Bendigo-Ophir Gold Project: Assessment of Environmental Effects from the Discharge of Contaminants into Air

Prepared for

Matakanui Gold Limited

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Quality Control Sheet

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Limitations:

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Executive Summary

This is an air quality assessment of effects of the Bendigo-Ophir Gold Project ("**BOGP**") for dust and gaseous emissions. **This assessment concludes that with the proposed air quality mitigation and monitoring any potential adverse effects from dust or gaseous emissions will be less than minor.**

Matakanui Gold Limited ("**MGL**") is proposing to establish the **BOGP**, which comprises a new gold mine, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell and will have a maximum disturbance footprint of 568 hectares (ha).

The BOGP involves mining four identified gold deposits referred to as Rise and Shine ("**RAS**"), Come in Time ("**CIT**"), Srex ("**SRX**") and Srex East ("**SRE**"). The resources will be mined by open pit methods at each deposit within the project site, with underground mining methods also proposed to be utilised at RAS to access the deeper gold deposits. The key activities which have the potential to generate dust within the BOGP are the establishment and operation of:

- Haul roads;
- The four open pits;
- Engineered landforms;
- Tailing Storage facility;
- Soil stockpiles; and
- Ore Crushing.

The types of particulate matter discharged from these activities include:

- Coarse particulate- Deposited dust and total suspended particulate (TSP);
- Fine particulate– PM_{10} (10-micron diameter or less) which can be inhaled;
- Respirable crystalline silica (RCS); and,
- Fine particulate containing elevated levels of arsenic (As).

The are five potential sources of gaseous air contaminants:

- Processing plant - leaching and adsorption tanks;
- Processing plant - acid wash and elution columns;
- Processing plant - electro-winning cells;
- Processing plant - induction furnace; and,

- Underground mine vents and portal.

The types of gaseous contaminants discharged from these activities include:

- Hydrogen cyanide (HCN);
- Ammonia (NH_3); and
- Combustion products discharged from machines and vehicles - including PM_{10} and nitrogen dioxide (NO_2).

The potential adverse effects of the air contaminants discharged from the BOGP are:

- Amenity effects – dust being deposited on surfaces;
- Ecological effects – Flora or fauna adversely impacted; and
- Health effects – particulate matter and gaseous contaminants inhaled by people.

The BOGP has a total area of 568 ha and traverses an area with two distinctly different meteorological zones and two different types of receiving environment. For these reasons, the assessment of air quality impacts has been undertaken in two parts based on the different meteorological zones.

The key dust emission mitigation measures which will be defined in the Air Quality Management Plan (AQMP) and the proposed consent conditions will include:

- Maintain adequate buffer distance (500 m) between large-scale earthworks or point air discharge sources and sensitive receptors;
- Ensure adequate water supply and provide appropriate infrastructure and machines for dust suppression;
- Material removal, stockpiling and handling when material and/or wind conditions will not result in dust being blown across the site boundary;
- Engineered and maintained road surface which minimise free fine material which can generate dust;
- Dampen surfaces of haul roads and stockpiles. (The site has sufficient water for typical and for high demand dust suppression);
- Minimising material drop heights;
- Vegetating soil stockpiles;
- Road speed limits; and
- Water sprays at fine material transfer points in the processing plant.

The key gaseous emission mitigation measures which will be defined in the AQMP, and the proposed consent conditions will include the processing plant:

- Maintaining pH between 10 and 12 in wet chemistry vessels to eliminate HCN gas;
- Induction furnace exhaust capture and discharge via 15 m stacks; and
- Particulate filtration of induction furnace exhaust flows.

The assessment of potential amenity effects resulting from the discharge of dust found that for both the northern and southern zones any adverse effects would likely be less than minor.

An ecological survey has identified native herbs in the vicinity of the proposed BGOP proposed activities. However, onsite observations of plant health suggest the type and scale of dust discharged from the activities is not expected to pose any toxicological risks to flora.

Based on the nature of the BOGP dust, the separation distance to the nearest location where the public may be exposed for any duration of more than one hour, and the implementation of the proposed management measures, any adverse health impacts from the particulate matter (PM_{10}, RSC and As) discharged from the proposed mine will be negligible and certainly less than minor.

The potential discharge of hydrogen cyanide and ammonia gaseous contaminant have been assessed. Based on PDPs' assessment of these discharges the potential the potential for any adverse health effects to occur from the discharge of gaseous contaminants from the processing plant is negligible.

To ensure that any actual adverse effects are no greater than the potential adverse effects assessed in this report, PDP recommend that the air discharge consent conditions define the:

- Type and maximum scale of activities which are permitted to discharge contaminants to air;
- Environmental bottom lines and/or performance measures; e.g. no deposited dust or gaseous discharges which are offensive, objectionable, noxious or dangerous effect beyond the boundary of the site;
- Mitigation measures which shall be implemented;
- Environmental monitoring programme which will identify if the:
    - Mitigation measures are being effective; and,
    - Environmental bottom line is being complied with; and,
- Form and content of an air quality management plan to meet the recommendations made in Good Practice Guide Dust (MfE, 2016).

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1.0 Introduction

1.1 Project Overview

Matakanui Gold Limited (“**MGL**”) is proposing to establish the Bendigo-Ophir Gold Project (“**BOGP**”), which comprises a new gold mine, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell.

The BOGP is located within the footprint of Minerals Exploration Permit 60311, which is held by MGL under the Crown Minerals Act 1991. MGL also has land access agreements with Bendigo and Ardgour Stations. The BOGP is located adjacent to land administered by the Department of Conservation (“DOC”), including the Bendigo Historic Reserve, the Bendigo Conservation Area and the Ardgour Conservation Area.

The BOGP involves mining four identified gold deposits named Rise and Shine ("**RAS**”), Come in Time (“**CIT**”), Srex (“**SRX**”) and Srex East (“**SRE**”). The resources will be mined by open pit methods at each deposit within the project site, with underground mining methods also proposed to be utilised at RAS to access the deeper gold deposits.

The majority of the mining activities, ancillary facilities and associated infrastructure will be located in Shepherds Valley somewhat hidden from the view of the public. Access, and service and administration offices are planned to be located on the adjoining Ardgour Terrace.

Figure 1 below provides an overview of the footprint associated with the establishment, operation and rehabilitation of the BOGP, which includes a maximum disturbance footprint of 568 ha.

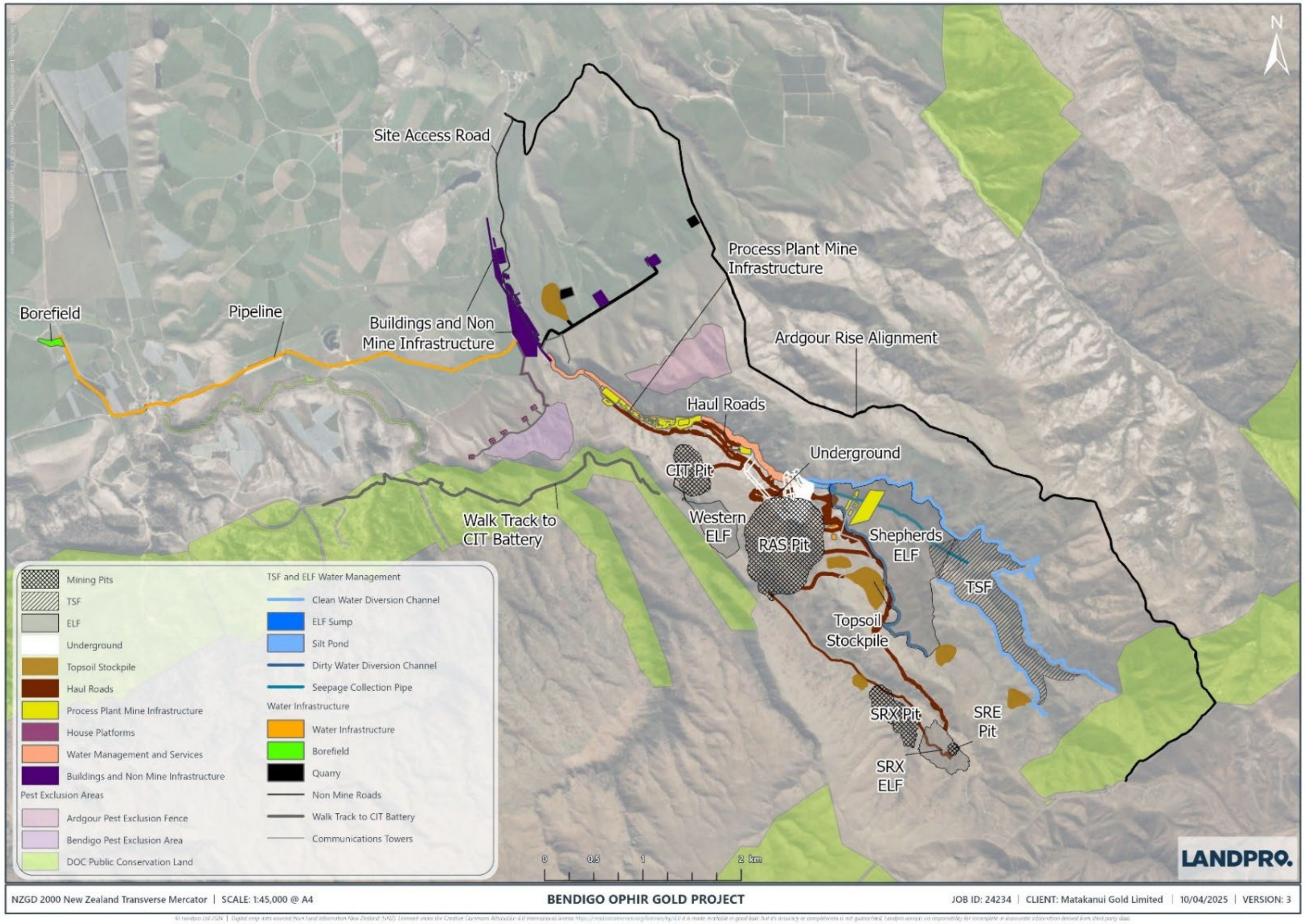

Figure 1 BOGP general site layout, Source (Santana Minerals Limited, 2025)

A full description of the various activities comprising the establishment, operation and rehabilitation within the BOGP is provided in the Assessment of Environmental Effects prepared by Mitchell Daysh Limited. However, by way of summary, the BOGP includes the following components:

- The establishment of the RAS Open Pit and SRX Open Pit, which are planned to form partial pit lakes at closure;
- The establishment of RAS Underground which is planned to be backfilled with cement paste;
- The establishment of the CIT Open Pit, which is the smallest of footprints and is planned to be progressively backfilled with waste rock from the RAS Open Pit and profiled to integrate with the surrounding terrain. Rehabilitation will enable nearby native herb fields to be re-established at the completion of mining activities;
- The establishment of the small SRE Open Pit, which will be backfilled with waste rock before being covered with overburden to form the engineered landform for the adjoining SRX Open Pit ("**SRX ELF**").
- A conventional hard rock gold processing plant (1.2 million tonnes per annum ("**Mtpa**")expandable to 1.8 Mtpa) applying modern Carbon-in-Leach ("**CIL**") technology constructed in the lower reach of Shepherds Valley. The plant will operate in a closed water circuit with the Tailings Storage Facility. Residual chemicals in the tailings slurry will be detoxified and/or precipitated with specialist plant.
- The operation of the process plant will be supported by ancillary facilities such as maintenance workshops, raw material and process chemical storage, fuel depot, laboratory and warehousing. Mine offices, carparking and security services will also be established.
- The construction of the plant in the lower reaches of Shepherds valley will include the realignment of Shepherds Creek;
- The establishment of water storage dams and tankage for use in the process plant, dust suppression and drinking water supply;
- The establishment of a Tailings Storage Facility ("**TSF**") in the upper reach of Shepherds Valley (including clean water diversion drains), which will utilise waste rock from mining activities within the project site;
- The establishment of permanent engineered landforms in the Shepherds Valley ("**Shepherds ELF**") and an unnamed creek west of RAS pit ("**WELF**");
- The establishment of temporary topsoil, vegetation and brown rock stockpiles around the project site;

- The extraction of groundwater from the Bendigo Aquifer for use in mining-related activities as well as supplying BOGP drinking water and replacing small irrigation water takes from Shepherds Creek. Bore water will be pumped to the processing plant via a pipeline over a distance of approximately 7 km.
- The establishment of supporting infrastructure / activities for the project, such as the upgrade of Ardgour Road and parts of Thomson Gorge Road to provide improved access to the BOGP, internal mine access and haul roads, water pipelines and underground utilities, and electricity supply to the project site from Lindis Crossing via a new 66kV overhead powerline that will follow the existing road reserve corridor;
- A realignment of part of Thomson Gorge Road, via Ardgour Station (Ardgour Rise) is planned to provide public access through to the Manuherikia Valley.
- Main explosives magazines and emulsion mixing facilities (located outside the project site on Ardgour Terrace);
- The establishment of non-operational infrastructure associated with the BOGP on the Ardgour Terrace, including security, first aid and administrative offices, geology facilities, high voltage substation and temporary construction workers accommodation; and
- The establishment of pest exclusion area(s) for ecological enhancement activities.

1.2 Site Location and Emission of Contaminants to Air

The BOGP footprint has a maximum disturbance area, including contingency of 568 ha. The project land disturbance activities include the pits (RAS, CIT, SRX and SRE), ELF, TSF, process plant, infrastructure and haul roads. The mine design and schedule aim to allow for progressive rehabilitation, keeping disturbed areas to the minimum necessary for efficient working of the mine and to minimise potential dust and negative water management effects.

The development, operation and remediation processes associated with the BOGP that have the potential to discharge contaminants to air include:

- Site development – dust;
- Mining – dust;
- Ore Processing – dust and gases; and,
- Remediation – dust.

1.3 Phased Mine Development

The emissions of dust and gaseous pollutants will vary over the life of the mine. The mine will be developed and operated in phases as detailed in **Table 1.**

Table 1: Phased Mine Development and Operation

Year	Mining Phase	Description of Phase
0 to 0.5	Startup	Pioneering / RAS Pre-Strip, Initial Jean Creek Silt Pond, earthworks at process plant.
0.5 to 2	Project Development	Construction of process plant, TSF, Shepherds Creek Silt Pond, North Diversion Channel, Commissioning, mining RAS pre-strip (Pre-strip ends month 19) and the and construction of the Western Engineered Land Form (WELF).
3 to 4.5	RAS pit mining on its own	Operations (Pit ore production in month 20. Underground (UG) Development begins month 54)
4.5 to 5	RAS pit with UG development	Operations (UG Ore production begins month 70)
6 to 11	RAS pit plus RAS UG	Operations (UG Ore production months 70 to 150)
	RAS Pit plus RAS UG plus CIT Pit	Operations (CIT Pit mined months 102 to 114)
	RAS Pit plus RAS UG, plus CIT backfilled, plus SRX	Operations (SRX Pit mined months 145 onwards)
10 to 13.3	RAS UG continues on its own with CIT and SRX open pit feeds	Operations (all mining completed month 160)
11 to 31	All mining completed. Closure	Active closure of pits, TSF, and wider site, plus setup of active water treatment plant (option)
31 onwards	Post-Closure	Passive treatment and maintenance

To provide an indication of the locations and sizes of the dust sources over the life of the mine. Figure 2 shows the startup phase (Year 1) and Figure 3 shows the RAS Pit plus RAS UG, plus CIT backfilled, plus SRX (year 11).

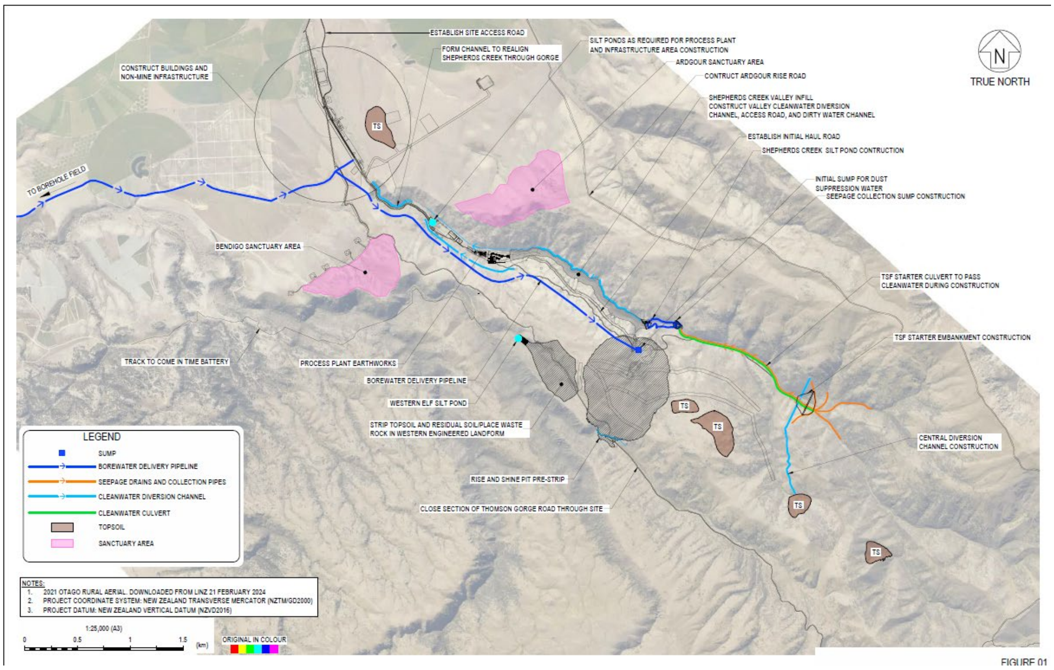

Figure 2 BOGP Start Up Phase, Source (Matakanui Gold Limited, 2024)

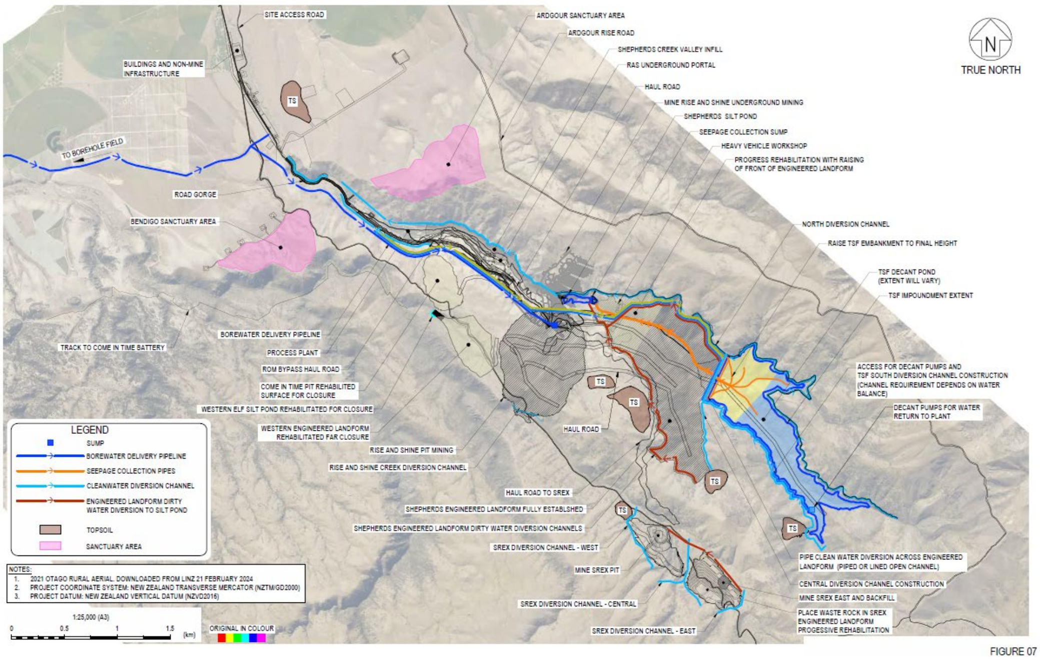

Figure 3 Operation RAS Pit Operation, RAS Underground - CIT backfilled SRX Pit, Source (Matakanui Gold Limited, 2024)

1.4 Assessment Scope

The air quality assessment considers the emission of, and effects of, dust and gaseous contaminants discharged into air from the following activities:

- The establishment of haul roads and other infrastructure;
- The establishment, and operation of the RAS Open Pit and RAS Underground Mine and SRX Open Pit;
- The establishment, operation and rehabilitation of the CIT and SRE Open Pits;
- The establishment of a Tailings Storage Facility in the upper reach of Shepherds Valley;
- The establishment of an engineered landforms in Shepherds Valley (Shepherds ELF, WELF) and Rise and Shine Valley (SRX ELF);
- Operation of machines and travel over the haul roads;
- A conventional hard rock gold processing plant in the lower reach of Shepherds Valley; and,
- The establishment of topsoil stockpiles.

1.5 Assessment Objectives

1.5.1 Dust assessment

The objectives of the dust assessment are to:

- Confirm the dust sources and locations;
- Quantify the amount of dust likely to be discharged from each source;
- Review the potential toxicity of the different dust types;
- Assess the sensitivity of the receiving environment;
- Identify the key and any critical risks from the potential emissions of dust; and
- Make recommendations for dust mitigation.

1.5.2 Gaseous Contaminant Assessment

The objectives of the gaseous contaminant assessment are to:

- Confirm the gaseous contaminant sources and locations;
- Quantify the type and amount of gaseous contaminants likely to be discharged from each source;

- Review the potential toxicity of the different gaseous contaminant types;
- Assess the sensitivity of the receiving environment to the effects of gaseous contaminants;
- Identify the key and any critical risks from the emission of gaseous contaminants;
- Provide a summary of the Occupational Health and Safety (OHS) mitigation, and monitoring for the discharge of hydrogen cyanide (HCN) from the processing of gold ore; and
- Make recommendations for gaseous contaminant mitigation;

2.0 Types of Air Contaminants Discharged

This section provides a general overview of the types of particulate and gaseous air contaminants discharged from the proposed activities. The types of contaminants described in sections 2.1 and 2.2 are generic and while relevant to the BOGP emissions the effects described are not site specific.

2.1 Types of Particulate Matter

The key contaminants relevant to the project are:

- Coarse particulate matter ("**PM**") >10 µm (dust); and
- Inhalable PM comprising particles with a diameter less than 10 µm ("$\mathbf{PM_{10}}$") and with a diameter less than 2.5 µm ("$\mathbf{PM_{2.5}}$").

Minerals extraction and processing can result in large amounts of dust emitted to air. Processes with the potential to create dust include the handling and crushing of solid material (such as happens in mines) (MfE, 2016), (Western Australia Department of Environment and Conservation, 2011).

Dust is a generic term that describes airborne particles dispersed into the air via a variety of both natural and anthropogenic means (MfE, 2016). Often the term "dust" is used interchangeably with "particulate matter". Dust particles vary greatly in diameters, from approximately 100 µm to less than 2.5 µm, thus ranging from particles large enough to be visible to the human eye, and particles small enough to be inhaled into human lungs. **Figure 4** shows the particle size of different types of dust. This report focuses on the particles captured within the soil and road dust envelope shown in **Figure 4**. For the purposes of this report the particulates from 1.0 µm to 100 µm will be referred to with the generic term "dust".

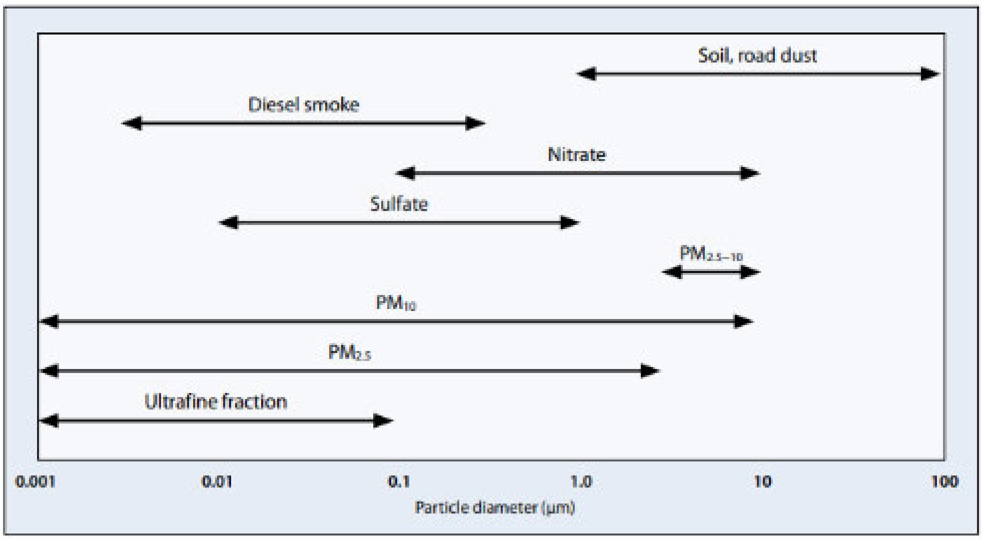

Figure 4: Particle size of different dust types (World Health Organisation, 2005)

Dust is categorised by particle size (defined by the aerodynamic diameter of particles) as follows:

- Deposited dust – PM of generally between 30 µm and 100 µm in diameter. This size fraction falls out of suspension in the air relatively rapidly and deposits on exposed surfaces, generally within 100 m of the source. The bulk of dust emissions from handling and storage of ore will be comprised of this fraction (MfE, 2016).
- Total suspended particulates ("**TSP**") – PM of generally less than 30 µm in diameter. PM of this size fraction remains suspended in the air for a longer time and therefore has the potential to travel further than larger fractions. TSP (particularly the coarse fractions larger than 10 µm) have the potential to affect visibility.
- Fine inhalable or respirable fractions of TSP such as PM_{10} can penetrate the nose or mouth under normal breathing conditions. PM_{10} is currently the size fraction that is monitored and managed under the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (NESAQ) to reduce health effects of PM in New Zealand (MfE, 2016).

The colour of dust will vary with the material being excavated and processed:

- Overburden soil – brown;
- Brown rock overburden – brown;
- Schist overburden – grey; and,
- Ore rock – black.

Approximately 90% of the material excavated and processed at BOGP mine will produce grey dust and the remaining 10% will likely be brown dust.

Arsenic (“**As**”) is a main pathfinder element for gold mineralisation. As such, it is found in naturally elevated concentrations in areas which have gold ore deposits. The Otago Schist usually contains between 5-20 ppm(w/w) As, which is slightly higher than the "background" levels of the Earth's crust (Otago University, 2025). Santana Minerals Limited (SML) staff collected soil samples from locations in and around the proposed CIT, RAS, SRX and SRE pit sites and tested those samples for As. A number of small areas of the mine which will be worked have been identified as having elevated As levels. The overburden soil from these areas may generate dust which contains naturally elevated levels of As.

The Rise and Shine shear zone includes quartz which may contain trace amounts of crystalline quartz silica, which has been classified by IARC as (Group I) carcinogenic to humans when inhaled (International Agency for Research on Cancer (IARC), 1997). Prolonged or repeated inhalation of respirable crystalline silica (“**RCS**”) can also cause a lung disorder, silicosis (WorkSafe NZ, 2016). While the ore will contain crystalline quartz silica, most of the material is bound into larger particles of rock that cannot be inhaled. RCS is sometimes considered in detail for large scale mines when they are crushing and screening large volumes of ore. Given the type and volume of material being extracted from the BOGP, it is likely that low concentrations of RCS would be experienced (See **Section 12.2**).

2.2 Gaseous Contaminants

The key source of gaseous contaminants potentially discharged from the BOGP mine will be generated by the processing plant. The types of gaseous contaminants potentially discharged from the ore processing plant and tailing storage facility include:

- Hydrogen Cyanide (“**HCN**”) – Only if the wet chemistry processes are not managed correctly (See **Section 6.1**); and,
- Ammonia (“$\mathbf{NH_3}$”) discharged from the electrowinning cells (See **Section 6.1).**

There will also be gaseous contaminants discharged from the exhausts of the diesel-powered vehicles and machines used at the BOGP mine. The key gaseous contaminants discharged from the vehicles and machines to be used at the BOGP mine are:

- Particulate matter (PM_{10} and $PM_{2.5}$); and
- Nitrogen dioxide (“$\mathbf{NO_2}$”).

3.0 Potential Adverse Effects of Air Contaminants

This section provides a general overview of the potential effects of the particulate and gaseous air contaminants discharged from the proposed activities. The potential adverse effects described in sections 3.1 and 3.2 are generic and while relevant to the BOGP emissions, the effects described are not site specific. The site-specific adverse effects for the BOGP emissions are assessed in detail at sections 10.0 to 12.0.

3.1 Particulate Matter

Having considered the size, composition and quantity of the dust discharged from the site preparation, material extraction and mechanical ore processing, the potential adverse effects of particulate matter are:

- Amenity effects – dust being deposited on surfaces;
- Health effects – PM_{10} and RCS inhaled by people; and,
- Ecological effects – Flora or fauna adversely impacted.

Dust nuisance is caused where dust impacts on amenity values. Dust nuisance impacts include soiling of property such as windows, houses, cars, and washing hung out to dry. The degree of amenity effects tends to increase with darker colors of dust. For example, coal dust is considered more offensive than grey aggregate dust.

Dusty conditions can adversely affect people's ability to enjoy an outdoor environment (MfE, 2016). Airborne dust can cause effects on visibility, which is largely considered a matter of aesthetics. Visibility effects are usually only a concern in the immediate vicinity of the source. Extreme loss of visibility can also be a safety concern for road traffic and aircraft.

Human health effects can occur from exposure to smaller size fractions of particulate matter, PM_{10} (World Health Organisation, 2021). Some elements within PM_{10} particles also pose different levels of toxicity, including RCS and As. **Section 12.2** of this report provides an assessment of the potential human health impacts of dust on the nearest sensitive receptors to the site.

The key impacts of dust from this material will be on amenity values and via direct inhalation.

Arsenic is toxic to animals, including humans and is also a carcinogen (cancer-causing agent), and causes both skin and lung cancers. Arsenic is of most concern when it is in potable water supplies (Otago University, 2025).

High dust loadings can have a significant effect on plant life (MfE, 2016) including:

- Reduced photosynthesis leading to reduced growth and plant vigor;

- Increased incidence of pests and disease;
- Reduced effectiveness of pesticide sprays; and
- Crop blemishing, potentially leading to the downgrading of produce.

3.2 Gaseous Pollutants

The ore processing plant includes some air discharge stacks for gaseous pollutants. Further minor gaseous pollutants are discharged from vehicles, construction machinery and other diesel combustion equipment utilised across the site.

Cyanide compounds, including HCN, can be discharged if the wet chemistry processes are not appropriately controlled. However, given the pH controls within the gold cyanidation process, air discharges of HCN are not expected. People inhaling high concentrations of HCN can experience chronic, acute, or even fatal effects. Early symptoms of cyanide poisoning include light-headedness, giddiness, rapid breathing, nausea, vomiting (emesis), feeling of neck constriction and suffocation, confusion, restlessness, and anxiety.

Ammonia can have adverse health effects when exposure occurs at high concentrations. The severity of health effects depends on the route of exposure, the dose and the duration of exposure. Exposure to high concentrations of NH_3 in air causes immediate burning of the eyes, nose, throat and respiratory tract and can result in blindness, lung damage or death. Inhalation of lower concentrations can cause coughing, and nose and throat irritation.

4.0 Air Quality Assessment Criteria

This section presents the dust assessment criteria relevant to the contaminants being discharged from the BOGP.

4.1 Dust

4.1.1 Amenity Effects

The relevant criterion for amenity dust effects is set out in the *Good Practice Guide for Assessing and Managing Dust* (MfE, 2016):

> *There shall be no discharge of particulate matter that is objectionable to the extent that it causes an adverse effect at or beyond the boundary of the subject property.*

While wording may vary from council-to-council the assessment criteria is widely accepted for use across New Zealand. While this is a qualitative assessment criterion, the Dust Good Practice Guide provides recommendations on how to undertake an objective and robust assessment against this qualitative assessment criteria, which have been adopted for the assessment at section 10.0.

4.1.2 Buffer Distances

As dust particles decrease in diameter, both their potential airborne travel distances and potential for human health impacts increase. Larger dust particles have less of an impact on health but can cause adverse amenity impacts (visual plumes and/or deposited dust) (MfE, 2016).

The potential amenity impact of any dust source is highly dependent on the distance between the source and receptor. A receptor that is 500 m or greater from any dust source is highly unlikely to experience a detrimental effect on amenity values. The recommended buffer distance for a mine with blasting is 500 m (Environmental Protection Agency Victoria, 2024). A receptor between 250 m and 100 m from a dust source employing good practice dust suppression measures is unlikely to experience a detrimental effect on amenity values. Any receptor that is less than 100 m from a dust emitting site could potentially experience a detrimental effect on amenity values.

4.1.3 Health Effects - Dust

The relevant guidelines for assessing the off-site health effects of PM_{10} are defined in the National Environmental Standards for Air Quality: Ambient Air Quality Standards (NES:AQ AAQS) (Ministry for the Environment, 2004) and ambient air quality guidelines (AAQG) (Ministry for the Environment, 2002) as follows:

- 50 µg/m³ PM_{10} as a 24-hour average, allowing one exceedance in a 12-month period (NES:AQ AAQS); and
- 20 µg/m³ PM_{10} as an annual average (AAQG).

NZ-based standards or guidelines are not available for all potential constituent elements of the dust, including inorganic arsenic and RCS. The GPG Industry (MfE, 2016a) recommends that applicable air quality assessment criteria are selected using a hierarchy. The most relevant assessment criteria for As and RCS are:

- 0.2 µg/m³ inorganic arsenic as a 1-hour average, adopted from the California Office of Environmental Health Hazard Assessment Reference Exposure Levels (State of California OEHHA, 2025a)
- 0.0055 µg/m³ inorganic arsenic as an annual average, adopted from the AAQG; and
- 3 µg/m³ RCS as an annual average, adopted from the OEHHA REL (State of California OEHHA, 2025a).

4.1.4 Ecology Effects

Dust deposits can have significant effects on plant life, though mainly at high dust loadings (MfE 2016). This can include:

- Reduced photosynthesis due to reduced light penetration to the leaves. This can cause reduced growth rates and plant vigour. It can be especially important for horticultural crops, through reductions in fruit setting, fruit size and sugar levels. It can also lead to reduced forestry yields;
- Increased incidence of plant pests and diseases. Dust deposits can act as a medium for the growth of fungal diseases. In addition, it appears that sucking and chewing insects are not affected by dust deposits to any great extent, whereas their natural predators are affected;
- Reduced effectiveness of pesticide sprays due to reduced penetration; and,
- Rejection and downgrading of produce due to crop blemishing. Once again, this is a particular issue for horticultural crops.

The impacts of dust on plants are variable and largely dependent on the chemical composition of the dust and plant type. It is difficult to determine a universal effects assessment criteria for the ecological effects of deposited dust. Despite the lack of a specific ecological assessment criteria, onsite observations of plant health[1] suggest that the soil and rock dust are not currently posing any toxicological risks to flora.

4.2 Gaseous Contaminants

4.2.1 Ammonia

In accordance with the recommended hierarchy for air quality assessment criteria from the GPG Industry (MfE, 2016a) the relevant human health criteria for NH_3 are:

- 3,200 µg/m³ NH_3 as one-hour average, adopted from the OEHHA REL (State of California OEHHA, 2025b);
- 200 µg/m³ NH_3 as an annual average, adopted from the OEHHA REL (State of California OEHHA, 2025b).

Ammonia also poses ecological risks to flora. The NZ AAQG sets ‘critical levels’ for some air pollutants to protect ecosystems. The ecological critical level for NH_3 is 8 µg/m³ as an annual average.

[1] Personal Comment. Mary Askey, Santana Minerals 2 May 2025.

Within the site boundaries, air quality exposure and the resulting human health risks are controlled by Workplace Health and Safety Legislation (Ministry of Business, Innovation, and Employment, 2023). The workplace exposure standard for NH_3 inhalation in NZ workplaces is a Time-Weighted Average of 25 ppm averaged over an 8-hour work shift, and a Short-Term Exposure Limit of 35 ppm, not to be exceeded during any 15-minute work period.

4.2.2 Hydrogen Cyanide

There are no NZ-based standards or guidelines for HCN. The relevant human health criteria are:

- 340 µg/m³ HCN as a one-hour average, adopted from the OEHHA REL (State of California OEHHA, 2025a);
- 9 µg/m³ HCN as an annual average, adopted from the OEHHA REL (State of California OEHHA, 2025a).

The workplace exposure standard for HCN inhalation in NZ workplaces is a Time-Weighted Average of 1 ppm averaged over an 8-hour work shift, and a ceiling of 5 ppm, not to be exceeded for any duration.

5.0 Sources and Mitigation of Dust

5.1 Overview

It is very difficult to accurately quantify the amount of the dust that will be discharged from the BOGP. However, to provide a high level qualitative estimated it has been assumed that the disturbance footprint will be up to 568 ha, a total of 22.3 Mt of ore processed at a rate of 1.5 Mt year, 2013 Mt of waste rock and 289 Mt of non-ore bearing will be excavated and stored.

The key activities which have the potential to generate dust within the BOGP are the establishment and operation of:

- The four open pits - (Section 5.2);
- Soil stockpiles - (**Section 5.3**);
- Haul Roads - (**Section 5.4**);
- Engineered landforms - (**Section 5.5**);
- Ore Crushing - (**Section 5.6**);
- Tailing Storage facility - (**Section 5.7**).

In addition to the specific dust mitigation measures detailed for the key activities, the site will adopt best practice dust mitigation for general sources of dust (**Section 5.8**). This section closes with an assessment of water demand and water supply for dust suppression (**Section 5.9**).

5.2 Open Pits: RAS, CIT, SRX and SRE

The BOGP mine includes four open pits, RAS, CIT, SRX and SRE. **Figure 6** shows the location and size of the four pits within the site boundary. The physical dimensions of the four pits are shown in **Table 2.**

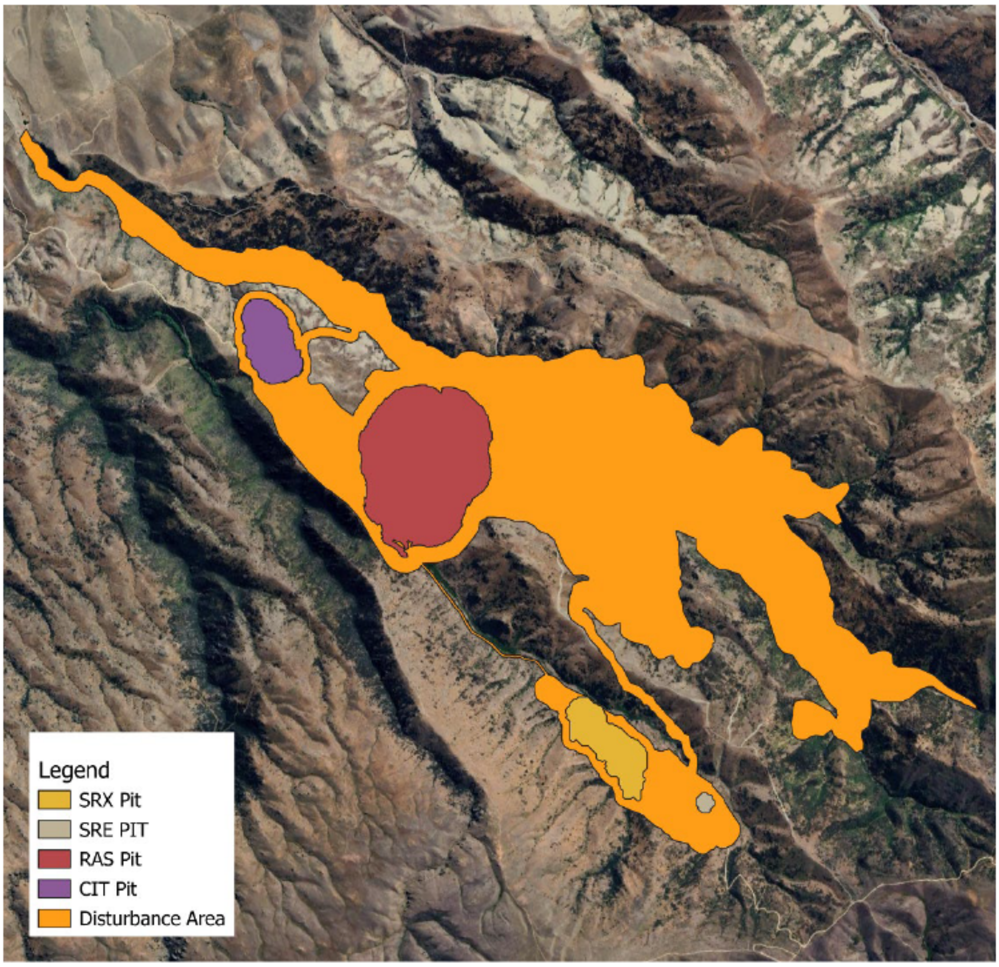

Figure 5: Location and size of the RAS, CIT, SRX and SRE pits within the site disturbance area.

Table 2: Dimensions of Open Pits

Pit	Dimensions	Approx. Area (ha)	Volume (Mbcm)	Life of pit (years)	Staging of pit development
RAS	1,000 m long, 900 m wide, 200 m deep	64	81	8	1
CIT	540 m long, 300 m wide, 50 m deep TBC	14	TBC	2	3

Table 2: Dimensions of Open Pits

Pit	Dimensions	Approx. Area (ha)	Volume (Mbcm)	Life of pit (years)	Staging of pit development
SRX	650 m long, 210 m wide, 88 m deep	15	TBC	2	2
SRE	100 m long, 100 m wide, 40 m deep	1	TBC	2	2

The sources, characteristics of the pit dust particles are outlined in **Table 3.**The key dust generating activities, methods and dust mitigation strategies associated with the development and operation of the pits is outlined in **Table 4.**

Table 3: Sources and characteristics of pit dust

Activity	Dust type	Relative size of dust source
Soil overburden removal	Soil dust. Brown in colour Mainly TSP with a small component of PM_{10}.	Large
Drilling and Blasting	Brown waste rock dust or grey ore dust. Mainly TSP with a component of PM_{10}.	Medium
Rock overburden and ore removal	Brown waste rock dust or grey ore dust. Small amounts of TSP with a minor component of PM_{10}.	Small

Table 4: Pit dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
Soil overburden removal	Soil scraping by tracked dozer. Soil loaded into dump truck by backhoe excavator or wheeled FEL.	Not undertaking soil overburden removal when windspeeds are greater than 7.5 metres per second (“**m/s**”) and toward sensitive receptors within 500 m of the site boundary and when dust is seen blowing over the site boundary. Minimising drop heights from excavator to dump truck. Dampen surface of soil.

Table 4: Pit dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
		Maintain adequate buffer distance (500 m) to sensitive receptors.
Drilling and Blasting	Bulk waste drilling – Ore drilling	Not undertaking drilling or blasting when windspeeds are greater than 7.5 m/s and toward sensitive receptors within 500 m of the site boundary and when dust is seen blowing over the site boundary. Maintain adequate buffer distance (500 m) to sensitive receptors.
Rock overburden and ore removal	Rock overburden and ore loaded into dump truck by backhoe excavator or wheeled FEL.	Not undertaking rock overburden and ore removal when the rock material is coated with fines and windspeeds are greater than 7.5 m/s and toward sensitive receptors within 500 m of the site boundary and when dust can be seen blowing over the site boundary. Maintain adequate buffer distance (500 m) to sensitive receptors.

For the purposes of providing a spatial context for a buffer distance (500 m) from the dust source to any sensitive receptor, **Figure 6** shows a 500 m buffer around the entire project boundary. The sensitive receptors captured within or close to this boundary are identified and discussed in **Section 8.4**.

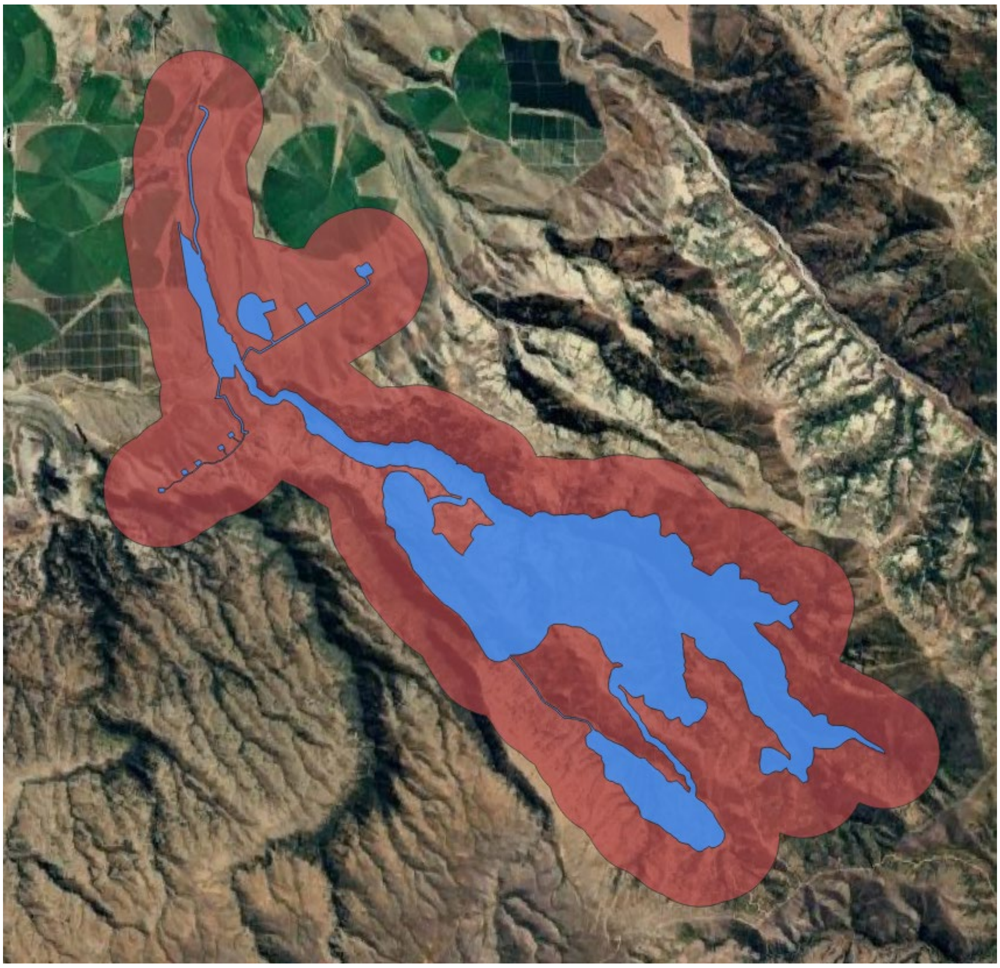

Figure 6: 500 m buffer distance (red) around the project boundary (blue).

5.3 Stockpiles

5.3.1 Soil

Site stripping and reinstatement operations, and overburden handling activities should be avoided during dry and windy conditions. Soils handling is generally a short-lived activity in a discrete area and there is considerable flexibility as to its timing. Overburden can usually be worked at higher moisture contents than soils which can reduce the risk of unacceptable dust emissions. Use of soil scrapers is effective in minimising soil handling.

The BOGP mine includes six stockpiles where overburden soil will be stored until it is used for remediation. **Figure 7** shows the location and size of the six soil stockpiles within the site boundary. The physical dimensions of the stockpiles are shown in **Table 5.**

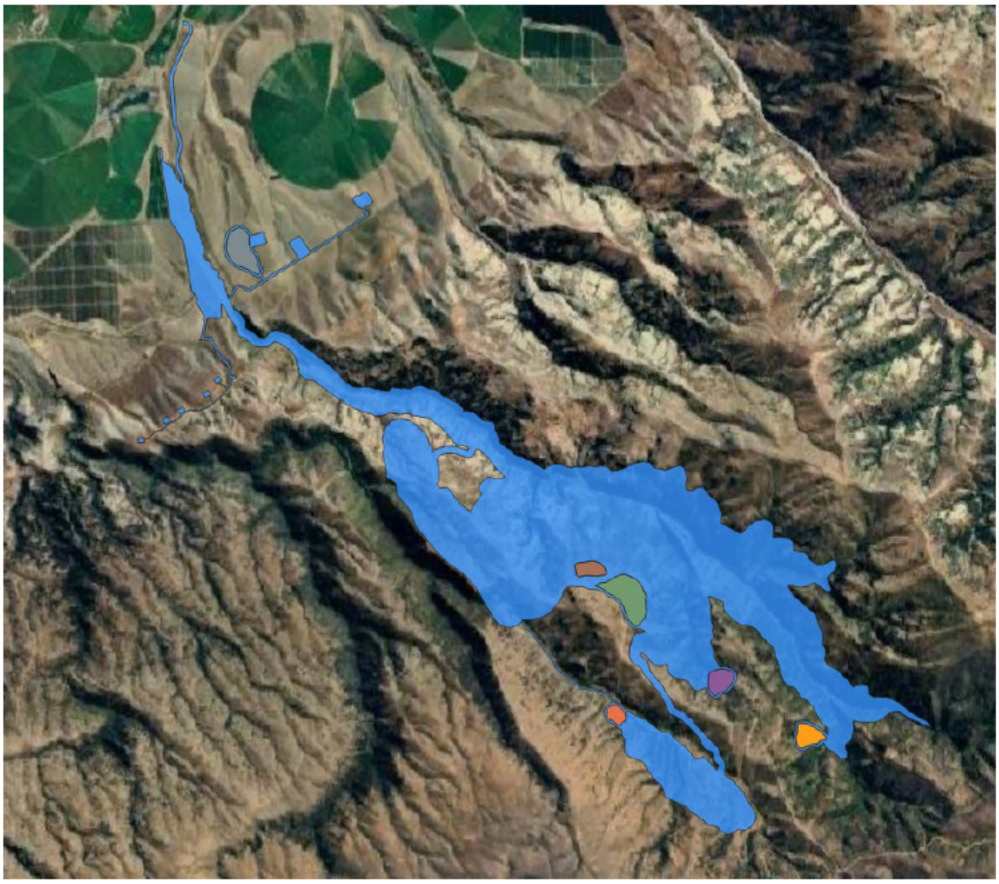

Figure 7: Location and size of the soil stockpiles within the site boundary.

Table 5: Dimensions of Soil Stockpiles		
Colour on Figure 7	Approx. Area (ha)	Elevated As levels
grey	6.5	no
brown	2.7	no
green	9.0	no
purple	3.5	no
orange	3.4	no
pink	1.9	yes

The sources, characteristics of the soil stockpile dust particles are outlined in **Table 6.** The key dust generating activities, methods and dust mitigation strategies associated with the soil stockpiles are outlined in **Table 7.**

Table 6: Sources and characteristics of soil stockpile dust

Activity	Dust type	Relative size of dust source
Soil overburden	Soil dust. Brown in colour. Mainly TSP with a small component of PM_{10}.	Medium
Elevated arsenic soil overburden	Soil dust. Brown in colour. Mainly TSP with a small component of PM_{10} containing As with concentrations between 150 and 500 ppm[1].	Medium

Notes:

1. *As is regulated by the NES:CS with a Soil Contamination Standard (industrial) of 70 mg/kg - so these natural levels are high.*

Table 7: Soil stockpile dust generating activities and dust mitigation strategies

<table>
<tr><th>Activity</th><th>Dust generation method</th><th>Mitigation measures</th></tr>
<tr><td>Soil overburden</td><td rowspan="2">Dumping soil from dump truck
Shaping soil stockpile by backhoe excavator or tracked dozer.
Wind erosion on unconsolidated surfaces.</td><td>Targeting the soil stockpile building or disturbance for when the soil moisture and/or wind conditions are such that dust plumes are unlikely to be blown across the site boundary.
Minimising drop heights from excavator and dump truck.
Dampen surface of soil.
Maintain adequate buffer distance (500 m) to sensitive receptors.
Establish vegetative cover on stockpile surface which is resistant to wind erosion.
Build soil stockpiles to a maximum height of 30 m.</td></tr>
<tr><td>Elevated As soil overburden (Pink Stockpile in Figure 8)</td><td>Keep elevated arsenic soil overburden in a separate stockpile. Do not mix with uncontaminated soils.
Document the location and quantity of elevated As soil stockpiles.
Dampen surface elevated As soil stockpiles in response to any soil dust witnessed.</td></tr>
</table>

Table 7: Soil stockpile dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
		Minimise time elevated As soil is stockpiled. Where practical direct transfer elevated As soils to rehabilitation areas where the native material was high in As. Establish vegetative cover on elevated As soil stockpile surfaces which is resistant to wind erosion. Use elevated As soil overburden for rehabilitation in areas with naturally elevated levels of these contaminants (i.e. Soil from SRX pit used on SRX ELF, Soil from southwest side of CIT returned to SW side during rehabilitation of CIT).

5.3.2 Ore

The BOGP mine includes one stockpile where ore will be stored until it is transported to the processing plant. **Figure 8** shows the location and size of the ore stockpile within the site boundary. The physical dimensions of the ore stockpile are shown in **Table 8.**

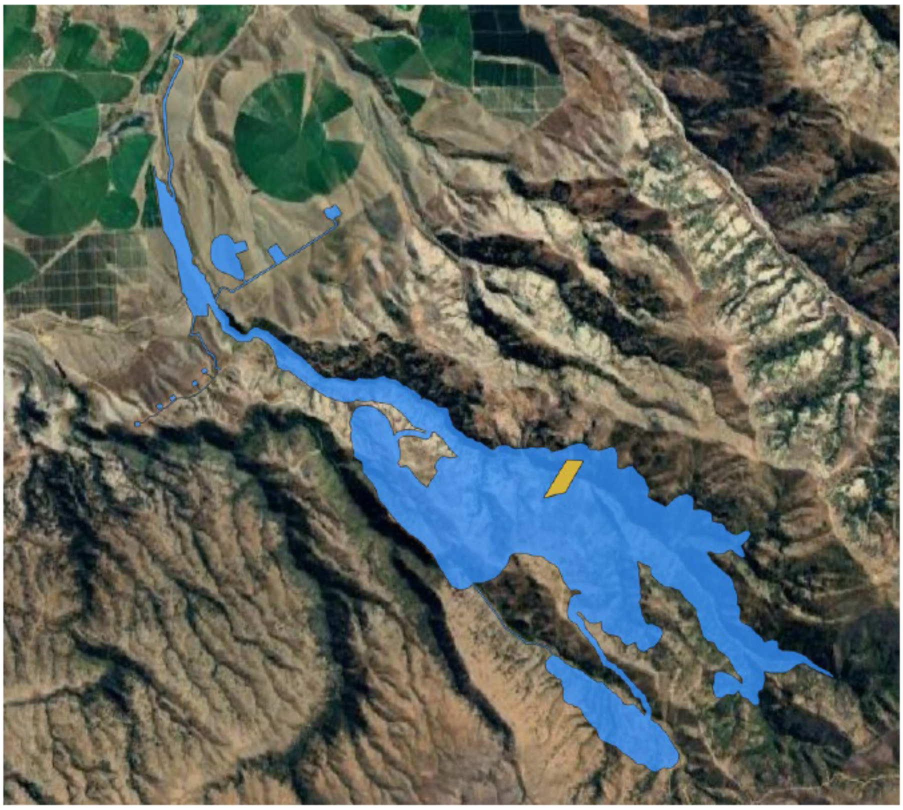

Figure 8: Location and size of the ore stockpile within the site boundary.

Table 8: Dimensions of Ore Stockpile			
Stockpile	**Colour on Figure 9**	**Approx. Area (ha)**	**Approx. Vol (loose tonnes)**
1	Yellow	5.6	560,000

The sources, characteristics of the ore stockpile dust particles are outlined in **Table 12.** The key dust generating activities, methods and dust mitigation strategies associated with the ore stockpile is outlined in **Table 13.**

Table 9: Sources and characteristics of soil stockpile dust		
Activity	**Dust type**	**Relative size of dust source**
Ore rock stockpiling	Ore dust. Grey in colour. Mainly TSP with a small component of PM_{10}.	Small

Table 10: Soil stockpile dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
Ore rock stockpiling	Dumping Rock from dump truck Shaping ore stockpile by wheeled FEL. Wind erosion on unconsolidated surfaces.	Minimising drop heights from excavator and dump truck. Maintain adequate buffer distance (500 m) to sensitive receptors.

5.4 Haul Roads and Public Road Works

The BOGP mine includes the development and use of haul roads which will be travelled by machines as soil, rock, ore and tailings are transported from the pits to stockpiles, ELFs, processing plant or TSF. The project will also require some small sections of new or re-aligned public roads to efficiently connect the BOGP mine with the local roading network. These works include:

- Upgrades to the Ardgour and Thomsons Gorge Roads (TGR) from SH8 to the entry point of Shepherds valley;
- A new road from TGR through the "neck" of the lower Shepherds gorge into the process plant area; and
- Re-alignment of the western portion of the TGR to follow the Ardgour ridge through an existing easement in the DOC reserve and then re-joining with the TGR at Thomsons saddle.

The surfaces of the haul and re-engineered public roads will be unsealed. **Figure 9** shows the location of the haul roads, access roads, and new or re-aligned public roads. The dimensions of the haul roads, access roads, and re-engineered public roads are shown in **Table 11**.

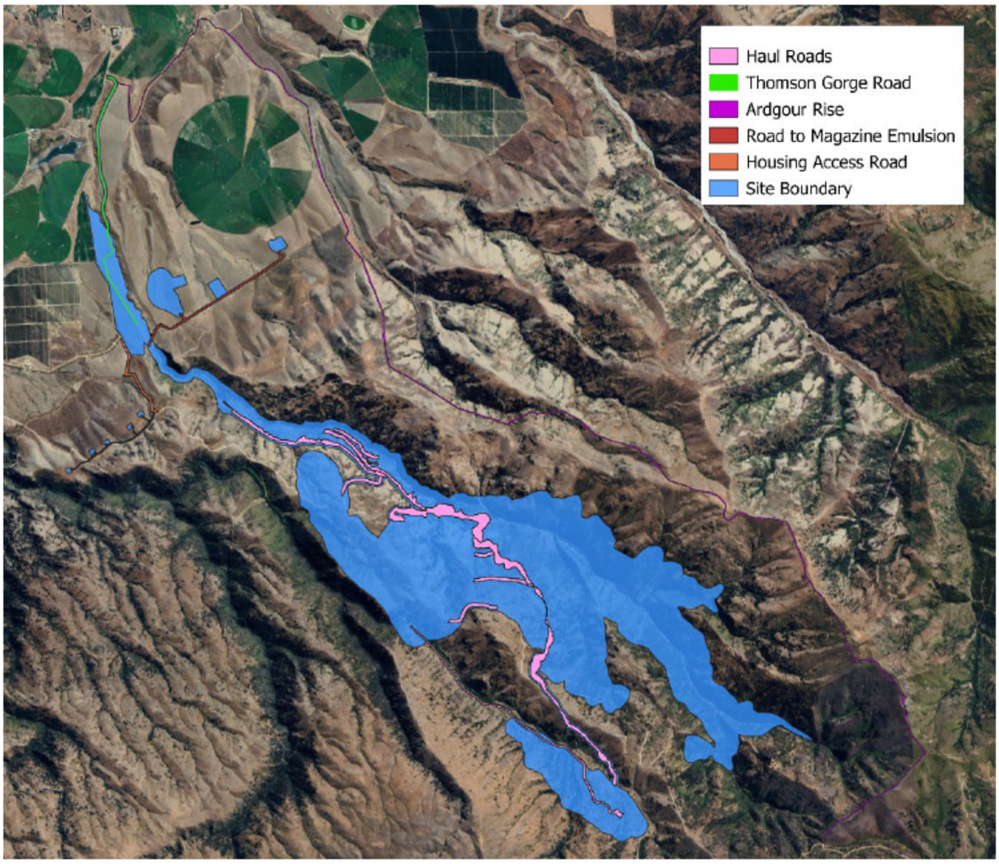

Figure 9: Location and size of the BOGP haul roads and access roads

Table 11: Dimensions of haul road and re-engineered public roads		
Area	**Approx. Area (ha)**	**Total length(km)**
Haul roads	38.4	11.8
Ardgour Rise	12.1	13.4
New Site Access Road	1.8	2.4
Housing access road	2.6	2.1
Road to Magazine Emulsion	2.8	1.6

The sources and characteristics of the haul road dust particles are outlined in **Table 12.** The key dust generating activities, methods and dust mitigation strategies associated with the haul roads are outlined in **Table 13.**

Table 12: Sources and characteristics of unsealed road dust

Activity	Dust type	Relative size of dust source
Haul road construction	Soil dust. Brown in colour. Brown rock dust. Brown in colour Mainly TSP with a small component of PM_{10}.	Medium
Haul road use	Brown rock dust. Brown in colour. Mainly TSP with a small component of PM_{10}.	Large

Table 13: Unsealed road dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
Haul road construction. Upgrades to Ardgour and Thomsons Gorge Roads (TGR) from SH8 to the entry point of Shepherds valley. A new road from TGR into the process plant area. Re-alignment of the western portion of the TGR to follow the Ardgour ridge.	Establishing haul road foundation by backhoe excavator and tracked dozer. Establishing roadway surface dumping surface material from dump truck and rolling surface. Wind erosion on unconsolidated surfaces.	Not undertaking haul road construction activities when windspeeds are greater than 7.5 m/s and toward sensitive receptors within 500 m of the site boundary and when dust can be seen blowing over the site boundary. Minimising drop heights from excavator and dump truck. Dampen surface of construction surfaces. Maintain adequate buffer distance (500 m) to sensitive receptors.
Haul road use	Up to 420 vehicle movements per day. 68% light duty vehicles. - <3,500 kg tare weight 32 % heavy duty vehicles - >3,500 kg tare weight.	Engineered surface which minimises free fine material which can generate dust. Maintain haul road surfaces to avoid excess fines and potholes. Reduction of speed limit to 20 kph when dust can be seen blowing over the site boundary. Dampen surface of haul roads.

5.5 Engineered Landforms

The development of BOGP mine pits requires the removal and storage of large volumes of waste rock. The waste rock will be stored in three engineered landforms as shown in **Figure 10.** The ELFs will be constructed with waste rock which will not contain nor be covered in any substantial amount of fine materials. The construction of the ELFs will not be a significant source of dust. The ELFs will be progressively remediated by covering with soil and planting with shallow rooted plants**.** The distribution of soil on to the surface of the ELFs can be a moderate source of dust emissions. The dimensions of the landforms are shown in **Table 14.**

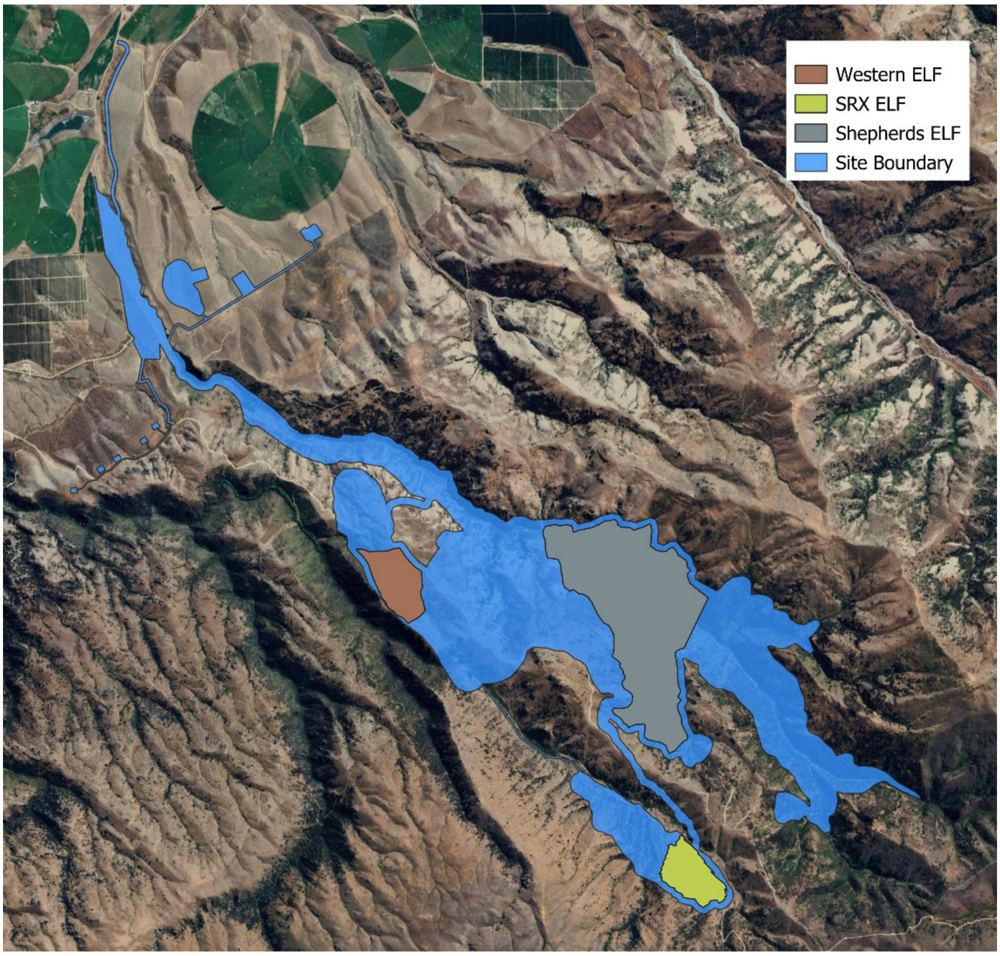

Figure 10: Location and size of the engineered landforms.

Table 14: Dimensions of ELFs

ELF	Approx. Area (ha)	Waste Rock content
Shepherds Creek engineered landform	111	103.6 (million loose cubic metres)
SRX rock dump	16	5,900 (kT)
Western ELF	17	10,732 (kT)

The sources, characteristics of the ELF dust particles are outlined in **Table 15.** The key dust generating activities, methods and dust mitigation strategies associated with the ELFs is outlined in **Table 16.**

Table 15: Sources and characteristics of ELF dust

Activity	Dust type	Relative size of dust source
ELF construction	Brown rock dust. Brown in colour Mainly TSP with a small component of PM_{10}.	Small
ELF rehabilitation	Soil dust. Brown in colour. Mainly TSP with a small component of PM_{10}.	Moderate

Table 16: ELF dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
ELF construction	Rock overburden dumped by dump truck and ELF formed by backhoe excavator or tracked dozer.	Maintain adequate buffer distance (500 m) to sensitive receptors.
ELF rehabilitation	Dumping soil from dump truck. Shaping soil covering by backhoe excavator or tracked dozer. Wind erosion on unconsolidated surfaces.	Targeting the soil stockpile building or disturbance for when wind conditions are such that dust plumes are unlikely to be blown across the site boundary. Minimising drop heights from excavator and dump truck.

Table 16: ELF dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
		Dampen surface of soil in the working area. Maintain adequate buffer distance (500 m) to sensitive receptors. Establish vegetative cover on stockpile surface which is resistant to wind erosion.

5.6 Ore Processing Plant

The ore bearing rock will be transported to the processing plant. The location of the ore processing plant within the site boundary is shown in yellow in **Figure 11**. The western yellow area includes the processing mill and office, and the eastern yellow area represents the workshop.

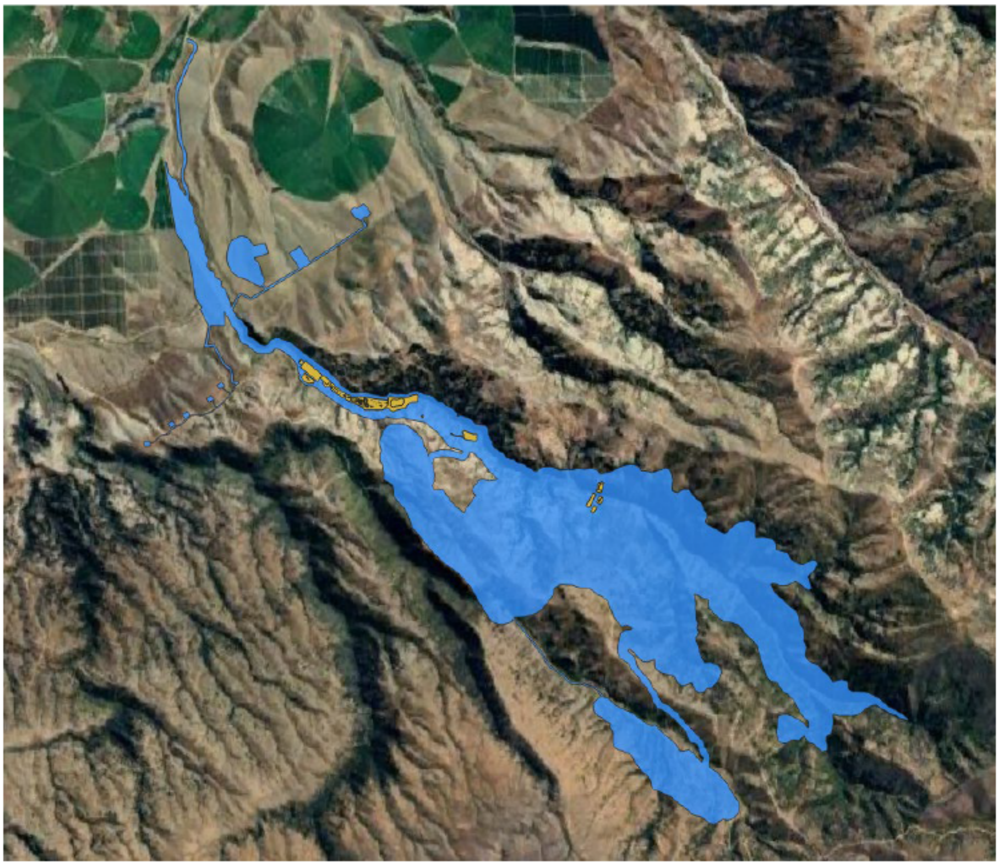

Figure 11: Location and size of the ore processing plant (yellow)

The key sources of dust in the ore processing plant are:

- Unsealed access road:
- Run of Mine (“**ROM**”) pad;
- ROM bin;
- Covered crushed ore stockpile;
- Lime silo; and,
- Reagent make-up.

Figure 12 shows the location of dust sources of the ore processing plant. **Table 17** describes the sources and characteristics of ore processing plant dust. **Table 18** details the ore processing plant dust generating activities and dust mitigation strategies.

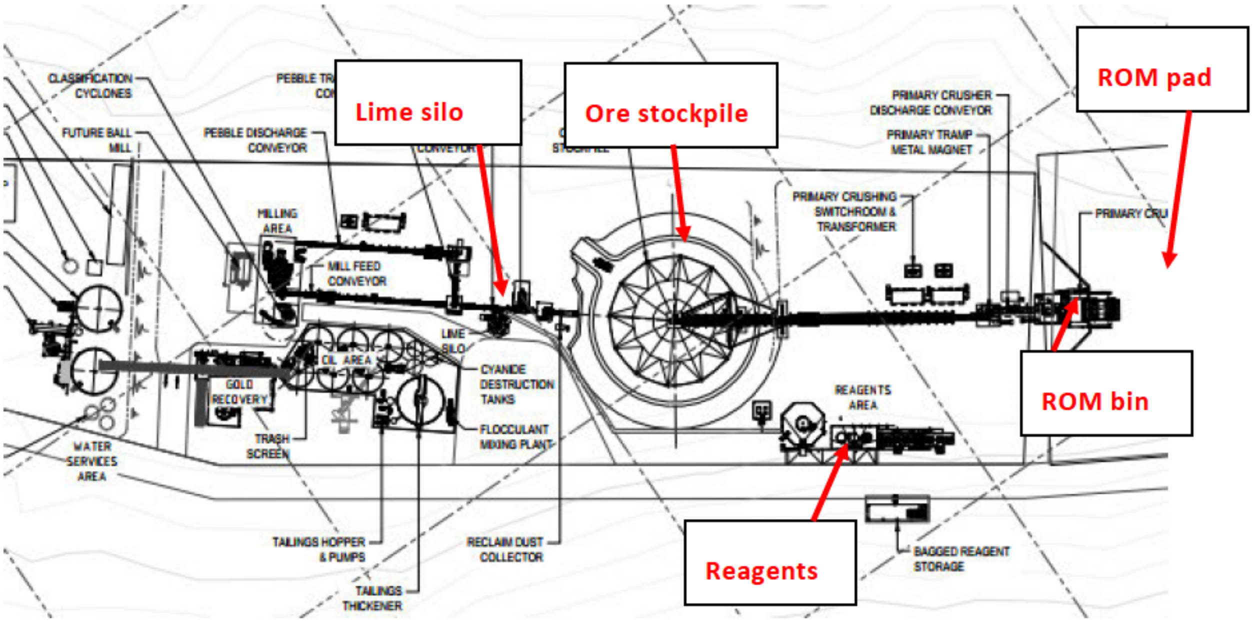

Figure 12. Dust sources of the ore processing plant.

Table 17: Sources and characteristics of ore processing plant dust

Activity	Dust type	Relative size of dust source
Vehicle movements on access road	Brown/grey rock and soil dust. Mainly TSP with a small component of PM_{10}.	Medium
ROM pad	Grey/black rock dust. Mainly TSP with a small component of PM_{10}.	Small
ROM bin	Grey/black rock dust. Mainly TSP with a small component of PM_{10}.	Small
Covered crushed ore stockpile	Grey/black rock dust. Mainly TSP with a small component of PM_{10}.	Medium
Reagent make-up	White dust. Mainly TSP with a small component of PM_{10}.	Small
Lime silo	White dust. Mainly TSP with a small component of PM_{10}.	Small

Table 18: Ore processing plant dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
Vehicle movements on access road	See **Section 5.4**.	See **Section 5.4**.
ROM pad	ROM ore is stockpiled on the pad for blending into the plant feed. ROM ore is deposited by trucks and moved by Loader (“**FEL**”).	Maintain adequate buffer distance (>500 m) to sensitive receptors. Dust mitigation is by use of water truck.
ROM bin.	ROM Ore is deposited into the open ROM bin by FEL.	Dust mitigation by water sprays. Automated as FEL approaches bin. Feed out of this bin is by apron feed, water sprays at transfer points and over crushers.

Table 18: Ore processing plant dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
Covered crushed ore stockpile.	Material is deposited into the crushed ore stockpile by conveyor. Ore is removed by apron feeders located in a tunnel below the stockpile.	Water sprays at transfer points to mitigate dust. Ore crusher fitted with high pressure low volume misting system. Dust mitigation in tunnel is by extraction at transfer points and extraction along tunnel length to a wet scrubber.
Lime silo.	Silo delivers lime into mill feed conveyor which is transporting primary crushed ore to the SAG mill.	Silo dust collector is reverse pulse with felt bags and will return collected dust to the silo. Lime discharge to the conveyor belt by a screw feeder (very little dust generated as drop height is minimal).
Reagent make-up.	Dry reagents are unloaded from bulk bags.	All dry reagents are unloaded from bulk bags inside an enclosed bulk bag breaker located directly above the make-up tank. Dust is contained within the enclosure bulk bag breaker.

5.7 Tailings Storage Facility

The process tailings will be pumped to a conventional wet TSF facility constructed in the upper Shepherds Valley. **Figure 13** shows the location and size of the TSF. The TSF dam will be constructed with waste rock which will not contain nor be covered in any substantial amount of fine materials. The construction of the TSF will not be a significant source of dust. The tailings are pumped to the TSF as a slurry and are wet when they arrive and are deposited. The continuous delivery of the tailings slurry to the TSF keeps the surface damp. Therefore, the operational TSF does not discharge dust. When complete the TSF will be progressively remediated by covering with soil and planting with shallow rooted plants. The distribution of soil on to the surface of the TSF can be a moderate source of dust emissions. The dimensions of the TSF are shown in **Table 19**.

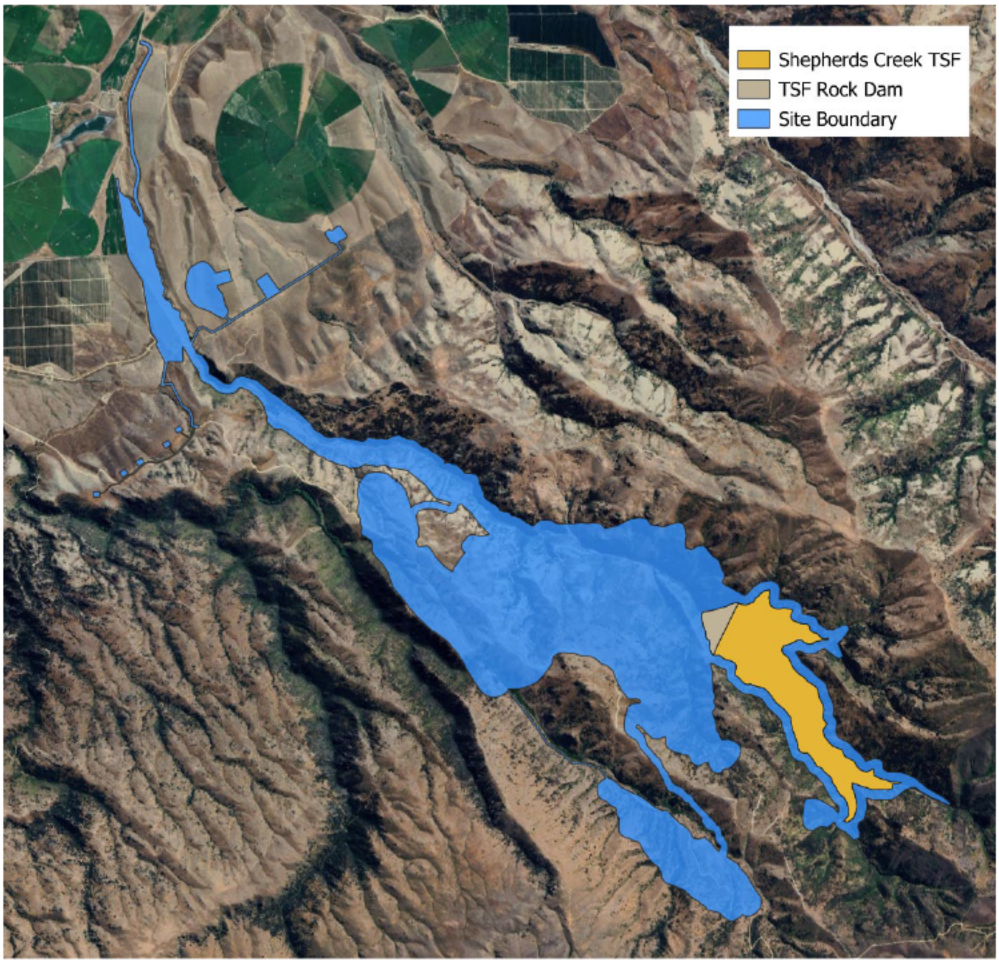

Figure 13: Location and size of the TSF

Table 19: Dimensions of TSF

TSF	Approx. Area (ha)	Capacity
TSF rock dam	8.6	3,000 kT
Shepherds TSF	60	21.5 million m^3

The sources and characteristics of the ore processing plant dust particles are outlined in **Table 20.** The key dust generating activities, methods and dust mitigation strategies associated with the ore processing plant are outlined in **Table 21.**

Table 20: Sources and characteristics of ore processing plant dust

Activity	Dust type	Relative size of dust source
TSF construction.	Grey/black rock dust. Mainly TSP with a small component of PM_{10}.	Small.
TSF operation.	Grey/black rock dust. Particulates < 100 µm.	Negligible.
TSF remediation.	Brown soil dust. Mainly TSP with a small component of PM_{10}.	Medium.

Table 21: Ore processing plant dust generating activities and dust mitigation strategies

Activity	Dust generation method	Mitigation measures
TSF construction.	Rock overburden dumped by dump truck and ELF formed by tracked dozer.	Maintain adequate buffer distance (500 m) to sensitive receptors.
TSF operation.	The tailings are pumped to the TSF as a slurry and are wet when they arrive and are deposited.	The continuous delivery of the tailings slurry to the TSF keeps the surface damp. Therefore, the operational TSF does not discharge dust.
TSF remediation.	Dumping soil from dump truck. Shaping soil covering by backhoe excavator and tracked dozer. Wind erosion on unconsolidated surfaces.	Targeting the soil stockpile building or disturbance for the cooler and wetter months of the year when soil moisture content is relatively high (March to October). Not undertaking soil stockpile building or disturbance when: • Windspeeds are greater than 7.5 m/s; and • Winds are blowing toward sensitive receptors within 500 m of the site boundary; and, • Dust can be seen blowing over the site boundary

Table 21: Ore processing plant dust generating activities and dust mitigation strategies		
Activity	**Dust generation method**	**Mitigation measures**
		Minimising drop heights from excavator and dump truck. Dampen surface of soil. Maintain adequate buffer distance (500 m) to sensitive receptors. Establish vegetative cover on stockpile surface which is resistant to wind erosion.

5.8 Other Dust Sources

Dust sources other than those detailed in **Sections 5.2 to 5.7** will be controlled using best practice dust mitigation as detailed in **Table 22.**

Table 22: Good Practice Mitigation – Design Measures	
Mitigation and Design	**Description**
Phasing of extraction activities	As far as practicable, dust-generating activities have been located away from highly sensitive receptors Minimisation of dust through site design is addressed through extraction of ore in 3 stages, minimising unconsolidated areas.
Design and location of dust-generating activities	Stockpiles, haul roads, and exposed areas have been located a reasonable distance away from sensitive receptors. Dust generating potential from each of these areas will be minimised.
Management	An AQMP has been produced and will be adhered to. Effective site management practices are critical to demonstrate the willingness of the operator to control dust emissions and provides a mechanism for auditing of site operations. Such management procedures are outlined within the AQMP. This includes recording of all dust and air quality complaints, identification of cause(s), appropriate measures taken to reduce emissions in a timely manner, and record of the measures taken.

Table 22: Good Practice Mitigation – Design Measures

Mitigation and Design	Description
Provision for water supply	Planning and design of the scheme has made provision for water supply to meet the site demand for mitigation and damping.
Equipment and vehicles	The site has been designed to minimise haul route distances and to locate haul routes away from sensitive receptors.
Planting	Soil stockpiles will have surfaces stabilised by planting of vegetation.
Training	MGL will provide training to the site personnel on dust mitigation. Training will also cover 'emergency preparedness plans' to react quickly in case of any failure of the planned dust mitigation.
Monitoring	An appropriate monitoring scheme will be implemented. This includes a range from visual inspections, wind monitoring and real-time PM_{10} continuous monitoring locations. MGL will undertake on-site inspections, audit the monitoring programme, carry out regular site inspections to monitor compliance with the AQMP and adjust the frequency of site inspections according to dust risk (higher frequency in dry and windy conditions)
Communication	MGL maintains open communication channels with the surrounding communities via scheduled meetings, making contact details public and establishing a complaints system.
Planning of activities	Some activities should ideally be planned only during favourable weather conditions. Where possible, particularly dusty activities should be avoided during extended periods of dry and windy conditions. As outlined in the AQMP, excavation of ore from open pits and earthworks activities will cease if winds are greater than 7.5 m/s and when dust can be seen blowing over the site boundary.
Vehicle movements	Site traffic is often the greatest source of dust on sites. Standard good practices for site haulage include: - Regular clearing, grading and maintenance of haul routes. - When sensitive receptors are within 250 m of a highly trafficked area, lay down a bed of pea metal (<6 mm stone), which keeps the truck tyres out of contact with fine dust. - Setting a site-specific and enforceable speed limit of 60 km/hour.

Table 22: Good Practice Mitigation – Design Measures

Mitigation and Design	Description
	• The speed limit reduces to 20 km/hour on sections of road when the road surface and/or wind conditions are such that dust plumes are likely to be blown across the site boundary. • Evenly loading vehicles to avoid spillages. • Application of water at recommended the rate (Section 5.9.2) on highly trafficked roads (as detailed in Section 5.4) when dust risk is high (e.g. warm, sunny and windy days).

5.9 Dust Mitigation Water Supply and Demand

5.9.1 High risk soil moisture conditions

Water increases the weight of individual dust particles and links dust particles together forming a cohesive and protective surface thus making dust less susceptible to wind pickup. The relationship between dust particulate and rainfall was investigated by (Yassen, 2000). Simple regression and multiple regression techniques were used to model dust concentrations as a function of meteorological conditions. The results of this study revealed that a correlation between dust and rainfall yields negative relationship between rainfall and dust concentrations (i.e. greater rain fall, the lower the dust concentrations).

The Ministry for Environment (MfE) recommends that water is applied at a rate of 1 litre/m^2/hour for dust suppression (MfE, 2016). The Otago Regional Council does not have a recommended dust suppression water application rate, but the Bay of Plenty Regional Council recommends a rate of 5 mm/day (Environment Bay of Plenty, 2010). The Bay of Plenty Regional Council also states that water should be applied after seven consecutive days without rain during summer and spring conditions, with water suppression applied daily until the next rainfall. The IAQM Mineral Dust Guidance (IAQM, 2016) states that dry days are often defined as days with less than 0.2 mm of rainfall.

The rate of evapotranspiration from a mine or haul road surface is the key variable that determines the amount of water needed to control dust. It is accepted good practice to apply water at daily rate that achieves a 1mm differential between evapotranspiration and water application.

5.9.2 Water Demand

One of the key dust mitigation measures is the application of water. As a benchmark for dust suppression the Ministry for the Environment Good practice guide on assessing and managing dust recommends a water application rate 1 mm/hour (or 1 litre/m^2 per hour). This recommended water application rate often proves to be conservative for most sites because:

- The application rate of 1 mm/hr is higher than needed for some areas in NZ. I.e. the soil water evaporation rate is less than 1 mm/hr. The site evapo-transpiration data usually peaks at 0.8mm/hour on the hottest part of the hottest days over summer.
- Depending on dust management strategies:
  - The whole of the active area may not need watering
  - Every hour in the working day may not need watering
- No impact of meteorological conditions has been considered:
  - Rainfall will reduce water demand
  - Some April to September inclusive will require significantly less water (if any) to suppress dust emissions.

Three stages of the mine life cycle have been identified as providing representative scenarios for assessing the water demand for dust mitigation. The three stages of the mine life cycle assessed are detailed in **Table 23.**

Table 23: Mine life cycle stages for assessing dust mitigation water demand

Stage of mine life cycle	Timing (years)	Dust Sources
Startup and Project Development	0 to 2	Accommodation area development Haul Roads and public roads development Ore Processing plant development RAS site prep Soil stockpiles
RAS pit mining on its own	3 to 5	Haul Roads use RAS pit Processing plant Soil stockpiles

Table 23: Mine life cycle stages for assessing dust mitigation water demand		
Stage of mine life cycle	**Timing (years)**	**Dust Sources**
RAS Pit plus RAS UG, plus CIT (CIT Pit mined months 102 to 114) (SRX Pit mined months 145 onwards)	6 to 11	Haul Roads use RAS pit CIT Pit Processing plant Soil stockpiles

The dust suppression water demand volumes have been calculated for the three assessment scenarios using the following assumptions:

- Water application rate 1 mm/hr (1 L/m^2/hr);
- Water applied to roads for 8 hours per day;
- 10 % of infrastructure construction site areas may need water suppression at any one time;
- 50% of active ELF area may need water suppression at any one time;
- 50% of haul Roads may need water suppression at any one time; and,
- Processing plant requires 10 m^3/hr for dust suppression.

shows the volume of water per hour required for dust suppression for the key dust sources associated with each of the three site development and operational scenarios.

Table 24: Dust mitigation water demand				
Stage of mine life cycle	**Dust Sources**	**Area of dust source (ha)**	**Dust suppression area (ha)**	**Volume of water (m^3/hr)**
Startup and Project Development Years 1 and 2	Accommodation area development	15	1.5	15
	Ore Processing plant development	10	1	10
	Haul Road RAS to Plant	3.2	1.6	16.2
	Haul Road RAS to ELF	8.7	4.4	43.5
	ELF	1	0.5	5

Table 24: Dust mitigation water demand

Stage of mine life cycle	Dust Sources	Area of dust source (ha)	Dust suppression area (ha)	Volume of water (m^3/hr)
	Haul road length to topsoil outside	3.9	1.9	19.3
	Infrastructure area	2	1	10.2
	Haul road to TS stack	2	1	10.2
	Total volume of dust suppression water (m^3/hr)			**129 (36 l/s)**
RAS pit mining Years 3 to 5	Haul Road RAS to Plant	**3.2**	**1.6**	16.2
	Haul Road RAS to ELF	**8.7**	**4.4**	43.5
	ELF	**1**	**0.5**	5
	Haul road length to topsoil outside	**3.9**	**1.9**	19.3
	Dust suppression infrastructure area	**2**	**1**	10.2
	Average haul road to TS stack	**2**	**1**	10.2
	Processing plant	**NA**	**NA**	10
	Total volume of dust suppression water (m^3/hr)			**114 (32 l/s)**
RAS pit plus CIT or SRX pit mining Years 6 to 11	Haul Road RAS to Plant	**3.2**	**1.6**	16.2
	Haul Road RAS to ELF	**8.7**	**4.4**	43.5
	ELF	**1**	**0.5**	5
	Haul road length to topsoil outside	**3.9**	**1.9**	19.3
	Dust suppression infrastructure area	**2**	**1**	10.2
	Average haul road to TS stack	**2**	**1**	10.2
	Processing plant	**NA**	**NA**	10

Table 24: Dust mitigation water demand

Stage of mine life cycle	Dust Sources	Area of dust source (ha)	Dust suppression area (ha)	Volume of water (m^3/hr)
	CIT or SRX to Plant/ELF	**7.5**	**3.7**	37.4
	Total volume of dust suppression water (m^3/hr)			**152 (42 l/s)**

5.9.3 Water Supply

The BOGP water supply system will need to be designed to deliver up to 110 l/s or 50 l/s, 396 m^3/hr or 9504 m^3/day. In addition to the BOGP water supply system, after two years from the start of the site development, a minimum of 5 l/s water will be available for dust suppression from the dewatering of the pits. BOGP's water supply system has been designed and sized to service the whole mine's requirements - including water for dust suppression. When considering the site's total demand for water supply and the volume of water available, BOGP is confident that there will be sufficient water for dust suppression even at the peak rate of 42 l/s[2].

5.9.4 Summary

MGL will ensure that 50 l/s of water is available daily for potential dust suppression purposes for the first two years of site development and a minimum of 55 l/s in subsequent years. There will be two dust suppression water carts on site. Use of a cart rather than fixed sprinkler lines allows dust suppression target areas to move around with staging of ore extraction. Should the need be identified by visual dust monitoring, fixed sprinklers, mobile k-line sprinkler system, water truck with cannon may also be opted for instalment along haul roads and active mine areas in addition to the water cart.

During the period of peak demand for dust suppression water (summer for RAS pit plus CIT or SRX pit mining) the water demand is estimated to be 42 l/s. The water supply during that period will be at least 55 l/s. This means there will be at least 12 l/s (43 m^3/hr) available for dust suppression for any dust sources beyond those identified in **Table 24** which may on occasion require suppression. (e.g. soil overburden removal, soil stockpiles, soil bunds).

In summary, the site provides sufficient water for typical and for high demand dust suppression. All water supply and dust mitigation systems installed will be designed to ensure 1 mm water per hour over mine operation target areas on dry days at any stage of the mine's life.

[2] Personal communication. Mary Askey Santana Minerals. 02 May 2025.

6.0 Sources and Mitigation of Gaseous Air Contaminants

6.1 Ore Processing Plant

There are four potential sources of gaseous air contaminants from the ore processing plant:

- Leaching and adsorption tanks;
- Acid wash and elution columns;
- Electro-winning cells; and,
- Induction furnace.

Figure 14 shows the location of potential gaseous air contaminants from the ore processing plant. **Table 17** describes the sources and characteristics of ore processing plant gaseous air contaminants. **Table 18** details the ore processing plant gaseous air contaminants generating activities and gas mitigation strategies.

It is important to note that the proposed controls shall minimise the gaseous air contaminant discharges to 'low levels', with these discharges further dispersing in air over the substantial separation distances to off-site receptor locations (refer **Section 8.4**).

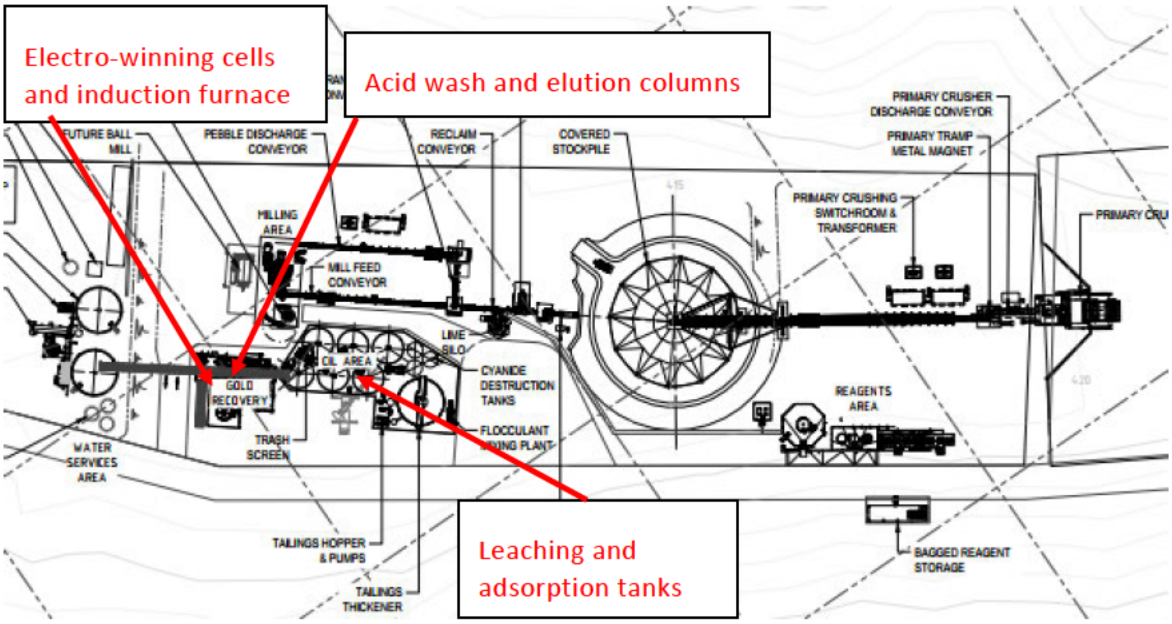

Figure 14: Gaseous pollutant sources of the ore processing plant.

Table 25: Sources and characteristics of ore processing gaseous pollutants

Process	Pollutant type	Quantity of Emission
Leaching and adsorption tanks	HCN	Zero – subject to mitigation.
Gold recovery Acid wash and elution columns	HCN	Zero – subject to mitigation.
Electro-winning cells	NH_3	Minor
Induction furnace	Particulate and base metals	Minor

Table 26: Ore processing plant gaseous pollutant generating activities and mitigation measures

Activity	Gas generation method	Mitigation measures
Leaching and adsorption tanks	CN^- ions in solution will combine with H^+ ions to produce HCN gas.	Worksafe requirements. pH maintained at between 10 and 12. pH Alarms and HCN sensors.
Gold recovery Acid wash and elution columns	CN^- ions in solution will combine with H^+ ions to produce HCN gas.	Worksafe requirements. pH maintained at between 10 and 12. pH Alarms and HCN sensors.
Electro-winning cells	During the electrowinning process	Gases from the electrowinning cells are captured by a hood and then are fan forced and vented to the atmosphere and from a 15 m high stack. Amount of NH3 generated is low and significant dilution occurs via the discharge method and configuration.
Induction furnace	The gold smelting process removes impurities from gold ore. To remove these impurities, extremely high temperatures, pressure and a number of fluxes are used.	Fume hood. Glass silica curtains. Furnace Bag Filter System.

Table 26: Ore processing plant gaseous pollutant generating activities and mitigation measures		
Activity	**Gas generation method**	**Mitigation measures**
	In these extreme conditions, particulate matter can be produced and discharged from the liquid mixture of metals and slag (Si0) contained in the furnace curable.	Comprehensive dust extraction system. Draws away and filter's fumes and captures dust particles. Environmental and OHS requirements. Reverse Jet self-cleaning polyester filter bags. Any fumes are captured by a hood and then are fan forced and vented to the atmosphere and from a 15 m high stack.

6.2 Machinery and Vehicles

The key combustion products discharged from the burning of diesel in machines and vehicles are PM_{10} and NOx. The operational phase is likely to result in an approximate maximum of 420 vehicle movements per day throughout the site. Approximately 32% of these vehicles will be heavy duty (TARE >3,500 kg). PDP's experience with large quarry and mining sites shows that the operation of diesel-powered machinery and vehicles are usually a minor source of gaseous contaminants which rapidly disperse to negligible concentrations in air. For this reason, the effects of combustion products discharged from the burning of diesel in machines and vehicles are not considered further in this assessment.

6.3 Underground Portals

In the underground mine the following diesel-powered machinery will be operated:

- Two twin boomed development jumbos;
- Three 50-t dump trucks; and
- One 17-t bucket underground loader.

As for the above-ground machines, the key combustion products discharged from the underground machines are PM_{10} and NO_x.

The underground mine will be served by two inlet ventilation portals fitted with 110 kW ventilation fans. Two fans will draw air down into the mine and two fans to drive air back up and discharge via the by two ventilation portals. The underground mine ventilation system will draw up to 200 m^3/s which MGL has determined is more than sufficient to meet the health and safety requirements for the miners working underground. The ventilation portals will be 3 m wide and 3 m high and discharge horizontally at ground level.

When assessing the potential adverse impacts of the contaminants discharged from the underground mine the key aspects to be considered are the:

- Relatively low gaseous pollutant discharge rate of the underground machines; and
- High ventilation flow rate which complies with health and safety requirements.

Table 27 and **Table 28** provide the diesel machine emission rates and mine exhaust portal concentrations for PM_{10}, and NO_2 respectively.

Table 27: Underground machine PM_{10} emissions and discharge concentrations

Machine (diesel engine power (kW))	PM_{10} Emission rate (g/s)[1]	Mine air exhaust flow rate (m^3/s) and exit velocity (m/s)[3]	Mine exhaust portal PM_{10} concentration ($\mu g/m^3$) 1-hour average	PM_{10} NES:AQ AAQS ($\mu g/m^3$) 24-hour average
2 x Twin boomed Jumbos (121 kW)	0.001	200 m^3/s 22 m/s	5	50
3 x 50-t dump trucks (359 kW)	0.004		22	
17-t bucket underground loader (162 kW)	0.009		45	
Maximum emission rate[2]	**0.014**		**72**	

Notes:

1. *Assumes E5 emission standards*
2. *Assumes all machines are operating at full power at the same time*
3. *Assumes a 9 m^2 mine exhaust portal*

Table 28: Underground machine NO_2 emissions and discharge concentrations

Machine	NOx Emission rate (g/s)[1]	Mine air exhaust flow rate (m^3/s) and exit velocity (m/s)[4]	Mine exhaust portal NO_2 concentration (mg/m^3)[2] 1-hour average	NO_2 NES:AQ AAQS (mg/m^3) 1-hour average
2 x Twin boomed Jumbos (121 kW)	0.027	200 m^3/s 22 m/s	27	200
3 x 50-t dump trucks (359 kW)	0.120		120	
17-t bucket underground loader (162 kW)	0.180		180	
Maximum emission rate[3]	**0.327**		**327**	

Notes:

1. *Assumes E5 emission standards*
2. *Assumes 20% of NOx is NO_2*
3. *Assumes all machines are operating at full power at the same time*
4. *Assumes a 9 m^2 mine exhaust portal*

Table 27 and **Table 28** respectively show that the mine exhaust portal concentration of PM_{10} and NO_2 are a factor of approximately 1.5 above the relevant NES:AQ AAQS within the vent. Considering the exit velocity of 22 m/s the mine exhaust stream will quickly be diluted with ambient air to bring the concentrations of both pollutants to below the respective NES:AQ AAQS. The distance between the portals and the site boundary is a minimum of approximately 200 m. By the time the portal plumes reach the site boundary the concentrations of PM_{10} and NO_2 will be well below their respective NES:AQ AAQS. The locations where the plume is likely to cross the site boundary are not areas where any member of the public is likely to be exposed to the pollutants. The risk of exposure to the vented underground exhaust gases is very low.

It is concluded that adverse impacts of the contaminants discharged from the underground portals will be less than minor and are not considered further in this assessment.

7.0 Dispersion and Travel Distance of Dust

This section provides a general overview of the dispersion and travel distance of dust discharged from the proposed BOGP activities. The dust dispersion and travel distance described in sections 7.1, 7.2 and 7.3 are generic, and while relevant to the BOGP, the descriptions of these dust behaviours are not site specific.

7.1 Meteorology impacts on the generation and transportation of Mine dust

Dust emissions from mines are predominantly fugitive in nature (i.e. defined as an area source as opposed to a point source which can more easily be captured and filtered). Dust emissions can vary substantially from day-to-day, depending on the level of activity, the number of truck movements and the weather conditions. The day-to-day variability in downwind dust concentrations is clearly demonstrated in the Yaldhurst dust monitoring study (Mote, 2018). The scale (or magnitude) of potential dust impacts also depends on dust suppression and other mitigation measures applied by MGL to control dust emissions on site. Five primary factors influence the potential for dust impacts:

- Wind speed across the surface. Dust emissions from exposed surfaces generally increase with increasing wind speed. However, dust pick up by winds is only significant at wind speeds above 5 m/s (11 knots or a Beaufort scale number of 3). Above wind speeds of 10 m/s (20 knots) dust pick up increases rapidly;
- Moisture content of the material. Moisture binds particles together, preventing them from being disturbed by winds or vehicle movements;
- The area of exposed surface. The larger the area of exposed surfaces the more potential there is for dust emission. Vegetated surfaces are less prone to wind erosion than bare surfaces;
- The percentage of fine particles in the exposed surface material. The smaller the particle size the more easily the particles are able to be picked up and entrained in the wind; and
- Disturbances such as traffic and loading and unloading of materials. Vehicles travelling over exposed surfaces tend to pulverise any surface particles. Particles are displaced from rolling wheels and the surface. Dust is also sucked into the turbulent wake created behind moving vehicles.

Wind speed and rainfall (surface moisture) are the two key meteorological factors that impact the generation of Mine dust.

7.2 High risk windspeed conditions

Figure 15 shows the relationship between PM_{10} concentrations down wind of a dust source and windspeed as measured in an open area (Watson J., 2000).

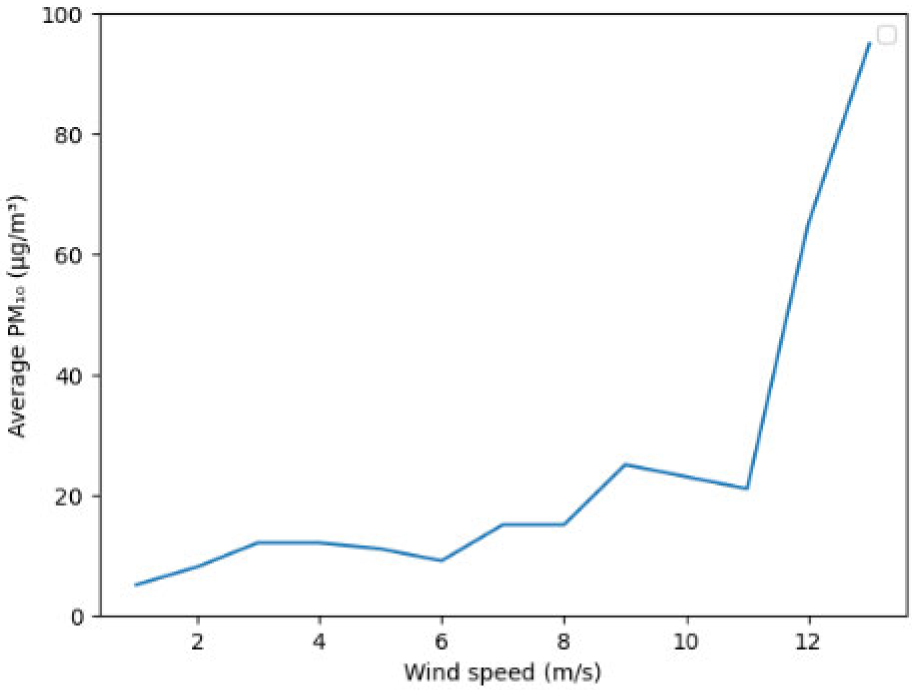

Figure 15 Variation of hourly PM_{10} concentrations with windspeed (reproduced from (Watson J., 2000))

Figure 15 shows that dust pick up begins to occur at moderate windspeeds above 6 m/s. The relationship between wind speed and dust concentrations shown in **Figure 15** is consistent with the measurements made by the USEPA (USEPA, 2006). The Ministry for the Environment ("**MfE**") Good Practice Guide for dust (GPG Dust) (MfE, 2016) suggests that high-risk conditions occur when windspeeds are over 7.5 m/s. **Figure 15** shows that at windspeeds between 4 and 6 m/s PM_{10} concentrations are relatively consistent. PM_{10} concentrations increase consistently with windspeeds of 6 to 9 m/s and increase significantly with windspeeds above 11 m/s. This data suggests that the GPG Dust's definition of high-risk wind speeds is slightly conservative.

For the purposes of this assessment, it is considered that high risk dust conditions occur when windspeeds are over 7.5 m/s.

7.3 Dust travel distance

7.3.1 Introduction

The distance that dust travels before settling on a surface primarily depends on the particle size, density of particle material, wind speed and turbulence.

Dust particles made up of denser material travel shorter distances than particles of the same size with lower densities (e.g. coal dust vs wood fibres). There is a linear relationship between the density and travel distance for particles of the same size, under the same meteorological conditions (Wet Earth Mining, Dust & Water Solutions Australia, 2015). Respirable dust, such as PM_{10}, has greater potential for travel potential than coarse dust material (>30 μm) due to its lower mass.

The higher the wind speed the more energy and turbulence an airflow will contain. Higher speed, more turbulent wind conditions will lift more dust from a surface and carry it further before it is deposited back to earth.

Global and regional scale events such as wind and dust storms over the Sahara Desert can mobilise up to 6 km into the atmosphere and carry dust for 100s of km (Nasa Earth Observatory, 2023). The size of the dust source and energy of the windstorms that generate global and regional scale dust events are both much greater than experienced at open cast mines. The size of the proposed mine pits and the energy of the local wind systems combine to result in dust impacts being classified as a local scale impact (less than 1,000 m from the source).

The following sections present information to illustrate how far dust from open cast mines is likely to travel. While all the data presented is not directly related to dust emissions from large gold mines, the theory on dust travel distance presented is directly relevant to the type and size of dust which will be discharged from the BOGP.

7.3.2 IAQM United Kingdom Monitoring

The IAQM produced guidance on the assessment of Mineral Dust Impacts for Planning (IAQM, 2016). The Guidance collates, analyses and presents a body of PM_{10} UK monitoring data that has been collected downwind of quarries from members of the IAQM. The measurements are made over the full range of wind speeds experienced in the UK. To check that the IAQM data is relevant for Otago, a comparison of the wind speed frequencies was made for mid-latitude England and Otago (Appendix D). The comparison showed that the frequency of medium (> 5m/s) and high (>7.5 m/s) risk windspeeds in mid-latitude UK and Otago were similar. This comparison indicates that the IAQM data is useful as an indicator of likely travel distance of dust from Otago mines.

Figure 16 shows PM_{10} incremental concentrations as a function of distance downwind from quarries. An incremental concentration is the change above background concentrations (i.e. **Figure 16** only shows the impact of PM_{10} discharged from the quarry). It is important to note that the data shown in **Figure 16** PM_{10} travel distance for larger fractions of the dust plume e.g. coarse dust (30 µm) will be less than for PM_{10}.

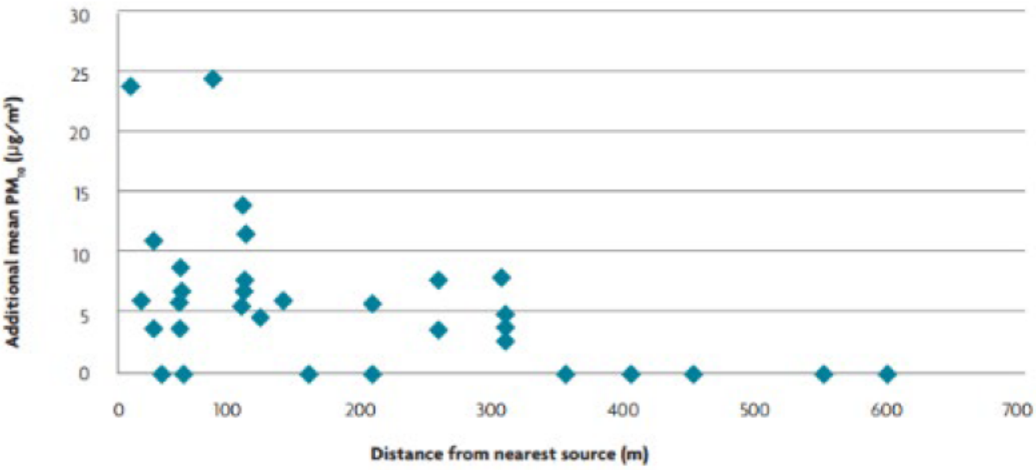

Figure 16 PM_{10} increment, all windspeeds downwind from quarry pit operations (IAQM, 2016)

Figure 16 show that the incremental changes in PM_{10} concentrations more than 300 m downwind of a quarry are zero. From this data, IAQM concludes that PM_{10} concentrations follow an exponential decay (i.e. concentrations exponentially approach background concentrations with increasing distance from the source (IAQM, 2016). The data demonstrates that the impacts of PM_{10} discharged from quarries do not extend beyond 300 m downwind of the quarry or any of the quarries associated activities. As coarse particles are larger and therefore settle more rapidly the maximum distance of impacts for coarse particulate matter discharged from quarries will be less than 300 m.

Using the PM_{10} monitoring data, IAQM has developed three distance categories for receptors based on the distance from the receptor to the quarry which are shown in **Table 29**.

Table 29: Categorisation of Receptor Distance from Source

Category	Criteria
Distant	Receptor is between 200 m and 400 m 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

7.3.3 Mote Yaldhurst Monitoring

Mote reported on an air quality monitoring campaign undertaken at locations in and around the Yaldhurst Quarry area for four months from 22 December 2018 (Mote, 2018). The purpose of this monitoring was to characterise the nature of particulate by measuring short-term (hourly) and long-term (24-hour and three-month) particulate levels and measuring different size fractions of particulate at multiple locations.

One approach to using the Mote data to estimate plume travel distance is to consider the monitored 24-hour average PM_{10} concentrations. It is important to note that the PM_{10} 24-hour average concentration incorporates the impact of the 1-hour peak events.

The maximum 24-hour average PM_{10} concentration measured at the background site was 57 $\mu g/m^3$. The average of the maximum 24-hour average PM_{10} concentrations measured at the three monitoring sites located 160, 190, and 250 m downwind of the site was 59 $\mu g/m^3$, 4% higher than the background site. The comparison of the maximum 24-hour average PM_{10} concentration measured at background and the three 160 to 250 m downwind sites suggest that beyond 250 m, the change in PM_{10} concentrations due to the influence of the quarry's emissions is not distinguishable from background PM_{10} concentrations.

7.3.4 Stokes Law Modelling

Stoke's Law can be used to calculate the air resistance (drag) a particular dust particle will experience. The drag force increases with particle density and radius, and as such smaller particles can travel further before settling on a surface. Once the air resistance has been calculated the model can estimate travel distances of particles at different wind speeds and from different discharge heights. For this investigation travel dust distances have been calculated using Stokes' Law with the following assumptions:

- The density of mine waste rock is approximately 2.6 g/cm^3;
- The average particle diameter is 50 µm (typically, nuisance dust has a diameter of between 20 µm and 100 µm); and
- A release height of 3 m (above ground level) to reflect a dust discharge from a 3 m high stockpile. Some resource consents allow stockpiles up to a height of 5 m. But stockpiles are located on the valley floor and even with a height of 5 m most mine's dust discharges will occur below, at or near ground level.

Figure 17 depicts the typical distances travelled by a typical dust particle (50µm diameter) for a range of wind speeds. **Figure 17** shows at:

- Very high windspeeds (15 m/s), dust can typically be expected to travel no more than 250 m from the source before settling;
- High windspeeds (7.5 m/s), dust can typically be expected to travel no more than 150 m from the source before settling; and
- Moderate windspeeds (5 m/s), dust can typically be expected to travel no more than 75 m from the source before settling.
- A release height of 3 m (conservative as most sources will be close to ground).

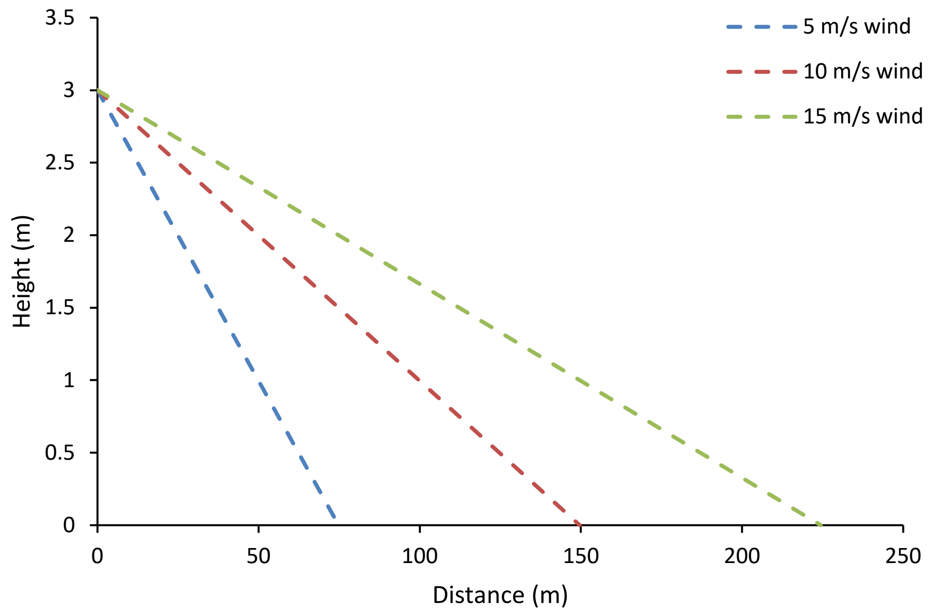

Figure 17: Predicted particle travel distance with wind-speed

The travel distance of a 30 µm diameter particle was modelled using Stokes law for the same release height at windspeeds of 5, 10 and 15 m/s. The calculated travel distance for a 30 µm diameter particle was 200 m, 400 m and 600 m respectively for the three windspeeds considered. In summary, Stoke's Law modelling shows that at a windspeed of 15 m/s particles with a diameter of:

- 50 µm would be unlikely to travel any further than 250 m; and
- 30 µm would be unlikely to travel any further than 600 m.

7.3.5 Summary

Two monitoring programmes and a modelling exercise have been investigated to establish the likely travel distance of dust discharged from open pit quarries. The independent monitoring studies arrive at similar conclusions, that at the highest likely windspeeds mine dust is unlikely to travel more than 250 – 300 m downwind of the mine. It is important to note the open shallow pit (<10 m deep) quarry dust data discussed above is likely to be conservative (i.e. concentrations higher) than emissions from the much deeper pits (with reduced wind speeds and reduced dust suspension) that are proposed as part of the BOGP mine.

The Stokes Law modelling of the travel distance of larger particles (50 µm) aligns well with the findings of the two monitoring programmes. However, the Stokes Law travel distance modelling suggests smaller particles (30 µm) may travel up to 600 m which is further than the two monitoring programmes indicates. This finding suggests that the Stokes Law modelling provides a conservative estimate of travel distance for smaller particles. Stokes Law modelling is included in this report simply to provide a comparison to the other methods of estimating and understanding dust travel distance that are included in Section 7.0. Stokes Law modelling is not used directly in the assessment of dust effects and therefore this finding has no impact on the conclusions reached from the AEE.

8.0 Receiving Environment

This section describes the receiving environment and assesses the sensitivity of that to the discharge of contaminants to air from the proposed BOGP mine.

8.1 Topography

The main impact area is contained within two valley systems, the RAS Creek Valley and the Shepherds Creek Valley as shown in orthographic perspective in **Figure 18.** The view provided in **Figure 18** is from the eastern end of the site looking south-east. **Figure 19** shows a plan view of the two valleys within which the BOGP mine will sit**.** Shepherds Creek valley floor is shown by a green line, the Rise and Shine Creek valley floor is shown by a yellow line. The project outline is shown in blue. Shepherds Creek valley floor is at an approximate elevation of 595 m asl with the northern valley wall rising 290 m over a distance of 1,000 m and the southern valley wall rising high valley wall to the north and 253 m high valley wall to the south. The Rise and Shine Creek valley floor is at an approximate elevation of 756 m asl with the northern valley wall rising 100 m over a distance of 250 m.

Figure 18: BOGP layout in the RAS Creek valley and the Shepherds Creek valley, from the northwest looking southeast (Santana Minerals Limited, 2024c)

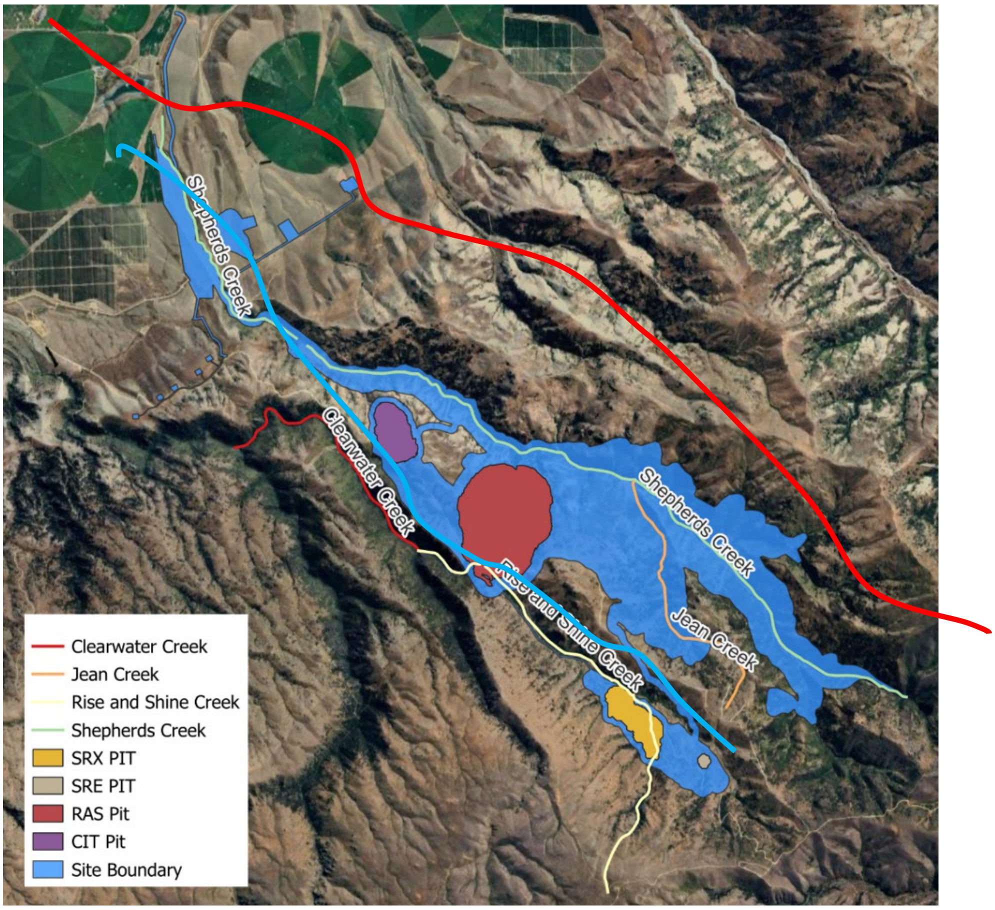

Figure 19: BOGP layout in the RAS Creek valley and the Shepherds Creek valley

8.2 Meteorology

A key to assessing the air quality impacts at a specific site is understanding the meteorology of the area. The two key meteorological factors which influence the emissions and dispersion of dust are wind and rain. A meteorological monitoring network has been operating in the area of BOGP since February 2023.

8.2.1 Monitoring Sites and Equipment

Figure 20 shows the location of the four meteorological monitoring sites (green dots) that have been installed to collect wind data to inform the dust assessment. A photograph of the monitoring equipment is shown in **Figure 21**. It is important to note that the Lake Clearview monitor will be shifted to the site's administration offices on Ardgour Terrace when those buildings have been set up. The new site is approximately 2 km due east of the current Lake Clearview site and is shown as the green circle in **Figure 21**. The new site will meet the requirements of usefully assessing the dust impacts of the mining operation. The metadata for each of the sites is shown in **Table 30.**

Figure 20: Locations of meteorological monitoring sites

Figure 21: Photograph of the Lake Clearview meteorological monitoring equipment

Table 30: Metadata for meteorological monitoring sites

Site name	Install date	Equipment	Anemometer height (m)	Data capture rate (%)
Lake Clearview	11 Feb 2023	The Gill Windsonic Ultrasonic Wind Sensor is a high-end meteorological grade wind speed and direction sensor. The Harvest Air Temperature/Relative Humidity/Barometric The sensor has a calibrated accuracy of ±0.1°C (temperature), ±1.5% relative humidity, and ±1.5mbar barometric pressure. The HyQuest TB3 is a high-quality tipping bucket rain gauge with accuracy of ±2% for measuring rainfall.	10	99.9
CIT	11 Feb 2023		6	99.8
RAS	13 Dec 2024		6	NA
SRX	11 Feb 2023		6	100

8.2.2 Wind – Lake Clearview

Figure 22 shows the windrose for the data collected at the Lake Clearview meteorological monitoring site (**Figure 20**) February 2023 to November 2024.

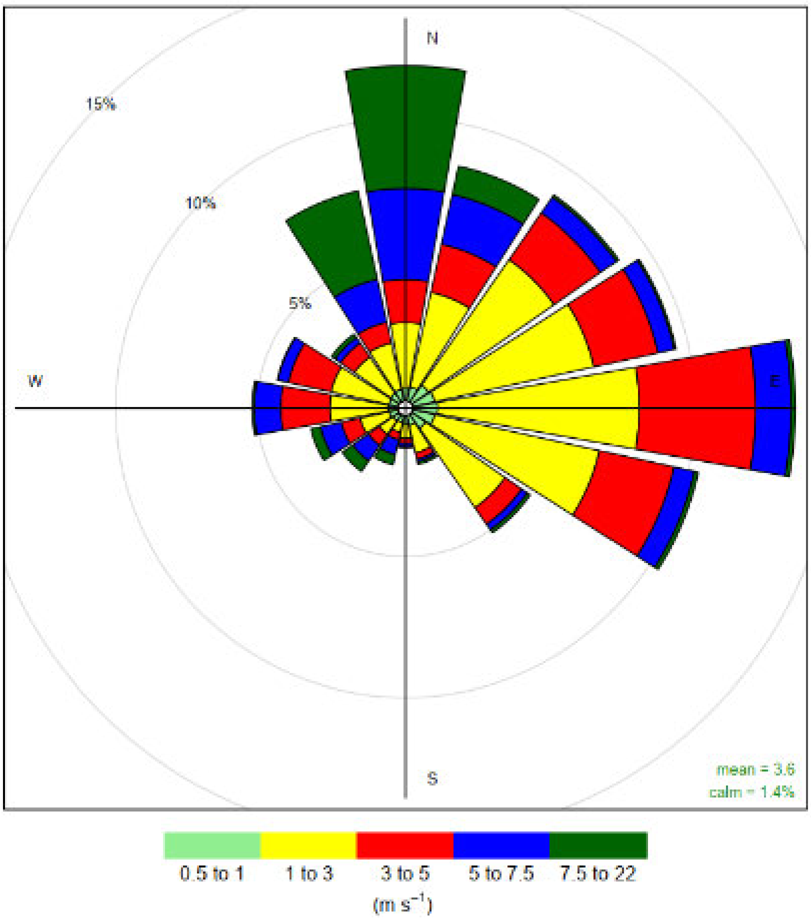

Figure 22: Windrose for Lake Clearview monitoring station (Feb 2023 - June 2024)

Figure 22 indicates that the wind conditions experienced on site are:

- Easterly and northerly are the predominant wind directions;
- Winds from the westerly quarter at a relatively low frequency; and,
- Very low frequency winds from the southerly direction;
- Windspeeds >7.5 m/s (that present a high risk of dust events) occur approximately 5 % of the time.

8.2.3 Wind SRX and Come in Time Monitoring Sites

Figure 23 shows the windroses for the data collected at the SRX and Come in Time meteorological monitoring sites (**Figure 20**) February 2023 to November 2024.

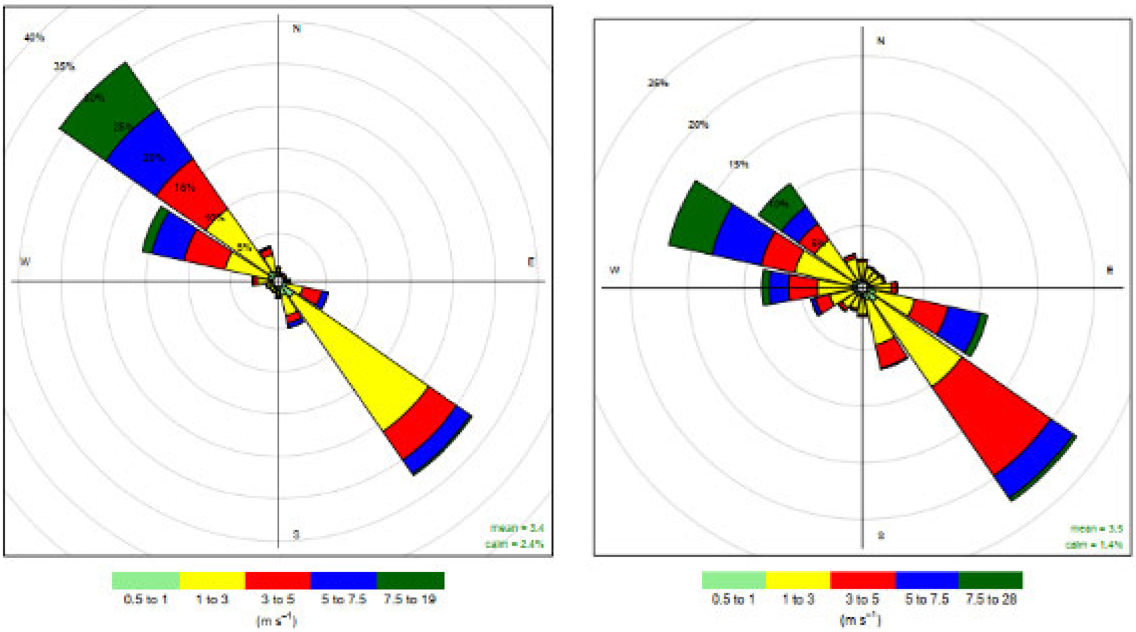

Figure 23: Windroses for SRX (righthand panel) and Come in Time (lefthand panel) monitoring sites (Feb 2023 - November 2024)

Figure 23 indicates that the wind conditions experienced on these two sites are very similar and are:

- North-westerly and south-easterly are predominant wind directions which align with the direction of the RAS Creek valley and the Shepherds Creek valley;
- Very Low frequency winds from other directions;
- There is a low frequency of windspeeds (>7.5 m/s) that present a high risk of dust events; and
- Windspeeds >7.5 m/s (that present a high risk of dust events) occur approximately 4 % of the time.

A comparison of **Figure 22** and **Figure 23** shows that the wind patterns within the RAS Creek valley and the Shepherds Creek valley are completely different to those experienced in the wider Bendigo area. The wind at the SRX and CIT sites are strongly impacted by the topography surrounding the sites.

8.2.4 Rainfall

Figure 24 shows the average monthly rainfall monitored at the Lake Clearview, CIT and SRX sites (Feb 2023 - November 2024). **Figure 24** shows the percentage of days each month with rainfall > 5 mm/day (Feb 2023 - November 2024).

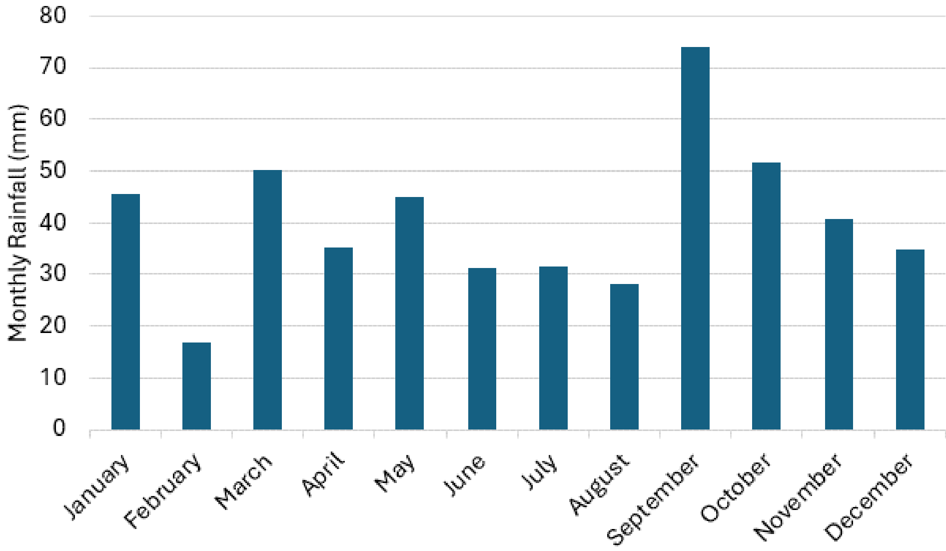

Figure 24: Average monthly rainfall Lake Clearview (Feb 2023 - November 2024)

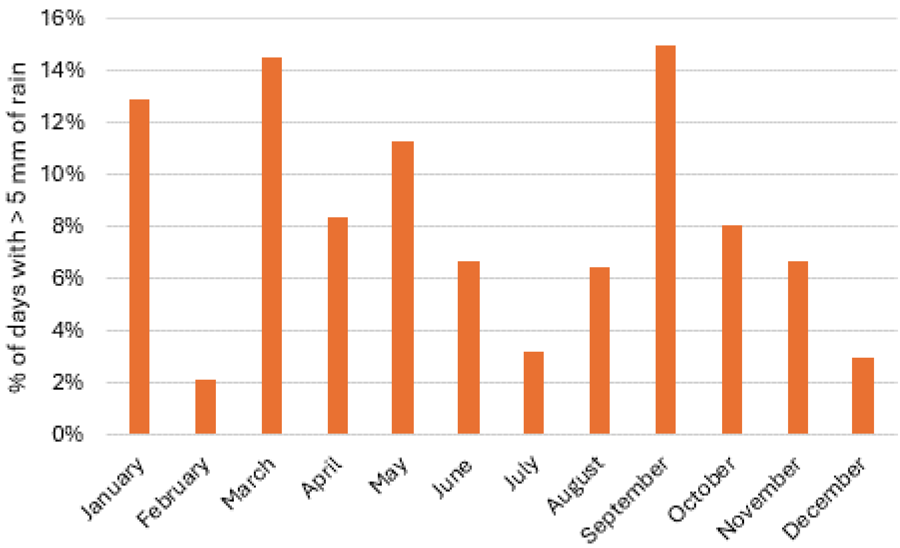

Figure 25: Percentage of days each month with rainfall > 5 mm/day (Feb 2023 - November 2024)

Figure 24 shows the average monthly rainfall is approximately 30 mm/month. There is no clear seasonal pattern of rainfall in the area, except slightly higher rain occurs in spring (September and October). **Figure 24** shows the range of wet days per month varies between 2% and 15%. On average there are 6% of days per month where rainfall is above 5 mm/day.

8.3 Background Particulate and Dust Monitoring

8.3.1 Monitoring Sites and Equipment

Figure 26 shows the location of the five dust deposition monitoring sites that have been installed to collect dust data to inform the assessment. The Ardgour Flats site location was selected to provide background dust data, the CIT Battery site was selected to provide dust data at a location which will visited by the public, the other three sites were located close to major dust sources. A real time PM_{10} monitor (e-BAM) has also been installed at the Lake Clearview site (See **Figure 20**). It is important to note that the e-BAM instrument used at this site does not provide data that meets the requirements of the National Environmental Standard for Air Quality ("**NES-AQ**"). The e-BAM has US EPA equivalency accreditation; however, in New Zealand the PM_{10} data from this instrument is considered indicative but not precise. NES-AQ compliant monitoring instruments require an environmental air-conditioned environmental enclosure and mains power supply, therefore these instruments were not practical for the BOGP dust monitoring programme.

A photograph of a dust deposition gauge (lefthand panel) and the e-BAM real-time dust monitoring equipment (righthand panel) is shown in **Figure 27.** It is important to note that the Lake Clearview monitor will be shifted to the site's administration offices on Ardgour Terrace when those buildings have been set up. The new site is approximately 2 km due east of the current Lake Clearview site and is shown as the green circle in **Figure 27**. The new site will meet the requirements of usefully assessing any off-site dust impacts of the mining operation.

In December 2024 an ES-642 dust monitor was installed at the CIT Valley North site. The main purpose of this monitor is to collect data which will provide an early warning of potential dust impacts and proactively allow the mitigation of these dust sources before the plume passes over the site boundary. The metadata for each of the sites is shown in **Table 31.**

Figure 26: Locations of dust deposition monitoring sites

Figure 27: Photograph of the dust deposition gauge (lefthand panel) and real time dust monitoring equipment (right hand panel).

Table 31: Metadata for dust monitoring sites

Site name	Install date	Equipment and PM measurement type	Data capture rate (%)
Lake Clearview	11 February 2023	e-BAM Plus – PM_{10}	99.8
CIT Valley North	11 December 2024	ES-642 - TSP	NA
Ardgour Flats	11 September 2024	Dust Deposition Gauges to meet the requirements of ISO4222.2 – deposited dust	100
CIT Valley			
CIT Stamper			
CIT Valley North			
RAS			

8.3.2 Realtime PM_{10}

Figure 28 and **Figure 29** respectively show the timeseries of 1-hour and 24-hour average PM_{10} concentrations measured at Lake Clearview February 2023 to November 2024. **Figure 30** shows polar plot of weighted 1-hour average PM_{10} concentrations measured at Lake Clearview February 2023 to November 2024.

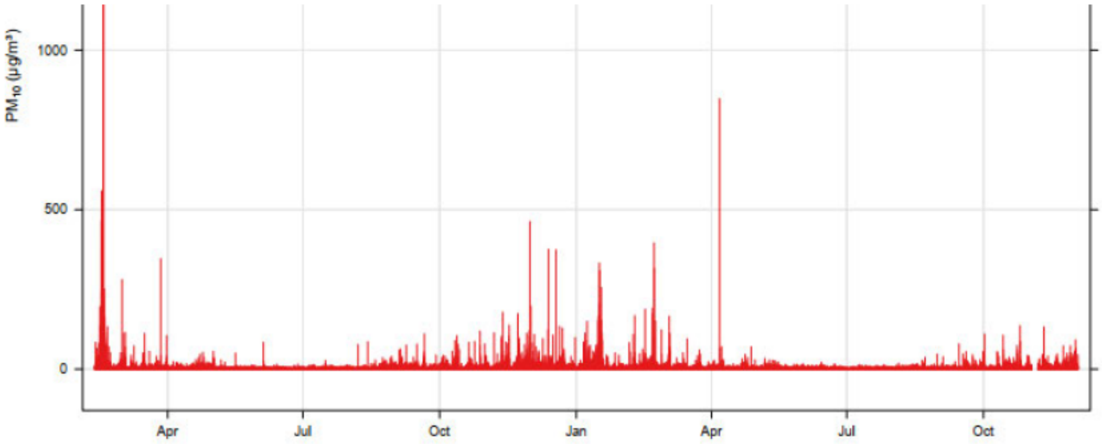

Figure 28: Timeseries 1-hour average PM_{10} concentrations Lake Clearview February 2023 to November 2024

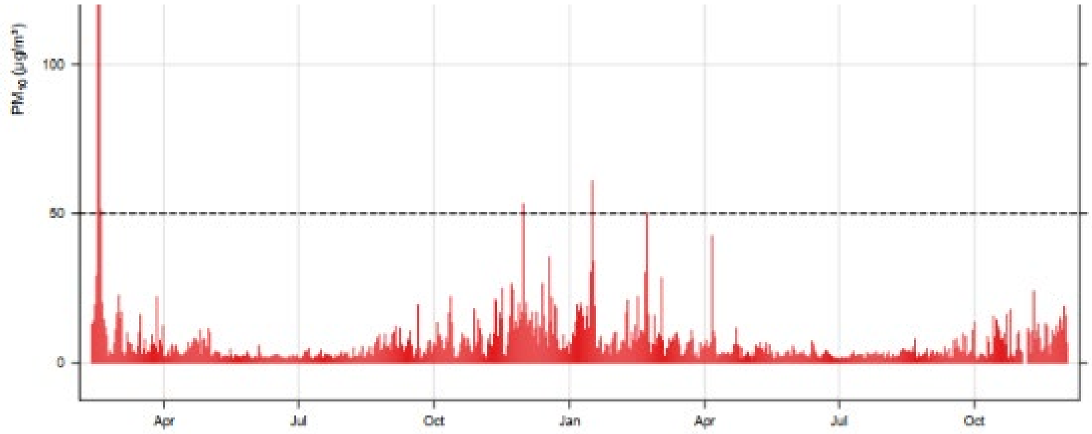

Figure 29: Timeseries 24-hour average PM_{10} concentrations Lake Clearview February 2023 to November 2024

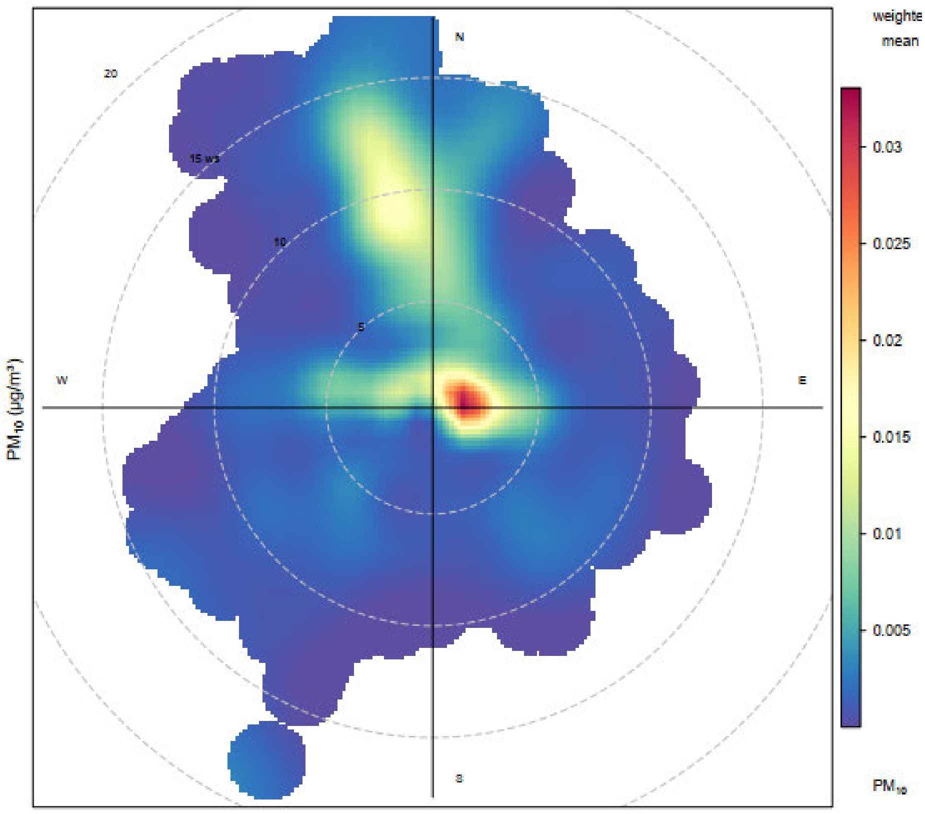

Figure 30: Polar plot weighted 1-hour average PM_{10} concentrations Lake Clearview February 2023 to November 2024

The key points extracted from the PM_{10} monitoring data are:

- The extreme February 2023 peaks are likely artifact data arising from the install and stabilisation of the monitoring equipment;

- There is a clear seasonal pattern where PM_{10} concentrations are low over the months April to September (average PM_{10} concentration µg/m^3);
- The levels experienced in April to September are typical of a rural background site;
- There are frequent and relatively high PM_{10} events in the period November 2023 to April 2024 (Average 6-month PM_{10} concentration µg/m^3);
- The levels experienced in November to April are higher than expected for typical of a rural background site and indicate that this is a relatively dusty area;
- The strongest source of PM_{10} appears to be located to the east of the site and generates the highest concentrations under low windspeeds (>2.5 m/s). The strongest source of PM_{10} is most likely traffic using the Matilda Rise unsealed road; and,
- The second strongest source of PM_{10} appears to be located to the north of the site and generates the highest concentrations high windspeeds (~10 m/s).

8.3.3 Dust Deposition

Table 32 shows the dust deposition rates for the 5 sampling sites for a period of seven months. **Table 32** shows that the measures dust deposition rates at the five sites ranges from 0.52 to 1.41 g/m^2/day. To put this in context, the MfE recommended mitigation trigger value for dust deposition is 4 g/m^2/day. The monitored dust deposition rates align with PDP's experience at similar background sites where there are no significant sources of dust within 500 m of the monitor.

Table 32: Average dust deposition rates (September 2024 to March 2025

Site	Average dust deposition rate (g/m^2/day)
Ardgour Flats	0.52
CIT Valley	0.65
CIT Stamper	1.41
CIT Valley North	1.10
RAS	0.78

8.4 Sensitive Human and Horticultural Receptors

The BOGP is located within the footprint of Minerals Exploration Permit 60311, which is held by MGL under the Crown Minerals Act 1991. MGL also has land access agreements with Bendigo and Ardgour Stations. Residential, ecological, and horticultural receptors are considered to have a high sensitivity to dust impacts and are listed as requiring consideration in the Dust GPG. The Dust GPG recommends that a dust assessment consider the impacts on specific locations with high sensitivity to the impacts of dust.

The land use areas surrounding the proposed site can be classified into three main categories; pastoral, horticultural and high country grazing.

Figure 31 shows the BOGP full footprint, 250 m buffer (brown zone - dust sources no blasting) 500m buffer (purple zone - dust sources including blasting) and surrounding environment:

- Pastoral (red circle on the north of the site);
- Horticultural (yellow circle on the west of the site); and
- High country grazing (blue circle surrounding the south-east of the site).

The pastoral receptor area is located in relatively close proximity to the mine accommodation development. The horticultural receptor area is located in relatively close proximity to the realigned roadways and haul roads. The high country grazing area is located in relatively close proximity to the mine pits, stockpiles, haul roads, tailings dam, ELF and processing area.

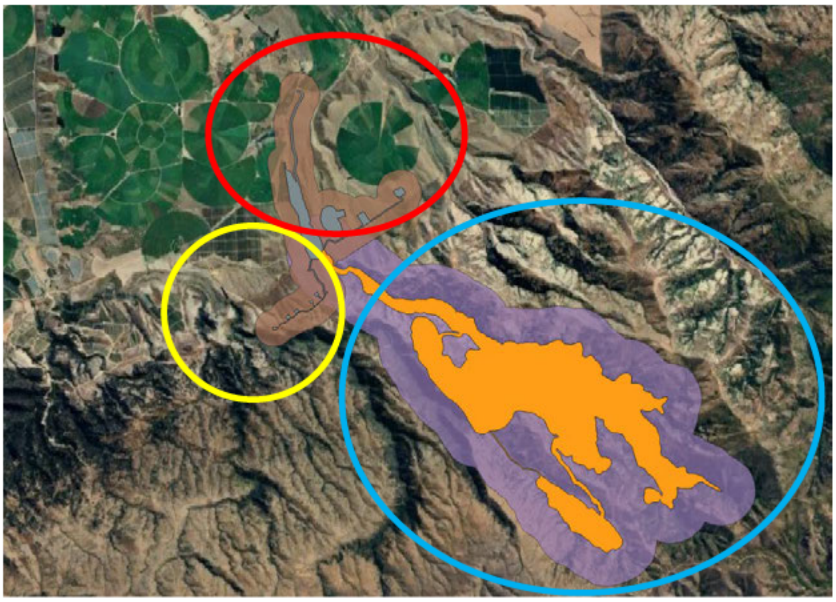

Figure 31: Bendigo-Ophir Gold Project – full footprint, 250 and 500 m buffer and surrounding environment.

Figure 32 shows the footprint of the northern and western arms of BOGP, 250 m buffer (brown area) and potentially sensitive dust receptors.

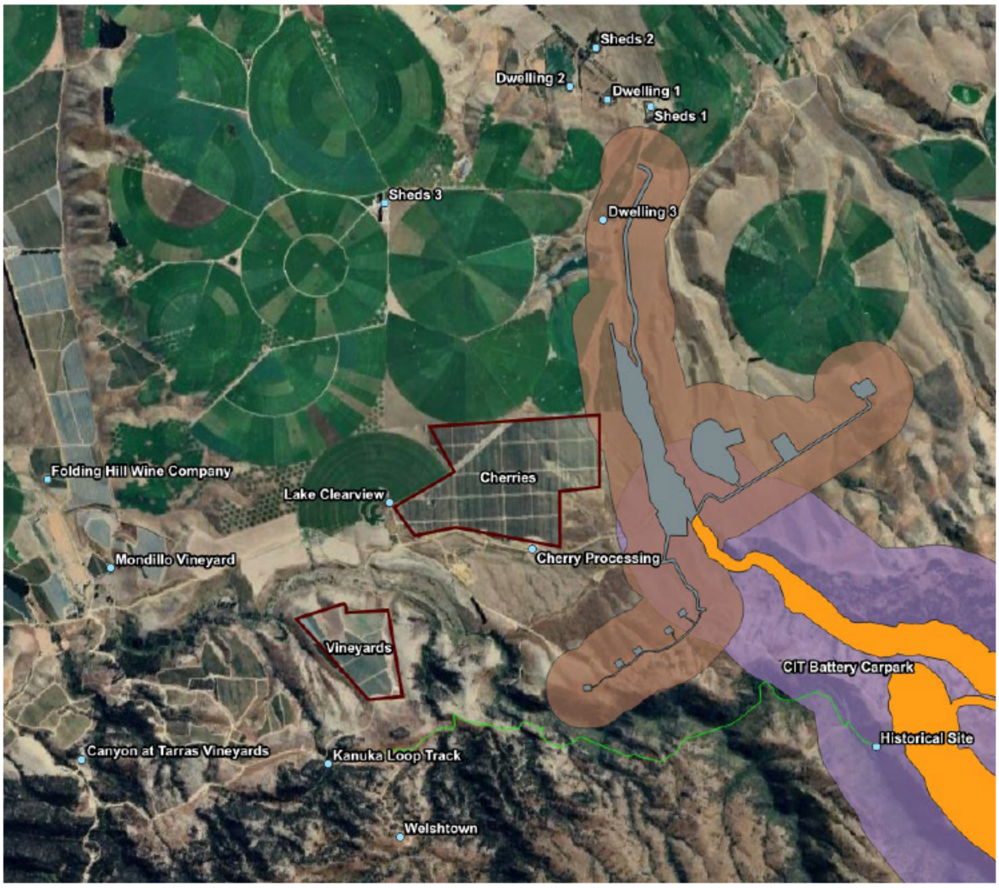

Figure 32: Bendigo-Ophir Gold Mine Existing Environment – north and western section footprint, 250 m buffer and potentially sensitive dust receptors

The details of each of the closest sensitive receptors in downwind directions from BOGP are shown in **Table 33.**

Table 33: Potential Sensitive Receptors

Type	Figure 34 Identifier	Shortest Distance to BOGP site boundary (m)	Downwind Direction/s from BOGP
Dwelling	Dwelling 1	480	South
Buildings	Shed 1	360	South
Dwelling	Dwelling 3	140	South to east
Horticultural	Cherry orchard	160	South to east
Horticultural	Cherry processing	830	South to east

Table 33: Potential Sensitive Receptors

Type	Figure 34 Identifier	Shortest Distance to BOGP site boundary (m)	Downwind Direction/s from BOGP
Horticultural	Vineyard	970	East
Recreation-	Kanuka Loop track	>1,000	East
Historic	Welshtown	>1,000	East
Historic	Stamper Battery	120	North to east

Notes:

1. *Downwind direction considered for entire site boundary due to uncertainty about specific sensitive area within the site.*
2. *Dwellings and buildings have been identified through desktop study using google maps and observations made during the site visit.*

8.5 Sensitive Ecological Receptors

An ecological survey has been undertaken of the project area. The survey identified an area within which native annual herbs grow which creates a sensitive receptor which needs to be considered within the dust impact assessment[3]. **Figure 33** shows the area[4] within which the annual herbs are located (green area).

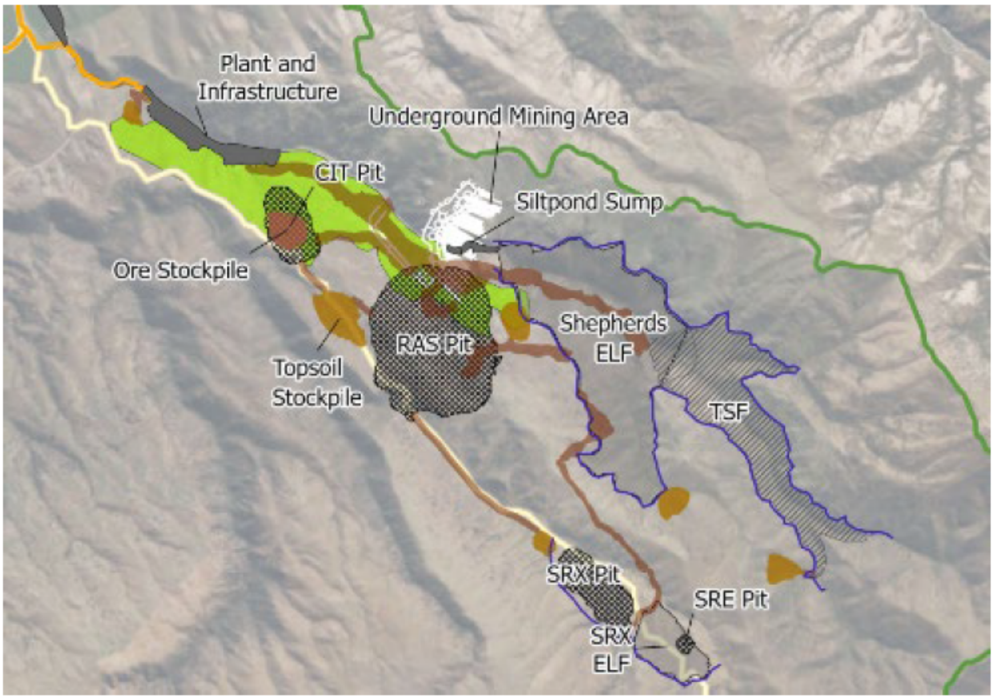

Figure 33. Location of annual herbs

[3] Personal communication. Mary Askey. Santana Minerals. 2 May 2025.

9.0 Assessment Methods

This section presents the dust assessment methods used to assess the impacts of dust being discharged from MGL's proposed Mine.

9.1 Dust – Amenity, Ecological and Health

9.1.1 Qualitative Method for Assessment of Dust Impacts (FIDOL)

The nuisance effects of dust emissions are influenced by the nature of the source, sensitivity of the receiving environmental and on individual perception. For example, the level of tolerance to dust deposition can vary significantly between individuals. Individual responses can also be affected by the perceived value of the activity producing the dust.

The GPG Dust (MfE, 2016) recommends that the nuisance effect of dust emissions may be assessed by using FIDOL factors to take into account the nature of the source in the context of the receiving environment. These factors are described in **Table 34.**

Table 34: Description of the FIDOL Factors

Frequency	How often an individual is exposed to the dust
Intensity	The concentration of the dust
Duration	The length of exposure
Offensiveness/character	The type of dust
Location	The type of land use and nature of human activities in the vicinity of the dust source

Different combinations of these factors can result in adverse effects. Location is particularly important as this relates to the sensitivity of the receiving environment.

Depending on the severity of the dust event, one single occurrence may be sufficient to consider that a significant adverse effect has occurred. In other situations, however, the event may be short enough, and the impact on neighbours sufficiently minor, that the events would need to be happening more frequently for an adverse effect to be deemed to have occurred.

The FIDOL assessment method considers each of these factors in a qualitative manner.

9.1.2 Source, Pathway, Receptor Model

The IAQM based in the UK produced a document providing 'G*uidance on the Assessment of Mineral Dust Impacts for Planning* (IAQM, 2016). This describes a source-pathway-receptor (S-P-R) model for the assessment of mineral dust impacts. The S-P-R concept presents the hypothetical relationship between the source(s) of the dust, the pathway (P) by which exposure might occur and the receptor (R) that could be adversely affected. The IAQM S-P-R approach provides a series of assessment matrices which are used to estimate the dust impact risk, the pathway effectiveness and the likely magnitude of amenity effects (e.g. loss of amenity due to dust deposition or visible dust plumes, including nuisance, annoyance or dust complaints) at each sensitive receptor location.

The S-P-R method presented by IAQM has been integrated with the FIDOL assessment method from the Dust GPG to provide a comprehensive qualitative assessment of likely dust impacts from the proposed activities at BOGP.

9.2 Gaseous Contaminants

When selecting the most appropriate method to assess the potential adverse health effects of the gaseous contaminants discharged from the processing plant the following factors were considered:

- Type of contaminants discharged;
- The estimated amount of contaminants discharged;
- Emission reduction measures;
- Method of discharge (heights and locations of vents and stacks);
- Monitoring of emissions; and,
- Distance to any sensitive receptor.

Weighing up the above six factors, PDP consider the potential for any adverse health effects to occur from the discharge of gaseous contaminants as negligible. Therefore, it is considered a quantitative assessment which compares predicted ground level concentrations of contaminants against health impact assessment criteria is not required. This approach aligns with the recommendations provided in the Ministry for the Environment's Good Practice Guide on Assessing Discharges to Air from Industry (MfE, 2016a) for discharges which are unlikely to have any significant impact. The qualitative assessment method relies upon the combined effect of best practice emission mitigation, environmental monitoring and discharge methods to predict the scale of any adverse health effects arising from the estimated gaseous contaminant discharges.

10.0 Assessment of Amenity Effects from Dust

10.1 Introduction

The BOGP has a total area of 568 ha and traverses an area with two distinctly different meteorological zones as shown in **Figure 34**.

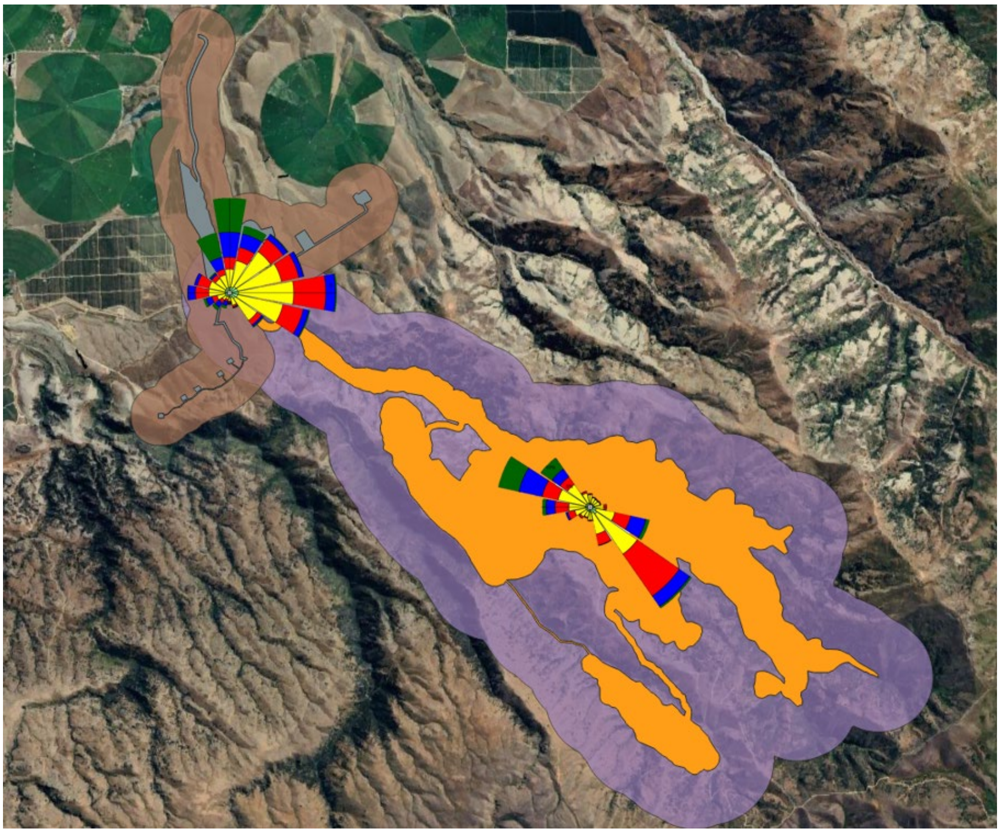

Figure 34. BOPG project footprint, 250 m and 500 m buffers and meteorological zones indicated by wind roses

For this reason, the assessment of dust impacts has been undertaken in two parts based on the different meteorological zones. The northern zone (grey and brown area in **Figure 34**) dust assessment is based on the meteorological data collected at Lake Clearview. The southern zone (orange and purple area in **Figure** 34**)** dust assessment is based on the meteorological data collected at the SRX monitoring site.

The assessment results for each of the five FIDOL factors are detailed in the following sections. Where useful, the determination of the impact of each of the FIDOL factors uses the criteria from IAQM. These are then drawn together in a summary assessment which considers the combined influence of all the FIDOL Factors.

10.2 Northern Zone

10.2.1 Dust Sources and Receiving Environment

Figure 35 shows the northern assessment zone. The grey area is the footprint of the BOGP and the brown area shows the 250 m buffer zone from the BOGP footprint. **Figure 35** also shows the potentially sensitive receptors which are located within 5 km of the site boundary.

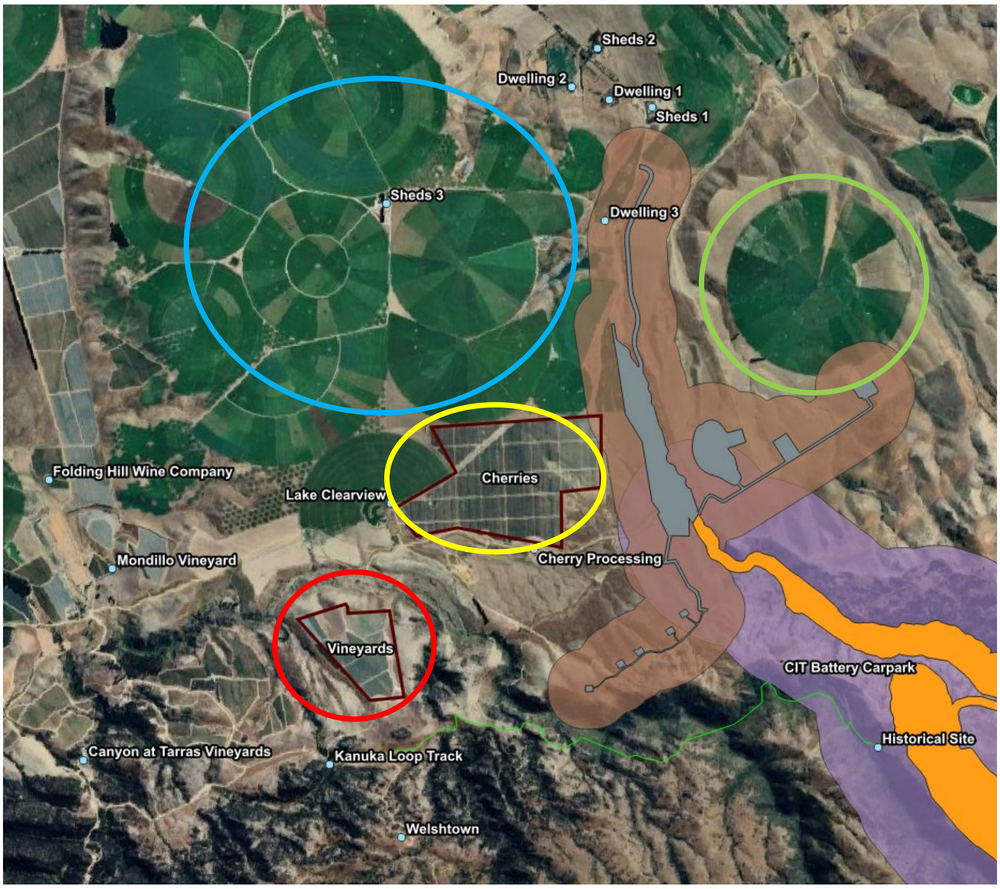

Figure 35. Northern assessment zone

The dust generating activities that will be undertaken within the northern zone for the BOGP are:

- Earthworks for Establishment of temporary construction workers accommodation and MGL administration area on the Bendigo Flats:
- Earthworks for the upgrade of Ardgour Road and Thomson Gorge Road;
- Processing plant activities; and,
- Vehicle movements on unsealed roads.

The land use areas surrounding the northern zone (**Figure 35**) are:

- Pastoral Zone 1 (green circle) and Pastoral Zone 2 (blue circle);
- Horticultural Zone 1 (yellow circle) and Horticultural -Zone 2 (red circle); and,
- Domestic/residential the northern part of the northern zone (blue dots).

10.2.2 Frequency

Frequency relates to how often dust may be experienced at an off-site location. The frequency at which dust can be detected at sensitive receptors will be a combination of the site operations and the meteorological conditions, such as high windspeeds and no rainfall. As a result of this, dust is more likely to be experienced off-site when wind speeds are more than 7.5 m/s during operations on dry days.

The description of the meteorology of the area provided in **Section 8.2** details the frequency, direction, and strength of winds, as measured between February 2023 to November 2024. In summary, the wind conditions experienced in the northern assessment zone are:

- Winds from the north through to the east are the predominant wind directions (approximately 66% of hours);
- Winds from the westerly quarter at a relatively low frequency; and,
- Very Low frequency winds from the southerly direction;
- Windspeeds >7.5 m/s (that present a high risk of dust events) occur approximately 5 % of the time.

Table 35 details the average number of dry days per month, based on an analysis of data from 2023 and 2024. Dry days are defined as days with less than 0.2 mm of rainfall, as suggested by IAQM. The dry days data is relevant to both assessment zones.

Table 35: Number of dry days per month

Dry Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No.	23	23	23	21	19	21	21	25	21	22	24	23
%	74	81	73	68	60	68	68	79	68	69	80	74

The months with the greatest number of dry days were November to March. These months will have the highest risk for fugitive dust emissions as there are fewer days where rainfall is experienced.

Table 36 details the frequency that northern zone sensitive receptors are downwind from BGOP dust sources during winds speeds above 7.5 m/s.

Table 36: Frequency of northern zone sensitive receptors being downwind from BOGP

Sensitive Receptor	Downwind Directions	Total time downwind		Time downwind with wind speeds >7.5 m/s		
		hours/year	% hours	hours/year	% hours	IAQM frequency classification
Houses/sheds	SSE to SSW	387	4.4%	37	0.4%	Infrequent
Dwelling 3	NE to S	4,682	53.4%	43	0.5%	Infrequent
Pastoral zone 1 (green)	S to NW	1,842	21.0%	117	1.3%	Infrequent
Pastoral zone 2 (blue)	NE to SE	44,43	50.7%	34	0.4%	Infrequent
Horticultural zone 1 (yellow)	NE to S	4,682	53.4%	43	0.5%	Infrequent
Horticultural zone 2 (red)	ENE to ESE	3,318	37.9%	21	0.2%	Infrequent

Table 36 shows that when windspeeds are above 7.5 m/s all sensitive receptors in the northern assessment zone will be infrequently downwind of a dust source during potentially dust-transporting meteorological conditions.

10.2.3 Intensity

The intensity of dust impacts is primarily determined by the distance (pathway between the dust source and receptors. Pathway effectiveness indicates how likely it is that the dust will carry from source to receptor. If dust can easily travel from source to receptor, the pathway is highly effective. The IAQM guidelines state that the distance between the dust source and the sensitive receptor is the primary factor influencing the pathway, with adjustments made depending upon the orientation of the receptor with respect to the prevailing wind and the topography, terrain, and physical features of the site. In the northern assessment zone there is no significant terrain that will influence the pathway between the BOGP footprint and the sensitive receptors. However, there are small ridges and clusters of trees and hedges on the boundaries of most of the sensitive receptors that will have a small effect on the pathway effectiveness.

Table 37 shows the categorisation of the receptor distance as defined in the IAQM guidelines. **Table 38** shows BOGP categorisation of receptor distance from source. This is a conservative categorisation based on earthworks being undertaken at the site boundary of the BOGP footprint. Most BOGP dust sources are at least 100 m within the boundary of the BOGP footprint apart from some public and haul roads.

Table 37: IAQM categorisation of receptor distance from source

Category	Criteria
Distant	Receptor is between 200 m and 400 m 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

Table 38: BOGP categorisation of receptor distance from source – northern assessment zone

Receptor	Distance to BOGP footprint boundary (m)	IAMQ Categorisation of Receptor Distance
Houses/sheds	360	Distant
Dwelling 3	100	Close
Pastoral zone 1	50	Close
Pastoral zone 2	120	Intermediate
Horticultural zone 1	200	Intermediate
Horticultural zone 2	>750	Distant

The pathway effectiveness is defined by combining the frequency of potentially dusty winds with the receptor distance classification as shown in **Table 39**. As the frequency of winds toward all sensitive receptors was ‘infrequent’ on the IAQM scale (**Table 34**), this results in a categorisation of ‘ineffective’ pathways for all sensitive receptors considered in the northern zone assessment (regardless of their distance) as shown in purple text in **Table 39.**

Table 39: Pathway Effectiveness for northern zone receptors

		Frequency of Potentially Dusty Winds			
		Infrequent	Moderately Frequent	Frequent	Very Frequent
Receptor Distance	Close	Ineffective	Moderately Effective	Highly Effective	Highly Effective
	Intermediate	Ineffective	Moderately Effective	Moderately Effective	Highly Effective
	Distant	Ineffective	Ineffective	Moderately Effective	Moderately Effective

The pathway effectiveness classifications can be combined with the Residual Source Emission (RSE) determination to estimate the overall Dust Impact Risk (**Table 40**).

Guidelines for determining residual source emissions ("**RSE**") for various dust generating activities are outlined in Appendix 4 of the IAQM guidelines. RSE is determined by factors such as the volume of materials being shifted and the number of machines being used on site. Without mitigation measures, the proposed earthworks would be assessed as having medium RSE. However, with the mitigation measures proposed PDP considers the RSE for all northern zone dust sources will most likely be small to medium. The earthworks required to develop the accommodation area and develop or realign the roads is predicted to have small RSE. The operation use roads RSE is predicted to be small to medium.

Using **Table 40** to combine the ineffective pathways with small and medium RSE values gives an overall Dust Impact Risk of negligible risk (shown in purple text) for all sensitive receptors considered in the northern zone assessment.

Table 40: Estimation of Dust Impact Risk for northern zone receptors

		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

10.2.4 Duration

Figure 36 shows the seasonal variation of average 1-hour wind speed for the Lake Clearview monitoring site. The average wind speed is highest in spring (September to November) and summer (December to February) afternoons with average speeds above 5 m/s between approximately 11 am and 8 pm. It is important to note that even during the warmer winder seasons the peak afternoon average windspeed is below the 7.5 m/s high dust risk criterion. The autumn and winter months have comparatively lower average wind speeds.

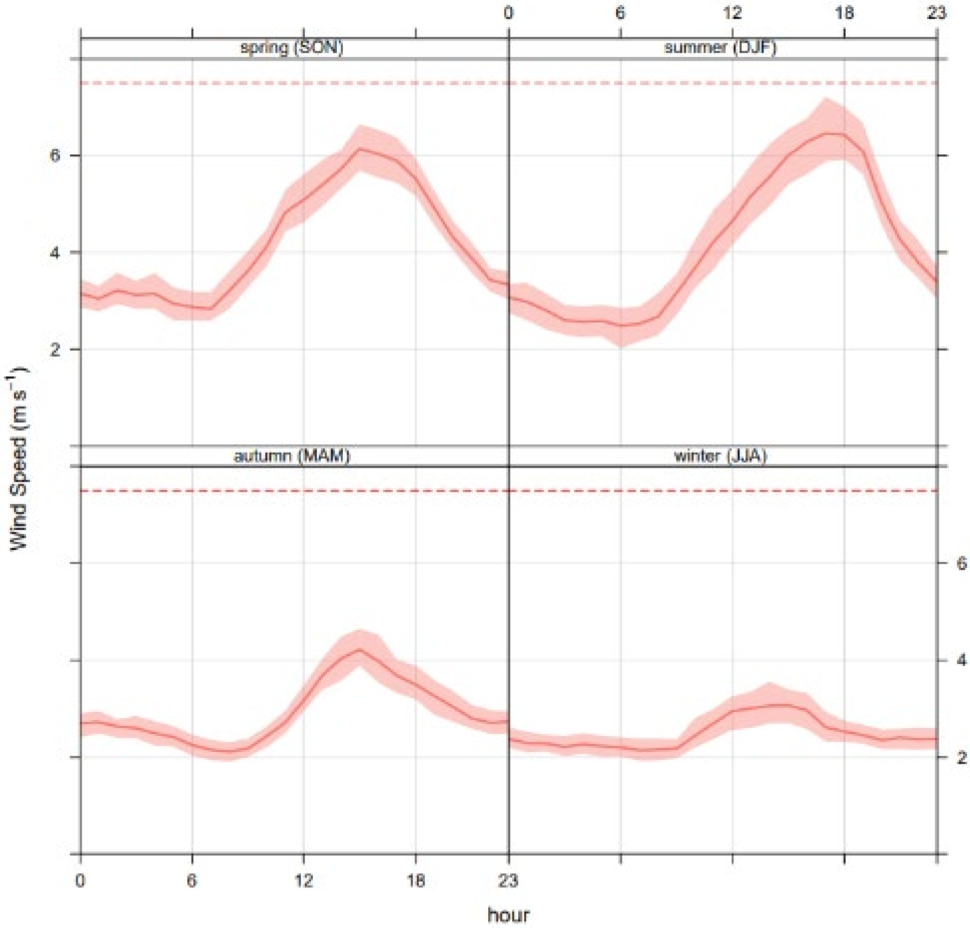

Figure 36: Seasonal pattern of average daily wind speed variation (Lake Clearview)

Table 41 shows the frequency of events where consecutive hours with average wind speeds above 7.5 m/s occur for the four seasons. The spring months have the highest percentage of consecutive hours where average wind speeds were greater than 7.5 m/s. In January, wind speeds were above 7.5 m/s for six or more consecutive hours 5% of the time. In summary, the meteorology of the northern assessment zone means that any high-risk dust event is likely to be short lived (less than 2 hours), but there can be infrequent high risk meteorological conditions that last more than four hours. These longer duration events tend to occur in spring.

Table 41: Percentage of consecutive hours where 1-hour average wind speed is > 7.5 m/s (2016 to 2020, Lake Clearview)

Month	Consecutive hours (% of total hours)						
	2+	4+	6+	8+	10+	12+	14+
Spring (SON)	11%	7%	5%	3%	2%	1%	1%
Summer (DJF)	4%	2%	1%	0%	0%	0%	0%
Autumn (MAM)	2%	1%	0%	0%	0%	0%	0%
Winter (JJA)	10%	6%	3%	2%	1%	0%	0%
Average	7%	4%	2%	1%	1%	0%	0%

The duration assessment does not consider any mitigation measures which will shorten the potential effects of dust during prolonged periods of high-risk wind conditions. The values in **Table 41** are considered conservative as wind direction and rainfall data have not been considered.

10.2.5 Offensiveness / character

Dust emissions occurring because of activities within the northern assessment zone site are expected to be in the particle size range of 1 µm – 100 µm. Smaller particles will be present as a result of earthworks and other potential sources of dust.

The dust will be grey to light brown in colour and is likely to be similar to the inert soil and rock dust typically generated by rural activities in the northern assessment area. The offensiveness of dust of this size, composition and colour in the receiving environment is likely to be low to moderate.

10.2.6 Location

The locations of the sensitive receptors with respect to the dust source are detailed in **Section 10.2.1** and shown in **Figure 35**. The three key land uses and their sensitivities to the effects of the discharge of dust are:

- Horticulture – highly sensitive;

- Residential – highly sensitive; and,
- Pastoral – low sensitivity.

10.2.7 Overall Findings of Northern Zone Dust Assessment

Table 42 can be used to combine the 'Negligible Risk' Dust Impact Risk values with the high and low receptor sensitivity classifications to assess the Magnitude of Dust Effects. This gives an overall result of 'Negligible Effect' for all six sensitive receptors listed in **Table 38** (shown as purple text). PDP consider the IAQM assessment demonstrates the impact of dust discharged from the proposed activities in the northern zone will not be offensive or objectionable. To ensure the residual source emissions are small, the measures proposed to mitigate and monitor the dust impact are detailed in **Section 13.0.**

Table 42: Descriptors for Magnitude of Dust Effects for northern zone receptors

		Receptor Sensitivity		
		Low	Medium	High
Dust Impact Risk	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

10.3 Southern Zone

10.3.1 Dust Sources and Receiving Environment

Figure 37 shows the southern assessment zone. The orange area is the footprint of the BOGP and the purple area shows the 500 m buffer zone from the BOGP footprint. **Figure 37** also shows the potentially sensitive receptor which is located within the buffer zone.

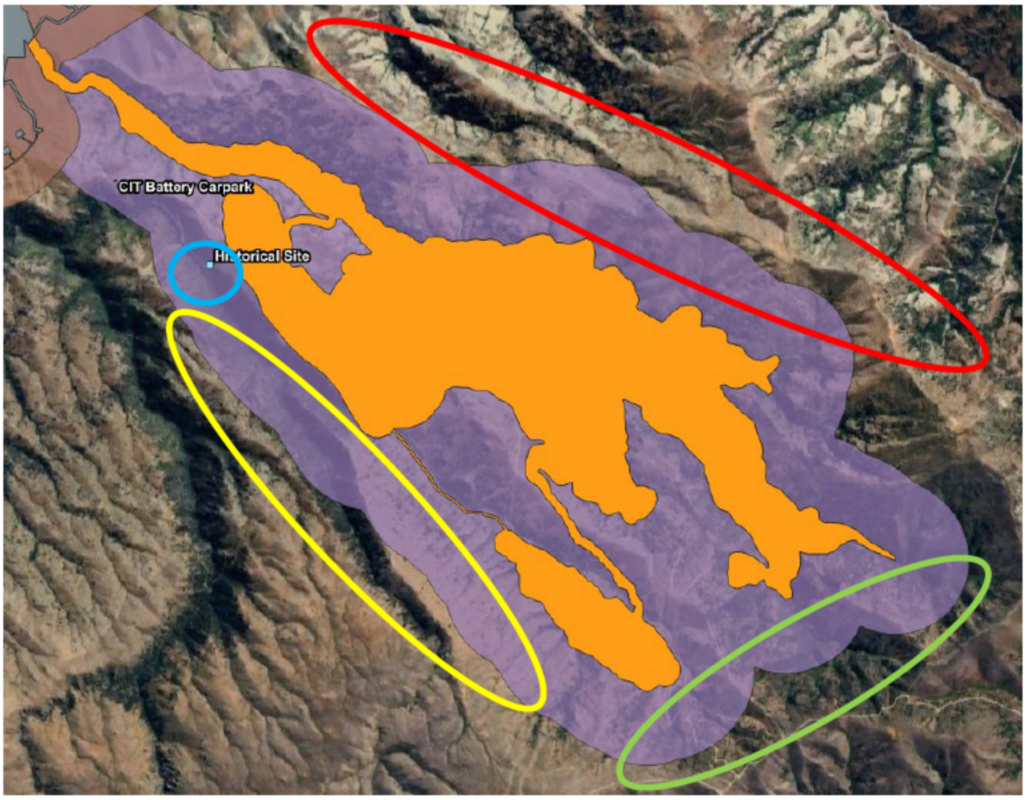

Figure 37. Southern Assessment zone

The dust generating activities that will be undertaken within the southern zone of the BOGP are detailed in **Section 5.0**. In summary the dust generating activities are:

- Site preparation and development;
- Overburden removal;
- Ore extraction;
- Ore, soil and overburden stockpiles;
- Engineered Landforms (western and main);
- The realignment of Thomson Gorge Road, via Ardgour Station, in order to provide public access through to the Manuherikia Valley; and
- Vehicle movements on unsealed Roads.

The land use areas surrounding the southern zone are

- High country grazing zone north - (red circle in **Figure 37**);
- High country grazing zone east - (green circle in **Figure 37**); and
- High country grazing zone south - (yellow circle in **Figure 37**); and

- Recreational/historic location (blue circle in **Figure 37**).

10.3.2 Frequency

The description of the meteorology of the area provided in **Section 8.2** details the frequency, direction, and strength of winds. In summary, the wind conditions experienced in the southern assessment zone are:

- North-westerly and south-easterly are very predominant wind directions which align with the direction of the RAS Creek valley and the Shepherds Creek valley;
- Very low frequency of winds from other directions; and,
- There is a low frequency of windspeeds (>7.5 m/s) that present a high risk of dust events.

Table 43 details the frequency that southern zone sensitive receptors are downwind from BGOP dust sources during winds speeds above 7.5 m/s.

Table 43: Frequency of southern zone sensitive receptors being downwind from BOGP

Sensitive Receptor	Downwind Directions	Total time downwind		Time downwind with wind speeds >7.5 m/s		
		hours/year	% hours	hours/year	% hours	IAQM frequency classification
Grazing zone north	NNW to SE	3661	41.8%	14	0.2%	Low
Grazing zone east	S to W	479	5.5%	0	0.0%	Low
Grazing zone south	WSW to N	4596	52.5%	573	6.5%	Moderate
Recreational/historic	N to E	167	1.9%	0	0.0%	Low

Table 43 shows that when windspeeds are above 7.5 m/s the historic and grazing zones north and ease will be infrequently downwind of a dust source during potentially dust-transporting meteorological conditions. Grazing zone south is classified as being downwind with a medium frequency (5-20% of the time).

10.3.3 Intensity

The intensity of dust impacts is primarily determined by the distance (pathway between the dust source and receptors. **Table 37** shows the categorisation of the receptor distance as defined in the IAQM guidelines. **Table 44** shows BOGP categorisation of receptor distance from source. This is a conservative categorisation based on earthworks being undertaken at the site boundary of the BOGP footprint. Most BOGP dust sources are at least 100 m within the boundary of the BOGP footprint apart from some public and haul roads which are relatively close to the boundary.

Table 44: BOGP categorisation of receptor distance from source – Southern Assessment Zone

Receptor	Distance to BOGP footprint boundary	IAMQ Categorisation of Receptor Distance
Grazing zone north	Adjacent	Close
Grazing zone east	Adjacent	Close
Grazing zone south	Adjacent	Close
Recreational/historic	100 m	Intermediate

The pathway effectiveness is defined by combining the frequency of potentially dusty winds with the receptor distance classification as shown in **Table 39**. This results in a categorisation of 'ineffective' pathways for grazing zones north and south and the historic site. The grazing zone east is categorised as having a moderately effective pathway. The pathway effectiveness classifications can be combined with the Residual Source Emission (RSE) determination to estimate the overall Dust Impact Risk (**Table 40**).

Without mitigation measures, the proposed southern zone dust generating activities would be assessed as having a large RSE. However, with the mitigation measures proposed PDP considers the RSE for all southern zone dust sources will most likely be small to medium.

Using **Table 40** to combine the pathway effectiveness with the RSE values for the southern zone dust sources gives an overall Dust Impact Risk of:

- Grazing zone north - ineffective pathway and medium RSE- negligible risk;
- Grazing zone east – moderately effective pathway and medium RSE- low risk;
- Grazing zone south - ineffective pathway and medium RSE- negligible risk; and,
- Recreational/historic - ineffective pathway and medium RSE- negligible risk.

10.3.4 Duration

Figure 36 shows the seasonal variation of average wind speed for the SRX monitoring site. The average wind speed is highest in spring (September to November) and summer (December to February) afternoons with average speeds above 4 m/s between approximately 11 am and 8 pm. It is important to note that even during the warmer windier seasons the peak afternoon average windspeed is below the 7.5 m/s high dust risk criterion. The autumn and winter months have comparatively lower average wind speeds.

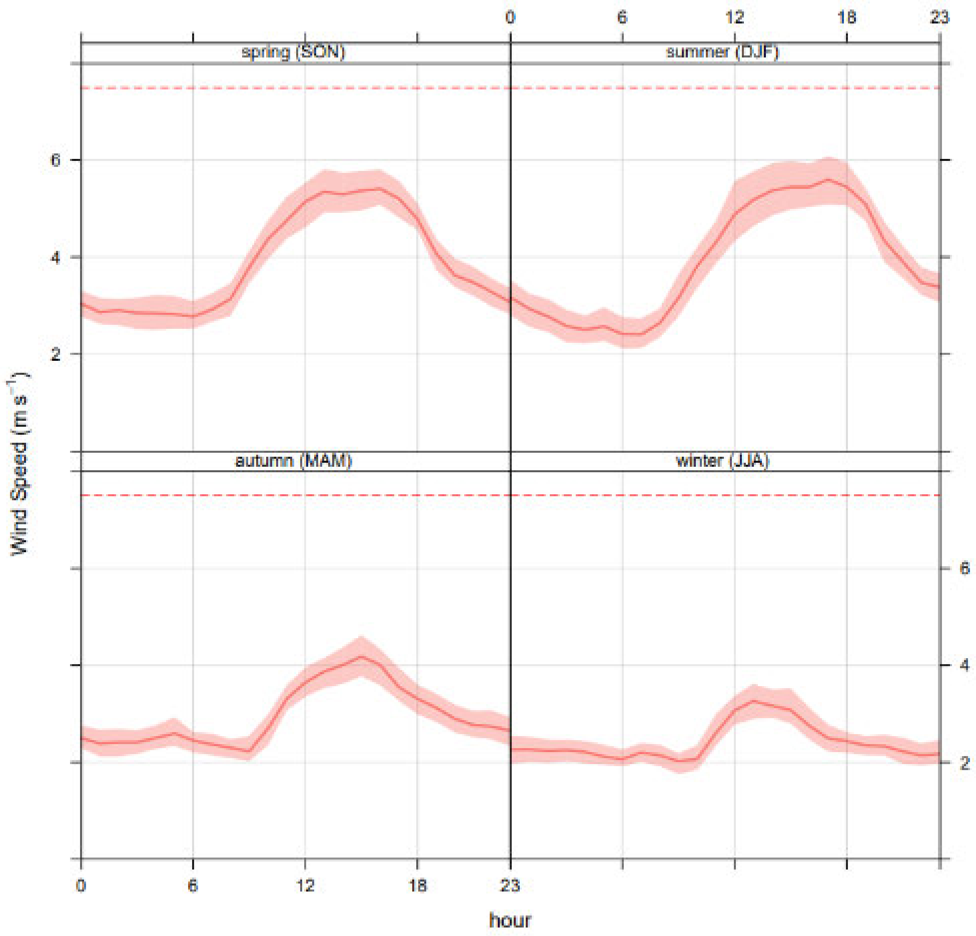

Figure 38: Seasonal pattern of average daily wind speed variation (SRX)

Table 45 shows the frequency of events where consecutive hours with winds above 7.5 m/s occur for the four seasons. The spring months have the highest percentage of consecutive hours where wind speeds were greater than 7.5 m/s. In January, wind speeds were above 7.5 m/s for six or more consecutive hours 5% of the time. In summary the meteorology of the southern assessment zone means that any high-risk dust event is likely to be short lived (less than 2 hours), but there can be infrequent high risk meteorological conditions that last more than four hours. These longer duration events tend to occur in spring.

Table 45: Percentage of consecutive hours where 1-hour average wind speed is > 7.5 m/s (2016 to 2020, SRX)

Month	Consecutive hours (% of total hours)						
	2+	4+	6+	8+	10+	12+	14+
Summer (DJF)	7%	5%	3%	2%	1%	0%	0%
Autumn (MAM)	3%	2%	1%	0%	0%	0%	0%
Winter (JJA)	2%	1%	0%	0%	0%	0%	0%
Spring (SON)	8%	4%	2%	1%	1%	0%	0%
Average	5%	3%	2%	1%	0%	0%	0%

The duration assessment does not consider any mitigation measures which will shorten the potential effects of dust during prolonged periods of high-risk wind conditions. The values in **Table 45** are considered conservative as wind direction and rainfall data have not been taken into account.

10.3.5 Offensiveness / character

Dust emissions occurring as a result of activities within the southern assessment zone site are expected to be in the particle size range of 1 µm – 100 µm. Smaller particles will be present as a result of earthworks and other potential sources of dust.

The earthworks and road dust will be grey to light brown or grey in colour and is likely to be similar to the inert soil and rock dust typically generated by rural activities in the southern assessment area. The offensiveness of dust of this size, composition and colour in the receiving environment is likely to be low.

The dust generated by the ore handling will be black in colour. The offensiveness of dust of this size, composition and colour in the receiving environment is likely to be moderate.

10.3.6 Location

The locations of the sensitive receptors with respect to the dust source are detailed in **Section 10.3.1** and shown in **Figure 37.** The two key land uses in the southern assessment zone and their sensitivities to the effects of the discharge of dust are:

- High country grazing– low sensitivity; and,
- Historic – medium sensitivity, low number of brief (< 1 hour) visits by the public.

10.3.7 Overall Finding of Southern Zone Dust Assessment

Table 42 can be used to combine Dust Impact Risk values with receptor sensitivity classifications to assess the Magnitude of Dust Effects for the southern assessment area. This gives an overall result of:

- Grazing zone north – negligible DRI and low receptor sensitivity - negligible dust effect;
- Grazing zone east – low DRI and low receptor sensitivity - negligible dust effect;
- Grazing zone south – negligible DRI and low receptor sensitivity - negligible dust effect; and,
- Recreational/historic - negligible DRI and low receptor sensitivity - negligible dust effect

At this point in the assessment, it is useful to highlight that all three high country grazing zones are within the boundaries of Ardgour and Bendigo Stations which are privately owned and who have given permission for the mine to be developed. This situation underlines the low sensitivity of the high-country grazing receiving environment.

PDP consider the IAQM assessment demonstrates the impact of dust discharged from the proposed activities in the southern zone will not be offensive or objectionable. To ensure the residual source emissions are small, the measures proposed to mitigate and monitor the dust impact are detailed in **Section 13.0**.

10.4 Cumulative Effects

As demonstrated in **Section 8.3** there are no significant sources of dust in the nearby area except for natural wind erosion and minor agricultural sources. Normal farming practice can involve the machine cultivation of soils which creates dust, as does the spreading of fertiliser. These are minor sources of dust at low frequencies. The development of a large scale mine in the rural area does pose a risk of generating cumulative dust effects. However as detailed in **Sections 10.2** and **10.3** the impact of the BOGP dust emissions will be negligible and therefore the risks cumulative dust effect arising from site emissions combining with the background dust levels is low. To minimise this risk, the dust emissions from the BOGP site will be well controlled and monitored as detailed in **Section 13.0.**

11.0 Assessment of Ecological Effects from Dust

The location of the ecologically sensitive receptor is shown in **Figure 33** and identifies the area of annual herbs as being located withing the southern zone of the assessment area (**Section 10.3**). The assessment outcomes for each of the southern zone FIDOL factors and IAQM criteria detailed in **Sections 10.3.2** to **10.3.6** have been used to inform the assessment of ecological effects.

The annual herb zone which is within 100 m of the key dust sources has been assessed as potentially having a:

- High frequency of exposure to the dust emissions:
- High intensity of dust loading;
- Long duration of dust exposure; and
- Moderate sensitivity to the impacts of dust;

PDP consider the conclusion based on the FIDOL/IAQM assessment demonstrates the impact of dust discharged from the proposed activities on the annual herbs will likely be:

- High on the plants located within 100 m of the key dust sources;
- Moderate on the plants located 100 m -200 m of the key dust sources; and,
- Low on the plants located more than 200 m of the key dust sources.

PDP consider the measures proposed to mitigate and monitor the dust impact which are detailed in **Section 13.0** will ensure the residual dust emissions are reduced, and impacts on the annual herbs are minimised.

12.0 Assessment of Potential Health Impacts

12.1 Introduction

As identified at **Sections 2.1, 2.2, 3.1, 3.2, 4.1**, and **4.2**, the proposed BOGP involves the discharges of PM_{10} and gaseous contaminants that pose a risk to human health where sufficient exposure occurs.

The Ministry for the Environment's *Good Practice Guide for Assessing Discharges to Air from Industry (GPG Industry)* (MfE, 2016a) recommends that the assessment of air discharges corresponds to the scale and significance of effects that may arise. Given the proposed emission control systems and separation distances, PDP consider that a qualitative health risk assessment methodology is appropriate for the gaseous contaminant discharges from BOGP.

12.2 Particulate discharges

If the PM_{10} or particulate matter containing As or RCS discharged from the BOGP is inhaled by people it has the potential to cause adverse health effects (See **Sections 3.1** and **4.1.3**). The dust discharged from excavation of soils and rock vehicles travelling over unsealed haul roads from unconsolidated surfaces contains a small amount of PM_{10}, which can penetrate into human lungs and cause adverse health effects.

Given the uncertainty in estimating dust emission and dispersion rates, it is a difficult task to quantify the potential increase in ground level concentrations of PM_{10}, As or RCS at or beyond the site boundary for BOGP proposed operation. Given this limitation, the most pragmatic approach is to undertake the assessment of potential health effects BOGP's particulate discharges using the Source-Pathway-Receptor (S-P-R) framework. BOGP's key sources and mitigation measures for each of these contaminants is detailed in **Table 46**.

Table 46: BOGP's key sources and mitigation measures for particulate discharges

PM type	Key source	Mitigation measures	Residual Source Emissions
PM_{10}	Earthworks and overburden removal and stockpiling. Rock blasting. Haul Roads and traffic.	Operational wind limits. Water suppression. Engineered and maintained road surfaces. Speed limits.	Medium.
RCS (PM_4)	Rock blasting. Rock crushing.	Operational wind limits. Enclosed and water suppressed rock crushing within the processing plant.	Negligible.
As (PM_{10})	Overburden removal and stockpiling at SRX and SRE.	Operational wind limits. Water suppression. Vegetating soil stockpiles.	Small.

The frequency of potential exposure from the locations of these sources in the northern and southern assessment zones is detailed in **Sections 10.2.2** and **10.3.2** respectively and assesses the potential frequency of any locations where humans may be exposure as infrequent.

The intensity of potential exposure of humans to these sources in the northern and southern assessment zones is detailed in **Sections 10.2.3, 10.3.2** and **10.3.3** respectively. The pathway effectiveness of these sources is assessed as 'ineffective' given the separation distances and low frequency of high-wind speeds toward sensitive receptors. The pathway effectiveness classifications can be combined with the RSE determination to estimate the overall Dust Impact Risk as negligible.

The duration of potential exposure of humans to these sources in the northern and southern assessment zones is detailed in **Sections 10.2.4** and **10.3.4** respectively. These analyses of wind data show that any potential exposure of humans to dust sources will be limited to 8 hours or less each year. Most likely less, because any members of the public are unlikely to be in an exposure location for any substantial length of time (e.g. > 1 hour).

The potential health impact to humans to elevated concentrations (above the ambient air quality assessment criteria detailed at section 4.1.3) and long duration exposure to $PM_{10,}$ RCS and As is high, i.e. receptors are highly sensitive.

In summary, it is concluded that the discharges of $PM_{10,}$ RCS and As from the BOGP are unlikely to cause any exceedance of the relevant ambient air quality assessment criteria at a location where people are likely to be exposed or a resulting health risk. PDP concludes that based on the nature of the BOGP dust, the separation distance to the nearest location where the public may be exposed for any duration of more than one hour and the implementation of the proposed management measures any adverse health impacts from the particulate matter (PM_{10}, RCS and As) discharged from the proposed mine will be negligible and certainly less than minor.

To confirm that the actual health effects of the particulate discharged from the BOGP mine are no greater than the assessed effects, the AQMP (**Section 13.0**) will include mitigation and monitoring requirements that ensure that there shall be no noxious, dangerous, objectionable or offensive dust beyond the boundary of the site. It is also important to note that the AQMP will significantly reduce the impact of dust exposure within the site boundaries, but worker exposure is outside the scope of this report.

12.3 Gaseous discharges

The processing plant is to be constructed near the centre of the site, relatively distant from off-site receptor locations (identified at **Section 8.4**). Point source discharge stacks are to be fitted with specific emissions control systems to minimise the discharges of hazardous air pollutants from the processing plant.

The likely discharges from the processing plant are detailed at **Section 6.1**. The key gaseous contaminants from the processing plant that pose a risk to human health are considered to be HCN and NH_3. The relevant ambient air quality assessment criteria for the protection of human health for these contaminants are detailed at **Section 4.2**.

The exact quantities of these gaseous contaminant discharges are not known at this stage, but will be variable across the project and operating days given the intermittent nature of ore processing proposed, and the processes involved. Further, these gaseous contaminant discharges are to be controlled by the process design (for example, maintaining a high pH within the gold cyanidation process minimises the generation of HCN) and emission control systems.

The processing plant air discharges are relatively distant (>500 m) from any identified sensitive receptor location (as identified at **Section 8.4**).

To inform a qualitative health risk assessment, **Table 47**:

- Lists the factors used to inform a qualitative assessment of potential health impacts from gaseous contaminants discharged from the BOGP;
- Notes whether the proposed activity aligns with accepted good practice for an activity of this type and scale; and
- Provides a qualitative risk factor for each of the assessment factors.

Table 47: Factors to inform a qualitative assessment of potential health impacts from gaseous contaminants

Assessment Factor	Details	Best practice	Qualitative risk index
Type of contaminants discharged	HCN, NH_3	N/A N/A	High High

Table 47: Factors to inform a qualitative assessment of potential health impacts from gaseous contaminants

Assessment Factor	Details	Best practice	Qualitative risk index
Amount of contaminants discharged;	HCN: Expected to be Zero. The discharge of HCN into air is not expected given the design of the processing plant, where the gold cyanidation process is to be undertaken in alkaline conditions (pH between 10 and 12) with automatic dosing to maintain these conditions and alarms to warn staff of break-downs. NH_3: Expected to be Low. Chemical reactions in the electro winning cells generate ammonia. The emission rates have been shown to be low and will be dispersed via a tall stack into a receiving environment with low sensitivity to the discharge of this contaminant.	Yes Yes	Low Moderate
Emission reduction measures	HCN - pH maintained at between 10 and 12. Continuous pH monitoring of process conditions reporting to the process plant control room in real time. - Automated dosing of alkaline reagents within the gold cyanidation process. - Alarms to warn operators of instances where the pH falls below 10. - Ambient air quality monitoring for HCN within the processing plant, alerting operators to abnormal conditions prior to any off-site effect arising.	Yes Yes	Low Low

Table 47: Factors to inform a qualitative assessment of potential health impacts from gaseous contaminants

Assessment Factor	Details	Best practice	Qualitative risk index
	Electrowinning cells and induction furnaces (NH_3 and particulate) - Fume hood - Glass silica curtains - Furnace Bag Filter System. - Gas and particulate extraction system. - Reverse Jet self-cleaning polyester filter bags. - Tall discharge stacks (15 m) for the effective dispersion of contaminants.		
Method of discharge - electrowinning cells and induction furnace	Gases are captured by fume hoods and then fan forced and vented to emission control systems and the atmosphere from a 15 m high stack.	Yes	Low
Monitoring of emissions	pH Alarms and HCN sensors. Environmental and Occupational Health and Safety requirements.	Yes Yes	Low Low
Distance to site boundary and sensitivity of receiving environment	>500 m The only land use occurring within 2 km of the processing plant is high country grazing on stations that have given land-access. There is a very low risk of any public persons entering areas where HCN or Ammonia discharges will have caused detectable concentrations in the air.	Yes	Negligible

A health risk arises where a hazard and exposure pathway both exist. The above considerations of gaseous contaminant discharges from the processing plant demonstrates that, while HCN and ammonia are hazardous, no credible exposure pathway exists. The separation distances to off-site receptor locations in particular are significant, and access to the site controlled by an active security system, so that it is unlikely that any persons would be exposed to gaseous contaminants, even in the unlikely event that the advanced emission controls proposed result in higher than anticipated discharges.

Weighing up qualitative risk indices for the above six assessment factors, PDP considers the potential for any adverse health effects to occur from the discharge of gaseous contaminants beyond the site is negligible. It is also important to note that the AQMP will significantly reduce the emission and impacts of gaseous pollutants within the site boundary, but worker exposure is outside the scope of this report.

13.0 Air Quality Management Plan

As noted throughout this report to ensure the residual source dust and gas emissions from the BOGP are minimised, an AQMP will be produced which details the measures proposed to mitigate and monitor the discharge air contaminants. The AQMP ties the mitigation measures and environmental monitoring programme together into an effective and auditable package.

The purpose of the AQMP will be to set out actions and measures to ensure that consent conditions for BOGP relating to air quality are achieved. In particular, the purposes of the AQMP are to:

- Ensure that there shall be no noxious, dangerous, objectionable or offensive dust beyond the boundary of the site; and,
- Ensure that the best practicable options for controlling emissions are adopted.

The content and structure of the AQMP will follow the best practice recommendations of the GPG Dust (MfE, 2016) and is likely to include but not be restricted to:

1. The purpose and objectives of the AQMP;
2. Standards to be achieved through implementation of AQMP;
3. Consent Compliance Requirements;
4. A description of the air contaminant sources on site;
5. A description of the receiving environment and identification of sensitive receptors within 250 or 500 metres of site boundaries;
6. The methods to be used for controlling the emission of contaminants to air;
7. A description of air quality, meteorological monitoring requirements;

8. Methods for determining the weather conditions that will trigger an air quality alert;
9. A description of procedures for responding to air quality alerts and associated follow up investigations and recording of findings;
10. A maintenance schedule for meteorological and particulate monitoring instruments;
11. Procedures, processes and methods for managing dust when staff are not on site;
12. A system for training employees and contractors to make them aware of the requirements of the AQMP;
13. Names and contact details of staff responsible for implementing and reviewing the AQMP;
14. A method for recording and responding to complaints from the public; and,
15. Review of and Reporting on the Monitoring Programme.

A draft of the AQMP is provided in Appendix A of this report.

14.0 Scope and Type of Consent Conditions

To ensure that any actual adverse effects are no greater than the potential adverse effects assessed in this report, PDP recommend that the air discharge consent conditions define the:

- Activities which are permitted to discharge contaminants to air;
- Environmental bottom lines and/or performance measures:
  - e.g. The discharges allowed by this consent must not result in visible dust plumes, deposited dust or gaseous discharges which are offensive, objectionable, noxious or dangerous effect beyond the boundary of the property on which the consent is exercised.
- Mitigation measures which shall be implemented;
- Environmental monitoring programme which will identify if the:
  - Mitigation measures are being effective; and,
  - Environmental bottom line is being complied with.
- Form and content of an air quality management plan so as to meet the recommendations made in GPG Dust (MfE, 2016);
- Requirements to record and respond to any complaints; and,
- Record keeping and Reporting requirements.

15.0 Summary of Findings

MGL are proposing to establish the BOGP, which comprises a new gold mine, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell.

The key activities which have the potential to generate dust within the BOGP are the establishment and operation of:

- The four open pits;
- Soil stockpiles;
- Haul roads;
- Engineered landforms;
- Ore Crushing; and
- Tailing Storage facility.

The types of particulate matter discharged from these activities include:

- Coarse particulate- Deposited dust and total suspended particulate ;
- Fine particulate – PM_{10} which can be inhaled;
- RCS; and,
- Fine particulate containing elevated levels of arsenic.

The are four potential sources of gaseous air contaminants:

- Processing plant - leaching and adsorption tanks;
- Processing plant - acid wash and elution columns;
- Processing plant - electro-winning cells;
- Processing plant - induction furnace; and,
- Underground mine vents and portal.

The types of particulate gaseous contaminants discharged from these activities include:

- HCN;
- NH_3; and
- Combustion products - including PM_{10} and NO_2.

The potential adverse effects of the air contaminants discharged from the BOGP are:

- Amenity effects – dust being deposited on surfaces;
- Ecological effects – Flora or fauna adversely impacted; and
- Health effects – particulate matter and gases inhaled by people; and,

The BOGP has a total area of 568 ha and traverses an area with two distinctly different meteorological zones and two different types of receiving environment. For these reasons, the assessment of air quality impacts has been undertaken in two parts based on the different meteorological zones.

The assessment of potential amenity effects resulting from the discharge of dust found that for both the northern and southern zones any adverse effect would likely be less than minor.

The ecological assessment demonstrates the adverse impact of dust discharged from the proposed activities on the area within which the annual herbs grow will range from high for plants growing within 100 m of the dust source, too low for the plants located more than 200 m from the key dust sources.

PDP concludes that based on the nature of the BOGP dust, the separation distance to the nearest location where the public may be exposed for any duration of more than one hour and the implementation of the proposed management measures any adverse health impacts from the particulate matter (PM_{10}, RCS and As) discharged from the proposed mine will be negligible and certainly less than minor.

A health risk arises where a hazard and exposure pathway both exist. The considerations of gaseous contaminant discharges from the processing plant demonstrates that, while HCN and NH_3 are hazardous, no credible exposure pathway exists. The separation distances to off-site receptor locations in particular are significant, so that it is unlikely that any persons would be exposed to gaseous contaminants, even in the unlikely event that the advanced emission controls proposed result in higher than anticipated discharges. Weighing up quantitative risk indices for the above six assessment factor factors, PDP consider the potential for any adverse health effects to occur from the discharge of gaseous contaminants is negligible.

To ensure the residual source dust and gas emissions from the BOGP are minimised, an AQMP will be produced which details the measures proposed to mitigate and monitor the discharge air contaminants. The AQMP ties the mitigation measures and environmental monitoring programme together into an effective and auditable package. The site's water supply system provides sufficient water for typical and for high demand dust suppression.

The purpose of the AQMP will be to set out actions and measures to ensure that consent conditions for BOGP relating to air quality are achieved. In particular, the purposes of the AQMP are to:

- Ensure that there shall be no noxious, dangerous, objectionable or offensive dust beyond the boundary of the site; and,
- Ensure that the best practicable options for controlling emissions are adopted.

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