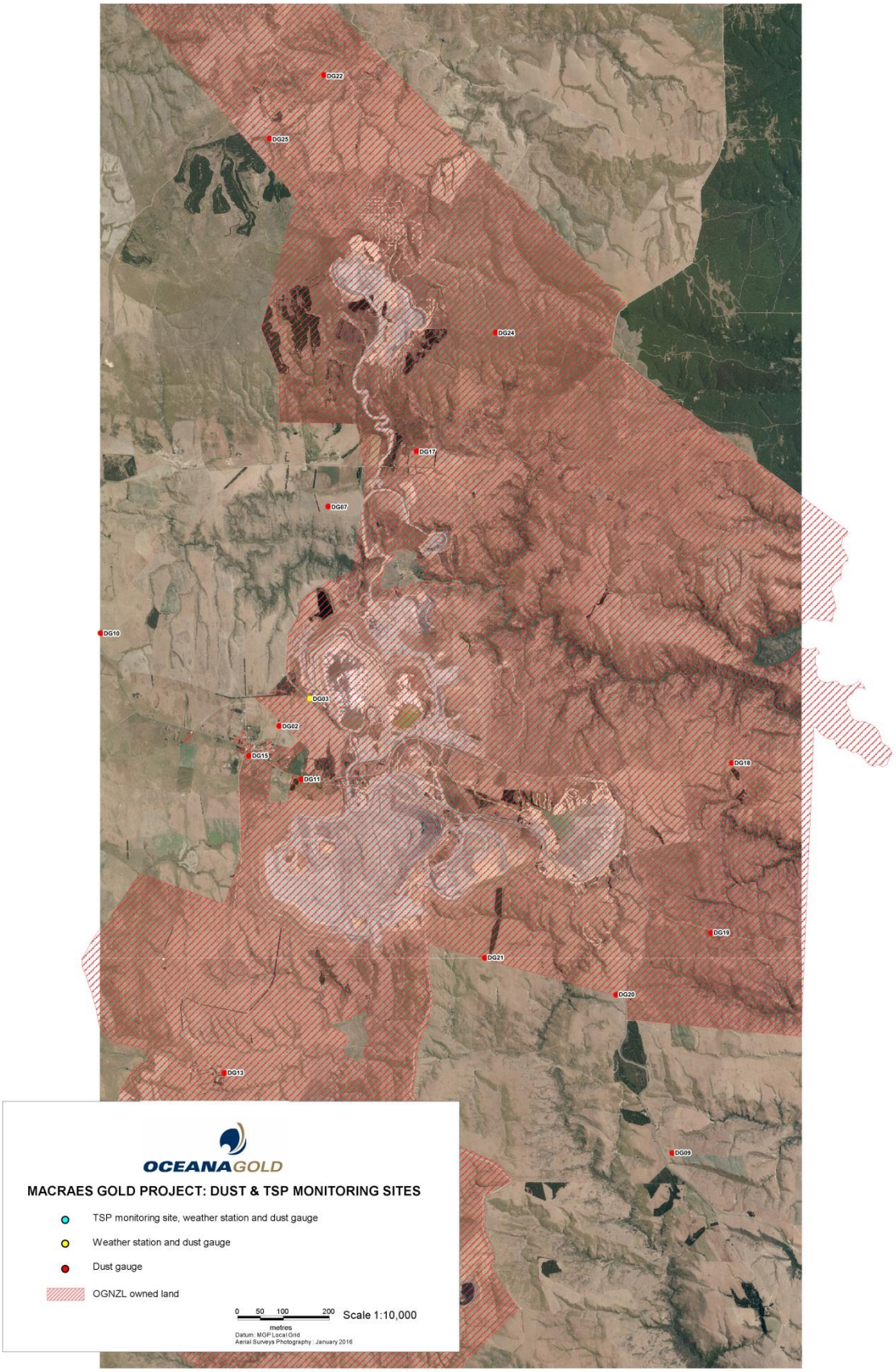

Figure 5-1: Depositional Dust and TSP Monitoring Sites

6 COMPLAINTS

Complaints may be referred by one or more of the regulatory authorities, a member of the public or an OceanaGold employee or contractor. It is the responsibility of the Environment and Community Manager to respond to and follow up all complaints regarding dust. The Environment and Community Manager is responsible for ensuring suitably qualified personnel are available to respond to complaints at all times.

Actions to be taken as soon as possible by the Environment and Community Manager

- All complaints are logged in InForm Stakeholder data base.
- Note the time, date, identity and contact details of complainant. Wind direction, strength and weather conditions are to be recorded. Note if complaint has been referred from a Consent Authority.
- Ask the complainant to describe the dust emission; whether it is constant or intermittent, how long it has been going on for, is it worse at any time of day, does it come from an identifiable source.
- As soon as possible after receipt of a complaint undertake a site inspection. Note all dust producing activities taking place, which staff member or contractor is responsible for the site and the dust mitigation methods that are being used. Order any remedial action necessary. If the complaint was related to an event in the recent past, note any dust producing activities that were underway at that time, if possible.
- As soon as practical (preferably within two hours) visit the area from where the complaint originated to ascertain if dust is still a problem.
- If it becomes apparent that there may be a source of dust other than activities at Macraes Gold Mine causing the dust nuisance it is important to verify this. Photograph and document the source and emissions.
- If complaint is received more than 12 hours after the event, conduct investigation including collecting relevant weather data, identifying operational activities at the time of the incident, collecting camera footage and interviewing operational staff. Investigations should endeavour to identify root cause and contributing factors.
- As soon as possible after the investigations have been completed contact the complainant to explain what has been found and remedial actions taken.
- If necessary, update any relevant procedures to prevent any recurrence of problems.
- Complete complaint form and file on complaint register.

Follow Up Actions

- Advise the Otago Regional Council as soon as practical that a complaint has been received and what the findings of the investigation were and any remedial actions taken.

7 RESPONSIBILITIES

OceanaGold as the holder of consents for Macraes Gold Mine site has the ultimate responsibility to ensure that all statutory requirements and conditions of consent are complied with and mining activities are carried out in accordance with the DMP.

Specifically, the following roles share operational responsibility for ensuring mining activities are carried out in accordance with the DMP:

- General Manager Macraes Operation
- Open Pit Mine Operations Superintendent
- Process Manager

These roles will have the following responsibilities:

- Overall responsibility at the site for ensuring that the dust control and mitigation measures and procedures outlined in Section 4 of the DMP are implemented effectively.
- Overall responsibility to ensure that dust emissions are avoided and mitigated as far as is practicable.

The Environment and Community Manager will have the following associated responsibilities:

- Responsibility to ensure that the dust monitoring programme is carried out as required.
- Responsibility to ensure that complaints are received and investigated as outlined in Section 6 of the DMP.
- Responsibility to ensure the DMP is current and reviewed at least annually.

All contractors and staff working on site are to ensure that their activities comply with the requirements of the DMP.

8 CONSULTATION, REPORTING AND REVIEW

8.1 Neighbours

OceanaGold will consult with the Macraes Community Incorporated (MCI) regularly, as part of the bi-monthly meeting process, to inform them of any issues relating to dust control at the Macraes Gold Mine site that may be of interest to the community and to obtain feedback from the community.

OceanaGold will advise the Macraes Community through MCI of the contact phone numbers to be used to advise OceanaGold of a complaint.

The contact phone numbers and email addresses to be used for registering a complaint are included in **Appendix E**.

8.2 OceanaGold to Otago Regional Council

OceanaGold will maintain a regular and formal reporting regime with the Otago Regional Council (ORC) to inform them of any issues regarding dust control at the site that may be of interest to them and to obtain feedback on compliance and performance.

OceanaGold will provide the ORC with contact numbers to be used to advise OceanaGold of a dust complaint. The contact phone numbers and email addresses to be used for registering a complaint are included in **Appendix E**.

OceanaGold will inform the ORC of the following:

- Any complaints received regarding dust as soon as practical after receipt of the complaint.
- Of any non-compliances with monitoring as outlined in Section 5. Any non-compliance will be reported to the ORC through the nominated compliance contact (currently Richard Green) or via the compliance email address (compliance@orc.govt.nz).
- Provide ORC with a copy of the DMP if any significant revisions of the DMP are made during the year.

8.3 Otago Regional Council to OceanaGold

OceanaGold requests that the ORC advise them of any complaints they receive regarding dust from the Macraes Gold Mine site immediately after the complaint has been lodged.

8.4 DMP Review Procedure

The DMP shall be reviewed regularly and at least annually preferably during the winter period and prior to the next dry season. The review shall take into account the following:

- The outcome of any reviews completed as the result of any non-compliant results;
- The outcome of the annual review of all dust monitoring data; and
- Whether management practices are resulting in compliance with the conditions of the relevant air discharge consents.

A copy of any updates to the DMP will be forwarded to the Otago Regional Council within one month of any update occurring. Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan.

9 EXCESSIVE DUST ACTION PLAN

In the event that personnel are unable to control dust adequately on the mine site and additional measures are required in order for OceanaGold to comply with the provisions of the resource consents OceanaGold shall initiate an emergency action plan. OceanaGold will maintain an in-house register of persons and contractors who have suitable equipment and personnel available that can be contacted at short notice in the event of a dust emergency occurring.

The emergency procedures may include, but are not limited to, the following:

- The use of additional water carts and irrigation systems; and
- Stopping work on areas of the site that are sources of excessive dust, where practical.

The Site Personnel Contacts list is included in **Appendix E.**

Appendix A

Resource Consents Held for Air Discharges

Appendix B

Tailings Storage Facilities Dust Control Manual

Tailings Storage Facilities

Dust Control Manual
April 2019

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10 INTRODUCTION

The Macraes operation currently has three tailings storage facilities. Two of these, the Southern Pit Tailings Impoundment option 11A and the Mixed Tailings Impoundment, are currently in a resting state. There is currently no tailings discharge to these embankments however both have not yet been decommissioned and so have the potential to receive more tailings material. All tailings material is currently being deposited into the Top Tipperary Tailings Storage Facility which is located to the east of the Frasers Pit.

This manual details dust control methods that are used to control and minimise the transmission of dust particles around and away from the tailings facilities.

The design of all three tailings storage facilities has been carried out by Engineering Geology Ltd (EGL) and a description of the embankment design and operation is contained in the Design Report for each impoundment. Reference should be made to these as required.

Details of the operation, maintenance and surveillance of the tailings storage facilities can be found in the respective Operation, Maintenance and Surveillance Manuals.

11 RESPONSIBILITIES

Oceana Gold (NZ) Ltd (OceanaGold), as owners of the tailings storage impoundments are ultimately responsible for the control of dust.

Supervision and monitoring of the quality of construction is undertaken by OceanaGold as is regular monitoring, maintenance and surveillance as detailed in the respective Manuals.

The installation and maintenance of dust control systems is the responsibility of the Projects and Civil Works departments.

The operation of dust control systems and the tailings distribution system is the responsibility of the Process Supervisor. A Daily Decision Tree (attached) is available to assist with operation of dust control systems.

Whilst the above listed departments are responsible for the control of dust, it is the responsibility of all staff to ensure that the systems in place are adequate and being operated correctly and when required. The impoundments are inspected periodically throughout the day however conditions may change between inspections. Any reports of excess dust should be alerted to the Environmental, Projects or Processing departments.

12 ENVIRONMENTAL CONDITIONS

During spring, the Macraes District is frequently subjected to strong drying winds. Wind gusts in excess of 100km/hr are not uncommon and the winds can continue for several days without ceasing. The worst of the winds are often experienced between August and October although strong winds at other times are not uncommon.

Dust generation does not however only occur during periods of strong wind. Particles begin to be mobilised at wind speeds of 5m/s. This means that lower winds also have an effect on the tailings surface and can move large amounts of dust. As the wind speed increases, the mobilised particles start to dislodge other particles and this can result in large movements of particles or dust. Also the finer the particles are, the more prone to movement they are.

When conditions have been dry and windy for extended periods of time, the surface of the embankments becomes dry which leads the particles to become more easily entrained by the wind. The water on the surface of the tailings binds the surface and increases the cohesion between particles making them harder to move. Whilst wind speed cannot be controlled, the moisture of the tailings surface can and so this can determine the dust suppression technique used to control dust as seen in the below section.

To assist with predicting times of high wind and limited rain, a weather forecasting service is provided at www.metconnect.co.nz, Login: Oceana, Password: auweather.

13 METHODS OF DUST CONTROL

13.1 Tailings Discharge

During and immediately following periods of active tailings discharge the tailings beach surface remains sufficiently damp that the potential for windborne dust generation is very low.

Tailings deposition is sequentially moved around the impoundment to decrease the chance that the tailings surface could dry out and become prove to dust creation. Tailings deposition is manually redirected around the impoundment through the use of knife gate valves to direct the tailings to a general area while spigots are used to control localised tailings deposition. This method of deposition also helps to keep the tailings surface level which limits localised drying conditions.

Tailings discharge to the Top Tipperary Tailings Storage Facility commenced in October 2013. Both the Southern Pit 11 Tailings Impoundment and Mixed Tailings Impoundment are therefore currently not in use and tailings discharge will only occur into these impoundments at times of maintenance to the Top Tipperary tailings discharge system. Dust control requirements on the Top Tipperary Tailings Storage Facility will therefore be minimal as tailings will be continuously discharged to this facility and the beach is unlikely to dry sufficiently to generate dust.

13.2 Rock Mattress Cover

Experience has shown that the area of the tailings surface with the most potential for dust generation is the tailings beach adjacent to the embankment crest.

As construction of both the Southern Pit 11 and Mixed Tailings Impoundments has been completed, capping of the outer regions of the surface has commenced. This involves placing a rock mattress over

the tailings surface of the impoundment. This rock mattress can consist of topsoil, grey rock or brown rock. The rock mattress will gradually extend across the entirety of the impoundment and will be covered in topsoil and vegetation. The purpose of the mattress is to prevent tailings surface exposure which removes the chance that it could be mobilised.

For details of the rock mattress and capping refer to the design documents and closure plan for each impoundment.

13.3 Dust Suppression System

A dust suppression system will be established following each stage of rockfill mattress construction to enable the distribution of water onto the inner surface not covered by the rock mattress. This system needs to be operational from August to March each year however it is prudent to continue to have this system in place at all times.

The dust suppression system generally consists of an outer ring main feeding soak hoses or sprinklers laid out over the tailings surface, however various combinations of open ended pipe discharge can be utilised as necessary to ensure good coverage and wetting.

The dust suppression system should be installed as soon as possible to prevent the risk of the tailings surface drying out. Whilst the strongest drying winds are during August to October, dust can be generated throughout the year.

Preservation of the crust on the dam surface is to be maximised by limiting traffic on the tailings surface wherever possible.

13.4 Existing covers

A layer of topsoil approximately 100mm to 200mm thick has been placed on the dry outer perimeter of the Southern Pit 11 impoundment. In total, approximately 15.5 ha has been topsoiled and vegetated.

Capping of a portion of the Mixed Tailings Impoundment with a rock mattress cover commenced in 2016. Sowing of this surface will occur during the first half of 2017.

14 OPERATION

The tailings distribution system is operated by the Processing Superintendent and follows plans implemented by the Senior Mine Engineer and EGL.

A site specific model that predicts hourly wind speed, direction and rainfall (provided by the MetService) is used to assist in the prediction of wind events (note – if heavy rain or rainfall warnings are indicated for Fiordland and the West Coast this will often indicate strong winds on the East Coast). It is the responsibility of the Processing Superintendent to initiate action in accordance with the Model predictions.

The tailings or dust suppression system is to be used 12 hours prior to any anticipated high wind event (defined as an event of greater than 40km/hr winds for greater than 4 hours from a west or northwest direction).

Should wind speeds increase without warning then the system will be activated as required by process operations personnel and the Processing Superintendent will be notified.

15 TRIAL DUST SUPRESSION TECHNIQUES

15.1 Vital Bon-Matt Stonewall

Stonewall is a co-polymer that is applied to the surface of the tailings. The product is diluted in water and then applied through a spray by any method. This could be from a water cart or a knapsack sprayer. The product creates a hard surface that is similar to that which would be seen if glue was applied to the surface. The tailings surface then becomes encapsulated underneath the Stonewall surface. This limits the dust generation by removing the potential for wind to erode the surface. Trials of this dust suppression technique occurred in 2015.

15.2 Vital Strike

Strike is a co-polymer based fertiliser to promote the growth of seed below its surface and increase soil stability. After seed has been broadcast, Strike is applied in much the same way as Stonewall. There is however fertiliser incorporated into the product which aids in the germination and growth of the seed. Trials of this dust suppression technique occurred in 2015.

15.3 Atomiser

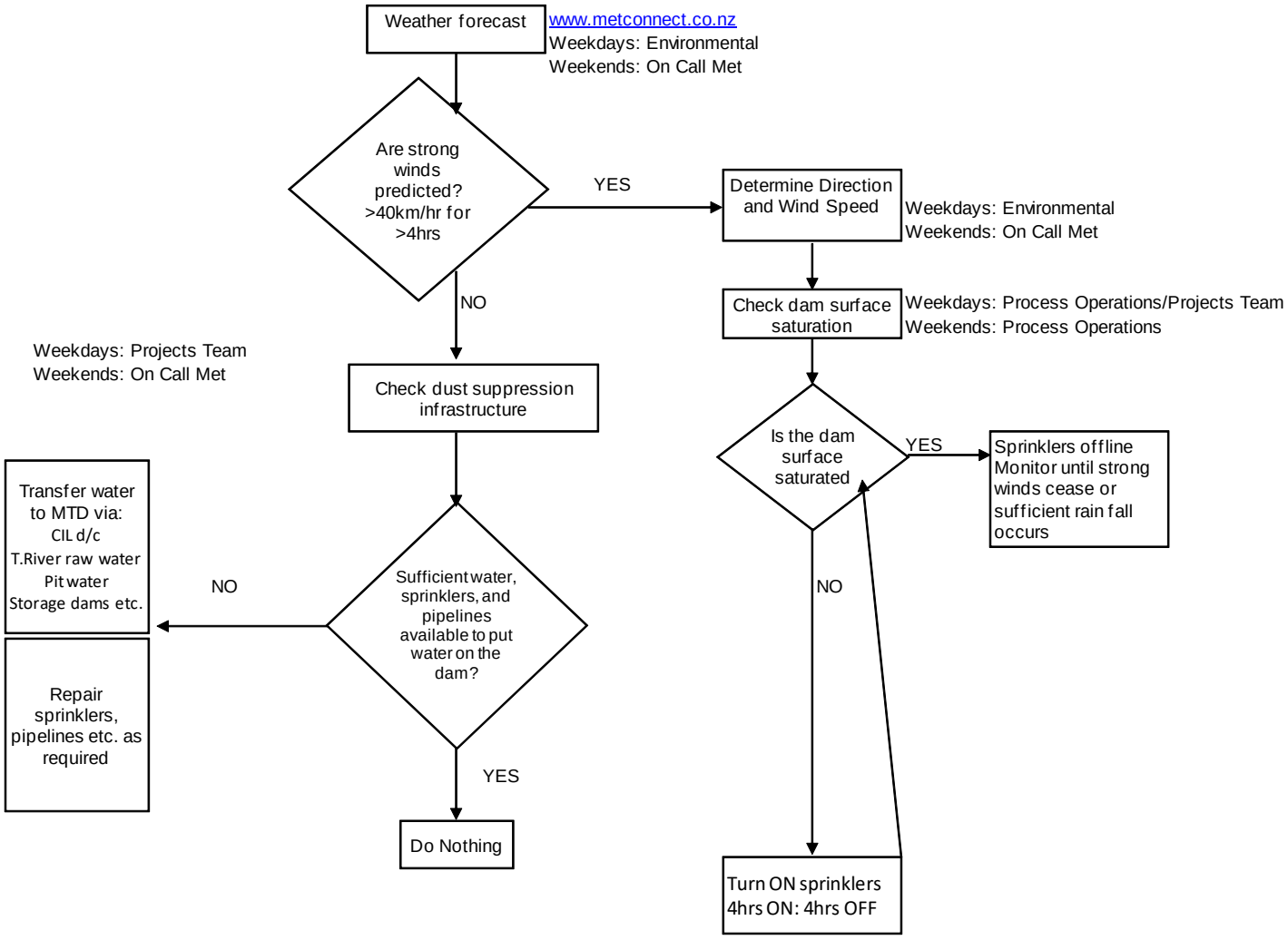
There have been many investigations into atomisers that can generate fog or mist using the process water available inside the impoundment. The aim of these investigations was to try to keep the tailings surface wet, act as a dust curtain, and evaporate any excess water that is inside the impoundment when there is a surplus. To date no trials have been undertaken.

16 MAINTENANCE

The installation and commissioning of any tailings or water distribution system for dust control is the responsibility of the Project Supervisor who once commissioned, hands it over to the Processing Superintendent. Thereafter inspections, monitoring and maintenance activities are the responsibility of operational personnel.

It is also the responsibility of all staff to report breakages or leaks in the pipes to their supervisor or the environmental team. Reports also need to registered as an Environmental Incident Report through INX InControl.

17 DUST SUPPRESSION DAILY DECISION TREE



Appendix C

Beaufort Wind Scale

The Beaufort Wind Scale (Land)

The Beaufort scale was long in use as a system for estimating wind speeds. It was introduced in 1806 by Admiral Sir Francis Beaufort (1774-1857) of the British navy to describe wind effects on a fully rigged man-o-war sailing vessel, and it was later extended to include descriptions of effects on land features as well. Today the accepted international practice is to report wind speed in knots (1 knot equals about 1.85 km, or 1.15 mi, per hour).

The Beaufort scale is divided into a series of values, from 0 for calm winds to 12 and above for hurricanes. Each value represents a specific range and classification of wind speeds with accompanying descriptions of the effects on surface features, as follows:

Beaufort	Avg miles per hour	Avg km per hour	Knots	Surroundings
0 (calm)	0	0	0 – 1	Smoke rises vertically.
1 (light air)	1 – 3	2 – 5	1 – 3	Smoke drift indicates wind direction.
2 (light breeze)	4 – 7	6 – 12	4 – 6	Wind felt on face; leaves rustle.
3 (gentle breeze)	8 – 12	13 – 20	7 – 10	Leaves, small twigs in constant motion.
4 (moderate breeze)	13 – 18	21 – 30	11 – 16	Dust and leaves raised up, branches move.
5 (fresh breeze)	19 – 25	31 – 40	17 – 21	Small trees begin to sway.
6 (strong breeze)	26 – 31	41 – 50	22 – 27	Large branches of trees in motion/
7 (moderate gale)	32 – 38	51 – 61	28 – 33	Whole trees in motion; resistance felt walking against wind.
8 (fresh gale)	39 – 46	62 – 74	34 – 40	Twigs and small branches break from trees.
9 (strong gale)	47 – 55	75 – 89	41 – 47	Larger branches break from trees.
10 (whole gale)	56 – 64	90 – 103	48 – 55	Trees broken and uprooted.
11 (storm)	65 – 74	104 – 119	56 – 63	Widespread damage.
12 (hurricane)	75+	120+	64+	Violence and destruction.

2004, Jeffers Petroglyphs Historic Site

from http://www.kites.org/jo/beaufort.html
and http://www.mountwashington.org/discovery/arcade/wind/beaufort.html

Appendix D

Watercare Services Limited Ambient Air Quality Monitoring Methods

Appendix E

Site Personnel Contact Details

Site Personnel Contact Phone Numbers

(Complaints and Emergencies)

Interim General Manager Macraes Operation

Alasdair Martin

Mobile: 0226769524

Email: alasdair.martin@oceanagold.com

Open Pit Mine Operations Manager

Kieran Rich

Mobile: 021 396 180

Email: kieran.rich@oceanagold.com

Process Manager

Quenton Johnston

Mobile: 021 248 8195

Email: quenton.johnston@oceanagold.com

Environment and Community Manager

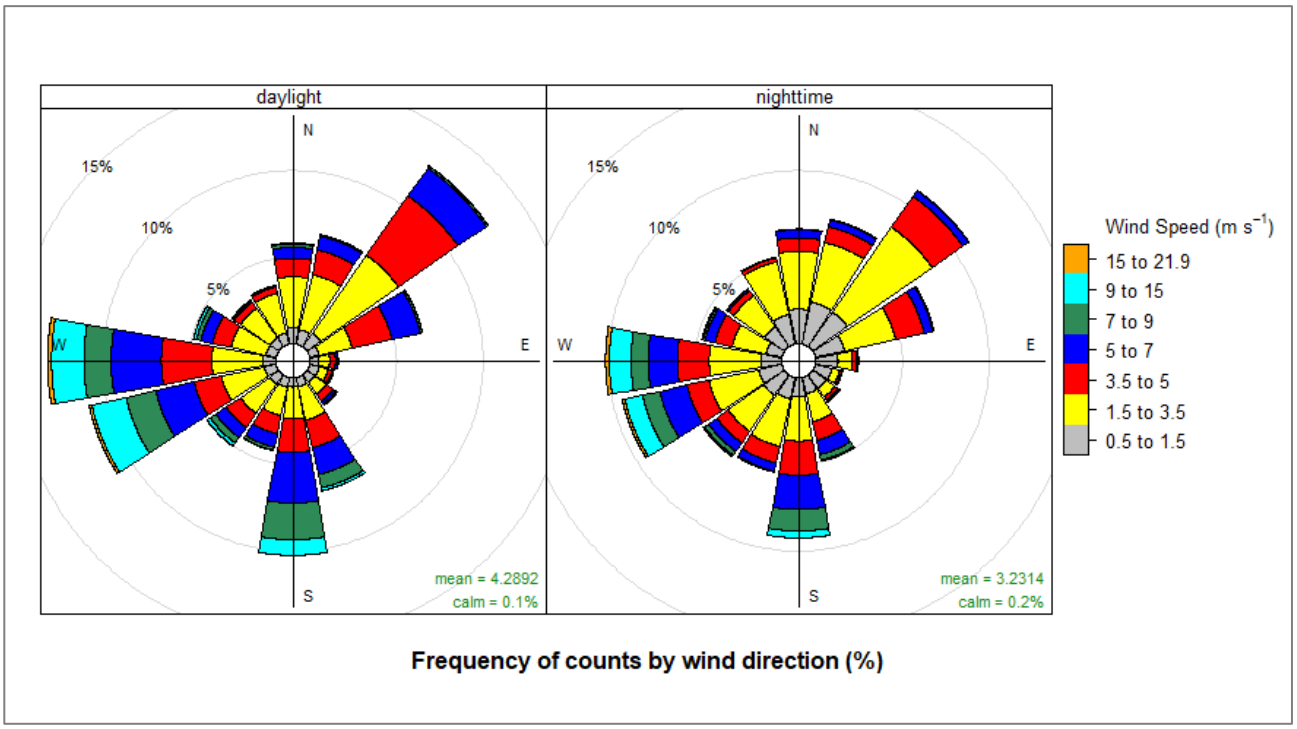
Gavin Lee

Mobile: 021 872 488

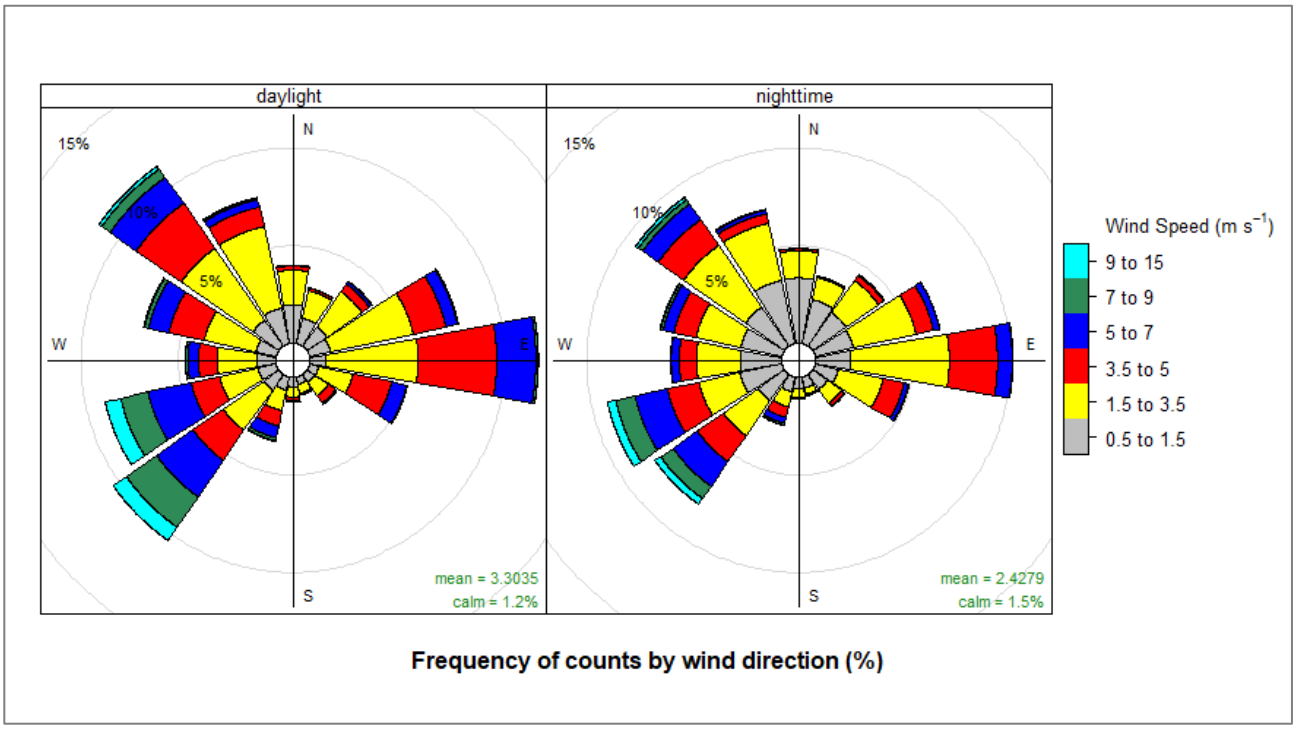
Email: gavin.lee@oceanagold.com

B

Appendix B – Day and Night Windroses



A 1. DG03 Wind rose for 01 January 2018 to 31 December 2022 during daytime (left) and night time (right).



A 2. DG15 Wind rose for 01 January 2018 to 31 December 2022 during daytime (left) and nighttime (right).

C

Appendix C – IAQM Risk Matrices

IAQM Risk Assessment – Coronation Pit

Introduction

The following information describes the IAQM risk assessment from the *Guidance on the Assessment of Mineral Dust Impacts for Planning*, May 2016, that was carried out for the Coronation Pit related to sensitive receptors R4, R5, (D) Golden Point Reserve and (E) Callery's Battery.

Residual Source Emissions

The IAQM method (Appendix 4) categorises the scale of the activity using a series of criteria which are described below.

Earthworks

A: Site Preparation/Restoration

Large working area <68 ha size, 2 Mt of ore will be extracted which requires the removal of 32 Mt of waste rock, small number of heavy plant <3, material of medium dust potential.

Overall: **Large**

B: Mineral Extraction

No drilling or blasting expected to occur.

Overall: **Does not apply**

C: Materials Handling

Small number of heavy plant <3, unconsolidated surface, material of medium dust potential and the activities are not close to site boundary.

Overall: **Medium**

D: On site transportation

Approximately 96 movements in 1 day assuming a 24-hour operation, 2.7 km length of unpaved haul road and a maximum speed of 60 km/h.

Overall: **Medium**

E: Mineral Processing

No mineral processing expected to occur.

Overall: **Does not apply**

F: Stockpiles/Exposed Surfaces

No stockpiles expected but the exposed surface is large.

Overall **Large**

Overall Rating: Large Residual Source Emissions

Determining Pathway Effectiveness

The frequency of strong winds combined with the distance to sensitive receptors allows for the effectiveness of the pathway of dust to receptors to be determined.

Categorisation of Frequency of Potentially Dusty Winds (Table A3-2)

Frequency Category	Criteria
Infrequent	Frequency of winds (>5 m/s) from the direction of the dust source on dry days are less than 5%
Moderately frequent	Frequency of winds (>5 m/s) from the direction of the dust source on dry days are between 5% and 12%
Frequent	Frequency of winds (>5 m/s) from the direction of the dust source on dry days are between 12% and 20%
Very frequent	Frequency of winds (>5 m/s) from the direction of the dust source on dry days are >20%

Categorisation of Receptor Distance from Source (Table A3-3)

Category	Criteria
Distant	Receptor is between 200 m and 400m from the dust source
Intermediate	Receptor is between 100 m and 200 m from the dust source
Close	Receptor is less than 100 m from the dust source

Pathway Effectiveness Table A3-4)

Receptor Distance Category	Frequency of potentially dusty winds			
	Infrequent	Moderately frequent	Frequent	Very frequent
Close	Ineffective	Moderately effective	Highly effective	Highly effective
Intermediate	Ineffective	Moderately effective	Moderately effective	Highly effective
Distant	Ineffective	Ineffective	Moderately effective	Moderately effective

Receptor Pathway Effectiveness Assessment for Sensitive Receptors

Receptor	Location relative to nearest dust source	Distance from Source category	Frequency downwind in winds >5 m/s	Frequency Downwind category	Dust Pathway Effectiveness category
R4 Four Mile Road	3.6 km northwest of Coronation North Backfill.	Distant	0.2% SE	Infrequent	**Ineffective**
R5 406 Horse Flat Road	2.2 km south of Coronation Pit ext	Distant	0.7% N	Infrequent	**Ineffective**
D Golden Point Reserve	2.9 km southeast of Coronation Pit ext	Distant	0.1% NW	Infrequent	**Ineffective**
E Callery's Battery	2.9 km southeast of Coronation Pit ext	Distant	0.1% NW	Infrequent	**Ineffective**

Estimation of Dust Impact Risk (Table A3-5)

		Residual Source Emissions		
		Small	**Medium**	**Large**
Pathway Effectiveness	Highly effective pathway	Low risk	Medium risk	High risk
	Moderately effective pathway	Negligible risk	Low risk	Medium risk
	Ineffective pathway	Negligible risk	Negligible risk	Low risk

Descriptors for Magnitude of Dust Effects (Table A3-6)

Dust Impact Risk	**Receptor Sensitivity**		
	Low	**Medium**	**High**
High Risk	Slight adverse effect	Moderate adverse effect	Substantial adverse effect
Medium Risk	Negligible effect	Slight adverse effect	Moderate adverse effect
Low Risk	Negligible effect	Negligible effect	Slight adverse effect
Negligible Risk	Negligible effect	Negligible effect	Negligible effect

Overall, the dust pathway effectiveness and residual source emissions ranking provide a dust impact risk which is then used in combination with the sensitivity of the receptor to estimate the magnitude of the dust effect.

The sensitivity of a receptor has been determined using guidance from *Box 3. Sensitivities of People to Dust Soiling Effects* from *Guidance on the Assessment of Mineral Dust Impacts for Planning* published by IAQM on May 2016.

Assessment of Magnitude of Dust Effects for Sensitive Receptors – Coronation Pit (Table A3-7)

Receptor	**Location relative to nearest dust source**	**Residual source emissions**	**Pathway effectiveness**	**Dust impact risk**	**Receptor sensitivity**	**Likely Magnitude of dust effect**
R4 Four Mile Road	3.6 km northwest of Coronation North Backfill.	Large	Ineffective	Low risk	High	**Slight adverse effect**
R5 Resident 406 Horse Flat Road	2.2 km south of Coronation Pit	Large	Ineffective	Low risk	High	**Slight adverse effect**
D Golden Point Reserve	2.9 km southeast of Coronation Pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
E Callery's Battery	2.9 km southeast of Coronation Pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**

IAQM Risk Assessment – IM

Introduction

The following information describes the IAQM risk assessment that was carried out for Innes Mills and FRBF, related to sensitive receptors R1, R2, A, R5, D and E.

Residual Source Emissions

The IAQM method categorises the scale of the activity using a series of criteria which are described below.

A: Site Preparation/Restoration

	Working area (Pit and Backfill)	Material Movement	Number of heavy plant
IM Stage 8	Approx. 185 ha	140 Mt of waste rock will be removed to access 16 Mt of ore.	< 3

Overall: **Large**

B: Mineral Extraction

No drilling or blasting expected to occur.

Overall: **Does not apply**

C: Materials Handling

Small number of heavy plant <4 simultaneously active, unconsolidated surface, material of medium dust potential and activities are not close to the site boundary.

Overall: **Medium**

D: On site transportation

	Truck movements in 1 day assuming a 24-hour operation	Length of unpaved haul road	Maximum vehicle speed
IM Stage 8	192 movements	2 km	60 km/hr

Overall: **Large**

E: Mineral Processing

No mineral processing expected to occur.

Overall: **Does not apply**

F: Stockpiles/Exposed Surfaces

No stockpiles expected but the exposed surface is large.

Overall **Large**

Overall Rating: Large Residual Source Emissions

Determining Pathway Effectiveness

The frequency of strong winds combined with the distance to sensitive receptors allows for the effectiveness of the pathway of dust to receptors to be determined referring to the Assessment Tables used in the Coronation Pit above.

Receptor Pathway Effectiveness Assessment for Sensitive Receptors IM & FRBF

Receptor	Location relative to nearest dust source	Distance from source category	Frequency downwind in winds >5 m/s	Frequency downwind category	Dust Pathway Effectiveness category
R9	0.84 km west of FRBF 1.0 km southwest of IMW	Distant	0.13% E 1.3% NE (IM & FRBF)	Infrequent	Ineffective
R1	1.0 km west of FRBF 1.1 km southwest of IMW	Distant	0.13% E 1.3% NE (IM & FRBF)	Infrequent	Ineffective
R2	1.5 km west southwest of FRBF 1.5 km southwest of IMW	Distant	1.2% ENE 1.3% NE (IM & FRBF)	Infrequent	Ineffective
A	1.7 km southwest of FRBF 1.7 km west southwest of IMW	Distant	1.3% NE 1.2% ENE (IM & FRBF)	Infrequent	Ineffective
R5	3.9 km northwest of IMW	Distant	0.2% SE	Infrequent	Ineffective
D	2.4 km north northwest of IMW	Distant	0.03% SSE	Infrequent	Ineffective
E	2.4 km north northwest of IMW	Distant	0.03% SSE	Infrequent	Ineffective

Overall, the dust pathway effectiveness and residual source emissions ranking provide a dust impact risk which is then used in combination with the sensitivity of the receptor to estimate the magnitude of the dust effect from the tables in the assessment above for Coronation Pit.

Assessment for Sensitive Receptors

Receptor	Location relative to nearest dust source	Residual source emissions	Pathway effectiveness	Dust impact risk	Receptor sensitivity	Likely Magnitude of dust effect
R9	0.84 km west of FRBF 1.0 km southwest of IMW	Large	Ineffective	Low risk	High	**Slight adverse effect**
R1	1.0 km west of FRBF 1.1 km southwest of IMW	Large	Ineffective	Low risk	High	**Slight adverse effect**

Receptor	Location relative to nearest dust source	Residual source emissions	Pathway effectiveness	Dust impact risk	Receptor sensitivity	Likely Magnitude of dust effect
R2	1.5 km west southwest of FRBF 1.5 km southwest of IMW	Large	Ineffective	Low risk	High	**Slight adverse effect**
A	1.7 km southwest of FRBF 1.7 km west southwest of IMW	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
R5	3.9 km northwest of IMW	Large	Ineffective	Low risk	High	**Slight adverse effect**
D	2.4 km north northwest of IMW	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
E	2.4 km north northwest of IMW	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**

IAQM Risk Assessment – Golden Bar

Introduction

The following information describes the IAQM risk assessment that was carried out for R6, R7 and R8.

Residual Source Emissions

The IAQM method categorises the scale of the activity using a series of criteria which are described below.

A: Site Preparation/Restoration

Large working area < 69 ha size, 1.3 Mt of ore will be extracted which requires the removal of 27 Mt of waste rock, small number of heavy plant < 2, material of medium dust potential.

Overall: **Large**

B: Mineral Extraction

No drilling or blasting expected to occur.

Overall: **Does not apply**

C: Materials Handling

Small number of heavy plant < 2, unconsolidated surface, material of medium dust potential.

Overall: **Medium**

D: On site transportation

Approximately 192 movements in 1 day assuming a 24-hour operation, 12.1 km length of unpaved haul road, maximum speed of 60 km/h.

Overall: **Large**

E: Mineral Processing

No mineral processing expected to occur.

Overall: **Does not apply**

F: Stockpiles/Exposed Surfaces

Large stockpile, daily transfer of material with medium dust potential.

Overall: **Large**

Overall Rating: Large Residual Source Emissions

Receptor Pathway Effectiveness for Sensitive Receptors Golden Bar

Receptor	Location relative to nearest dust source	Distance from source	Frequency downwind in winds >5 m/s	Frequency category	Dust Pathway effectiveness
R6 Residence 593 Macraes - Dunback Road	3.0 km north northeast of GB expanded pit	Distant	0.6% SSW	Infrequent	Ineffective
R7 Residence 659 Richie Road	3.9 km northeast of GB expanded pit	Distant	3.9% SW	Infrequent	Ineffective
R8 Residence 800 Stoneburn Road	3.2 km southeast of GB expanded pit	Distant	1.9% NW	Infrequent	Ineffective

Assessment for Sensitive Receptors Golden Bar

Receptor	Location relative to nearest dust source	Residual source emissions	Pathway effectiveness	Dust impact risk	Receptor sensitivity	Magnitude of dust effect
R6	3.0 km north northeast of GB expanded pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
R7	3.9 km northeast of GB expanded pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**
R8	3.2 km southeast of GB expanded pit	Large	Ineffective	Low risk	Medium	**Negligible adverse effect**