Waihi North Project – Wharekirauponga Underground Mine - Air Discharge Assessment – for Fast – track Approval Application

Prepared for Oceana Gold (New Zealand) Ltd
Prepared by Beca Limited
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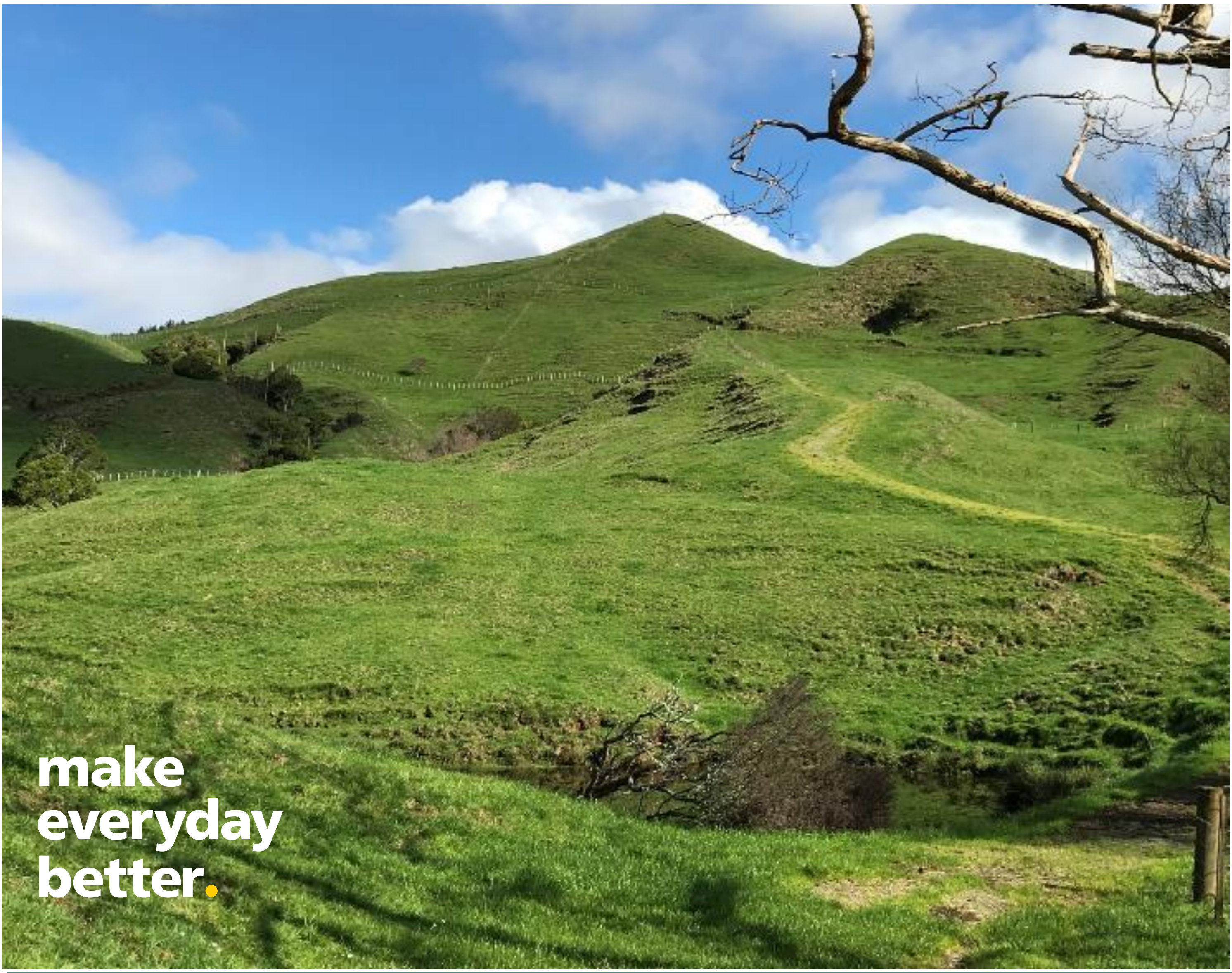
24 February 2025



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Revision History

Revision Nº	Prepared by	Description	Date
A	Mathew Noonan	Draft for client review	13 September 2024
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Document Acceptance

Action	Name	Signed	Date
Prepared by	Mathew Noonan		24 February 2025
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on behalf of	Beca Limited		

Executive Summary

Oceana Gold (New Zealand) Limited (OGNZL) operates an open cut and underground gold mining operation at Waihi in the Waikato Region. The current consented mining will cease production at the end of 2030.

Ongoing exploration of the Wharekirauponga orebody, approximately 11km northwest of the mine Processing Plant, has identified mineral resources that OGNZL wishes to mine. OGNZL proposes to establish a new underground mine beneath Department of Conservation land (Coromandel Forest Park), two decline tunnels to the orebody from OGNZL land at Willows Road, an ore transport tunnel connecting with the existing Processing Plant in Waihi town and associated surface infrastructure on OGNZL land at Willows Road to enable development of the Wharekirauponga Underground Mine (WUG). These new activities will form a key element of the Waihi North Project (WNP) which will allow OGNZL to extend mining until 2038.

The mine and tunnels will be developed by drilling and blasting using modern drilling jumbos, rock loading units and supporting equipment.

This air discharge report provides an assessment of the potential effects of discharges to air from the development and operation of the mine and tunnels, including surface infrastructure, to support an Assessment of Environmental Effects (AEE) to accompany an application for resource consent under the Fast track Approvals process to discharge contaminants to air.

The discharges to air associated with the construction and operation of the mine and tunnels are a permitted activity in the Waikato Regional Plan subject to conditions. While OGNZL anticipates that the proposed activity will comply with the permitted activity conditions, for certainty and completeness OGNZL wishes to apply for an air discharge consent.

Key features of the project, which may be potential sources of discharges to air during construction and operation, are as follows:

- Topsoil stripping and storage
- Tunnel portals
- Rock stack and clean and dirty water collection ponds
- Site access and haul roads
- Explosive magazines/emulsion storage
- Helipad
- Mine ventilation system and raises
- Noise earth bunds
- Package sewage treatment plant and soakaway area.
- Rehabilitation.

There will be no crushing or other processing of the excavated rock at the Willows Road site.

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

The results of ambient air quality monitoring and the complaints history for the nearby Waihi Mine site demonstrate that any increases above background concentrations of deposited dust, total suspended particulate (TSP), fine particles (PM_{10}) and silica, measured at sites in the vicinity of the previous and current mining operations are small and well below the relevant standards and guidelines recommended by the Ministry for the Environment. They are also within the limits set by current resource consent conditions for the Mine and permitted activity limits. These results show that methods currently used at the nearby Waihi Mine, to minimise discharges to air, are effective and appropriate.

The assessment of potential effects of the development and operation of the WUG and associated infrastructure described in this report has identified that there is a moderate to high risk of infrequent, short duration discharges of dust during dry windy conditions affecting the privately owned dwellings at 111 Willows Road. There is also a moderate risk from infrequent, short duration nuisance dust at the privately owned dwelling at 122 Willows Road.

No other privately owned dwellings are expected to be adversely affected by dust during site construction and operation.

The air discharge related risks are greatest when the surface infrastructure is being constructed and land areas are exposed and topsoil stockpiles unvegetated. It is recommended that a new weather station be installed close to the OGNZL-owned dwelling on Willows Road to monitor wind speed and direction, as well as total suspended particulate (TSP), and that some additional mitigation measures are implemented on site when weather conditions are conducive to the generation of dust.

Based on modelling undertaken separately by consultants Tonkin and Taylor as well as ecology assessments, the risks of discharges to people and native flora or fauna from discharges from the proposed tunnel raises is very low.

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

A draft Air Quality Management Plan has been prepared that describes the dust monitoring and mitigation methods to be used by OGNZL at the site.

The assessment of effects described in this report concludes that, providing OGNZL continues to use the methods currently used at the nearby Waihi Mine to minimise discharges to air, and adopts the additional monitoring and mitigation measures recommended in this report, the adverse effects of discharges to air from the project will be adequately avoided and mitigated. Consequently, the likelihood that these discharges will result in noxious, dangerous, offensive or objectionable effects beyond the site boundary is considered to be low.

1 Introduction

1.1 Overview

Oceana Gold (New Zealand) Limited (**OGNZL**) operates an open cut and underground gold mining operation at Waihi in the Waikato Region. The current mine will complete production at the end of 2030.

Ongoing exploration of the Wharekirauponga orebody, approximately 11km northwest of the mine Processing Plant, has identified mineral resources that OGNZL wishes to mine. The resource lies beneath Department of Conservation managed land (Coromandel Forest Park or **CFP**), within the Wharekirauponga Minerals Mining Permit (60541) area.

OGNZL proposes to establish a new underground mine (the Wharekirauponga Underground Mine" or "**WUG**") under the CFP, two tunnels to the orebody from OGNZL land at Willows Road, a tunnel connecting with the existing Processing Plant in Waihi town, and a separate decline to connect with associated infrastructure at Willows Road to enable development of the WUG. These new activities will form a key element of the Waihi North Project (**WNP**). The WNP seeks to extend mining until at least 2038.

A dual tunnel will be developed out to the WUG from the intersection of the tunnel from the Willows Road decline. A bypass drive that connects the ore transport tunnel with the Willows Road tunnel is also proposed. The tunnels will be developed by drilling and blasting using modern drilling jumbos, loaders and supporting equipment.

The WNP also includes other activities that will occur at the Waihi site at Baxter Road, at and nearby to the Waihi Surface Facilities Area (SFA). These include the mining of a new open pit near the Processing Plant (Gladstone Open Pit) which will be converted to a tailings storage on completion of mining the pit, a new tailings storage facility (**TSF3)** to the east of existing TSF1A, a new Northern Rock Stack (**NRS**) adjacent to the existing TSF2, upgrading of the existing Water Treatment Plant (WTP) and upgrading of the existing Processing Plant to increase ore processing capacity from 1.25 to 2.25 million tonnes per annum.

The air discharges arising from proposed activities at and around the Waihi Surface Facilities Area are discussed in a separate report.[1]

1.2 Project Summary

1.2.1 Overview

An overview of the WNP project is shown in Figure 1-1.

[1] *Waihi North Air Discharge Assessment – Southern Development* (Beca, 2021); prepared for OceanaGold (NZ) Ltd

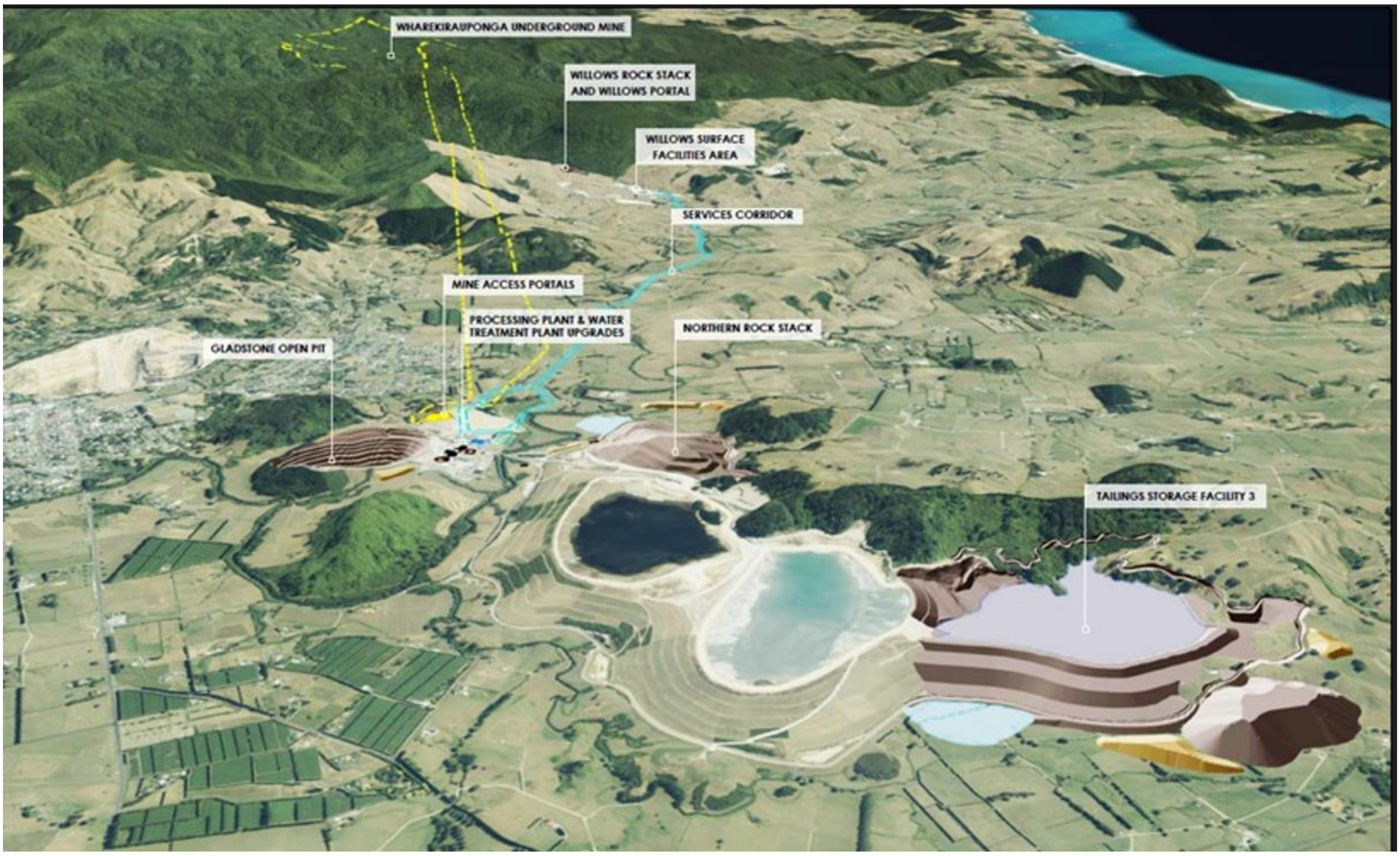

Figure 1-1 Overview of Waihi North Project (Source: OGNZL)

1.2.2 Services Trench

A services trench connecting the Willows Road Surface Facilities Area (**SFA**) to the existing Processing Plant will be constructed that will likely carry mine drainage and rock stack contact water (to WTP), treated water return, raw water line, potable water line, a 33kV cable and a fibre optic cable. The air quality effects of the construction of the services trench are discussed in more detail in a separate Beca report[2].

1.2.3 Surface infrastructure

Surface infrastructure at Willows Road will include:

- Office, crib room, change house, first aid room and stores building
- Small service workshop and wash down bay
- Lay down area for storage of tunnelling consumables such as poly pipe, vent bag and rock bolts/mesh
- A single rock stack of approximately 6ha in area with total storage capacity of 1,100,000m^3
- Topsoil stockpiles
- Sumps and ponds for general surface water collection/settling and stockpile/mine water collection
- Private road connection to Willows Road and internal site access roads
- Carpark
- Class 1 explosives magazine with appropriate separation and security
- Class 5 emulsion storage magazine with required separation
- Minor hazardous substances holdings including diesel, oils, greases, coolants, lime etc
- Helipad
- A package sewage treatment plant and soakaway area

[2] Beca (2024) *Services Trench Construction – Air Discharges Assessment*

- Security fencing, a real time surveillance camera system, gatehouse, signage and appropriately designed lighting
- A high voltage (HV) substation including HV and LV switch rooms and transformers.

1.2.4 Tunnel access portals

Two tunnel access portals will be developed: (1) an initial single, main access portal for tunnelling and return of stored rock for backfilling located at Willows Road farm (the "**Willows Portal**"); and (2) a single-materials handling portal located near the processing plant ("**WUG Portal**") that will be used to transport ore out of the mine and rock back into the mine for stope backfilling (on exhaustion of the Willows Road rock storage).

1.2.5 Wharekirauponga Underground Mine

Personnel, material and consumables access to the underground mine will occur entirely via the underground tunnel utilising either the Willows, or WUG Portals. Modified Avoca will be the mining method utilised at WUG and has been used successfully at Waihi as it is a flexible mining method for minimising dilution in narrow vein orebodies.

During the early stages of the mine, following commencement of stoping[3] and while development rock generation is still in progress, rock will be trucked internally from the active development faces to the stopes for backfill (i.e once stoping commences, there is no need to haul rock back to Willows Road). As the mine life progresses, capital rock development will cease and the stockpile at Willows Road will be drawn down as the material is used for underground backfill. Once the Willows Rock Stack (**WRS**) is exhausted, rock will be required to be imported into the mine from stockpiles at the Waihi Surface Facilities Area via the WUG Portal. Mined ore from WUG will be transported to the existing Waihi Processing Plant via the WUG Portal for gold and silver extraction.

The ventilation system has been designed to be adequate to supply sufficient quantities of air for safe and efficient tunnelling, exploration and mining operations in line with New Zealand regulatory requirements, including diesel exhaust dilution rates, airflows, velocities and dust. A minimum of two shafts are required at the orebody, with a possibility of up to four shafts being required, depending on final mine design and geotechnical constraints.

1.3 Air Discharge Consent Requirements

The discharges to air associated with the construction and operation of the tunnels are a permitted activity under Rule 6.1.16.1 of the Waikato Regional Plan subject to conditions. While it is anticipated that the activity will comply with the permitted activity conditions, for certainty OGNZL wishes to apply for an air discharge consent under Rule 6.1.9.2 of the Waikato Regional Plan. Other consents are required to authorise the project. On this basis, it is prudent to assess the effects of the resultant air discharges so that appropriate account is taken of all the effects that will likely accrue from the project.

1.4 Purpose of Report

This air discharges report has been prepared by Beca Ltd (**Beca**) on behalf of OGNZL to support an Assessment of Environmental Effects (**AEE**) to accompany an application for resource consent to discharge contaminants to air. The report provides an assessment of the potential effects of discharges to air from the development and operation of the WUG mine and tunnels, including surface infrastructure.

OGNZL is making application for consents under the new Fast-track Act. The Fast-track application covers activities normally covered by an application for resource consents under the Resource Management Act,

[3] Stope- excavation in a mine working in the form of a step or notch

1991 and all ancillary approvals required under the Crown Minerals Act, Wildlife Act, HNZPT Act and Public Works Act.

The assessment of environmental effects has been based on the results of current monitoring and mitigation processes at the nearby operating Waihi Mine site, in accordance with the Ministry for the Environment's "*Good Practice Guide for Assessing Discharges to Air from Industry:* and *"Good Practice Guide for Assessing and Managing Dust".*

The report contains the following information:

- A brief summary of the proposal, where it relates to discharges to air
- A description of the nature of the discharges to air resulting from the proposed activities
- A description of the receiving environment in terms of the potential influences on the effects of the emissions to air from the site
- A description of air quality standards and guidelines
- A description of air discharge sources and mitigation
- A description of the assessment methodology
- An assessment of the potential effects of the proposal on air quality
- Proposed mitigation and monitoring
- The conclusions from the assessment.

1.5 Limitations

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

2 Project Description

2.1 Overview

The WNP includes a number of different elements. A key component is the establishment of a new underground mine beneath Department of Conservation land (Coromandel Forest Park), two decline tunnels to the orebody from OGNZL land at Willows Road, an ore transport tunnel connecting with the existing Processing Plant in Waihi town and associated surface infrastructure on OGNZL land at Willows Road to enable development of the Wharekirauponga Underground Mine (WUG).

This air discharges report focuses on the surface infrastructure aspects of the WUG project which are most relevant to potential air discharge impacts on surrounding activities.

The surface infrastructure associated with the development of the tunnels will be located on farmland owned by OGNZL at Willows Road, 4-5km north of Waihi. It is estimated that the footprint of the surface infrastructure on the Willows Rd site will be approximately 18ha.

Certain critical infrastructure will be established prior to commencement of tunnelling with additional infrastructure to support mining being established later prior to commencement of operation.

Figure 2-1 shows the proposed Willows Road site layout.

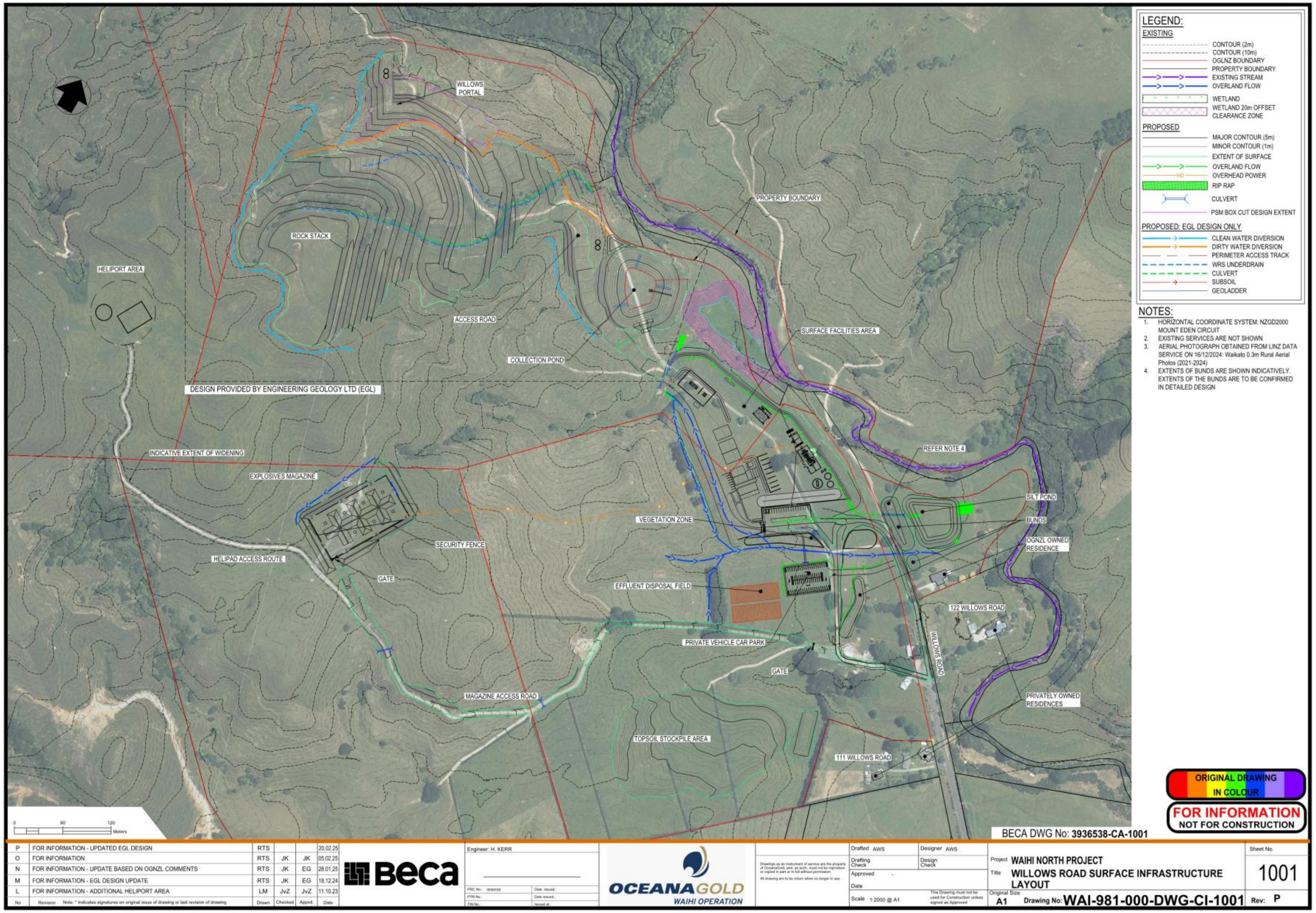

Figure 2-1 Willows Road Site Layout Area

2.2 Key Features of Project in Regard to Air Quality at Willows Road Site

2.2.1 Overview

Installation of the following key features of the project that may affect air quality at the Willows Road site, for a limited period, include:

- Topsoil stripping and storage
- Tunnel portals
- Willows rock stack (WRS) and clean and dirty water collection ponds
- Site access and haul roads
- Explosive magazines/emulsion storage
- Helipad site
- Tunnel ventilation system and raises
- Noise earth bunds
- Package sewage treatment plant and soakaway area
- Rehabilitation.

There will be no surface crushing or other processing of the excavated rock on the Willows Road site. Ore will be transported from the mine to the Processing Plant at Waihi via an underground tunnel (WUG Tunnel). This tunnel will also be used for the transport of rock material back into the mine for backfilling, towards the end of the mine's life, after stockpiles at Willows Road are empty.

2.2.2 Topsoil stripping and storage

Surface infrastructure facilities will be established prior to commencement of tunnelling. The surface footprint areas will first be stripped of topsoil which will be stockpiled in an area to the south of the Surface Facilities Area and used for subsequent works around the site. Transport of this material to storage will likely be by diesel trucks. Areas to be stripped include the Surface Facilities Area, collection pond sites and carpark.

Topsoil will be stockpiled in an area of approximately 3ha, at no greater than 3m depth. These stockpiles will be stabilised and grassed to prevent erosion and dust generation and to allow return to stock grazing once pasture has been established.

2.2.3 Tunnel portals

The portals will form the tunnel entrances. Following further geotechnical investigations to confirm the suitability of the locations, earthworks will be undertaken to form the portals. The works will be undertaken using suitable equipment including a backhoe excavator, bulldozer and rock-breaker. If necessary, blasting will also be used.

In respect of the Willows Portal, earthworks and construction tasks to establish the portal will be undertaken and may include a small box cut and/or Armco tunnel arrangement depending on geotechnical conditions. Initially, a single 250 kW ventilation fan will be installed at the entrance to the portal in a shipping container insulated for noise mitigation. This fan will be relocated underground and integrated into the overall tunnel ventilation system on completion of the first vent shaft. All ventilation equipment will be located underground thereafter.

Once operating, the portals will be intakes to the tunnel system and there will be no dust or diesel related emissions.

The location of the Willows Road portal is shown in Figure 2-2.

Other required equipment and accessories will be installed at the portal, including transformers, water storage tank, lighting, communications, and safety tag board.

In respect of the WUG Portal (located at the Waihi Processing Plant), a cut will be made into the hill. The portal will be formed and required services connected prior to commencement of operation.

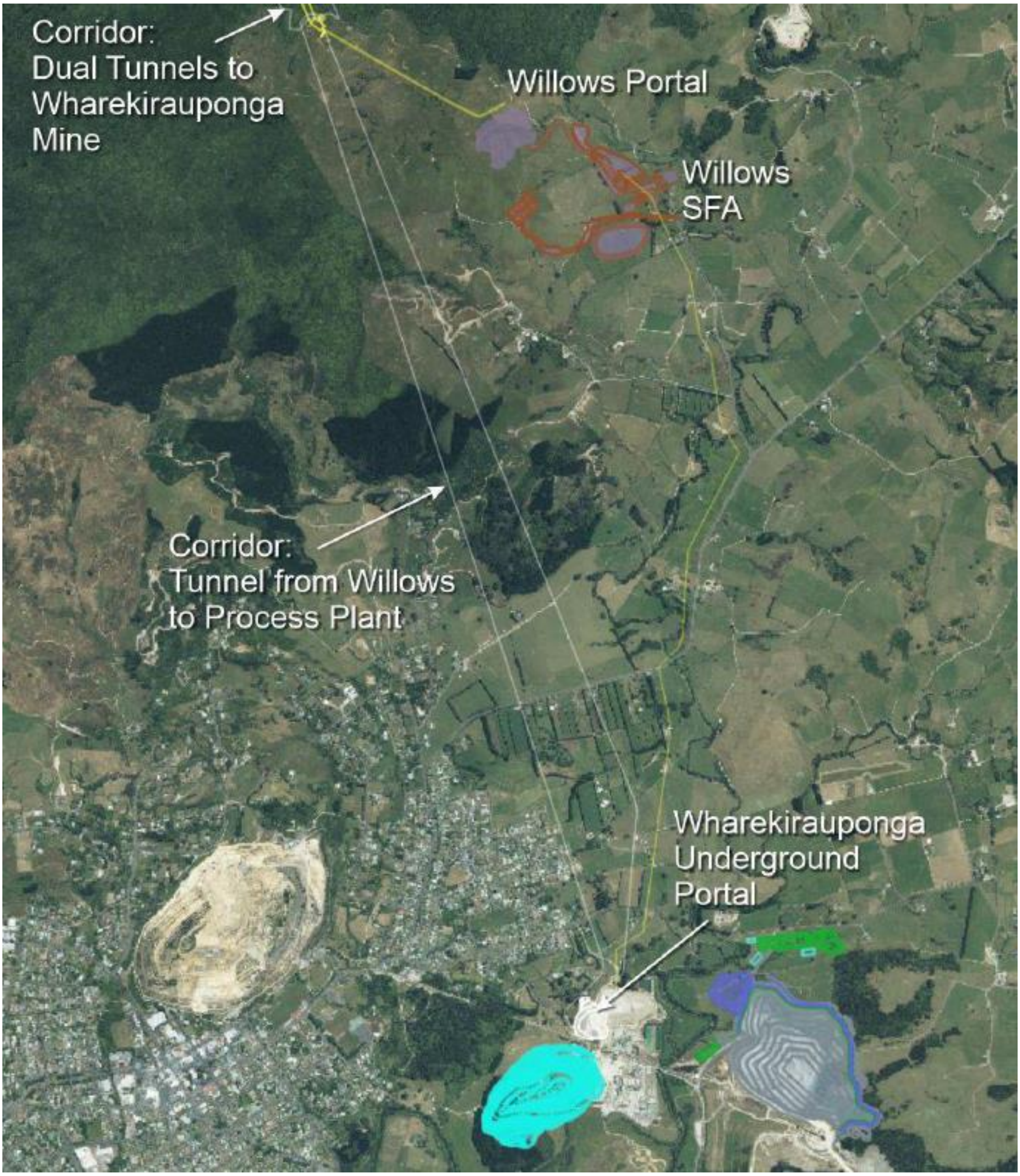

Figure 2-2. Location of Willows Road tunnel portal

Figure 2-3 shows an example of a tunnel portal.

Figure 2-3 Example tunnel portal (Source: OGNZL)

2.2.4 Rock stack /clean and dirty water collection ponds

The WRS of approximately 6ha in area will be developed as shown in Figure 2-4. The WRS will have a total capacity to store up to 1,100,000m^3 of rock. The stack will be constructed in 10m lifts, up to a height of 20m above natural ground level.

Rock will be progressively returned underground to backfill the mine during the stoping operation. This will be undertaken with a loader and truck via the Willows Road Portal. Once the WRS is exhausted, rock for backfilling stopes will be obtained from other Waihi mining operations. Rock stored in the NRS will be transported via reversal of the existing loadout conveyor from the NRS to an interim stockpile adjacent to the WUG portal. Ore trucks will be backloaded with this rock for returning to the mine.

Runoff water and drainage water from the rock stack will be collected in a collection pond located to the east of the stack. This pond, which will have an approximate capacity of 19,900m^3, is designed to contain a 1 in 10-year storm event over a 24- hour period. Collected water will be pumped to the existing Waihi WTP for treatment.

A separate runoff retention pond will also be located to the east of the Surface Facilities Area. This pond will collect and treat stormwater from the facilities area before discharge to the nearby Mataura Stream.

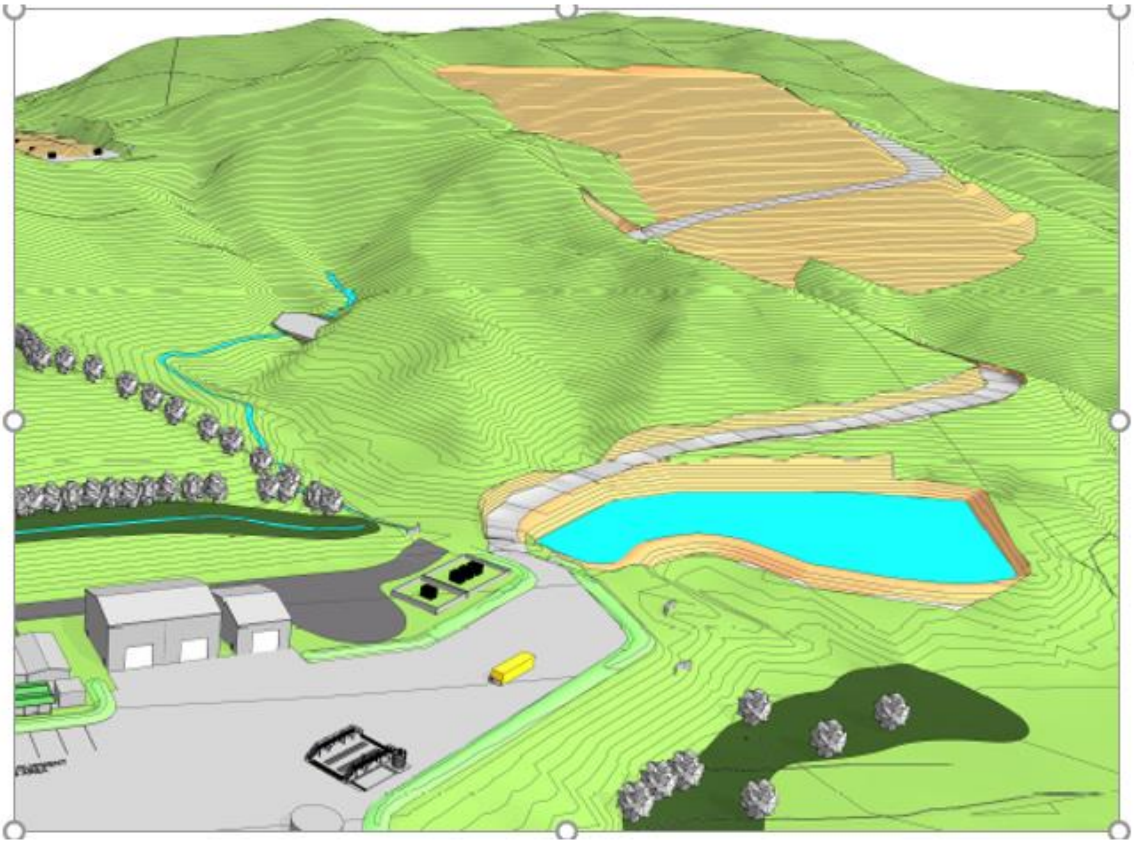

Figure 2-4. 3D View of Willows Road site rock storage and runoff retention ponds (Source: OGNZL)

2.2.5 Site access and haul roads

An internal access road off Willows Road will be constructed to the site with spur connections to the main site infrastructure including the first aid room and gate house, office/change house, workshop and magazine. These roads will not be sealed but will be constructed of gravel, with 6m running width and provision for drainage.

An 8m wide access road constructed of rock base with crushed rock surfacing will run from the Surface Facilities Area to the WRS and to the Willows portal which will include a connection to the farm track for transport of rock to the lower benches of the stack.

A separate 6m wide all-weather access road will be established to service the explosives storage magazines and access will be extended to the new helipad. The total length of onsite road construction will be approximately 2.5km.

Mobile machinery including two 45 tonne haul trucks, a grader, fuel truck and water cart will be used on the site roads.

2.2.6 Explosive magazines and emulsion storage facility/helipad site

A series of class 1 explosives magazines, which conform to New Zealand hazardous substances regulations, will be located on the surface at the Willows Rd project site (see location in Figure 2-1). The magazines will be locked and securely fenced, and access strictly controlled. Due to the long distances involved, a permanent underground magazine will be required at WUG in addition to the existing surface magazine, once stoping commences.

A class 5 emulsion storage facility will also be established as part of the surface infrastructure development. This will require fencing and appropriate separation distances from combustibles.

2.2.7 A helipad site will be established near the centre of the Willows farm site, to the northwest of the magazine. Tunnel ventilation system

The tunnel ventilation system has been designed to supply sufficient air for safe and efficient underground mine operation in line with New Zealand regulatory requirements including diesel exhaust dilution rates, airflows, velocities and dust.

2.2.8 Ventilation raises

The project will comprise up to 5 ventilation raises (one potentially serving as an egress shaft) which will have nominal diameters of up to 5.5m. The initial raise will be located on OGNZL - owned land, just south of the property boundary between Willows Farm Road and the CFP as shown on Figure 2-5.

A short above-ground exhaust stack (see Figure 2-6) will be installed.

The remaining shafts will be located within the Forest Park in the area indicated on **Figure 2-5.** The exact surface location of each raise will be determined by detailed site investigations to ensure the minimisation of effects on flora and fauna and geotechnical suitability. Construction will require disturbance of up to approximately 900m^2 for each site.

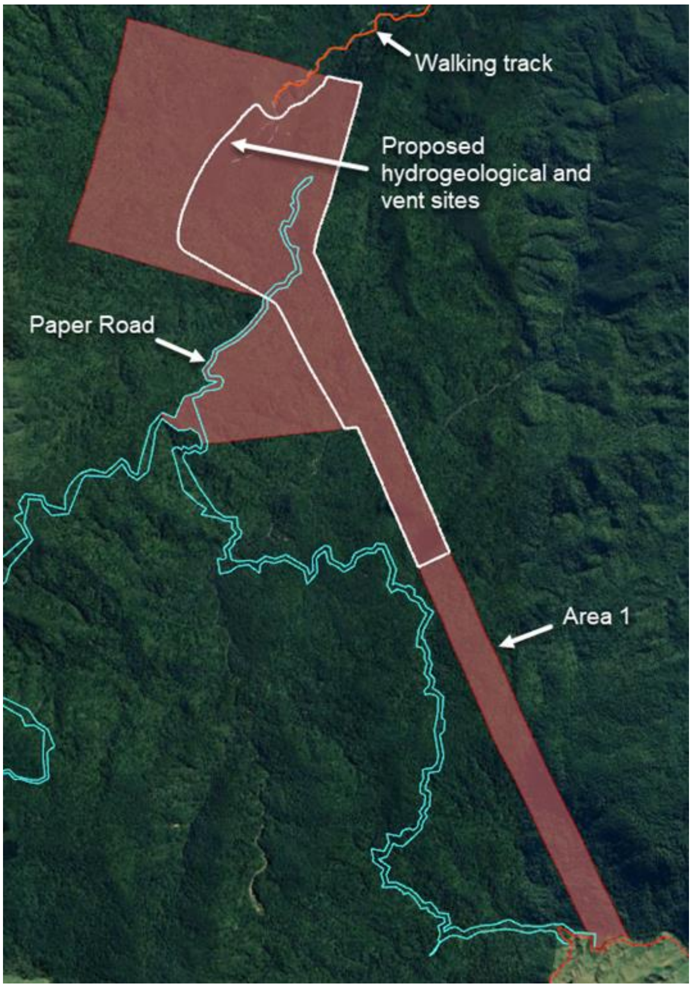

Figure 2-5 Tunnel alignment and potential ventilation shaft locations (Source: OGNZL)

Figure 2-6 Typical air vent

2.2.9 Noise earth bunds

Noise earth bunds will be formed on the south-eastern boundary of the Surface Facilities Area and further to the east across Willows Rd as shown in Figure 2-1 to attenuate noise at the closest houses. These bunds will be constructed using topsoil excavated from the site.

The bunds will be grassed to mitigate dust and visual impact.

2.3 Wastewater Treatment and Disposal

Wastewater from staff toilets, showers and canteen facilities will be treated in an MBR (membrane bioreactor) process before discharge to an approximately 2,500m^2 trench- based disposal area (see location in **Figure 2-1**).

2.4 Water Supply

Water harvested from tunnel dewatering will be piped to the OGNZL water treatment plant at Waihi. Treated water will then be pumped back to WUG for use underground and for surface dust suppression and vehicle washing.

Two water tanks are proposed on site, each with a storage capacity of 220m^3 (440m^3 total). One tank will be installed initially with the second tank installed when operational demand increases.

2.5 Tunnelling Operations

Following establishment of the Willows Portal and development of the first tunnel section (Willows Access tunnel) to the base of Vent Raise 1, typical dual-tunnel operations will consist of

- 10-15 firings per week of approximately 4 m in length each
- Digging and loading of the fired rock either directly onto a haul truck or hauling and placing in a stockpile cuddy within 200 m of the face (it is estimated that approximately 825 tonnes per day of rock will be generated)

- 5 return trips (average) per truck (4 trucks) per day from the development face of the tunnel to the surface rock stockpiles
- Rock will be stockpiled underground when excavated at night (additional trucks may be required as tunnel length increases)
- Infrequent Monday to Saturday deliveries of consumables and equipment
- Twice daily fuel deliveries to surface and underground works.

2.6 WUG Access Tunnel

A single 5km long tunnel will connect the dual tunnels at Willows Road (below the first ventilation shaft) to an additional portal (the WUG Portal) located at the Waihi Processing Plant. This tunnel will be primarily used for transport of ore on the commencement of mining. Once the Willows Road Rock Stack is exhausted, the tunnel will be used to convey rock from the NRS to the orebody to backfill stopes. The tunnel will also be used for general operational access between the mine and Processing Plant. Construction will take place in parallel with main access tunnels. Construction will take place from both ends which will enable construction without the need for an additional ventilation raise.

2.7 Mining

The underground mining operation will commence once the tunnels reach the orebody and appropriate ventilation has been established.

The mining process would include:

- Firing in stopes twice daily
- Trucks hauling ore 24 hours per day.

2.8 Working Hours

Initial works to establish surface infrastructure at the Willows Road site will be undertaken on a 24 hours per day/ 7 days per week basis subject to meeting specified noise limits. These noise limits are likely to mean that only a limited suite of low noise generating activities (i.e activities which meet the nigh time limits) will occur on Sundays and between 2200 and 0700 hours on Monday to Saturday.

Once the Willows portal is established and development of the tunnels can be commenced, work will continue on a 24 hours per day, 7 day per week basis (subject to specified noise limitations). Mining and ongoing development will also occur continuously.

During mining, although most of the work will be underground, there will be the requirement for machinery and personnel to return to the surface. This will, however, be less frequent as the mine progresses and as facilities are established underground such as workshop and magazine.

2.9 Work Schedule

It is estimated that the work to develop the tunnels, including preparatory and site establishment works, will take up to 48 months from consent approval, with first stopes expected 8 months later. The Life of Mine design and schedule will be finalised after completion of exploration drilling.

2.10 Closure and Rehabilitation

2.10.1 Site surface infrastructure

At the completion of the project, all surface infrastructure at the Willows Road site will be removed, and footprint areas fully rehabilitated to return the land to pre-tunnelling status suitable for farming. Stockpiled topsoil will be reclaimed for use in rehabilitation.

All rock will be returned underground. The area of the rock stack will be rehabilitated with topsoil and plantings to return the area to its original landform and use for arable farming, with riparian areas re-established and protected from stock.

The portal will be securely sealed, and the immediate entrance area backfilled with rock prior to placement of topsoil and establishment of pasture.

2.10.2 Ventilation shafts

All fencing and vent/egress surface infrastructure (vent chimneys) will be removed. Ventilation shafts will be filled in and surface areas around the raises revegetated. The site rehabilitation process will be the same as that endorsed by DoC and already employed elsewhere by OGNZL.

3 Environmental Setting

3.1 Overview

The Willows Road site, on which the supporting surface infrastructure is located, consists of approximately 200ha of dry stock and dairying farmland owned by OGNZL.

The Willows Road site boundary lies approximately 2km northeast of the Waihi town boundary. The WUG orebody is located approximately 11km north of Waihi town.

The topography is rolling terrain which rises relatively quickly to the north and northwest from the Willows Road site. There are several unnamed tributaries to the Mataura Stream on the site, some of which are spring fed or ephemeral.

The project location and surrounding land ownership are shown in Figure 3-1.

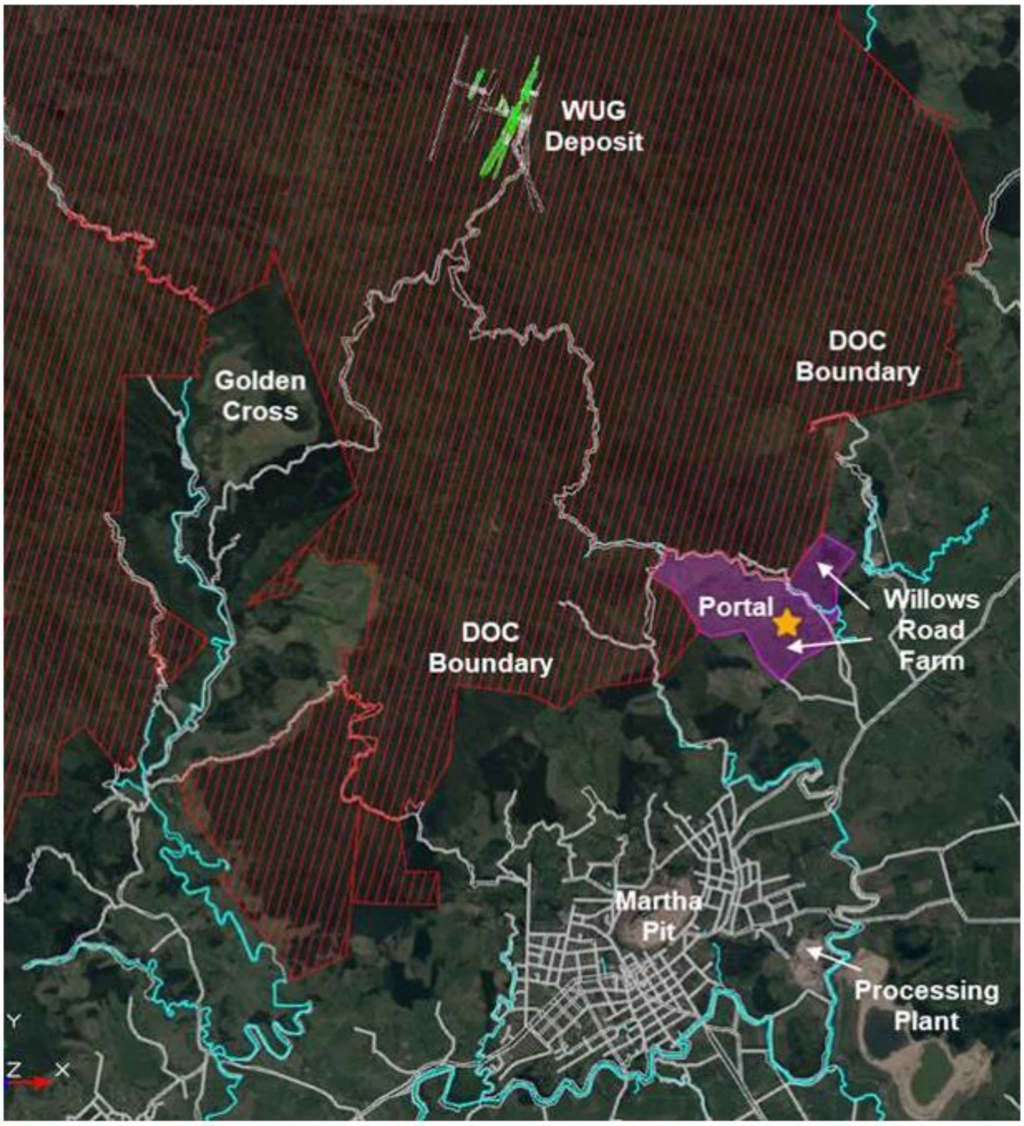

Figure 3-1 Project location and land ownership (Source: OGNZL)

3.2 Sensitive Receptors

3.2.1 Human receptors (dwellings)

There are several dwellings in the vicinity of the boundary of the Willows Road site. Figure 2-1 shows the key project surface features such as the Willows Portal, WRS, collection pond, retention ponds, access roads, noise bunds, topsoil storage, effluent disposal field and the locations of the nearest dwellings at 111, 112 and 122 Willows Road. Construction of these surface features will involve land disturbance (topsoil removal), earthworks, or storage of material during construction, which could produce dust under dry, windy weather conditions.

The nearest dwelling to the site is owned by OGNZL and is located immediately to the east of the proposed carpark across Willows Road. Several privately owned dwellings are located on Willows Road relatively close to the topsoil storage area and noise bunds. The dwelling at 122 Willows Road is approximately 109m to the east of the closest noise bund and 234m to the northeast of the topsoil stockpile, at their closest points. The dwelling at 111 Willows Road is approximately 145m to the east of the topsoil storage area, at its closest point. The dwelling at 112 Willows Road lies approximately 175m from the storage area on the eastern side of Willows Road.

The WRS and mine access road will be located approximately 600 m to the northwest of the nearest privately owned dwelling on Willows Road at their closest points. The Willows runoff collection pond will lie approximately 400m northwest of the nearest privately owned dwelling on Willows Road at its closest point. The tunnel portal is located at least 600 m to the northwest of the closest privately owned dwelling on Willows Road.

There is also a group of dwellings located to the southwest on Highland Road. The explosives magazine access road is the closest site surface development to Highland Road, lying at least 350 m to the northeast of dwellings at its closest point.

3.2.2 Ecological receptors

Construction of the tunnel ventilation system will occur within areas of native forest located within the Coromandel Forest Park. Native vegetation and other species will be treated as sensitive to dust and exposure to excessive dust minimised as far as practicable.

The general area of the proposed tunnel vent raises (vents) includes habitat for an endangered Archey's frog (*Leiopelma archeyi*). There are likely to be many frogs near to the proposed vent stacks. Frogs are very vulnerable to absorbing emissions in the air through their skin. The emissions will be vented 24 hours per day – i.e. including at night when frogs are active on the ground.

A report has been prepared by Consultants Tonkin and Taylor[4] on the effects of mine vent quality to inform an assessment of the effects on Archey's frog. (see **Appendix A**). This assessment was then used as the basis for the ecological report on the effects of the vent discharges on frogs prepared by RMA Ecology Ltd[5]

Tonkin and Taylor Ltd (2021) *Assessment of mine vent air quality impacts to inform an assessment of ecological effects of Archeys frog;* report prepared for OceanaGold (NZ) Ltd

[5] RMA Ecology Ltd (2022) Memorandum to Stephanie Hayton OGNZL from Graham Ussher *OGNZL Wharekirauponga frogs: Potential adverse ecological effects*

3.3 Air Shed Status

The National Environmental Standards for Air Quality (NESAQ) requires regional councils to identify areas where air quality is likely or known to not meet the national air quality standard. These areas are known as airsheds.

The Willows Road site is located outside the Waihi Airshed as gazetted by the NESAQ. All the surface and underground facilities are in the airshed comprised of the rural areas within the Waikato Region that are not specifically included in a specifically gazetted airshed. Figure 3-2 shows the boundaries of the Waihi Airshed.

Therefore, the site is not identified as being within a potentially polluted airshed and the restrictions on granting an air discharge permit under Regulation 17 of the NESAQ do not apply.

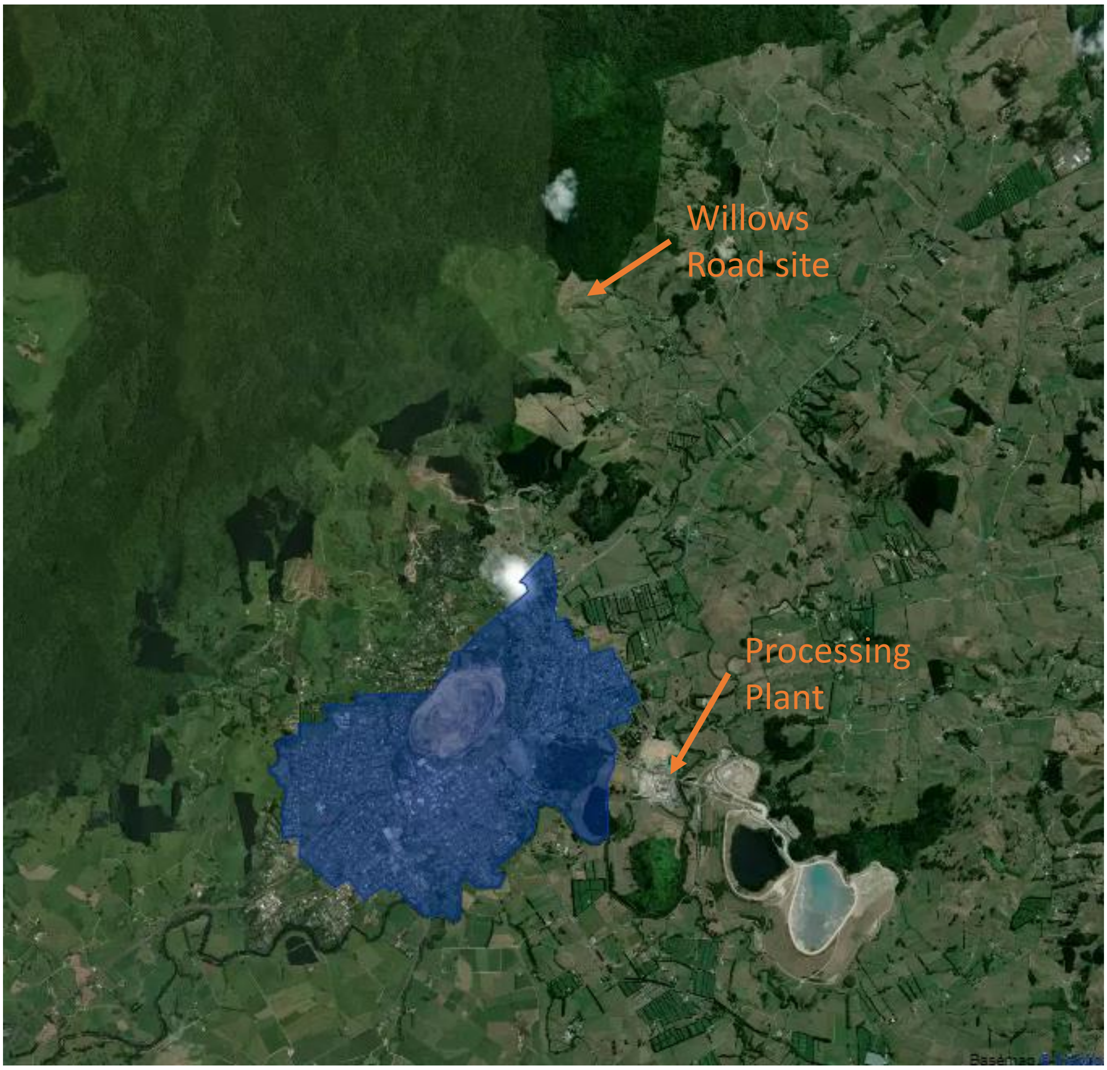

Figure 3-2 Boundaries of the Waihi Airshed (shown as a blue shade area)

3.4 Background Air Quality

The main land use in the vicinity of the Willows Road site is farming and the only current sources of air contaminants are those typical of rural areas such as unsealed roads, unvegetated fields, domestic heating and pollen. During periods of low rainfall and strong winds, background dust concentrations may increase due to the natural and agricultural sources in the area.

The Ministry for the Environment (MfE) *Good Practice Guide for Assessing and Managing Dust* (GPG Dust)[6] describes typical background concentrations of deposited dust for different environments. These are usually less than 1 g/m^2/30 days for rural areas such as the Willows Road site.

There is only a limited amount of data available relating to ambient concentrations of total suspended particulate (TSP) levels in New Zealand. The GPG Dust notes that background TSP levels in clean environments are about 10-20 µg/m^3. TSP concentrations at the Willows Road site are expected to be of this order, as there are no large sources of particulate in the area such as industries or urban developments.

OGNZL does not currently monitor air quality in the vicinity of the Willows Road site. However, OGNZL and predecessors have been monitoring deposited dust in the vicinity of the Waihi Gold Mine since 1982 and total suspended particulate (TSP) since 2005.

A summary of the results of air quality monitoring carried out at the Waihi Mine monitoring sites is included in Section 6.

3.5 Meteorological Data

The key meteorological parameters when assessing the effects of air discharges such as dust are wind speed and direction and rainfall/rainfall days. Winds that exceed 5 m/s can lift dust from unconsolidated surfaces. Wet conditions help suppress dust.

OGNZL measures wind speed and direction at a climate station located close to the Martha mine (Site 6.63 Met Station - see Figure 6.1). This climate station lies approximately 3 km to the south of the Willows Road site and 140 m to the east of Martha Pit.

3.5.1 Wind

The local topography at the Willows Road site is complex and is likely to influence local wind conditions. The site may be sheltered to some extent from the prevailing westerly winds, but there may also be channelled in a more north-westerly direction down the gully between the two steep hills on the southern and northern sides of the site.

Overall, however, there are no topographic features between the Barry Road climate station and the project site that would result in significant differences in the meteorological characteristics of these two sites. On this basis, the data measured at the climate station is also relevant to the project site.

A windrose showing hourly average windspeed and directions for the 7-year period of April 2017 – April 2024, at the Barry Road climate station, is provided in **Figure 3-3** (data supplied by OGNZL). The prevailing and strongest winds come from the west and south-westerly directions. Secondary winds come from the northeast and occur for approximately 11% of the time; while winds from other directions are rare.

The average wind speed measured in the period was 3 m/s and calm conditions (i.e wind speeds <0.5m/s) occurred for approximately 11 % of the time. Winds that exceed 5 m/s occurred for approximately 16% of the time.

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

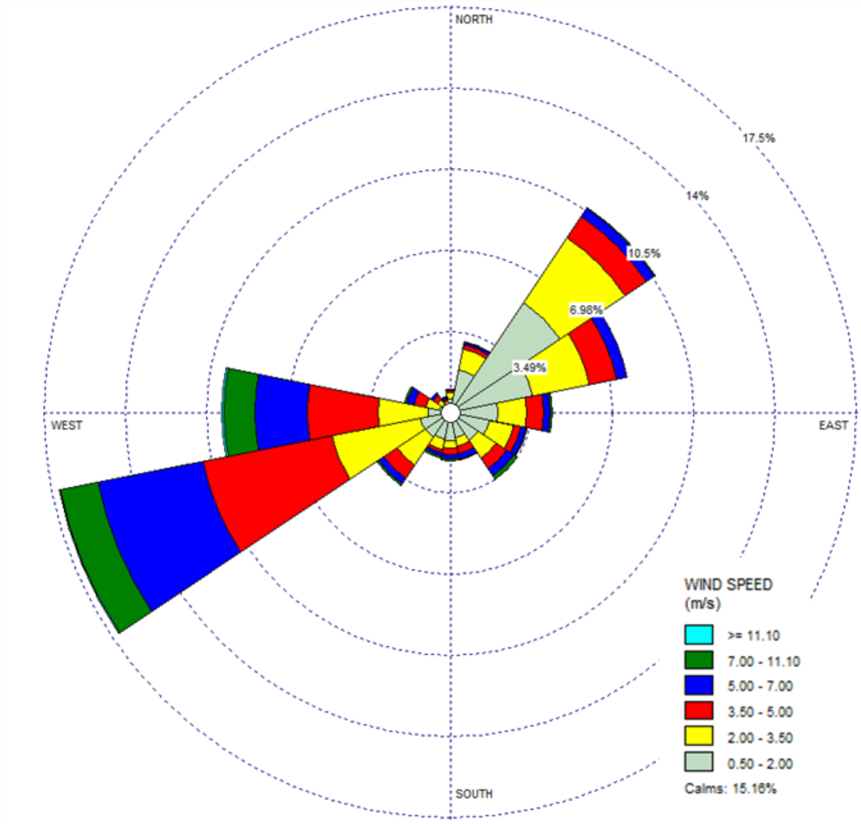

Figure 3-3 Windrose showing hourly average wind speed and directions at OGNZL climate station April 2017 to April 2024 (data supplied by OGNZL).

A windrose showing winds that exceed 5m/s is shown in Figure 3-4. From the generated wind frequency distribution data, winds from the west south-west through to the west, exceed 5m/s for approximately 10% of the time. Very high winds (>10m/s) from these directions occur approximately 0.4% of the time which is infrequent. Winds from all other directions that exceed 5m/s are very infrequent.

Wind direction patterns are relatively consistent throughout the year with spring having the highest average wind speeds and autumn the lowest.

Similar wind direction patterns are also observed during the day and night, although on average wind speeds are greater during the day (average wind speed 3.0 m/s) compared to the night (average wind speed 2.3m/s). The proportion of hours when wind speeds are less than 0.5m/s is also greater during the night compared to the day (20.0% of the time during the night vs 10% of the time during the day).

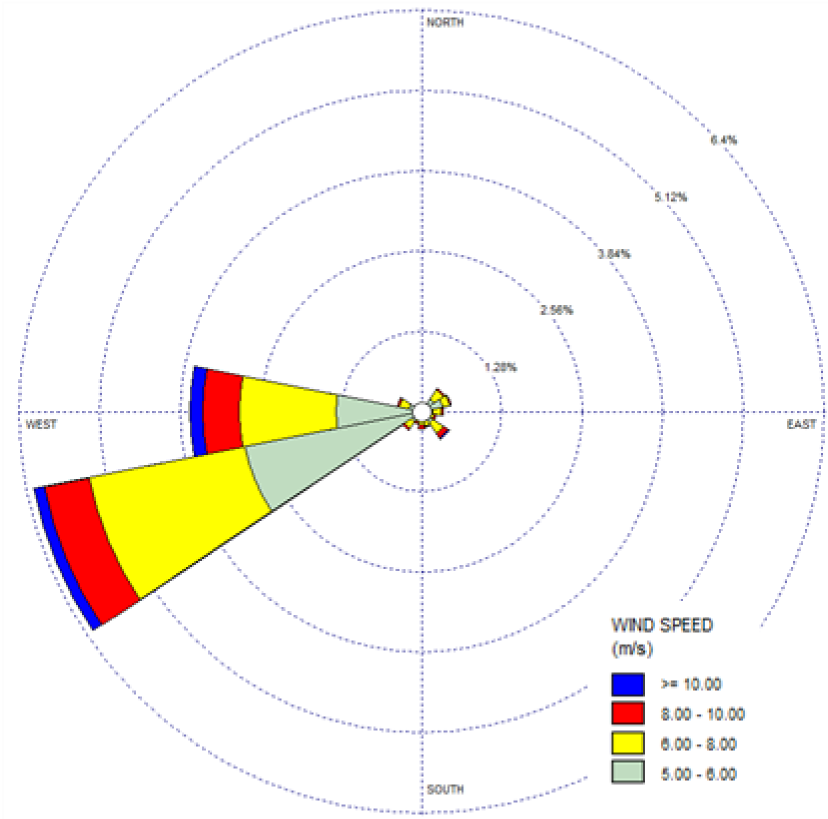

Figure 3-4 Windrose showing winds >5m/s at OGNZL Waihi Climate Station 1 April 2017 – 1 April 2024 (data supplied by OGNZL).

3.5.2 Rainfall

The annual average rainfall measured at Waihi between 2011 and 2023 is 1999 mm. The average monthly rainfall measured at Waihi for the period 2013 – 2024 is shown in Figure 3-5 and the average number of rain days measured at Waihi, for the same period, is shown in Figure 3-6.

A "rain day" is defined as a day when at least 1mm of rain is recorded. During these days, the exposed surfaces would be expected to remain moist for at least part of the day (some of the water will evaporate will over time) and therefore have a lower potential to generate dust.

An average 141 rain days occurred each year over an 11-year monitoring period (i.e rain days occurred for approximately 40% of the time). Annually, the number of rain days per year varied between 118 and 168 days.

The highest frequency of rain days occurred between July and September (rain days occurred for approximately 49% of the time), and the lowest frequency occurred during January to March (rain days occurred for approximately 27% of the time).

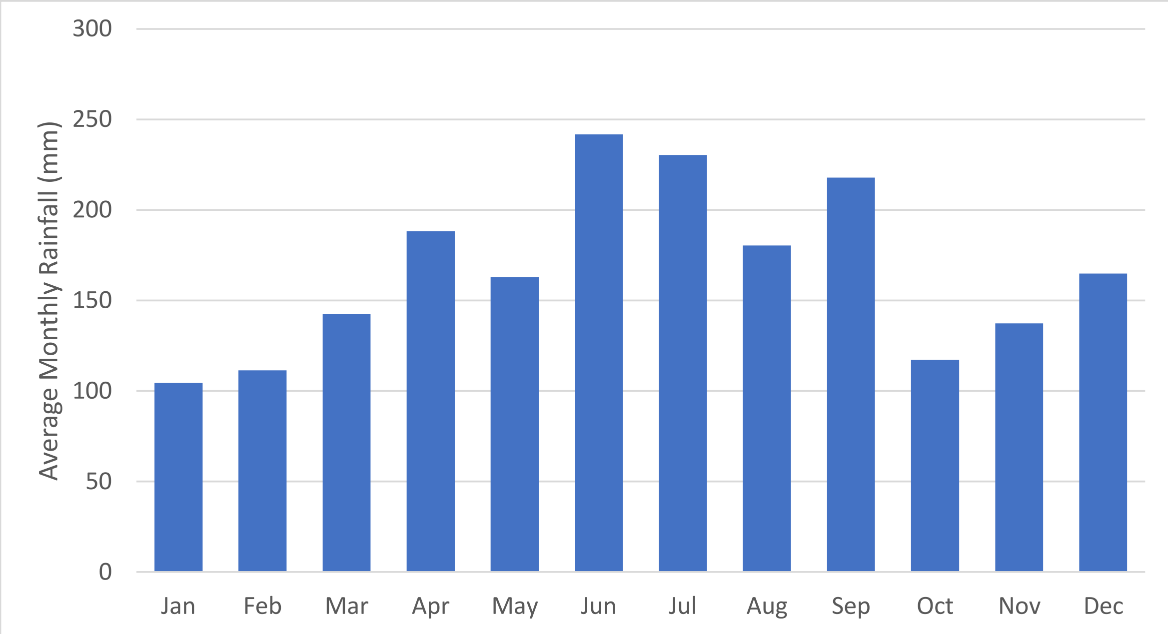

Figure 3-5 Monthly average rainfall at Waihi (January 2013 – December 2024) (mm)

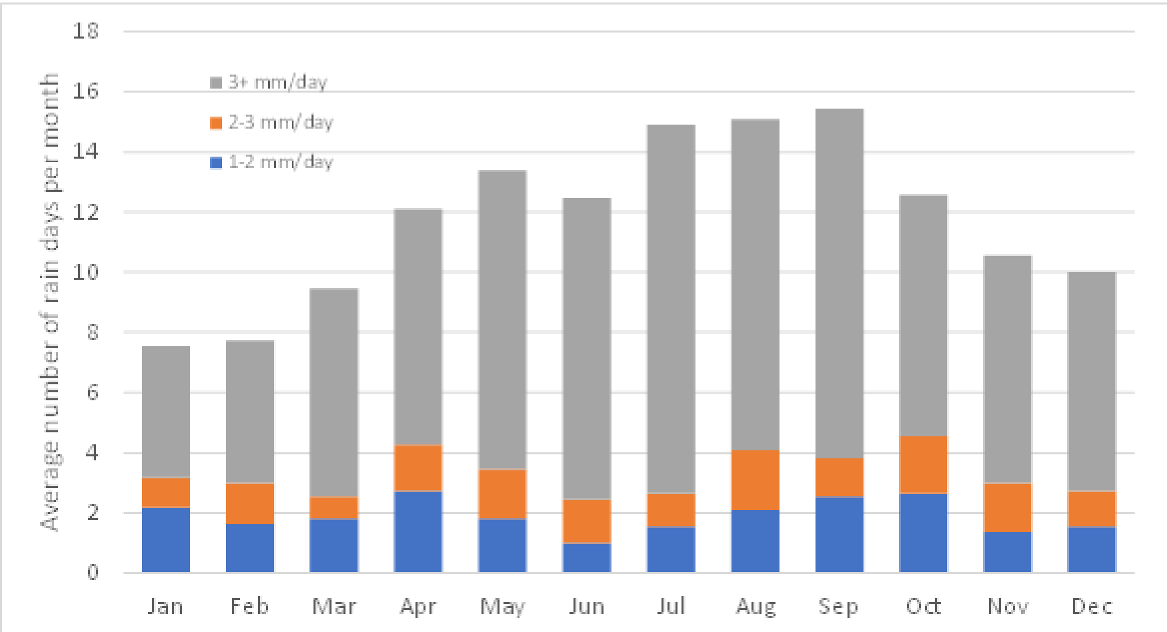

Figure 3-6. Average number of rain days (i.e. precipitation rate >=1 mm/day) per month measured at Waihi (January 2013 to December 2023)

4 Air Quality Standards and Guidelines

4.1 National Environmental Standards and Guidelines for Ambient Air Quality

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

- Air quality standards contained in the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (NESAQ)
- New Zealand Ambient Air Quality Guidelines (AAQG) published by the MfE (2002)
- Regional Plan objectives (unless more stringent than above criteria)
- World Health Organisation (WHO) guideline concentrations (where appropriate)
- California OEHHA reference exposure levels (REL) (acute and chronic) and the US EPA inhalation reference concentrations and unit risk factors (chronic)
- Texas effects screening levels (if these have been derived from toxicological data in a transparent manner).

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

The NESAQ and AAQG that are relevant to this project are summarised in Table 4-1. The OEHHA chronic REL for respirable silica is also shown in Table 4-1.

Table 4-1 Relevant air quality assessment criteria

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

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

[8] The annual guideline for silica of 3 µg/m^3 is approximately equivalent to a 24-hour average guideline of 9 µg/m^3. To convert concentrations for different averaging periods following power law equation $C_n = C_{t_2} (t_2/t_1)^{0.2}$ is used. In this instance, $9 \approx 3\,(365/1)^{0.2}$. Historically, the power law equation has been used in dispersion modelling assessments to estimate pollutant concentrations for different average periods when there was insufficient meteorological data to do so.

In February 2020, the MfE released a consultation document on some proposed amendments to the NESAQ[9] (MfE Consultation Document), including new standards for ambient air concentrations of $PM_{2.5}$ and some new controls on mercury emissions (not relevant to the Willows Road project area as there will be no gold processing on this site).

The proposed NESAQ standards for $PM_{2.5}$ are 25 µg/m^3 (24-hour average) and 10 µg/m^3 (annual average).

The WHO published updated air quality guidelines for PM_{10} and $PM_{2.5}$ in 2021[10]. The WHO defines targets not compliance limits. A recent Environment Court[11] decision notes that the WHO guidelines have no regulatory status, and there is no certainty they will be adopted by MfE. The existing and proposed NESAQ standards for PM_{10} and $PM_{2.5}$ are in line with WHO Interim Target Level 4.

4.2 Dust Guidelines

There are no New Zealand environmental standards or guidelines for deposited dust or TSP. However, the GPG Dust recommends "trigger" levels which are intended to be used for proactive management of dust on a site. These trigger levels are not intended for enforcement because exceedance of these levels does not necessarily infer an adverse effect offsite[12]. The trigger levels are intended to apply beyond the site boundary.

4.2.1 Deposited Dust

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

4.2.2 Total Suspended Particulate

The GPG Dust recommends "trigger" levels for TSP for various time-averaging periods and sensitivities of the receiving environment. The "trigger" levels included in the GPG Dust for TSP are shown in Table 4-2.

Table 4-2 GPG Dust TSP trigger levels

Trigger	Averaging Period	Sensitivity of receiving environment		
		High	Moderate	Low
Short term	5 min	250µg/m^3	n/a	n/a
Short term	1 hour	200 µg/m^3	250 µg/m^3	n/a
Daily*	24 hours (rolling average)	60 µg/m^3	80 µg/m^3	100 µg/m^3

* For managing chronic (ie, long term) dust only.

[9] Ministry for Environment (2020) *Proposed Amendments to the National Environmental Standards for Air Quality, Particulate Matter and Mercury Emissions*, February 2020

[10] World Health Organisation, 2021. *WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide*.

[11] Decision [2024] NZEnvC 247. Between Allied Asphalt Limited and Bay of Plenty Regional Council. 9 October 2024

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

The GPG Dust also provides guidance on the sensitivity of different receiving environments. For rural areas such as those surrounding the project site, the GPG Dust classifies the sensitivity to dust as “low” for rural activities but “moderate” to “high” for other activities such as industrial activities. Hence, in assessing the effects of dust it should be recognised that the residences near the Willows Road site will be more sensitive to such effects, on the basis that dust is derived from a non-rural activity source.

5 Air Discharges and Associated Mitigation Methods

5.1 Overview

The air discharges from the Willows Road site will be of a similar nature as those from the existing Martha Pit and underground mines, but on a smaller scale and across a shorter timeframe.

A draft Air Quality Management Plan (AQMP)[13] has been prepared for the project site based on the mitigation methods used by OGNZL to control any adverse effects of dust on the environment from the Waihi mining operations (refer Appendix B).

The potential discharges to air from the Willows Road site will be generated from the following sources:

- Dust from surface sources (earthworks, topsoil stripping, vehicle movements, unconsolidated surfaces, stockpiles and materials handling)
- Products of combustion from surface vehicles
- Products of combustion from underground vehicles, dust from excavations discharged via portal and ventilation raises and contaminants from underground blasting
- Rehabilitation of surface areas after development of the tunnel.

Once construction of the surface infrastructure is complete, the most significant sources of discharges to air within the site will be the placement of rock on the 20m high WRS and removal and recontouring of the progressively reclaimed stack.

5.2 Dust from Surface Sources

5.2.1 Nature of dust

The predominant contaminant discharge from the surface activities will be particulate matter (or dust) consisting of a wide range of size fractions. The larger settleable material is generally greater than 50 µm in diameter and has the potential to create a nuisance by soiling surfaces and causing irritation to eyes and the nose. However, because it is relatively large in size, this settleable material is usually deposited onto the ground within a short distance (approximately 100 - 200 m) from the source.

The finer fractions of dust (commonly referred to as total suspended particulate or TSP) are generally less than 20 µm in diameter and can be transported longer distances downwind. The portions of TSP that pose the greatest risk to health are those less than 10 µm in diameter (known as PM_{10}) and particulates less than 2.5 µm in diameter (known as $PM_{2.5}$). The major source of finer particulate in the atmosphere is from the products of combustion e,g from operation of diesel or petrol vehicles or machinery. While most of the particulate generated from the project's surface activities will be larger fractions (i.e greater than 10 µm), a portion will fall into the smaller size ranges.

The material to be excavated at the project site may contain crystalline silica. Consequently, the dust created during any mechanical processes will also contain a proportion of crystalline silica. Fine particles of crystalline silica (less than 10 µm) that can be inhaled deep into the lungs, known as respirable silica, can cause significant adverse human health effects (silicosis) if people are exposed to concentrations above recommended guideline levels over extended periods of time. Mechanical crushing is not proposed at the project site but some minor amounts of finer dust, that may contain crystalline silica, may still be generated at the rock stacks and during materials handling and from vehicle movements on unpaved WRS haul roads.

[13] Copy attached to AEE report prepared by Mitchell Daysh (2022)

5.2.2 Factors that influence dust generation

The major factors that influence dust generation from surfaces are:

- Wind speed across the surface - the critical wind speed for dust pick-up from surfaces without disturbances such as traffic is 5m/s - above 10m/s the pick-up increases significantly[14]
- The percentage of fine particles in the material on the surface
- Moisture content of the material on the surface
- The area of exposed surface
- Disturbances such as traffic, excavation, loading and unloading materials.

Vehicles travelling over exposed surfaces tend to pulverise surface particles. Particles are then lifted and dropped from rolling wheels and the road surface is exposed to strong air currents due to turbulence between the wheels and the surface. Dust is also sucked into the turbulent wake created behind moving vehicles.

The smaller the particle size on the road or an exposed surface, the more easily the particles can be picked up and entrained in the wind. Moisture binds particles together preventing them from being disturbed and mobilised by wind or vehicle movements. Hence, one of the most effective means of minimising dust emissions is by keeping materials and surfaces damp.

It is possible to estimate the potential emissions from surface sources, such as will occur at the project site, using emission factors developed primarily by the US EPA and published in a number of publications including the US EPA AP 42 Database[15]. However, for fugitive dust sources such as those associated with the project, there is a high degree of uncertainty. This assessment of environmental effects has instead been based on comparing the existing and past air quality effects of mining at the Waihi site with the proposed activities, considering any differences in the operation and location in relation to sensitive receptors (i.e dwellings). This more qualitative assessment approach provides more certainty for decision making as it compares the actual effects and successful mitigation processes at the larger Waihi operation with the relatively small scale, more remote Willows Road site activities.

The following sections describe the proposed mitigation associated with the dust from surface sources at the site.

5.2.3 Soil disturbance and earthworks

The stripping and spreading of topsoil and general earthworks (including construction of the WRS, roads, water collection ponds and noise bunds) has the potential to generate significant quantities of dust if the process is not carefully managed. To control dust from these activities, OGNZL will use the following methods which are described in the AQMP and are successfully used at other sites in Waihi:

- Keep exposed areas to a minimum and re-vegetate as soon as practicable
- Use water to dampen surfaces where practicable and necessary
- Plan potentially dusty activities such as stripping and spreading of topsoil for days when low wind conditions are predicted.

[14] Air and Waste Management Association (2000) *Air Pollution Engineering Manual* 2nd Ed edited by Wayne T Davis

[15] United States Environmental Protection Agency AP 42 Emission Factor Database Chapter 13.

The National Pollution Inventory for Mining (NPI Manual) published by the Commonwealth of Australia16 estimates that the use of water to control dust during stripping, hauling and unloading activities can reduce the emissions of dust by 50%. Vehicles and roads

Heavy vehicles on unsealed access roads and general traffic around the project site works area have the potential to be significant sources of dust if not adequately managed. Dust from roads is primarily controlled by limiting the area of fine particles exposed to wind, keeping surfaces damp and controlling vehicle speeds. The following mitigation methods will be used by OGNZL to control dust from vehicles and haul roads:

- Limit vehicle speeds on unsealed haul roads and access roads within the project site
- The main entrance road to the site is to be sealed
- Minimise haul distances as far as practicable
- Regularly grade unsealed roads and keep laid with fresh gravel/rock
- Use approved surface binding agents for dust control where practicable and cost effective
- Require traffic to use wheel wash facilities located at main exits to prevent mud and debris being tracked offsite.

Speed controls on vehicles have an approximately linear effect on dust emissions. OGNZL will impose speed limits on site that are appropriate to the nature of the traffic and the design of the road.

The number of vehicles on site will be greatest during construction of the surface infrastructure facilities, which will be established prior to commencement of tunnelling. Once tunnelling commences, trucks will haul material from the tunnel to the rock stacks. Work vehicles will include two 45 tonne trucks, a grader and a water cart.

5.2.4 Loading and unloading topsoil and rock

The loading of material onto and off trucks has the potential to generate dust. During construction, trucks will be loaded with topsoil before discharge to stockpiles. Once tunnelling is underway, trucks will unload tunnelled rock onto the WRS. The following methods will be used by OGNZL to control dust from loading and unloading trucks:

- Wet underground rock prior to loading and cartage to surface
- Require machinery operators to minimise drop heights when unloading materials on to stockpiles and rock stack
- Dampen topsoil before it is moved where practicable.

5.2.5 Exposed surfaces

Exposed surfaces such as those on rock stockpiles, topsoil stockpiles, unvegetated noise bunds, ponds under construction and yard areas are potential sources of dust unless appropriately managed. The primary means of controlling dust on exposed surfaces is by revegetation wherever practical and keeping surfaces damp. The following methods will be used by OGNZL to control dust from exposed surfaces:

- Keep operational areas around stockpiles damp using a water cart as far as practicable
- Plant and maintain sustainable vegetation cover on topsoil stockpiles and the noise bund (grassed or hydroseeded) to prevent erosion and dust generation
- Seal the yard areas surrounding the most trafficked areas
- Use screens and fences if practicable in dust prone areas.

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[16] Commonwealth of Australia (2001) *National Pollutant Inventory Emission Estimation Technique Manual for Mining* Version 2.3.

The NPI Manual also estimates that re-vegetation of stockpiles reduces their dust generation capacity by 99%.

5.2.6 Supply of water for dust suppression

As some of the proposed dust mitigation measures depend on the use of water as a dust suppressant, a reliable and sufficient water supply must be available on site. As a general "rule of thumb", the GPG Dust recommends that an application rate of up to 1 litre/m^2/hr may be needed for areas requiring dust control. It is noted that this rate is very conservative as it is typically much higher than the rate of evaporation.

The above application rate does not need to be applied over every square metre of ground for every hour of every day - but sufficient water is required to be available to effectively suppress dust when required.

As noted in Section 2.4, water will be supplied to water storage tanks on site for dust suppression and other uses. The proposed water storage will be sufficient for dust suppression as proposed.

5.3 Products of Combustion from Surface Vehicles

The operation of diesel or petrol vehicles at the site will generate products of combustion which include particulate matter ($PM_{10,}$ $PM_{2.5,}$), nitrogen oxides (NOx) and carbon monoxide (CO).

The frequency and number of vehicle movements at the site will diminish once the surface infrastructure is completed. The site is relatively remote, compared with the Waihi Mine site and it is expected that the effects of emissions from diesel and petrol-powered vehicles will be minimal beyond site boundaries. OGNZL will use electric powered equipment where practicable, which do not produce contaminants from the combustion of fuel.

5.4 Air Discharges from Tunnelling and Mining

5.4.1 Overview

The nature of air discharges from tunnelling and mining will be the same as those from other mining activities carried out by OGNZL at the Waihi site. The discharges associated with these activities will be:

- Dust from construction of portals and the ventilation system
- Products of combustion from vehicles and dust from tunnelling and mining that are discharged to air via the ventilation system
- Contaminants from blasting that are discharged to air via the ventilation system.

5.4.2 Dust from construction of portal and ventilation system

The construction of the portals and ventilation system has the potential to generate dust from earthworks, loading and unloading of materials and vehicle movements. To control dust, OGNZL will use standard methods used at the Waihi site, including the watering of exposed surfaces and limiting vehicle speeds.

5.4.3 Dust and vehicle emissions from ventilation system

Tunnelling and mining will generate dust from excavation, materials handling and vehicle movements, as well as combustion products from vehicles. All underground emissions will be discharged to air via either the portal or the ventilation raises. Therefore, unlike surface activities, discharges generated underground will be exhausted as point sources, rather than as diffuse sources over a larger area. In cool calm conditions emissions from the ventilation raises may be visible as a plume of water vapour.

The use of diesel produces the products of combustion including particulates, sulphur dioxide (SO_2), NO_X and CO. OGNZL proposes to use electric powered equipment, where practicable, which do not produce emissions of combustion related contaminants. Low sulphur diesel is also used.

The amount of ventilation provided within the exploration drive will be sufficient to provide a safe working environment for underground workers. This means that the concentration of contaminants will be required to meet the Workplace Exposure Standards (2020) set by Worksafe New Zealand. This means that any effects from exposure, after discharge from the ventilation raises, will be negligible.

OGNZL will carry out regular monitoring of the underground air quality to ensure that the Worksafe air quality standards are being met.

Conditions within underground exploration drives are usually damp. However, if necessary, any dust generated from tunnelling activities will be controlled using water carts and sprayers and muck piles will be watered, prior to placing material onto trucks for transport to the surface.

5.4.4 Emissions from blasting

Blasting using ammonium nitrate/fuel oil explosives (ANFO) will be used to construct the tunnel (including the portal if required) and during mining. Blasting generates emissions of CO, NO_x and small quantities of SO_2, as well as dust particulates from the shattering of rock. Low sulphur diesel is used in the ANFO.

During blasting operations, the area of the tunnel in proximity to the blast is evacuated and machinery emissions cease, therefore the emissions generated from diesel engines, vehicle movements and excavation will not occur at the same time as blasting emissions.

Blasting exhaust and any emissions from vehicles during tunnelling will initially exit through the portal. However, once the tunnel has been advanced and the ventilation crosscut and raises have been developed, primary fans will be installed at a bulkhead at the base of the raises and exhaust air will exit through the ventilation raises. The fans previously located outside the portal will then be moved down the tunnel and hung in the decline backs approximately 50 m from the ventilation raises. This will provide the ventilation for the remainder of the tunnel.

Following blasts, the air quality within the tunnel will be tested and cleared before personnel are allowed to enter.

Contaminant emissions (particulates, CO, NO_x) from the Favona ventilation shaft (which is similar to the WUG mine ventilation shafts) were measured in August 2007 by Watercare Services Ltd during a series of 5 blasts. The results are summarised in Section 6.3. The concentrations of contaminants are expected to decrease rapidly with distance from the source (either the portal or raise) and to be well below NESAQ and AAQG guideline levels, where members of the public may be exposed beyond the site boundary.

5.5 Air Discharges from Wastewater Treatment and Effluent Disposal Area

An MBR (membrane bioreactor) wastewater treatment system will be installed to cater for toilets and staff washing and lunchroom facilities. An MBR plant produces a high-quality effluent with low organic load, suitable for discharge to land.

The treated effluent will be discharged to a subsurface disposal field to the northwest of the Topsoil Stockpile Area. The discharge of treated effluent is not expected to cause any adverse odour nuisance issues due to the high-quality wastewater and subsurface-based discharge. The disposal field will be located at least 200m from the nearest privately owned dwelling which is an appropriate separation distance.

6 Existing Effects of Waihi Operations on the Environment

6.1 Potential for Dust to Cause Adverse Effects

6.1.1 FIDOL factors

Dust deposition is the settling of dust onto surfaces. The effects of dust can be subjective and are dependent on the sensitivity of the receiving environment. Some people will find dust a nuisance, others will be less concerned. For example, dust fallout on a gravel road or rural farmland may not be a nuisance to some neighbours even at relatively high deposition rates. However, others may find the dust objectionable or offensive.

Typically, the most common areas of concern from dust deposition arise at residential properties, or similar sensitive locations such as schools or retail premises. Concerns typically relate to the visual soiling of clean surfaces such as cars, window ledges, washing on lines and deposits on vegetation.

The GPG Dust[17] notes that potential for a dust discharge to cause an objectionable or offensive effect depends on the characteristics of the dust fallout. These characteristics are known collectively as the FIDOL factors and are also used to consider whether an air discharge has caused an offensive or objectionable effect.

The FIDOL factors are:

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

6.1.2 Dust deposition measurement and TSP monitoring

Dust deposition is typically measured over a period of about 30 days using a dust gauge. However, this does not mean that dust deposition occurs gradually and evenly over that 30-day period. Dust concentrations in the ambient air, downwind of a dust discharge vary with the rate of dust emission and the wind conditions. Therefore, the rate of dust deposition varies as well. It is possible that most of the dust deposition measured in a 30-day period by a dust gauge occurs during a small number of short, relatively high-rate deposition events, or it may occur at a relatively constant rate throughout the month. Short term events of relatively high-rate dust fallout are more likely to be noticed by residents as deposits on surfaces, cars and washing.

Total suspended particulate (TSP) monitoring measures particles that are suspended in the air. Most monitoring equipment collects particles that vary in size between 0.1µm and about 100µm. The finer fractions can travel large distances downwind before they reach ground level. The larger fractions of TSP can have nuisance effects, but the perception of the potential for TSP to cause health effects is usually the cause of most concern for nearby residents.

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

6.2 OGNZL Air Quality Monitoring Programme

6.2.1 Current air quality monitoring sites

OGNZL does not currently monitor air quality in the vicinity of the Willows Road site which lies approximately 2km to the northeast of Waihi town boundary in a rural farmland setting.

However, OGNZL and predecessors have been monitoring deposited dust in the vicinity of the Waihi Gold Mine since 1982 and TSP since 2005. Over the years, new monitoring sites have been added and others removed to accommodate changes in the mining operation and the locations of sensitive receptors. Monitoring of PM_{10} and respirable silica has also been carried out biennially along with other specific monitoring of some contaminants. During 2024, OGNZL operated a total of 11 permanent monitoring sites of which 8 are used to measure deposited dust and 6 are used to measure TSP. The TSP monitoring sites are located in Waihi township and/or close to Martha Pit. Meteorological parameters are measured at one location (Met Station 6.63). The locations of the current monitoring sites (with windrose overlaid) are shown in Figure 6-1. A description of each site is provided in Table 6-1 of the *Waihi North Project Air Discharge Assessment-Waihi Facilities Report (Beca, 2024).*

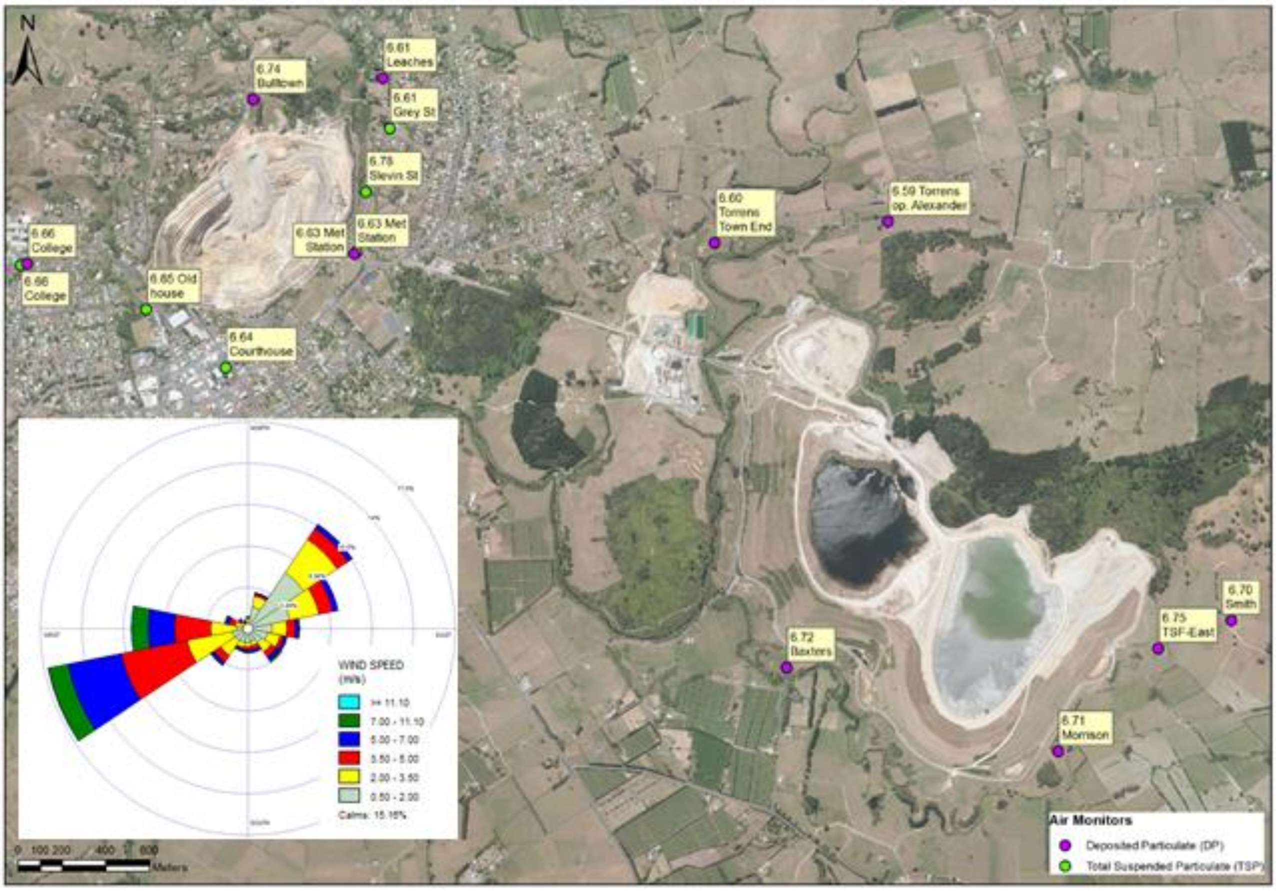

Figure 6-1 Locations of current air quality and meteorological monitoring sites around Waihi Mine (Source: OGNZL)

6.3 Results of Monitoring around Waihi Mine

The results of long-term air discharge monitoring around the Waihi Mine site provide a good indication of the effects of emissions of the key contaminants (deposited dust, TSP, $PM_{2.5}$ and PM_{10} and silica) from a significantly larger scale of activity, within a more sensitive environment than will occur at the Willows Road site during construction. These results therefore represent a likely worst-case scenario of the effects of the WUG project activities on local air quality.

The results of long-term monitoring at the Waihi mine are summarised in Section 6-2 of the *Waihi North Project Air Discharge Assessment-Waihi Facilities Report (Beca, 2024).*

From this summary, it is concluded that:

- Dust deposition rates at all sites surrounding the mine are relatively low and generally comparable to local background levels (MfE and consent trigger levels only exceeded infrequently during previous 20 years of monitoring[18]). Deposition rates are relatively low when compared to the MfE guideline of 4 g/m^2/30-days.
- Prior to the sealing of Martha Eastern Perimeter Road, TSP concentrations have only been elevated close to the mine pit. Beyond 150 – 250m concentrations are similar to those recorded in other parts of Waihi).
- OGNZL has not carried out any monitoring of ambient $PM_{2.5}$ concentrations in the Waihi area. However, dust from mining sources consists predominantly of larger particles that are greater than PM_{10} in size. The major sources of anthropogenic $PM_{2.5}$ in Waihi are expected to be domestic heating sources and vehicle emissions and will include a minor contribution from OGNZL.
- PM_{10} and silica concentrations (24-hour average), based on OGNZL monitoring until the end of 2014 and continuous monitoring by Waikato Regional Council (WRC) between 2008 and 2011, were well within health-based guidelines[19]. Monitoring was discontinued by agreement with the WRC as it was agreed that ambient air quality within the Waihi Airshed did not pose any significant potential health risks for these contaminants.
- Blast contaminant emissions from the Favona Mine Vent shaft were measured in August 2007 by Watercare Services Ltd[20] and can be compared approximately to the 1-hour average ambient NESAQ and AAQG values for CO and NO_2. While short term peak concentrations of both CO and NO_2 were elevated above averages, the average concentrations were all less than the AAQG and NEASQ values.

6.4 Complaints

6.4.1 Dust

OGNZL records all complaints it receives regarding mining operations at its Waihi operations. Figure 6.2 shows the number of complaints received by OGNZL each year since 2002 which related to dust and other discharges to air. All complaints that are received are included in the data record even if the cause of the complaint could not be determined, or attributed to the mine. However, two complaints attributed to pollen have been excluded.

The historical complaints data demonstrates that in most years, the number of dust related complaints received is less than 10 which is a moderate to low level for a mining activity the size of the Waihi Mine and which is located within a sensitive receiving environment. During 2004 and 2011, the number of complaints was on average higher, with 18 complaints being received in 2004 and 28 in 2011. The complaints were attributed to a very dry windy November, combined with a water cart breakdown for 36 hours and no sprinklers being used on a temporary portable crusher. To prevent a recurrence of the problems, a back-up water cart was contracted and a requirement for using sprinkler systems on any new crushing equipment was implemented by OGNZL.

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[18] Note: not all these exceedances were due to mining. Deposition from bird dropping, and the application of fertiliser are attributed causes of some exceedances

[19] From *Waihi Gold Annual Monitoring Report* 2014

[20] Watercare Services Ltd (2007) *"Newmont Waihi Gold; Particulate, Carbon Monoxide and Oxides of Nitrogen Emission Testing"* August 2007

The source of non-dust related complaints has varied and included herbicide spray, fires, and steam emission from the mine shafts. Only one complaint has been received by OGNZL with regards to odour during the period[21].

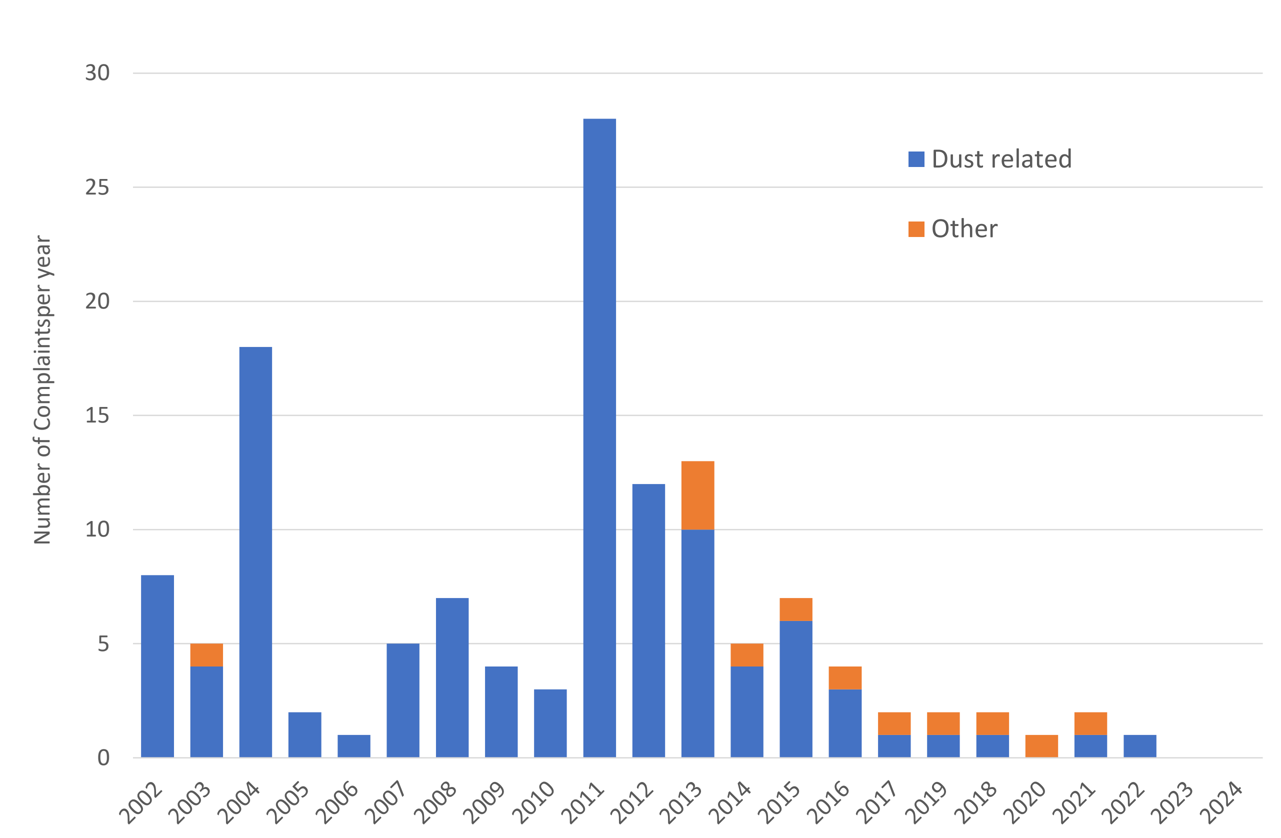

Figure 6-2 Air Quality Complaints Received by OGNZL (2002-2024)

6.4.2 Emissions from blasting

At times, complaints have also been received regarding odours and smoke from blast emissions. In response to a series of 3 complaints, relating to odours from blasting in the Martha Pit in February 2004, , a notification system was established for the Waihi Mine. The system notifies residents known to be sensitive to blast odours when blasts are due to occur and when winds are from the northeast to southeast, are less than 5m/s and when the blast is to be located on the west wall of the open Martha Pit (i.e not underground as proposed for WUG). No substantiated complaints regarding blasting odours have been received by OGNZL since 2005 and none associated with any of the Waihi operations.

6.5 Summary of Current and Past Effects of Mining in Waihi

The results of ambient air quality monitoring and the complaints history for the Waihi Mine demonstrate that any increase above background contaminants (deposited dust, TSP, $PM_{2.5}$ and PM_{10} and silica) concentrations, measured at sites in the vicinity of the mining operation, are below the relevant standards and guidelines recommended by MfE and within the current resource consent limits.

[21] Note: OGNZL adopts a conservative approach and records all complaints received regardless of whether they are attributable to the operations

However, it should be noted, that the current deposited and suspended dust monitoring programme does not provide any information on short term dust concentrations and that, at times, locations downwind of the Waihi Mine may experience higher than normal dust concentrations for short periods of time, which may be noticeable to the public. Nevertheless, the results of the long-term monitoring programme and the findings of WRC's 4-year monitoring program indicate that any such events do not occur sufficiently frequently, or are of sufficient magnitude, to increase the long-term average concentrations above the relevant guidelines and standards.

The risk of discharges to air from blasting resulting in ambient concentrations of contaminants that exceed the NESAQ and AAQG at locations, where members of the public may be exposed, have also been demonstrated by monitoring to be minimal. No complaints have been received regarding blasting emissions since the notification system was instituted in 2005 and blasting procedures were changed. These complaints related to an open pit and not to underground operations as proposed at WUG.

Overall, it is considered that based on long term monitoring results and the record of complaints, past and current discharges to air from the nearby Waihi mining operation are not having significant effects on ambient air quality and that current mitigation methods are appropriate. The Waihi mine activity is a significantly larger operation than will occur at the Willows Road site, within a more sensitive environment and therefore provides a good basis for consideration of likely worst-case effects of Willows Road site surface activities.

Regardless, the expected effects of the proposal, based on local site conditions, have also been assessed (see Section 7).

7 Potential Effects of Project on Environment

7.1 Potential Adverse Effects of Discharges to Air

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

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

7.2 Approach to Assessment of Effects

7.2.1 Overview

For consent applications with a number of potential intermittent diffuse sources of dust (e.g WRS and topsoil storage), as well as dust from point sources (e.g vents and portals) over a hilly site, it is difficult and impractical to estimate likely overall site emission rates using dispersion modelling techniques. Where these constraints are present, qualitative methods should be used.

The historical and existing effects of the Waihi Mine activities (surface and underground) have also been used to assess the potential impacts of the Willows Road project on nearby sensitive receptors (dwellings). This includes analysing the results of the past 24 years of monitoring data, as well as assessing complaints received over this period. The significantly larger Waihi site lies within a more sensitive receiving environment than the Willows Road site and includes an open pit operation (not proposed at Willows Road). The Waihi site therefore provides an effective "worst case" scenario against which the likely air discharge effects of tunnel construction and underground mining can be assessed. The likelihood of each of the potential sources of dust at the site resulting in adverse effects on the nearest sensitive receptors has been assessed, considering the location of the receptor relative to the source, the likely frequency of potential impacts and the likely severity (intensity and duration) of the potential impact. Where an elevated risk of adverse effects occurring has been identified, additional dust control and monitoring methods are recommended to mitigate the risk.

The risk factors assigned to each sensitive receptor group are in accordance with the factors shown in Table 7-1[22].

[22] The risk factors shown in Table 7-1 are based on the risk assessment procedure recommended in *Guidance on the Assessment of Mineral Dust Impacts for Planning"* published by the Institute of Air Quality Management in May 2016.

Table 7-1 Risk factors assigned to sensitive receptor groups

Risk Factors	Less than 50m from works	Between 50m and 100m from works	Between 100m and 200m from works	Further than 200m from works
Downwind of works in prevailing wind conditions	Very high	High	Moderate	Moderate
Downwind of works in secondary wind conditions	High	Moderate	Moderate	Low
Infrequently downwind	Moderate	Low	Low	Low

7.3 Sensitivity of Receiving Environment

As part of the FIDOL "location" factor (refer Section 6.1) the sensitivity of the receiving environment needs to be taken into consideration. Different locations have different sensitivities to dust and can be broadly classified as having "high", "moderate" or "low" sensitivity. The degree of sensitivity in any location is based on characteristics of the land use, including the time of day and the reason people are at the location (e.g. for work, home living, or recreation).

In a residential area, an acceptable frequency of a dust (or odour) event is likely to be much lower than would be acceptable in an industrial or rural area. Similarly, the acceptance of deposited dust and odour in a residential area will be lower than what is acceptable in industrial areas.

The GPG Dust provides guidance with regards to classifying the sensitivity of different land uses to dust nuisance effects. Residential areas are classified as having a high sensitivity to dust and odour nuisance effects for the following reasons;

- People can be present at all times of day and night, both indoors and outdoors
- People of high sensitivity (including children and the elderly) can be exposed
- People usually expect a high level of amenity in their home and tend to carry out activities at residences which are highly sensitive dust and odour such as dining, outdoor living, and drying clothes.

The land which surrounds the Willows Road site is rural in character. Rural areas generally have lower sensitivity to dust nuisance compared to residential areas due to the lower population density of these areas. Agricultural fields and forestry areas can be expected to have a low occupancy, particularly at night.

However, a higher level of air quality amenity would be expected at the nearby rural dwellings. The GPG Dust classifies rural dwellings as having a moderate to high sensitivity to dust nuisance effects.

The nearest privately owned dwellings to the site are located at 111 and 122 Willows Road (between approximately 100m and 150m from the topsoil storage areas at their closest points).

7.4 Potential Range of Effects of Dust

7.4.1 Overview

Mining activities will generate a wide range of dust particle sizes, but the particulate generated from the processes required to develop and operate the tunnels and associated infrastructure are likely to consist of mainly the larger size fractions (i.e greater than 10 µm or 0.01 mm), with a smaller proportion of the finer particulates (PM_{10} and $PM_{2.5}$) from vehicle emissions. Particles greater than 50 µm (or 0.05 mm), which are expected to make up most of the particulate generated by the project, have the potential to create nuisance effects due to soiling of surfaces and irritation of eyes and nose.

The distance a particle that is entrained in the wind will travel is dependent on the height of discharge above the ground, the particle size and the wind speed. For example, in a 5 m/s wind a 100 µm (0.1 mm) particle disturbed from ground level will settle back onto the ground within approximately 10 m from the source. However, a 10 µm particle may travel up to 1 km under the same conditions[23]. Because deposited particulate is relatively large, it usually falls out of the air within 100 - 200 m of the source[24]. Dust nuisance is therefore most likely to occur where sensitive receptors are located within such proximity (i.e up to 200 m) of a significant dust source if appropriate mitigation is not carried out.

The finer particles (known as suspended particulate or TSP) are generally less than 20 µm (0.02mm) in diameter and can travel large distances downwind. The portions of TSP that pose the greatest health risks are PM_{10} and $PM_{2.5}$ as they can penetrate the respiratory tract. $PM_{2.5}$ can move deeper into the lungs and is responsible for an increase in human morbidity and mortality in some circumstances.

Local environmental conditions may influence the potential range of dust effects. High average wind speeds, a high frequency of strong winds, or complex topography may increase the potential range over which dust can travel. Discharges from elevated sources can travel proportionally further before reaching ground level. Discharges from below ground level (e.g within pits or low points) are likely to reach ground level closer to the source. The WRS and the outlets to the ventilation raises will be located on elevated terrain. Taking this into account, it is considered that areas within approximately 200 m of these elevated dust sources may be adversely affected under worst case weather conditions, if appropriate mitigation measures are not implemented.

7.4.2 Wind speed and direction

Based on wind data at the nearby Barry Road climate station, the wind speed and frequency of stronger winds (ie >5m/s) that blow generally in the direction of the closest dwellings is relatively high (ie from the west south westthrough to the west, winds exceed 5m/s approximately 20% of the time). However, very high winds (>10m/s) from these directions occur relatively infrequently ie approximately 0.4% of the time respectively. Strong winds from other directions are expected to be low.

The stronger wind conditions from the southwest to west, as well as the hilly terrain may increase the range of downwind dust effects beyond the site boundary, especially during the construction of surface infrastructure.

7.4.3 Results of OGNZL and WRC monitoring at Waihi

The results of OGNZL and WRC ambient air monitoring programmes (as summarised in the *Waihi North Project Air Discharge Assessment-Waihi Facilities Report (Beca, 2022)* show that the impact of emissions from the Martha Mine have only a relatively small impact on TSP concentrations at downwind distances of 150 – 210 m from mine operations. The effect of site activities was only statistical evident on TSP concentrations prior to 2010, and the sealing of the Martha Eastern Perimeter Road. These results provide an indication, for assessment purposes, of the likely impacts of dust from the Willows Road site operation.

TSP concentrations measured at monitoring Site 6.78 (Slevin St) and Site 6.61 (Grey Street) are similar or only slightly higher than background TSP concentrations. Site 6.78 (Slevin St) and Site 6.61 (Grey Street)

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

[24] Institute of Air Quality Management (2016) *Guidance on the Assessment of Mineral Dust Impacts for Planning*

are both located in the prevailing wind direction and would therefore be frequently downwind of the mine and potentially exposed to site emissions. Only one exceedance of the consented TSP trigger limit was recorded at Site 6.78 (Slevin St) over the 19-year monitoring period (in July 2010). The monitoring results suggest that emissions from current Waihi mine operations have only a small impact on the air quality at these locations.

Higher average TSP concentrations and dust deposition rates are measured at Site 6.63 (Met Station) which is located approximately 140 m from the mine operations. However, only 6 exceedances of the TSP consent trigger limit have occurred since 2005, and one exceedance of the dust deposition rate consent limit since 2000. No exceedances have been recorded since the site office carpark (50m upwind of monitor) was sealed in 2010. The distribution of TSP concentrations recorded at the Site 6.63 (Met Station) since 2010 are statistically similar to those recorded at the background monitoring station (Site 6.66 (College))

Although it not possible to assess the occurrence of any short-term dust nuisance effects from this data, the monitoring results suggest there is a relatively low risk that sensitive receptors, located more than 150 – 210m from the mine, would experience dust nuisance effects when appropriate mitigation procedures are implemented.

The Institute of Air Quality Management (IAQM) provides guidance for the assessment of impact of dust emitted from mineral extraction and processing operations and considers receptors located more than 400 m from open dust generation activities processing hard rock, or more than 250 m from dust generation activities processing soft rock (e.g. sand, gravel, and soil), are unlikely to experience adverse nuisance or health effects.

7.5 Consideration of FIDOL Factors

The dust generated from the Willows Road site during construction and operation is likely to be of reasonably low intensity under lighter wind conditions (i.e. <5m/s) and unlikely to be discernible beyond the site boundary.

However, under the reasonably frequent higher wind conditions (>5m/s) from the southwest to west also experienced at the site (~20% of the time), there is the potential during construction for higher intensity dust generation to occur from exposed excavations and topsoil storages.

The separation distances are relatively small to the nearest privately owned dwellings at 111A and 111B Willows Road (approximately 145m to the east of the topsoil storage, which may not be sufficient (in the absence of appropriate management) to effectively mitigate infrequent, short duration dust nuisance under strong wind conditions. Dust emissions will not be continuous and will vary with wind speed and areas of exposed land or unconsolidated topsoil material. While the rural area, in which the neighbouring dwellings are located, may occasionally also receive dust from other sources, nuisance dust from the Willows Road site could be considered offensive if it occurs more frequently, or in greater quantities than is typically experienced.

Based on an assessment of the proposal against the FIDOL factors, the risks from infrequent, short duration adverse effects (nuisance dust), arising from the proposed construction activity (in the absence of appropriate mitigation and management) is considered to be moderate to high at the privately owned dwellings located at 111 Willows Road and moderate at the privately owned dwelling at 122 Willows Road. The topsoil stockpile area would potentially large source of dust (i.e. up to 3ha during) during strong dry wind condition while being formed. However, once vegetated it should cease to be a significant source of dust.

The distances from the nearest noise bund and the topsoil storage area to the dwelling at 122 Willows Road are 109m and 234m respectively. The noise bund is a relatively minor source of dust, and only during construction and such time that a vegetation cover is established.

The risk from dust during construction is considered low at all other dwellings at a greater distance from the site.

The ongoing operation of the WRS is not expected to create a significant risk of dust at the closest privately owned dwellings if appropriate mitigation is carried out.

Based on the assessment, when appropriate mitigation and management methods as currently used at the Waihi mine are implemented as described in Section 5, the adverse nuisance effects of dust generated by the proposed activities are expected to be low.

7.6 Potential Nuisance Effects of Deposited and Suspended Dust

7.6.1 Overview

Figure 7-1 shows the location of the proposed Willows Road site works and the distance to the nearest sensitive human receptors (i.e dwellings) overlaid with the windrose for Waihi. From Figure 7-1, it can be seen that the strongest, most frequent winds blow across the site from the west/southwest. This would blow any dust generated on site onto mainly rural land to the northeast. However, due to the complex nature of the local topography, these winds could also impact areas to the east - which includes the dwellings at 111 and 122 Willows Road.

Less frequent, lighter winds also blow across the site from the northeast/east. The lower strength of these winds means that dust is less likely to be entrained and then transported to downwind dwellings further to the southwest on Highland Road (at least 350m from site works).

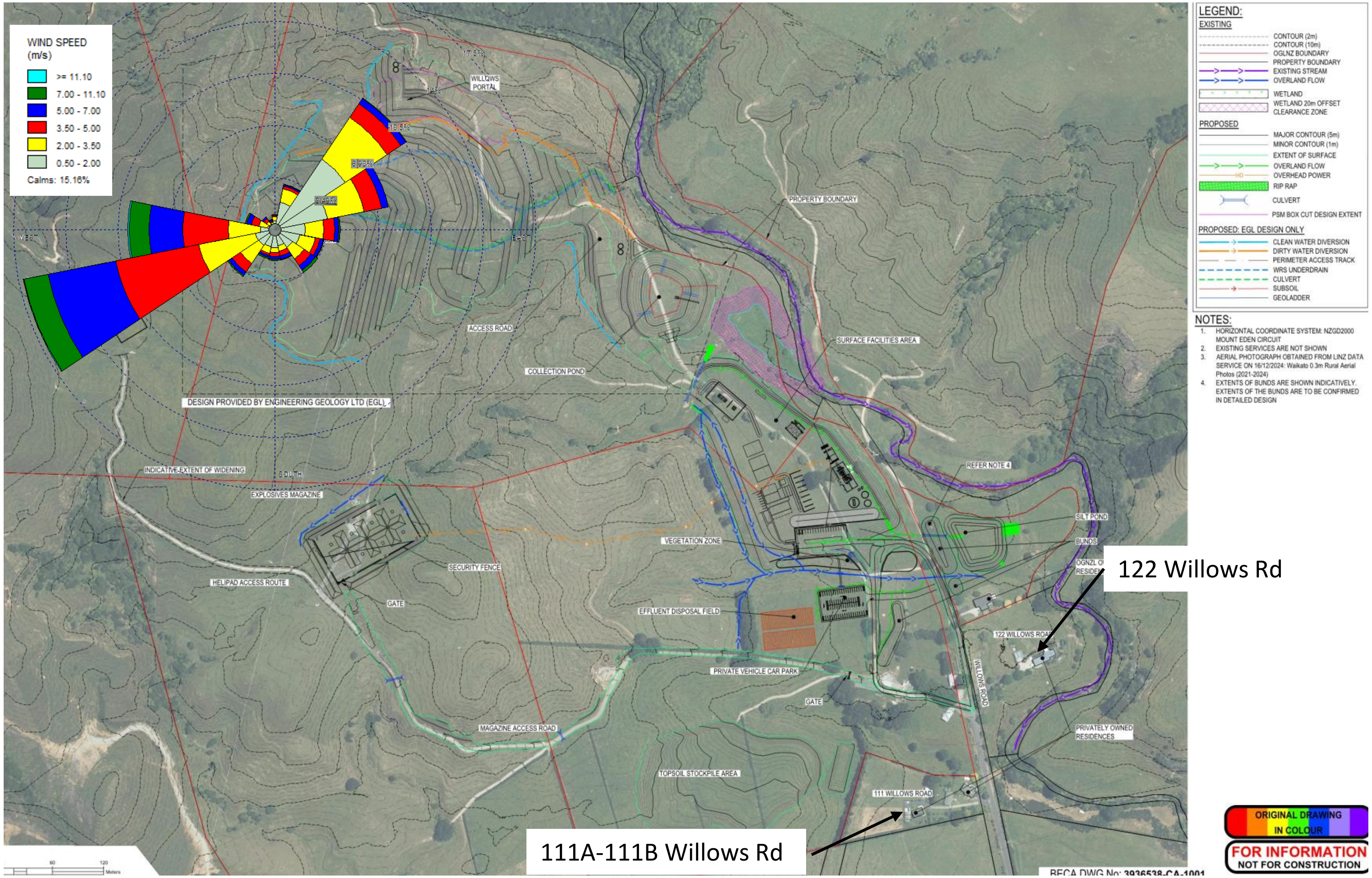

Figure 7-1 Plan showing Willows Road site layout, location of OGNZL and distances from surface infrastructure to nearest privately owned dwellings on Willows Road (with the Waihi windrose shown)

7.6.2 Effects of dust from project surface features on nearby dwellings

There are several privately owned dwellings in relative proximity to the boundary of the Willows Road site. These dwellings are considered to have a moderate to high sensitivity to dust nuisance effects when the dust from a new source (such as activities at the Willows Road site) is experienced more frequently, or in greater quantities than is typically experienced at present. The key project surface features that, without appropriate management, may cause nuisance dust to the nearest neighbours during development are the WRS, collection ponds, access roads, noise bunds and topsoil storage. Construction of these features will involve land disturbance (topsoil removal), earthworks, or storage of material during construction, which could produce relatively high volumes of dust under dry, windy weather conditions.

The nearest dwelling (132 Willows Road) is owned by OGNZL and is located immediately to the east of the proposed carpark. The privately owned dwellings at 111A and 111B Willows Road are located approximately 145m to the east southeast of the closest point to the topsoil storage area. The dwelling at 122 Willows Road lies further away to the east, at 245m from the topsoil stockpile and 109m from the nearest noise bund.

The rock stack and mine access road will be located approximately 600 m to the northwest of the nearest privately owned dwellings at their closest points. The rock stack runoff collection pond will lie approximately 400m northwest of these dwellings on Willows Road at its closest point.

Based on available data from the nearby Barry Road climate station, winds in excess of 5m/s (where dust pick-up may occur) occur from the southwest to west for approximately 10% of the time,. While these winds will tend to blow any dust onto rural land further to the east and northeast, the closest dwellings on Willows Road may also be impacted on occasion, depending on local topography.

During the formation of the topsoil store, the closest privately owned dwelling at 111 Willows Road may be at a moderate to high risk of being affected by nuisance dust from the topsoil stockpile, unless particular care is taken with dust control. The risk of dust nuisance at 122 Willows Road from the topsoil stockpiles is assessed as moderate, as the site lies approximately 245m from the stockpiles at their closest point. Once the construction works are finished and the surfaces of the topsoil stores and noise bund are consolidated and grassed, the risk of dust impacts on the nearest dwellings will reduce to low.

Providing the dust mitigation methods as described in Section 5 are carried out diligently, the risk of nuisance dust from the construction and operation of the WRS, tunnel portal and access roads affecting the nearest residences is expected to be low.

The closest dwellings on Highland Road, to the southwest of the Willows Road site , are all located at least 700 m from any likely major sources of dust during construction and are beyond the distance that dust is expected to travel under the expected prevailing light wind conditions in that direction. The magazine and heliport access road is the closest site surface feature and lies approximately 350 m to the northeast of Highland Road at its closest point. The road is not expected to be a source of nuisance dust at these dwellings due to the generally light winds that blow across the site from the northeast and the separation distance.

To monitor the effects of nuisance dust on the closest dwellings, it is recommended that the monitoring described in Section 8 is carried out.

7.6.3 Effects from portal and ventilation raises

The Willows Portal will be located at least 650m to the northwest of the nearest privately owned dwellings (at 111 and 122 Willows Road), which is well beyond the distance that dust from the site would be expected to travel. The ventilation raises will be sited significantly further away and will present negligible dust effect on dwellings. Winds from the northwest are generally light and will rarely exceed 5m/s.

While some earthworks will occur at these sites, the volumes are relatively small and the duration relatively short. During operation, small amounts of dust may be emitted from these locations. It is recommended that OGNZL use the control methods described in Section 5 to minimise the generation of dust both during construction and operation.

The low volumes of dust and the significant separation distance to the nearest privately owned dwellings means that the risk of dust creating adverse effects from these point sources is negligible.

7.7 Potential Health Effects

7.7.1 Overview

The construction and operations at the Willows Road site will involve the use of petrol- and diesel-powered motor vehicles and machinery which generate the products of combustion, including PM_{10}, $PM_{2.5}$, NOx and CO. Blasting emissions from the development of the tunnel portal, and operation of the mine, will also generate contaminants such as particulates. Respirable silica can be present in dust generated by mineral extraction activities which can cause adverse health effects. Fine particles of crystalline silica contained in dust (<10 µm) can be inhaled into the lungs and cause significant health effects (silicosis), if people are exposed above recommended guideline levels over extended periods of time.

Most of the particulate matter generated from the proposed operation will be of a larger-size fractions rather than PM_{10} or $PM_{2.5}$. Emissions from dust generation are therefore expected to make only a relatively small contribution to ambient PM_{10} or $PM_{2.5}$ concentrations outside the site boundary.

The recent report prepared by NIWA on $PM_{2.5}$ concentrations in New Zealand[25] also confirms that $PM_{2.5}$ concentrations in Waihi are likely to be below the proposed annual standard of 10 µg/m^3. Maximum 24-hour average $PM_{2.5}$ concentrations are also not predicted to exceed proposed NESAQ standard of 25 µg/m^3.

Background emission sources, including motor vehicles and home heating, are expected to the main contributor to the PM_{10} and $PM_{2.5}$ concentrations which occurred at the monitoring sites[26].

The proposed activities are in a rural environment where background PM_{10} and $PM_{2.5}$ concentrations would be lower than those which occurred at the semi-rural/suburban PM_{10} monitoring sites. Consequently, the PM_{10} concentrations observed during the monitoring programme, and the $PM_{2.5}$ concentrations derived from the PM_{10} monitoring results, are expected to be higher than these contaminant concentrations which will occur in the vicinity of the WNP.

7.7.2 Results of ambient air quality monitoring

The ambient air monitoring carried out by OGNZL and WRC of PM_{10} and respirable silica concentrations and combustion emissions from vehicles at various locations within Waihi and in the vicinity of the Waihi mine has shown that these contaminants are well below relevant guideline and standard concentration limits.

[25] NIWA (2019) *$PM_{2.5}$ in New Zealand- Modelling the current (2018) levels of fine particulate air pollution*; report prepared for the Ministry for Environment (December 2019)

[26] This assumption is supported by the TSP monitoring results. At distances of approximately 150m from Martha Mine, the recorded concentrations are only marginally higher than background TSP concentration. The relative contribution from mine emission sources to PM_{10} and $PM_{2.5}$ would be expected to be lower due to the larger particle size distribution of the emitted dust.

7.7.3 Respirable crystalline silica

There may be some potential for variation in crystalline silica content in rock mined from the WUG Mine and therefore, its potential to increase the respirable crystalline silica (RCS) content of airborne particulate matter in the Willows Road area. Mechanical crushing is not proposed at the Willows Road site but some minor amounts of finer dust, that may contain RCS, could still be generated at the rock stacks and during materials handling and from vehicle movements on unpaved WRS roads. Topsoil material, which will be stored closer to existing dwellings on Willows Road, will not be a significant source of RCS.

RCS has not been measured in ore to be mined at the WUG site. However, silica concentrations (24-hour average) around the Waihi site, based on OGNZL monitoring until the end of 2014 and continuous monitoring by Waikato Regional Council (WRC) between 2008 and 2011 were well within health-based guidelines[27]. Respirable silica concentrations did not exceed the OEHHA annual average guideline level of 3 µg/m^3 and monitoring was subsequently ceased as the WRC considered that ambient air quality within the Waihi Airshed (and notably downwind of the Martha Pit) did not pose any significant potential health risks. The monitoring also indicates that 24-hour average concentrations were also typically less than the annual average guideline level.

Monitoring work carried out at Yaldhurst near Christchurch[28] by Mote Ltd provides useful information on the assessment of the likely effects of RCS from the discharge of dust at the Willows Road site. The ambient air concentration of RSC was measured at six locations in the vicinity of seven operational quarries for a period of 4 months. The monitoring site were located between 50m and 650m from the quarries. Monitoring also occurred at two background sites.

Unlike the Willows Road project, quarry operations include mechanical crushing of aggregate which is a potential source of dust that may contain RCS. Therefore, the results at Yaldhurst would represent a worse case than would be expected at Willows Road.

The concentrations of RCS were compared with the California Office of Environmental Health Hazard Assessment (OEHHA) guideline of 3µg/m^3 (annual average). This guideline is recommended for assessing the long-term effects of RCS exposure. The study showed that only two of twenty samples recorded RCS above the level of detection and that the average concentration of these samples was 0.4 µg/m^3 (only 13% of the OEHHA guideline value). The two results above the limit of detection occurred at the 50m downwind site.

The Mote study demonstrated that the RCS concentrations downwind of an operating quarry using mechanical aggregate crushing equipment c remained well below the recognised health guideline value. The study highlighted the need for effective dust control to be carried out, especially when extraction and crushing operations occur within 100m of downwind dwellings.

The Canterbury Medical Officer reviewing the study results noted:

“Overall, the results show there is no serious public health risk to Yaldhurst residents from airborne dust. Nuisance dust levels will not cause long term health effects, but we know it can cause irritation and symptoms of concern in some people”.

The rock stack and mine access road (the most likely sources of RCS at the Willows Road site) will be located approximately 600 m to the northwest of the nearest privately owned dwellings on Willows Road, at their closest points. This provides a substantial and appropriate separation distance to the nearest sensitive

[27] From *Waihi Gold Annual Monitoring Report* 2014

[28] Mote Ltd (2018) *Yaldhurst Air Quality Monitoring Summary Report 22 December 2017 – 21 April 2018*, report prepared for Environment Canterbury

development. It is also noted (see Figure 7-1) that the nearest dwellings on Willows Road are infrequently downwind of the rock stack and mine access road and that wind speeds (which may mobilise dust) are generally low.

Despite the evidence from Waihi monitoring and the Mote study, it is acknowledged that the perception of risks to public health from RCS in dust discharged to air is an identifiable issue for people living close to existing or proposed mines and quarries. This emphasises the need for appropriate dust mitigation techniques to be demonstrably and diligently carried out at the Willows Road site.

7.7.4 Conclusions

The scale of the Willows Road project is small in comparison to the Waihi Mine and consequently, it is considered that the discharges to air of combustion products and respirable silica (RCS) from the proposed activities can be adequately avoided and mitigated and the risk of adverse health effects occurring is negligible.

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

It is worth noting that the quality of the air discharged from the proposed ventilation raises will be the atmosphere that mine workers will breathe for all but a few minutes each working day (when blast fumes are exhausted). The amount of ventilation provided will be sufficient to provide a safe working environment for underground workers. This means that the concentration of contaminants from these raises will meet the Workplace Exposure Standards (2020) set by Worksafe New Zealand.

Modelling by Tonkin and Taylor (December 2021) of predicted cumulative ambient air concentrations of PM_{10} and NO_2 in the vicinity of the proposed vents shows that contaminants will be very low when compared against human health assessment criteria.

7.8 Potential Effects on Ecology

7.8.1 Vegetation

Excessive dust has the potential to adversely affect vegetation by interfering with plant photosynthesis, promoting weed or disease incidence and interfering with the efficacy of pesticide and fertiliser applications. Excessive dust can also make pasture less palatable to stock. The nature and degree of effects of dust deposition on plants is dependent on the chemical characteristics of the dust, the particle size and the species of plants.

The vegetation around the Willows Road site surface infrastructure is predominantly pasture used for dairy farming. However, native vegetation is located within the CFP immediately to the north of the site, which will surround the proposed mine ventilation raises.

The tunnel ventilation raises will be constructed within, or close to the native vegetation. While there may be some short-term localised disturbance and minor dust deposition during construction, this will be minor in context and quickly wash off during subsequent rainfall. Any ongoing effects on native vegetation, from dust at the raises, during mining will very localised and minor.

7.8.2 Archey's Frog

The general area of the proposed raises includes habitat for a rare frog species (Archey's frog). The key discharges to air from the proposed vents are fine particulate matter less than ten microns (PM_{10}) and nitrogen dioxide (NO_2). Frogs are very vulnerable to absorbing emissions through their skin. RMA Ecology

(2022) notes that the risk of long-term effects from exposure to these contaminants are not known, but a precautionary approach suggests that these risks are not zero.

As noted earlier, consultants Tonkin and Taylor have modelled the discharge of PM_{10} and NO_2 to predict cumulative ambient discharge concentrations in the vicinity of the vents. The modelling found that PM_{10} and NO_2 concentrations near the vents will be very low, when compared with human health assessment criteria. PM_{10} concentrations are likely to be very similar to areas adjacent to an unpaved public road in the Coromandel (north of the WUG), where baseline ecological assessments of the Archey's frog habitat have been undertaken.

While no scrubbers or other air discharge treatment are proposed, providing the proposed mitigation (i.e. dampening exposed underground surfaces) is carried out, RMA Ecology concludes that the level of effect on Archey's frog, resulting from discharges from the vents, is considered to be very low.

7.9 Potential Cumulative Effects

There is negligible risk that dust from other mining activities at Waihi will combine with discharges to air from the Willows Road site, due to the proposed mitigation measures and the significant separation distance between the boundaries of active areas at the two sites (i.e approximately 4 km). However, any dust generated from the Willows Road site will combine with other sources of dust in the area.

Providing the proposed mitigation measures are carried out as described in Section 5, any increases are unlikely to exceed typical rural background dust levels and the risk of significant cumulative effects is therefore low.

7.10 Summary of Potential Effects

The assessment of potential effects has identified that in the absence of appropriate mitigation there is a moderate to high risk of infrequent, short duration adverse nuisance dust effects at the privately owned dwelling located at 111 Willows Road, (located 145m from the topsoil stockpiles). The risk from nuisance dust at 122 Willows Road, from the topsoil stockpile, is assessed as moderate. This risk of exposure to an increase in deposited dust is a result of surface disturbance and construction earthworks. However, dust levels are not expected to exceed standard and guideline values if mitigation measures are carried out by OGNZL as described in Section 5. These measures have been successfully used to mitigate dust and minimise effects on neighbours at the nearby Waihi mine for a long period of operation.

In order to further mitigate the risk of dust events causing adverse nuisance effects at the closest dwellings, particularly during construction, it is recommended that some additional monitoring of TSP and windspeed/direction, with associated actions if triggered, is carried out (see Section 8).

The concentrations of PM_{10}, $PM_{2.5}$, respirable silica, NO_2, and CO are not expected to exceed the current and proposed NESAQ and guideline values beyond the boundary of the Willows Road site. No monitoring of these parameters is considered necessary.

The risk of any significant adverse effects on native flora or fauna, resulting from discharges of dust from the project, including Archey's frog near the proposed vent raises, is very low.

Overall, providing OGNZL uses the dust mitigation measures successfully employed at the Waihi mine and implements the proposed additional monitoring measures (as described in Section 8), the risk of discharges to air creating adverse effects that are a nuisance, or can be deemed noxious, dangerous, offensive or objectionable beyond the Willows site boundary, is considered to be low.

8 Proposed Mitigation and Monitoring

8.1 Current Mitigation Measures used by OGNZL

The mitigation measures currently used by OGNZL to control dust at the Waihi Mine site will be used at the Willows Road site. These methods, which are well proven, are summarised in Section 5 and described in the AQMP prepared for the site.

8.2 Monitoring Programme

Ongoing visual monitoring of dust across the site will be undertaken during construction and operation of the project. Weather forecasts will be checked daily (wind and rainfall) to assist with planning site activities and dust controls.

Table 8-1 outlines the site dust monitoring programme that will be implemented when surface infrastructure is being installed and during operations. It should be noted that in the instance of strong winds, observations of dust moving off-site or a complaint, the monitoring will be undertaken more regularly.

Table 8-1 Dust Monitoring Programme

Monitoring Activities	Frequency
Check weather forecasts for strong winds and rainfall	Daily
Observe weather conditions via observations site weather station	Daily and as conditions change
Check TSP readings (see trigger values and actions in Table 8-2)	Daily and Hourly in winds over 5m/s (as per site weather station).
Inspect dust generating activities (earthworks, internal roads and stockpiles) to ensure dust emissions are effectively controlled. Complete dust inspection log.	Daily and as new activities are commenced.
Inspect water carts to ensure equipment is functioning effectively	Weekly, otherwise daily when operating
Monitor dust generating activities	In winds over 5 m/s (as per site weather station)

8.3 Weather and TSP Monitoring, Triggers and Actions

There is a moderate to high, short-term risk of dust generated at the site creating adverse effects at several privately owned dwellings located within approximately 200m (downwind) to the east/southeast of the Willows Road site during surface infrastructure construction (especially development of the topsoil stores) under dry, windy conditions.

To mitigate this risk, it is recommended that a weather and dust (TSP) monitoring station is installed on a suitable site in the vicinity of the OGNZL- owned dwelling (see approximate location of monitoring station in Figure 8-1), which will provide for the measurement of local meteorological information (particularly wind speed and direction) and total suspended particulate (TSP). The purpose of the monitoring will be to monitor short term (< 1 hour) dust concentrations and wind conditions with the outputs of the instruments able to be used to trigger additional dust control measures (if TSP concentrations or wind speeds exceed specified values) and if necessary, stop contributing dust-generating work.

It is further recommended that based on information obtained at the new monitoring station, that the following wind speed and TSP trigger levels be applied for reviewing and temporarily ceasing work and are included in the AQMP for the site. These trigger levels are based on those recommended in the GPG Dust and are summarised in Table 8-2. The monitoring should continue at least until vegetation is fully established on topsoil stores and the noise bunds and the construction of the surface infrastructure is complete.

Table 8-2 Recommended trigger values and actions for wind speeds and TSP concentrations at proposed dust monitoring site

Item	Trigger	Action
TSP Alert	TSP concentration (1-hour average) **exceeds 170 µg/m^{3}.**	Dust sources and dust control measures within 200 m of sensitive receptors on Willows Road will be reviewed and additional dust control methods shall be implemented if necessary, as detailed in the site AQMP.
TSP Alarm	TSP concentration (1-hour average) **exceeds 200 µg/m^{3}** Or TSP concentration (24-hour average) **exceeds 60 µg/m^{3}**	Contributing dust generating activities will cease within 200 m of sensitive receptors on Willows Road except for dust control activities as detailed in the AQMP.
Wind Speed Alert	Rolling hourly average wind speeds **exceed 5 m/s** and winds are blowing towards sensitive receptors.	Dust sources and dust control measures within 200 m of sensitive receptors on Willows Road will be reviewed and additional dust control methods shall be implemented if necessary, as detailed in the site AQMP.
Wind Speed Alarm (note does not apply during rain events)	Rolling hourly average wind speeds **exceed 7.5 m/s** and winds are blowing towards sensitive receptors.	Contributing dust-generating activities will cease within 200 m of sensitive receptors on Willows Road except for dust control activities as detailed in the site AQMP.

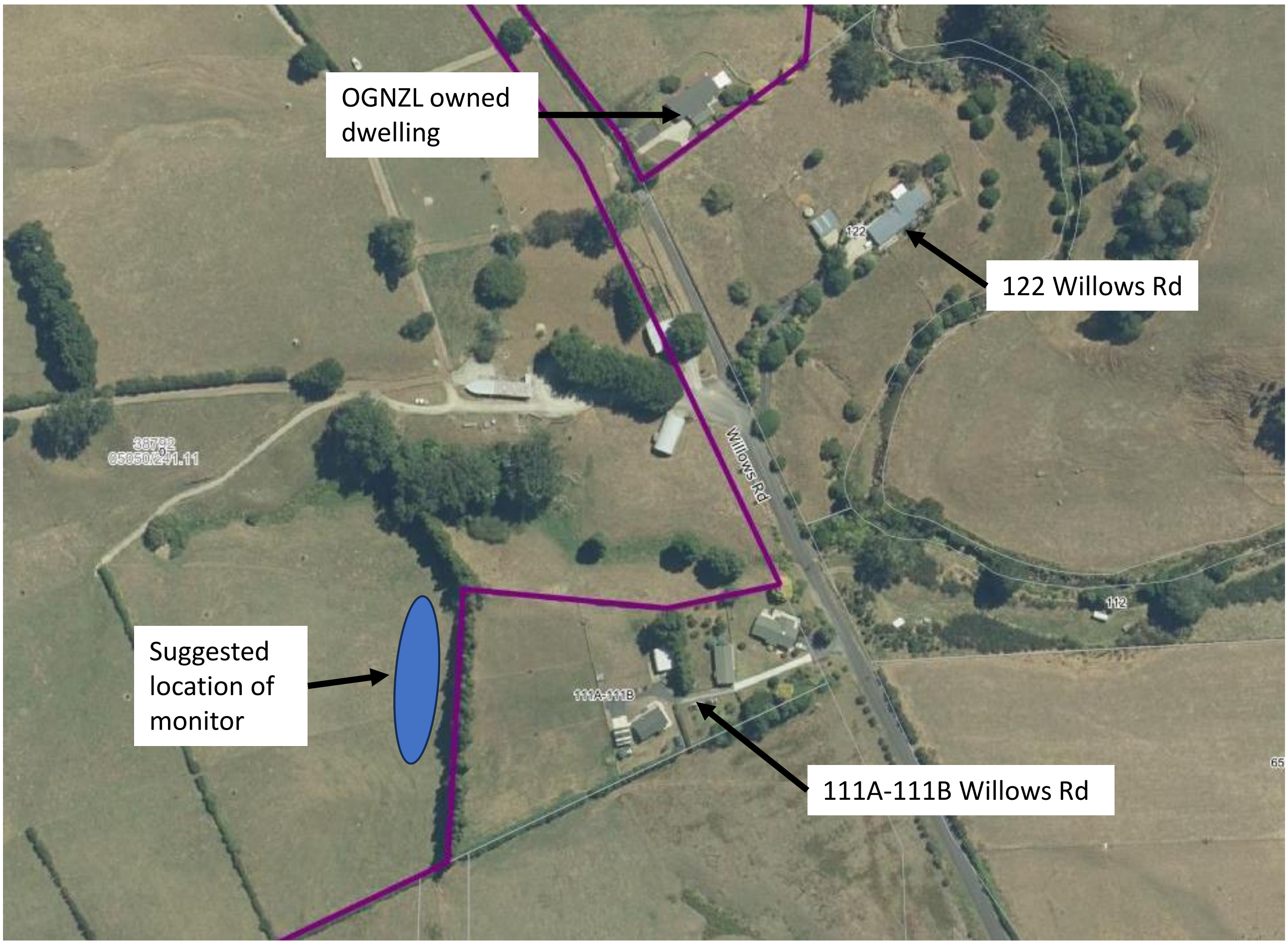

Figure 8-1 Plan showing the recommended location of the meteorological and TSP monitoring site.

9 Conclusions

OGNZL proposes to establish a new underground mine under the CFP. The new activities associated with this proposal will form a key element of the Waihi North Project. The discharges to air associated with the proposed work are a permitted activity in the Waikato Regional Plan subject to conditions. While it is anticipated that the proposed activities will comply with the permitted activity conditions, for certainty and completeness OGNZL wishes to apply for an air discharge consent.

This technical report provides an assessment of the potential effects of discharges to air from the development and operation of the mine and tunnels, including surface infrastructure, to support an Assessment of Environmental Effects (AEE) to accompany an application for resource consent under the Fast-track Approvals process to discharge contaminants to air.

The assessment of effects described in this report concludes that in the absence of appropriate controls, there is a short-term moderate to high risk of dust from the development of stockpiles of topsoil adversely affecting the nearest private dwelling at 111 Willows Road. The risk of nuisance dust at the dwelling at 122 Willows Road is assessed as moderate. The risk of dust generated from other site construction activities, such as the tunnel portal, rock stack, and access road adversely affecting private dwellings in the proximity of the project is assessed as low.

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

The risks of discharges to native flora or fauna, particularly the Archey's frog, near to the proposed tunnel raises is considered to be very low.

Providing OGNZL uses the methods currently used successfully at its other operations at the Waihi Mine to minimise discharges to air, along with the additional mitigation measures recommended in this report, discharges to air from the site will be adequately avoided and mitigated and the risk that these discharges will result in noxious, dangerous, offensive or objectionable effects is considered to be low.

A

Appendix A – Assessment of mine vent air quality impacts to inform an assessment of ecological effects on Archey's frog

REPORT

Assessment of mine vent air quality impacts to inform an assessment of ecological effects on Archey's frog

Prepared for
Oceana Gold (NZ) Limited
Prepared by
Tonkin & Taylor Ltd
Date
June 2022
Job Number
1017908

WAI-985-000-REP-LC-0049_RevB
TECHNICAL REPORT
WAIHI NORTH PROJECT – ASSESSMENT OF MIN VENT AIR QUALITY IMPACTS TO INFORM AN ASSESSMENT OF ECOLOGICAL EFFECTS ON ARCHEY'S FROG
GENERAL AREA 000

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Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
Jun 22	1	Final	R Chilton	J Simpson	J Simpson

Distribution:

Oceana Gold (NZ) Limited 1 PDF copy

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Table of contents

1 Introduction

Oceana Gold (NZ) Limited (OGNZL) is seeking resource consents for its Waihi North Project (WNP) which includes a new underground mine, the 'Wharekirauponga Underground Mine' (WUG) that is located approximately 11km north-west of the current Processing Plant under land administered by the Department of Conservation (DOC) (Coromandel Forest Park).

The Site infrastructure supporting the WUG will be located on OGNZL owned farmland located at the end of Willows Road, with only minimal surface features within the forest, in the form of fenced vent raises, on a legal road reserve owned by the Hauraki District Council.

A number of vent raises will exhaust the ventilation air from within the mine. The vent discharges will include particulate matter and products of combustion (notably oxides of nitrogen).

The general area of the proposed vent raises (vents) includes habitat for a rare frog species (Archey's frog). This report seeks to characterise the likely air quality in and around the mine vents and provide supporting information to enable an assessment of the ecological impacts on the Archey's frog habitat to be undertaken. The general approach used in this assessment is as follows:

- Determine likely ambient air quality impacts in the vicinity of the proposed vents (through dispersion modelling).
- Compare the model predictions with likely air quality adjacent to an unpaved public road in the Coromandel (north of the WUG) where a baseline ecological assessment of Archey's frog habitat has been undertaken.

The remainder of this report characterises the nature of discharges to air (Section 2), provides details of the assessment approach (Section 3), presents the dispersion modelling results that characterise the likely air quality in the vicinity of the proposed mine vents (Section 4) and compares those results to estimated concentrations adjacent to an unpaved road in the Coromandel where a population of Archey's frog is known to occur (Section 5).

This report has been prepared by Tonkin & Taylor Limited (T+T) for OGNZL in accordance with our letter of engagement dated 16 June 2021.

2 Nature of discharges to air from the vents

The main discharges to air from the vents will be particulate matter and products of combustion, particularly oxides of nitrogen (NOx), from the exhausts of mining equipment and trucks, as well as from blasting events.

WaterCare Services Limited (WaterCare) carried out source emission testing of total suspended particulate (TSP) and oxides of nitrogen (NO_X) on an existing mine ventilation shaft vent on 15 and 16 August 2007.[1] The results are summarised in Table 2.1.

[1] WaterCare 2009. Newmont Waihi Gold. Particulate, Carbon Monoxide and Oxides of Nitrogen Emission Testing – August 2007 – Amended. Report prepared by WaterCare Services Limited for Newmont Waihi Gold. 10 September 2009.

Table 2.1: Summary of emission testing

Parameter	Average value	Comment
Exhaust temperature	21 °C	
TSP concentration	1 mg/Nm³	Note concentration is well below WES-TWA for respirable and inhalable particulate matter
Nitrogen dioxide (NO_2) Oxides of nitrogen (NO_X)*	2.1 mg/Nm³ 3.1 mg/Nm³	

*NOx expressed as NO_2

The workplace exposure standards (WES)[2] can also be used to estimate maximum possible emission rates, given that the ventilation air needs to achieve these standards. Table 2.3 lists the current WES values. Two values are given for particulate matter (respirable and inhalable particulate matter). Inhalable particulate matter is the portion of airborne dust that is taken in through the mouth and nose during breathing – it relates to particles where more than 50% are smaller than 30 µm in diameter. Respirable particulate matter relates to the fraction of inhalable particulate matter that can penetrate and deposit in the lower bronchioles and alveolar region of the lungs – it relates to particles where more than 50% are less than 4 µm in diameter.

Comparing the results of the source emission testing (Table 2.1) with the WES values (Table 2.2) is not straightforward given the different averaging periods that the concentrations apply to. Source emission testing samples are typically made over an hour, whereas WES concentration values are expressed as an 8-hour average. Notwithstanding this, we note the following:

- Measured TSP concentrations levels are well below the both the inhalable and respirable particulate matter WES concentrations.
- The measured NO_2 concentration is slightly higher than the current WES concentration. However, the measure NO_2 concentration relates to peak conditions associated with underground blasting. Given this, an 8-hour average concentration that includes period when blasting is not occurring is expected to be lower and within the WES concentration.

Table 2.2: Applicable workplace exposure standards

Contaminant	WES-TWA (8-hour average)
Respirable particulate matter (PM_4)	3 mg/m³
Inhalable particulate matter	10 mg/m³
Nitrogen dioxide (NO_2)	1.9 mg/m³

From discussions with OGNZL, it is understood that current mine vent emissions are expected to be lower than in 2007. This is because more stringent workplace exposure requirements are now in-place, including greater controls on dust and higher exhaust emission standards for diesel-fired mining equipment and trucks.

On balance, we consider using the WES to derive model emission rates would produce unrealistically high emission rates. By contrast, the measured concentration values are expected by T+T to provide a more realistic basis for deriving emission rates, albeit a conservative one given the improved emission controls implemented since the testing was undertaken.

[2] Worksafe 2020. Workplace exposure standards and biological exposure indices. Edition 12-1.

The discharge and emission parameters assumed for each vent and used in the dispersion modelling assessment are summarised in Table 2.3. For the purposes of this assessment, it has been conservatively assumed all of the TSP discharge is in the PM_{10} size fraction.

Table 2.3: Discharge and emission parameters for each vent used in the dispersion modelling

Stack parameter	Value and unit	Comment
Discharge height	8 m above ground level	Provided by Oceana Gold
Stack diameter	5.5 m	Provided by Oceana Gold
Air flow rate	380 m^3/s	Provided by Oceana Gold
	338 Nm^3/s	Calculated, assuming 20°C discharge temperature
Discharge velocity	16 m/s	Calculated based on air flow rate of 380 m^3/s
Discharge temperature	20 °C	Rounded down from 2007 emission testing
TSP emission rate (assumed to be PM_{10})	0.34 g/s	Calculated from normalised flow rate and 1 mg/Nm^3 discharge concentration
NO_X emission rate	1.04 g/s	Calculated from normalised flow rate and 3.1 mg/Nm^3 discharge concentration

3 Approach

3.1 Overview

Dispersion modelling has been used to predict ambient contaminant concentrations in the vicinity of likely vent locations. These contaminants can then be compared to measured contaminant typically associated with a metalled public road in Northland where Waka Kotahi undertook ambient monitoring[3]. That study focused on measured concentrations of PM_{10} at varying distances from an unsealed public road as part of a study into the benefits and costs of available dust mitigation measures.

This comparison can then be used to infer concentrations that might be expected for a public unpaved road in the Coromandel to the north of the mine vents where it is understood that ecological surveys of the Archey's frog have been undertaken.

3.2 Dispersion modelling

The CALPUFF air dispersion model (version 7.2.1) was used to predict contaminant ground level concentrations of PM_{10} and NO_2 from the location of two mine vents provided by OGNZL. The discharge and emission parameters used as input to the model have been summarised Table 2.3.

The CALPUFF model is widely used in New Zealand, particularly for locations of complex terrain as is the case in this instance. CALPUFF was configured to predict contaminant ground level concentrations centred on the two mine vents for three grids of receptors as follows:

- 450 m by 450 m at a 50 m resolution.
- 800 m by 800 m at a 100 m resolution.
- 2,000 m by 2,000 m at a 200 m resolution.

[3] Bluett J, Aguiar M, Gimson N 2017. Impacts of exposure to dust from unsealed roads. Report prepared by Golder Associated (NZ) Limited for the NZ Transport Agency (Waka Kotahi). April 2017. NZTA Research Report 590.

A two-year meteorological dataset was developed using the CALMET meteorological model for the years 2016 and 2017. We note that 2016 and 2017 are expected to provide a suitable range of meteorological conditions due to those years experiencing a mix of La Niña and El Niño climatic conditions.

The model domain covered an area of 12.75 km (east to west) by 15km (north to south) at a 150 m grid resolution. Input data for the CALMET model were derived from the meteorological component of the TAPM model, as well as terrain and land use information sourced for Land Information New Zealand (LINZ). Appendix A provides figures that illustrates the CALMET model domain and terrain inputs along with details of the configuration of both the CALMET and CALPUFF models.

3.3 Background air quality

Indicative background concentrations, to enable an estimate of cumulative contaminant concentrations, have been sourced from the Waka Kotahi interactive background map (Figure 3.1).[4] The corresponding background concentrations for PM_{10} and NO_2 are summarised in Table 3.1. In practice, background concentrations in the forest area will better than expected of a rural area. Accordingly, we consider that these default background concentrations are likely to significantly overstate existing air quality in a pristine forested location.

Table 3.1: Background air contaminant concentrations (CAU number 534200)

Contaminant and averaging time	Concentration
PM_{10} 24-hour average	19 µg/m³
NO_2 1-hour average	37 µg/m³
NO_2 24-hour average	23 µg/m³

Figure 3.1: Waka Kotahi interactive map for background air quality concentrations.

[4] https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/tools/air-quality-map/

3.4 Human health assessment criteria

For completeness, the human health assessment criteria applied when considering the impacts of PM_{10} and NO_2 emissions are summarised in Table 3.2. Comparison against these concentrations is only made in this report to provide some context as to the magnitude of measured and modelled concentrations.

Table 3.2: Air quality assessment criteria

Contaminant and averaging period		Criteria	Source
PM_{10}	24-hour average Annual average	50 µg/m³ 20 µg/m³	NES_{AQ} AAQG
NO_2	1-hour average 24-hour average	200 µg/m³ 100 µg/m³	NES_{AQ} NES_{AQ}

NES_{AQ} = National Environmental Standards for Air Quality
AAQG = Ambient Air Quality Guidelines

4 Model results

4.1 Particulate matter

The predicted maximum 24-hour average PM_{10} concentrations are illustrated as a contour plot in Appendix B. This figure shows concentrations that are significantly influenced by impingement of the vent plumes against elevated terrain surrounding the vents. However, predicted concentrations are comparatively low, with the maximum off-site ground level concentration due to the vent discharges only of approximately 2 µg/m³ - this occurs at a location between the two vents. To put this concentration into context, it is less than the limit of detection of standard PM_{10} ambient monitoring instruments.

A maximum cumulative 24-hour average PM_{10} concentration of 21 µg/m³ is predicted, given a background concentration of 19 µg/m³ (see Section 3.3). This is less than half of the National Environmental Standard for Air Quality (NES_{AQ}) for PM_{10} (24-hour average concentration of 50 µg/m³).

The predicted maximum annual average concentrations is 0.17 µg/m³. This concentration is considered negligible and consequently a contour plot and further analysis is not provided.

4.2 Nitrogen dioxide

The model predicted maximum 1-hour and 24-hour average NO_X concentrations are presented as contour plots in Appendix B. From this, predicted maximum 1-hour and 24-hour average concentrations are approximately 11 µg/m³ and 6 µg/m³ respectively.

Nitrogen oxide (NO) can react with atmospheric background ozone and oxidise to form NO_2. This atmospheric conversion can be accounted for in air quality assessments. However, in this instance we have conservatively assumed all NO_X emitted is in the form of NO_2 and have conservatively added those concentrations to background levels set out in Section 3.3. Given this, we predict cumulative 1-hour and 24-hour average NO_2 concentrations of 48 µg/m³ and 29 µg/m³, noting that these are very conservative predictions. Notwithstanding their conservative nature, the cumulative concentrations are low when compared to the human health assessment criteria of 200 µg/m³ (1-hour average) and 100 µg/m³ (24-hour average).

5 Comparison with air quality near unpaved public roads

Bluett *el al* (2017) examined the impacts of exposure to dust from unsealed roads, which included monitoring PM_{10} adjacent to an unsealed road in Northland. The monitoring programme was undertaken in 2015. 7-day average vehicle counts were in the order of 250 vehicles per day, comprising approximately 30% heavy commercial vehicles (HCVs). Weekend average vehicle counts were in the order of 150 vehicles per day comprising approximately 16% HCV.

Figure 5.1 reproduces Figure 4.9 from Bluett *et al*, summarising measured PM_{10} concentrations, highlighting the weekend days (to illustrate the difference in air quality effects on days with lower traffic volumes). This plot shows measured 24-hour average concentrations at two locations; 5 m and 30 m set back from the roadside. Although lower than on weekdays, weekend traffic conditions gave rise to elevated PM_{10} concentrations that approached or exceeded the 50 µg/m³ (24-hour average) at 5 m from the roadside on two days over the eight weekends monitored. Concentrations were typically about 50% lower at 30 m from the roadside and were approximately 25 µg/m³ on four days.

The air quality measured in Bluett *el al* can be compared to likely air quality adjacent to unsealed roads with known populations of Archey's frogs to give an indication of their tolerance to dust and fine particles. Traffic monitoring was carried out in June 2021 on two unpaved roads in the Coromandel where ecological monitoring for Archey's frogs has been undertaken:

- '309 Road' near to Waiau Falls Scenic Reserve. The 7-day vehicle count in June 2021 was 174 vehicles per day, comprising on average 10.5% heavy commercial vehicles.
- 'Kennedy Bay Road' The 7-day vehicle count in June 2021 was 370 vehicles per day, comprising on average 8.2% heavy commercial vehicles.

Traffic flows on these unpaved roads in the Coromandel were broadly similar to the weekend traffic conditions in the Northland study of air quality impacts. Therefore, although there may be some difference in road conditions affecting dust emissions (road surface fines content and moisture), the measured concentrations adjacent to 309 Road (Coromandel) are likely to be similar to the weekend PM_{10} concentrations discussed above. That is, PM_{10} concentrations are likely to be greater than 25 µg/m³ (24-hour average) within 30 m from the road.

The modelled worst case cumulative PM_{10} concentrations as a result of emissions from the vents are less than 25 µg/m³ (24-hour average) (see Section 4.1). This indicates that PM_{10} concentrations in the vicinity of the vents are likely to be lower than at locations within 30 m of 309 Road, Coromandel, where populations of Archey's frogs are known to occur.

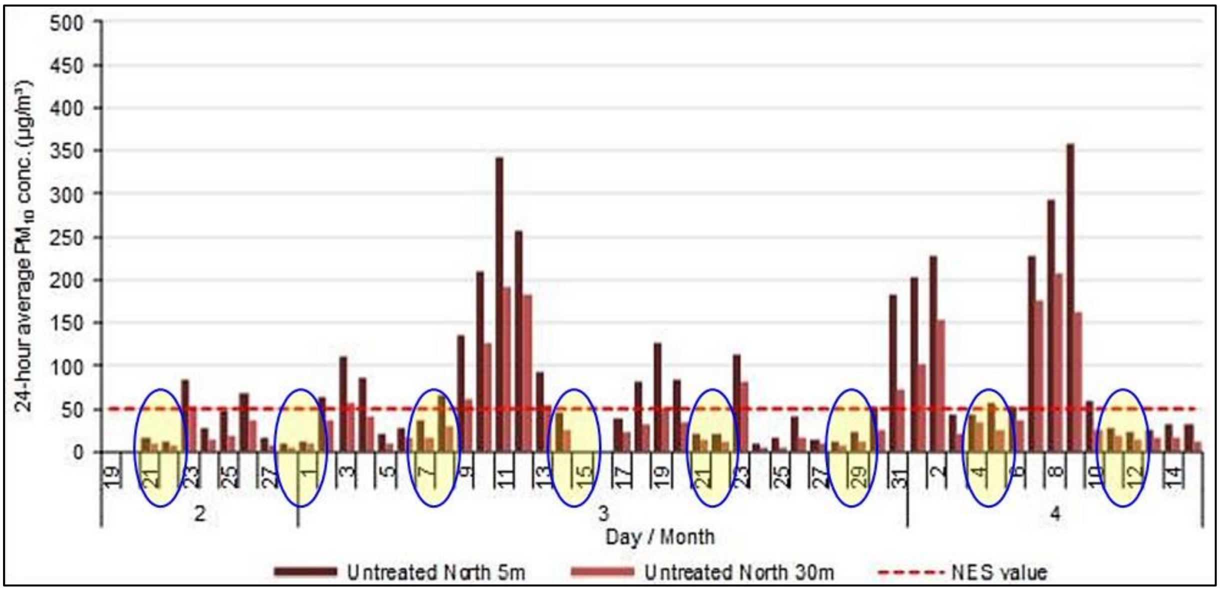

Figure 5.1: Reproduced Figure 4.9 from Bluet et al 2017, showing PM_{10} concentrations on the untreated roadway: north 5m and north 30m sites, 19 February to 16 April 2015. Weekend dates highlighted with blue circles.

6 Conclusion

This air quality assessment has been prepared on behalf of OGNZL to inform an ecological assessment of the impact of proposed mine vent discharges on Archey's frog habitat.

The key discharges to air from the proposed vents are fine particulate matter less than ten microns (PM_{10}) and nitrogen dioxide (NO_2).

The main conclusions of the assessment are as follows:

- Predicted cumulative ambient air concentrations of PM_{10} and NO_2 in the vicinity of the proposed vents are very low when compared against human health assessment criteria.
- Predicted cumulative concentrations of PM_{10} in the vicinity of the vent raises will be lower than measured concentrations adjacent to an unpaved road in Northland (based on weekend traffic volumes).
- Based on similarity in traffic levels, PM_{10} concentrations are likely to be similar in areas adjacent to an unpaved public road in the Coromandel (north of the WUG) where baseline ecological assessments of Archey's frog habitat have been undertaken. Therefore, it can be inferred that Archey's frogs at this Coromandel location are exposed to greater levels of PM_{10} than anticipated in the vicinity of the proposed vents.
- Predicted NO_2 concentrations in the vicinity of the proposed vent raises are very low and well within human health assessment criteria. T+T considers the predicted NO_2 concentrations in the vicinity of the vent raises are likely to represent background concentrations for many rural locations.

7 Applicability

This report has been prepared for the exclusive use of our client Oceana Gold (NZ) Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Waikato Regional Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:

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Richard Chilton

Technical Director – Air Quality

Authorised for Tonkin & Taylor Ltd by:

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Jenny Simpson

Project Director

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Appendix A: CALMET and CALPUFF configuration

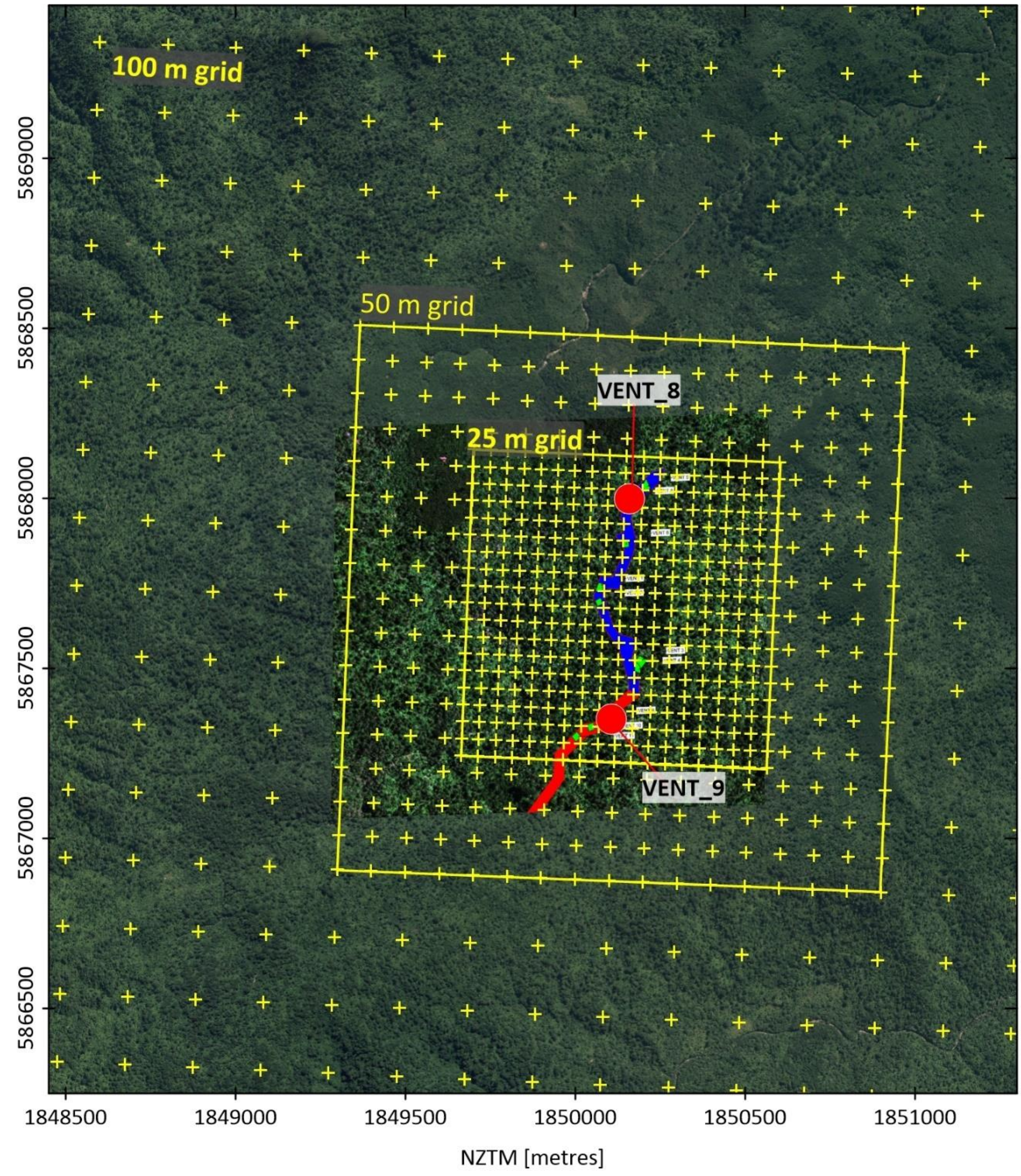

Figure 7.1: Receptor grids (yellow crosses)

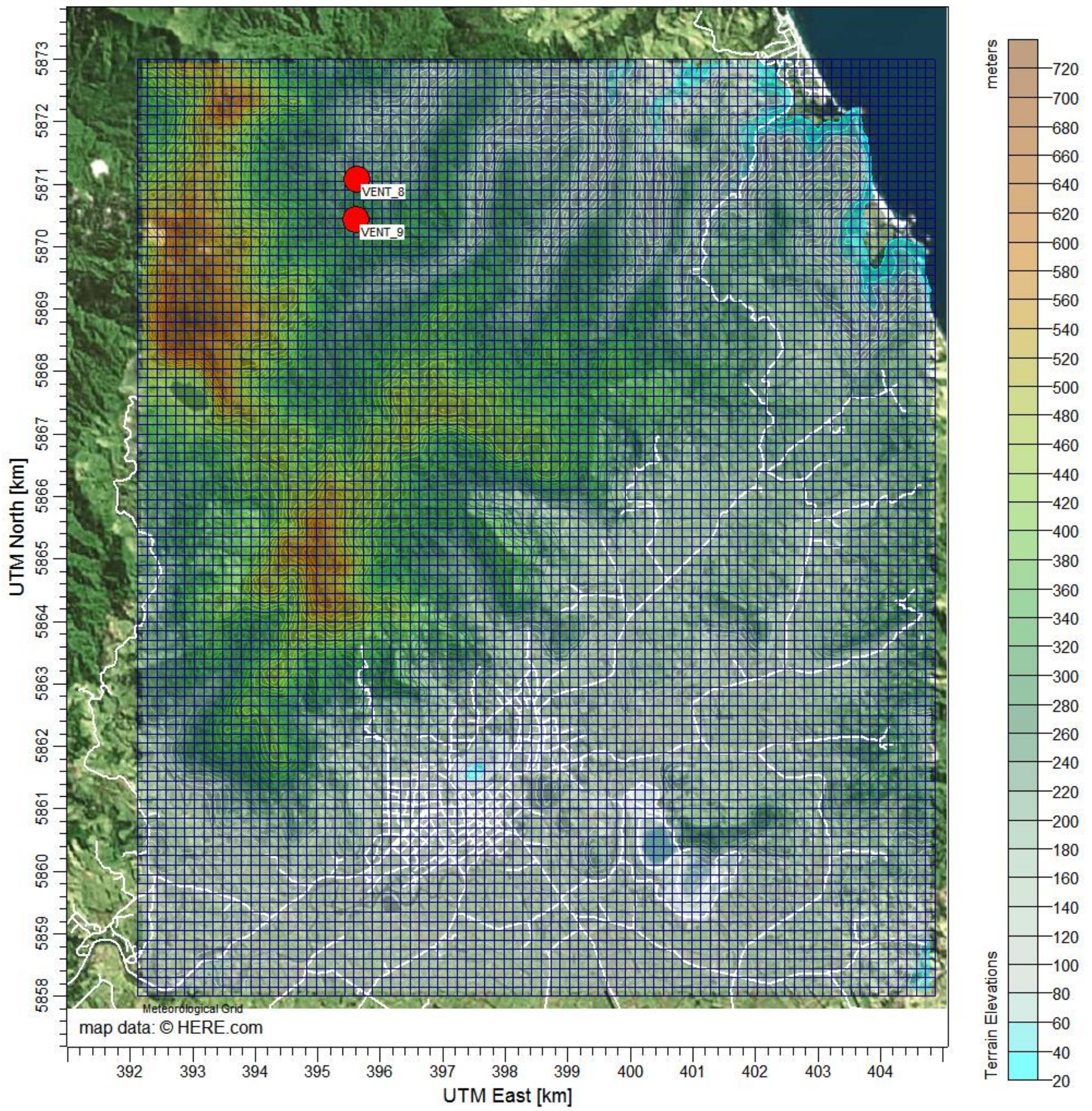

Figure 7.2: CALMET domain showing terrain heights derived from Shuttle Radar Topography Mission (SMRT) 30 m resolution data. Vent locations shown as red-circles.

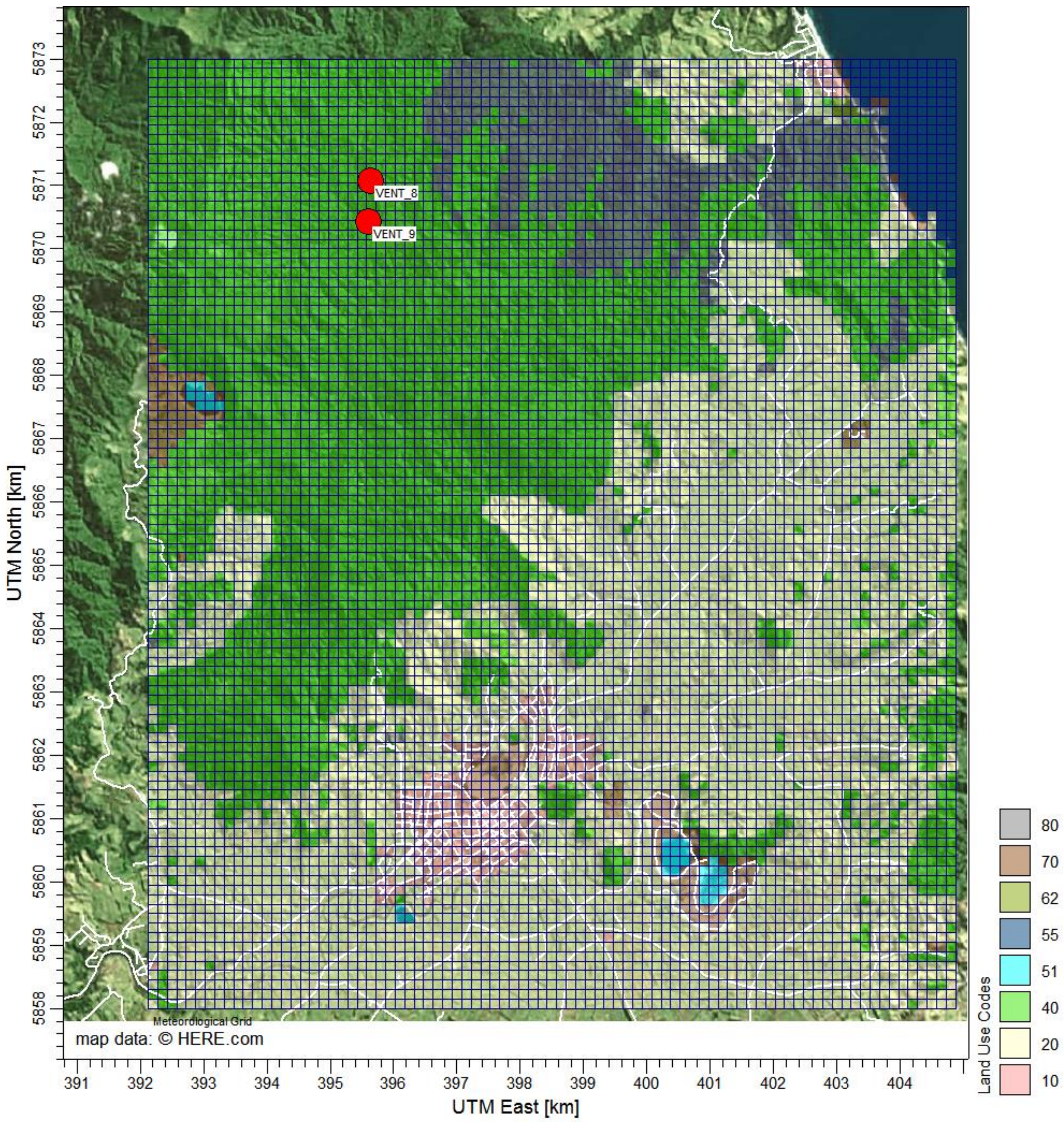

Figure 7.3: CALMET domain showing land use categorisation derived from New Zealand Land Cover Database (LCDB) version 5. Vent locations shown as red-circles.

Appendix B: Contour plots

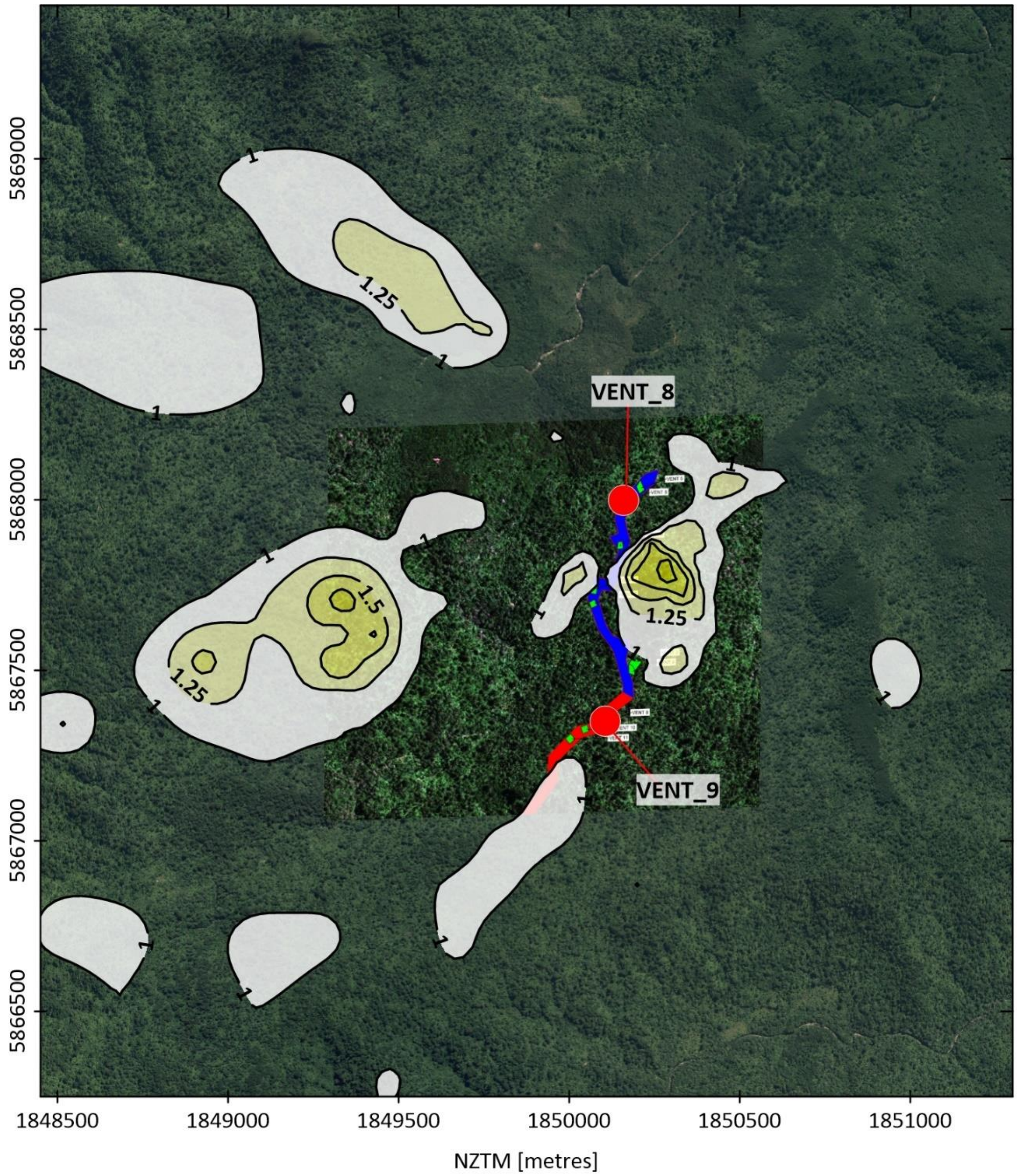

Figure 7.4: Model predicted maximum 24-hour average TSP concentrations excluding background

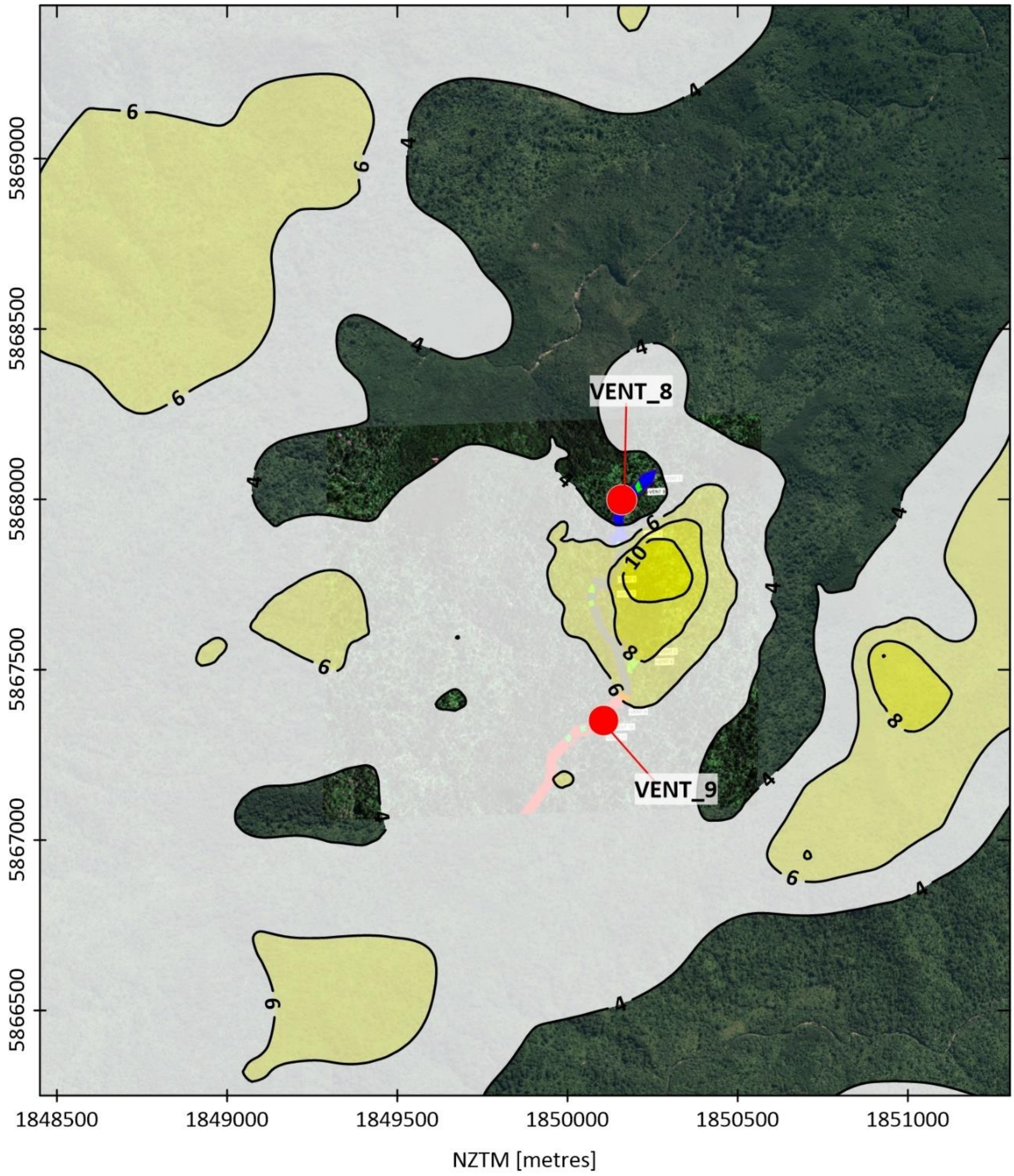

Figure 7.5: Predicted maximum 1-hour average NO_X concentrations excluding background

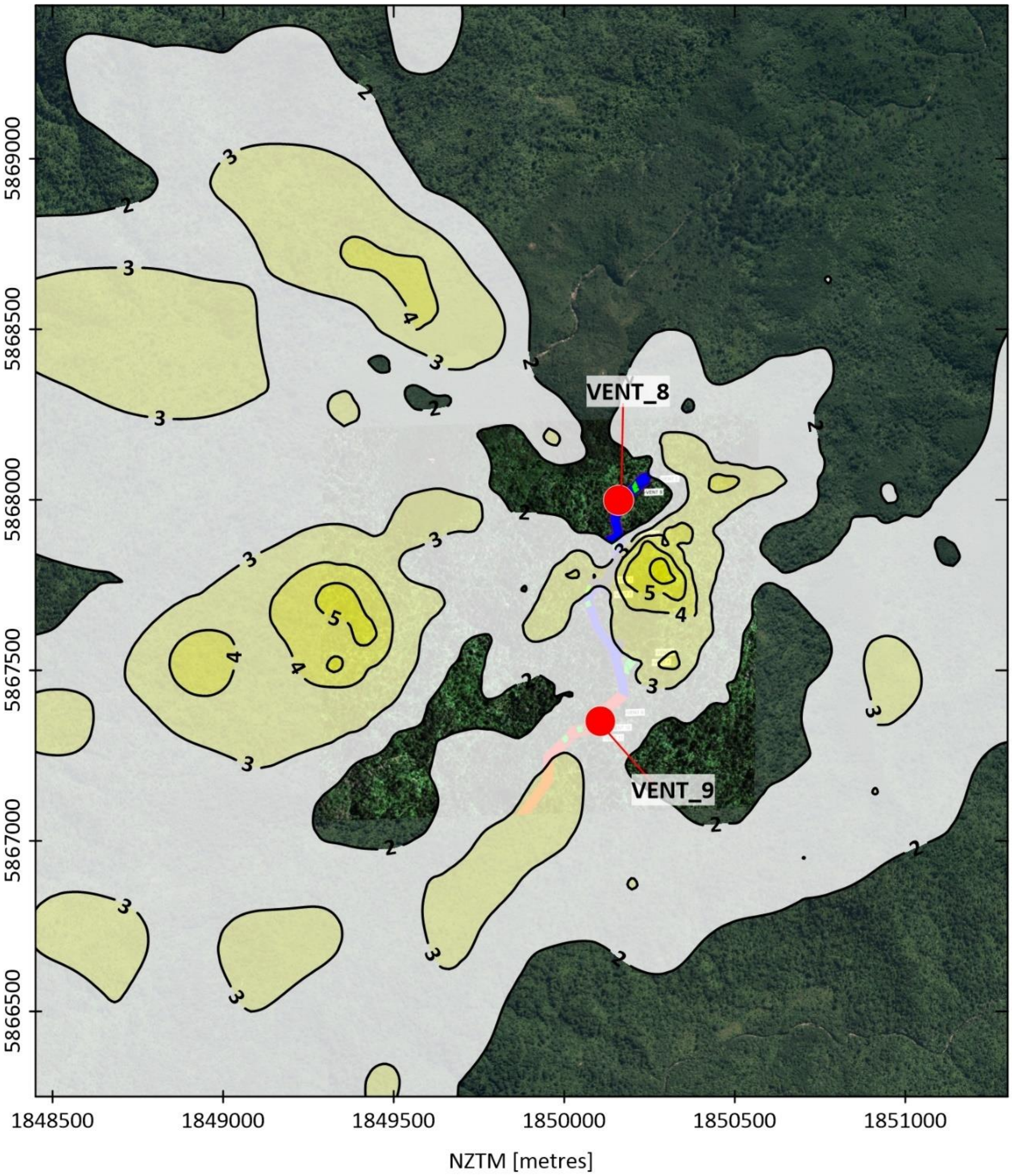

Figure 7.6: Predicted maximum 24-hour average NO_X concentrations excluding background

CALMET Parameters

TAPM 2016 NOOBs

INPUT GROUP: 0 -- Input and Output File Names		
Parameter	**Description**	**Value**
GEODAT	Input file of geophysical data (GEO.DAT)	GEO_UD.DAT
METLST	Output file name of CALMET list file (CALMET.LST)	CALMET.LST
METDAT	Output file name of generated gridded met files (CALMET.DAT)	CALMET.DAT
LCFILES	Lower case file names (T = lower case, F = upper case)	F
NUSTA	Number of upper air stations	0
NOWSTA	Number of overwater stations	0
NM3D	Number of prognostic meteorological data files (3D.DAT)	1
NIGF	Number of IGF-CALMET.DAT files used as initial guess	0

INPUT GROUP: 1 -- General Run Control Parameters		
Parameter	**Description**	**Value**
IBYR	Starting year	2016
IBMO	Starting month	1
IBDY	Starting day	1
IBHR	Starting hour	1
IBSEC	Starting second	0
IEYR	Ending year	2017
IEMO	Ending month	12
IEDY	Ending day	31
IEHR	Ending hour	23
IESEC	Ending second	0
ABTZ	Base time zone	UTC+1200
NSECDT	Length of modeling time-step (seconds)	3600
IRTYPE	Output run type (0 = wind fields only, 1 = CALPUFF/CALGRID)	1
LCALGRD	Compute CALGRID data fields (T = true, F = false)	T
ITEST	Flag to stop run after setup phase (1 = stop, 2 = run)	2
MREG	Regulatory checks (0 = no checks, 1 = US EPA LRT checks)	0

INPUT GROUP: 2 -- Map Projection and Grid Control Parameters		
Parameter	**Description**	**Value**
PMAP	Map projection system	UTM
FEAST	False easting at projection origin (km)	0.0
FNORTH	False northing at projection origin (km)	0.0
IUTMZN	UTM zone (1 to 60)	60
UTMHEM	Hemisphere of UTM projection (N = northern, S = southern)	S

INPUT GROUP: 2 -- Map Projection and Grid Control Parameters		
Parameter	**Description**	**Value**
XLAT1	1st standard parallel latitude (decimal degrees)	30S
XLAT2	2nd standard parallel latitude (decimal degrees)	60S
DATUM	Datum-Region for the coordinates	WGS-84
NX	Meteorological grid - number of X grid cells	85
NY	Meteorological grid - number of Y grid cells	100
DGRIDKM	Meteorological grid spacing (km)	0.15
XORIGKM	Meteorological grid - X coordinate for SW corner (km)	392.1250
YORIGKM	Meteorological grid - Y coordinate for SW corner (km)	5858
NZ	Meteorological grid - number of vertical layers	10
ZFACE	Meteorological grid - vertical cell face heights (m)	0.00,20.00,40.00,80.00,160.00,320.00,640.00,1200.00,2000.00,3000.00,4000.00

INPUT GROUP: 3 -- Output Options		
Parameter	**Description**	**Value**
LSAVE	Save met fields in unformatted output file (T = true, F = false)	T
IFORMO	Type of output file (1 = CALPUFF/CALGRID, 2 = MESOPUFF II)	1
LPRINT	Print met fields (F = false, T = true)	F
IPRINF	Print interval for output wind fields (hours)	1
STABILITY	Print gridded PGT stability classes? (0 = no, 1 = yes)	0
USTAR	Print gridded friction velocities? (0 = no, 1 = yes)	0
MONIN	Print gridded Monin-Obukhov lengths? (0 = no, 1 = yes)	0
MIXHT	Print gridded mixing heights? (0 = no, 1 = yes)	0
WSTAR	Print gridded convective velocity scales? (0 = no, 1 = yes)	0
PRECIP	Print gridded hourly precipitation rates? (0 = no, 1 = yes)	0
SENSHEAT	Print gridded sensible heat fluxes? (0 = no, 1 = yes)	0
CONVZI	Print gridded convective mixing heights? (0 = no, 1 = yes)	0
LDB	Test/debug option: print input met data and internal variables (F = false, T = true)	F
NN1	Test/debug option: first time step to print	1
NN2	Test/debug option: last time step to print	1
LDBCST	Test/debug option: print distance to land internal variables (F = false, T = true)	F
IOUTD	Test/debug option: print control variables for writing winds? (0 = no, 1 = yes)	0
NZPRN2	Test/debug option: number of levels to print starting at the surface	1
IPR0	Test/debug option: print interpolated winds? (0 = no, 1 = yes)	0
IPR1	Test/debug option: print terrain adjusted surface wind? (0 = no, 1 = yes)	0
IPR2	Test/debug option: print smoothed wind and initial divergence fields? (0 = no, 1 = yes)	0

INPUT GROUP: 3 -- Output Options		
Parameter	**Description**	**Value**
IPR3	Test/debug option: print final wind speed and direction? (0 = no, 1 = yes)	0
IPR4	Test/debug option: print final divergence fields? (0 = no, 1 = yes)	0
IPR5	Test/debug option: print winds after kinematic effects? (0 = no, 1 = yes)	0
IPR6	Test/debug option: print winds after Froude number adjustment? (0 = no, 1 = yes)	0
IPR7	Test/debug option: print winds after slope flow? (0 = no, 1 = yes)	0
IPR8	Test/debug option: print final winds? (0 = no, 1 = yes)	0

INPUT GROUP: 4 -- Meteorological Data Options		
Parameter	**Description**	**Value**
NOOBS	Observation mode (0 = stations only, 1 = surface/overwater stations with prognostic upper air, 2 = prognostic data only)	2
NSSTA	Number of surface stations	0
NPSTA	Number of precipitation stations	-1
ICLDOUT	Output the CLOUD.DAT file? (0 = no, 1 = yes)	0
MCLOUD	Method to compute cloud fields (1 = from surface obs, 2 = from CLOUD.DAT, 3 = from prognostic (Teixera), 4 = from prognostic (MM5toGrads)	4
IFORMS	Surface met data file format (1 = unformatted, 2 = formatted)	2
IFORMP	Precipitation data file format (1 = unformatted, 2 = formatted)	2
IFORMC	Cloud data file format (1 = unformatted, 2 = formatted)	1

INPUT GROUP: 5 -- Wind Field Options and Parameters		
Parameter	**Description**	**Value**
IWFCOD	Wind field model option (1 = objective analysis, 2 = diagnostic)	1
IFRADJ	Adjust winds using Froude number effects? (0 = no, 1 = yes)	1
IKINE	Adjust winds using kinematic effects? (0 = no, 1 = yes)	0
IOBR	Adjust winds using O'Brien velocity procedure? (0 = no, 1 = yes)	0
ISLOPE	Compute slope flow effects? (0 = no, 1 = yes)	1
IEXTRP	Extrapolation of surface winds to upper layers method (1 = none, 2 = power law, 3 = user input, 4 = similarity theory, - = same except layer 1 data at upper air stations are ignored)	1
ICALM	Extrapolate surface winds even if calm? (0 = no, 1 = yes)	0
BIAS	Weighting factors for surface and upper air stations (NZ values)	0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0
RMIN2	Minimum upper air station radius of influence for surface extrapolation exclusion (km)	4
IPROG	Use prognostic winds as input to diagnostic wind model (0 = no, 13 = use winds from 3D.DAT as Step 1 field, 14 = use winds from 3D.DAT as initial guess field, 15 = use winds from 3D.DAT file as observations)	14
ISTEPPGS	Prognostic data time step (seconds)	3600
IGFMET	Use coarse CALMET fields as initial guess? (0 = no, 1 = yes)	0
LVARY	Use varying radius of influence (F = false, T = true)	F

INPUT GROUP: 5 -- Wind Field Options and Parameters		
Parameter	**Description**	**Value**
RMAX1	Maximum radius of influence in the surface layer (km)	0
RMAX2	Maximum radius of influence over land aloft (km)	0
RMAX3	Maximum radius of influence over water (km)	0
RMIN	Minimum radius of influence used in wind field interpolation (km)	0.1
TERRAD	Radius of influence of terrain features (km)	3
R1	Relative weight at surface of step 1 fields and observations (km)	0
R2	Relative weight aloft of step 1 field and observations (km)	0
RPROG	Weighting factors of prognostic wind field data (km)	0
DIVLIM	Maximum acceptable divergence	5E-006
NITER	Maximum number of iterations in the divergence minimization procedure	50
NSMTH	Number of passes in the smoothing procedure (NZ values)	2,9*4
NINTR2	Maximum number of stations used in each layer for interpolation (NZ values)	10*99
CRITFN	Critical Froude number	1
ALPHA	Empirical factor triggering kinematic effects	0.1
NBAR	Number of barriers to interpolation of the wind fields	0
KBAR	Barrier - level up to which barriers apply (1 to NZ)	10
IDIOPT1	Surface temperature (0 = compute from obs/prognostic, 1 = read from DIAG.DAT)	0
ISURFT	Surface station to use for surface temperature (between 1 and NSSTA)	-1
IDIOPT2	Temperature lapse rate used in the computation of terrain-induced circulations (0 = compute from obs/prognostic, 1 = read from DIAG.DAT)	0
IUPT	Upper air station to use for the domain-scale lapse rate (between 1 and NUSTA)	-1
ZUPT	Depth through which the domain-scale lapse rate is computed (m)	200
IDIOPT3	Initial guess field winds (0 = compute from obs/prognostic, 1 = read from DIAG.DAT)	0
IUPWND	Upper air station to use for domain-scale winds	-1
ZUPWND	Bottom and top of layer through which the domain-scale winds are computed (m)	1.0, 1.00
IDIOPT4	Read observed surface wind components (0 = from SURF.DAT, 1 = from DIAG.DAT)	0
IDIOPT5	Read observed upper wind components (0 = from UPn.DAT, 1 = from DIAG.DAT)	0
LLBREZE	Use Lake Breeze module (T = true, F = false)	F
NBOX	Lake Breeze - number of regions	0

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters		
Parameter	**Description**	**Value**
CONSTB	Mixing height constant: neutral, mechanical equation	1.41
CONSTE	Mixing height constant: convective equation	0.15
CONSTN	Mixing height constant: stable equation	2400

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters		
Parameter	**Description**	**Value**
CONSTW	Mixing height constant: overwater equation	0.16
FCORIOL	Absolute value of Coriolis parameter (1/s)	0.0001
IAVEZI	Spatial mixing height averaging? (0 = no, 1 = yes)	1
MNMDAV	Maximum search radius in averaging process (grid cells)	1
HAFANG	Half-angle of upwind looking cone for averaging (degrees)	30
ILEVZI	Layer of winds used in upwind averaging (between 1 and NZ)	1
IMIXH	Convective mixing height method (1 = Maul-Carson, 2 = Batchvarova-Gryning, - for land cells only, + for land and water cells)	1
THRESHL	Overland threshold boundary flux (W/m**3)	0
THRESHW	Overwater threshold boundary flux (W/m**3)	0.05
ITWPROG	Overwater lapse rate and deltaT options (0 = from SEA.DAT, 1 = use prognostic lapse rates and SEA.DAT deltaT, 2 = from prognostic)	0
ILUOC3D	Land use category in 3D.DAT	16
DPTMIN	Minimum potential temperature lapse rate (K/m)	0.001
DZZI	Depth of computing capping lapse rate (m)	200
ZIMIN	Minimum overland mixing height (m)	50
ZIMAX	Maximum overland mixing height (m)	3000
ZIMINW	Minimum overwater mixing height (m)	50
ZIMAXW	Maximum overwater mixing height (m)	3000
ICOARE	Overwater surface fluxes method	10
DSHELF	Coastal/shallow water length scale (km)	0
IWARM	COARE warm layer computation (0 = off, 1 = on)	0
ICOOL	COARE cool skin layer computation (0 = off, 1 = on)	0
IRHPROG	Relative humidity read option (0 = from SURF.DAT, 1 = from 3D.DAT)	1
ITPROG	3D temperature read option (0 = stations, 1 = surface from station and upper air from prognostic, 2 = prognostic)	2
IRAD	Temperature interpolation type (1 = 1/R, 2 = 1/R**2)	1
TRADKM	Temperature interpolation radius of influence (km)	500
NUMTS	Maximum number of stations to include in temperature interpolation	5
IAVET	Conduct spatial averaging of temperatures? (0 = no, 1 = yes)	1
TGDEFB	Default overwater mixed layer lapse rate (K/m)	-0.0098
TGDEFA	Default overwater capping lapse rate (K/m)	-0.0045
JWAT1	Beginning land use category for temperature interpolation over water	999
JWAT2	Ending land use category for temperature interpolation over water	999
NFLAGP	Precipitation interpolation method (1 = 1/R, 2 = 1/R**2, 3 = EXP/R**2)	2
SIGMAP	Precipitation interpolation radius of influence (km)	100.
CUTP	Minimum precipitation rate cutoff (mm/hr)	0.01

CALPUFF Parameters

Oceana Gold
2 vent scenarion (Vent 8 & 9)
PM10 and NO2

INPUT GROUP: 0 -- Input and Output File Names		
Parameter	**Description**	**Value**
PUFLST	CALPUFF output list file (CALPUFF.LST)	CALPUFF.LST
CONDAT	CALPUFF output concentration file (CONC.DAT)	CONC.DAT
DFDAT	CALPUFF output dry deposition flux file (DFLX.DAT)	DFLX.DAT
WFDAT	CALPUFF output wet deposition flux file (WFLX.DAT)	WFLX.DAT
LCFILES	Lower case file names (T = lower case, F = upper case)	F
NMETDOM	Number of CALMET.DAT domains	1
NMETDAT	Number of CALMET.DAT input files	28
NPTDAT	Number of PTEMARB.DAT input files	0
NARDAT	Number of BAEMARB.DAT input files	0
NVOLDAT	Number of VOLEMARB.DAT input files	0
NFLDAT	Number of FLEMARB.DAT input files	0
NRDDAT	Number of RDEMARB.DAT input files	0
NLNDAT	Number of LNEMARB.DAT input files	0
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-01-01-01-0000-2016-02-01-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-02-01-00-0000-2016-03-03-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-03-03-00-0000-2016-04-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-04-02-00-0000-2016-05-03-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-05-03-00-0000-2016-06-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-06-02-00-0000-2016-07-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-07-02-00-0000-2016-08-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-08-02-00-0000-2016-09-01-00-0000.DAT

INPUT GROUP: 0 -- Input and Output File Names		
Parameter	**Description**	**Value**
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-09-01-00-0000-2016-10-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-10-02-00-0000-2016-11-01-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-11-01-00-0000-2016-12-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-12-02-00-0000-2016-12-31-23-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-12-29-00-0000-2016-12-31-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2016-12-31-00-0000-2017-01-01-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-01-01-00-0000-2017-01-03-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-01-01-01-0000-2017-02-01-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-01-03-00-0000-2017-01-04-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-02-01-00-0000-2017-03-04-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-03-04-00-0000-2017-04-03-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-04-03-00-0000-2017-05-03-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-05-03-00-0000-2017-06-03-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-06-03-00-0000-2017-07-03-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-07-03-00-0000-2017-08-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-08-02-00-0000-2017-09-02-00-0000.DAT

INPUT GROUP: 0 -- Input and Output File Names		
Parameter	**Description**	**Value**
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-09-02-00-0000-2017-10-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-10-02-00-0000-2017-11-01-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-11-01-00-0000-2017-12-02-00-0000.DAT
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET_2017-12-02-00-0000-2017-12-31-23-0000.DAT

INPUT GROUP: 1 -- General Run Control Parameters		
Parameter	**Description**	**Value**
METRUN	Run all periods in met data file? (0 = no, 1 = yes)	0
IBYR	Starting year	2016
IBMO	Starting month	1
IBDY	Starting day	1
IBHR	Starting hour	1
IBMIN	Starting minute	0
IBSEC	Starting second	0
IEYR	Ending year	2017
IEMO	Ending month	12
IEDY	Ending day	31
IEHR	Ending hour	22
IEMIN	Ending minute	0
IESEC	Ending second	0
ABTZ	Base time zone	UTC+1200
NSECDT	Length of modeling time-step (seconds)	3600
NSPEC	Number of chemical species modeled	2
NSE	Number of chemical species to be emitted	2
ITEST	Stop run after SETUP phase (1 = stop, 2 = run)	2
MRESTART	Control option to read and/or write model restart data	0
NRESPD	Number of periods in restart output cycle	0
METFM	Meteorological data format (1 = CALMET, 2 = ISC, 3 = AUSPLUME, 4 = CTDM, 5 = AERMET)	1
MPRFFM	Meteorological profile data format (1 = CTDM, 2 = AERMET)	1
AVET	Averaging time (minutes)	60
PGTIME	PG Averaging time (minutes)	60
IOUTU	Output units for binary output files (1 = mass, 2 = odour, 3 = radiation)	1

INPUT GROUP: 2 -- Technical Options		
Parameter	**Description**	**Value**
MGAUSS	Near field vertical distribution (0 = uniform, 1 = Gaussian)	1
MCTADJ	Terrain adjustment method (0 = none, 1 = ISC-type, 2 = CALPUFF-type, 3 = partial plume path)	3
MCTSG	Model subgrid-scale complex terrain? (0 = no, 1 = yes)	0
MSLUG	Near-field puffs modeled as elongated slugs? (0 = no, 1 = yes)	0
MTRANS	Model transitional plume rise? (0 = no, 1 = yes)	1
MTIP	Apply stack tip downwash to point sources? (0 = no, 1 = yes)	1
MRISE	Plume rise module for point sources (1 = Briggs, 2 = numerical)	1
MTIP_FL	Apply stack tip downwash to flare sources? (0 = no, 1 = yes)	0
MRISE_FL	Plume rise module for flare sources (1 = Briggs, 2 = numerical)	2
MBDW	Building downwash method (1 = ISC, 2 = PRIME)	1
MSHEAR	Treat vertical wind shear? (0 = no, 1 = yes)	0
MSPLIT	Puff splitting allowed? (0 = no, 1 = yes)	0
MCHEM	Chemical transformation method (0 = not modeled, 1 = MESOPUFF II, 2 = User-specified, 3 = RIVAD/ARM3, 4 = MESOPUFF II for OH, 5 = half-life, 6 = RIVAD w/ISORROPIA, 7 = RIVAD w/ISORROPIA CalTech SOA)	0
MAQCHEM	Model aqueous phase transformation? (0 = no, 1 = yes)	0
MLWC	Liquid water content flag	1
MWET	Model wet removal? (0 = no, 1 = yes)	0
MDRY	Model dry deposition? (0 = no, 1 = yes)	0
MTILT	Model gravitational settling (plume tilt)? (0 = no, 1 = yes)	0
MDISP	Dispersion coefficient calculation method (1= PROFILE.DAT, 2 = Internally, 3 = PG/MP, 4 = MESOPUFF II, 5 = CTDM)	2
MTURBVW	Turbulence characterization method (only if MDISP = 1 or 5)	3
MDISP2	Missing dispersion coefficients method (only if MDISP = 1 or 5)	3
MTAULY	Sigma-y Lagrangian timescale method	0
MTAUADV	Advective-decay timescale for turbulence (seconds)	0
MCTURB	Turbulence method (1 = CALPUFF, 2 = AERMOD)	1
MROUGH	PG sigma-y and sigma-z surface roughness adjustment? (0 = no, 1 = yes)	0
MPARTL	Model partial plume penetration for point sources? (0 = no, 1 = yes)	1
MPARTLBA	Model partial plume penetration for buoyant area sources? (0 = no, 1 = yes)	0
MTINV	Strength of temperature inversion provided in PROFILE.DAT? (0 = no - compute from default gradients, 1 = yes)	0
MPDF	PDF used for dispersion under convective conditions? (0 = no, 1 = yes)	1
MSGTIBL	Sub-grid TIBL module for shoreline? (0 = no, 1 = yes)	0
MBCON	Boundary conditions modeled? (0 = no, 1 = use BCON.DAT, 2 = use CONC.DAT)	0
MSOURCE	Save individual source contributions? (0 = no, 1 = yes)	0
MFOG	Enable FOG model output? (0 = no, 1 = yes - PLUME mode, 2 = yes - RECEPTOR mode)	0
MREG	Regulatory checks (0 = no checks, 1 = USE PA LRT checks)	0

INPUT GROUP: 3 -- Species List		
Parameter	**Description**	**Value**
CSPEC	Species included in model run	PM10
CSPEC	Species included in model run	NOX

INPUT GROUP: 4 -- Map Projection and Grid Control Parameters		
Parameter	**Description**	**Value**
PMAP	Map projection system	UTM
FEAST	False easting at projection origin (km)	0.0
FNORTH	False northing at projection origin (km)	0.0
IUTMZN	UTM zone (1 to 60)	60
UTMHEM	Hemisphere (N = northern, S = southern)	S
RLAT0	Latitude of projection origin (decimal degrees)	0.00N
RLON0	Longitude of projection origin (decimal degrees)	0.00E
XLAT1	1st standard parallel latitude (decimal degrees)	30S
XLAT2	2nd standard parallel latitude (decimal degrees)	60S
DATUM	Datum-region for the coordinates	WGS-84
NX	Meteorological grid - number of X grid cells	85
NY	Meteorological grid - number of Y grid cells	100
NZ	Meteorological grid - number of vertical layers	10
DGRIDKM	Meteorological grid spacing (km)	0.15
ZFACE	Meteorological grid - vertical cell face heights (m)	0.0, 20.0, 40.0, 80.0, 160.0, 320.0, 640.0, 1200.0, 2000.0, 3000.0, 4000.0
XORIGKM	Meteorological grid - X coordinate for SW corner (km)	392.1250
YORIGKM	Meteorological grid - Y coordinate for SW corner (km)	5858
IBCOMP	Computational grid - X index of lower left corner	9
JBCOMP	Computational grid - Y index of lower left corner	70
IECOMP	Computational grid - X index of upper right corner	39
JECOMP	Computational grid - Y index of upper right corner	100
LSAMP	Use sampling grid (gridded receptors) (T = true, F = false)	F
IBSAMP	Sampling grid - X index of lower left corner	1
JBSAMP	Sampling grid - Y index of lower left corner	1
IESAMP	Sampling grid - X index of upper right corner	2
JESAMP	Sampling grid - Y index of upper right corner	2
MESHDN	Sampling grid - nesting factor	1

INPUT GROUP: 5 -- Output Options		
Parameter	**Description**	**Value**
ICON	Output concentrations to CONC.DAT? (0 = no, 1 = yes)	1
IDRY	Output dry deposition fluxes to DFLX.DAT? (0 = no, 1 = yes)	0

INPUT GROUP: 5 -- Output Options		
Parameter	**Description**	**Value**
IWET	Output wet deposition fluxes to WFLX.DAT? (0 = no, 1 = yes)	0
IT2D	Output 2D temperature data? (0 = no, 1 = yes)	0
IRHO	Output 2D density data? (0 = no, 1 = yes)	0
IVIS	Output relative humidity data? (0 = no, 1 = yes)	0
LCOMPRS	Use data compression in output file (T = true, F = false)	T
IQAPLOT	Create QA output files suitable for plotting? (0 = no, 1 = yes)	1
IPFTRAK	Output puff tracking data? (0 = no, 1 = yes use timestep, 2 = yes use sampling step)	0
IMFLX	Output mass flux across specific boundaries? (0 = no, 1 = yes)	0
IMBAL	Output mass balance for each species? (0 = no, 1 = yes)	0
INRISE	Output plume rise data? (0 = no, 1 = yes)	0
ICPRT	Print concentrations? (0 = no, 1 = yes)	0
IDPRT	Print dry deposition fluxes? (0 = no, 1 = yes)	0
IWPRT	Print wet deposition fluxes? (0 = no, 1 = yes)	0
ICFRQ	Concentration print interval (timesteps)	1
IDFRQ	Dry deposition flux print interval (timesteps)	1
IWFRQ	Wet deposition flux print interval (timesteps)	1
IPRTU	Units for line printer output (e.g., 3 = ug/m**3 - ug/m**2/s, 5 = odor units)	3
IMESG	Message tracking run progress on screen (0 = no, 1 and 2 = yes)	2
LDEBUG	Enable debug output? (0 = no, 1 = yes)	F
IPFDEB	First puff to track in debug output	1
NPFDEB	Number of puffs to track in debug output	1000
NN1	Starting meteorological period in debug output	1
NN2	Ending meteorological period in debug output	10

INPUT GROUP: 6 -- Subgrid Scale Complex Terrain Inputs		
Parameter	**Description**	**Value**
NHILL	Number of terrain features	0
NCTREC	Number of special complex terrain receptors	0
MHILL	Terrain and CTSG receptor data format (1= CTDM, 2 = OPTHILL)	2
XHILL2M	Horizontal dimension conversion factor to meters	1.0
ZHILL2M	Vertical dimension conversion factor to meters	1.0
XCTDMKM	X origin of CTDM system relative to CALPUFF system (km)	0.0
YCTDMKM	Y origin of CTDM system relative to CALPUFF system (km)	0.0

INPUT GROUP: 9 -- Miscellaneous Dry Deposition Parameters		
Parameter	**Description**	**Value**
RCUTR	Reference cuticle resistance (s/cm)	30
RGR	Reference ground resistance (s/cm)	10

INPUT GROUP: 9 -- Miscellaneous Dry Deposition Parameters		
Parameter	**Description**	**Value**
REACTR	Reference pollutant reactivity	8
NINT	Number of particle size intervals for effective particle deposition velocity	9
IVEG	Vegetation state in unirrigated areas (1 = active and unstressed, 2 = active and stressed, 3 = inactive)	1

INPUT GROUP: 11 -- Chemistry Parameters		
Parameter	**Description**	**Value**
MOZ	Ozone background input option (0 = monthly, 1 = hourly from OZONE.DAT)	1
BCKO3	Monthly ozone concentrations (ppb)	80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00
MNH3	Ammonia background input option (0 = monthly, 1 = from NH3Z.DAT)	0
MAVGNH3	Ammonia vertical averaging option (0 = no average, 1 = average over vertical extent of puff)	1
BCKNH3	Monthly ammonia concentrations (ppb)	10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00
RNITE1	Nighttime SO2 loss rate (%/hr)	0.2
RNITE2	Nighttime NOx loss rate (%/hr)	2
RNITE3	Nighttime HNO3 loss rate (%/hr)	2
MH2O2	H2O2 background input option (0 = monthly, 1 = hourly from H2O2.DAT)	1
BCKH2O2	Monthly H2O2 concentrations (ppb)	1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00
RH_ISRP	Minimum relative humidity for ISORROPIA	50.0
SO4_ISRP	Minimum SO4 for ISORROPIA	0.4
BCKPMF	SOA background fine particulate (ug/m**3)	1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00
OFRAC	SOA organic fine particulate fraction	0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15
VCNX	SOA VOC/NOX ratio	50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00
NDECAY	Half-life decay blocks	0

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters		
Parameter	**Description**	**Value**
SYTDEP	Horizontal puff size for time-dependent sigma equations (m)	550
MHFTSZ	Use Heffter equation for sigma-z? (0 = no, 1 = yes)	0
JSUP	PG stability class above mixed layer	5

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters		
Parameter	**Description**	**Value**
CONK1	Vertical dispersion constant - stable conditions	0.01
CONK2	Vertical dispersion constant - neutral/unstable conditions	0.1
TBD	Downwash scheme transition point option (<0 = Huber-Snyder, 1.5 = Schulman-Scire, 0.5 = ISC)	0.5
IURB1	Beginning land use category for which urban dispersion is assumed	10
IURB2	Ending land use category for which urban dispersion is assumed	19
ILANDUIN	Land use category for modeling domain	20
Z0IN	Roughness length for modeling domain (m)	.25
XLAIIN	Leaf area index for modeling domain	3.0
ELEVIN	Elevation above sea level (m)	.0
XLATIN	Meteorological station latitude (deg)	-999.0
XLONIN	Meteorological station longitude (deg)	-999.0
ANEMHT	Anemometer height (m)	10.0
ISIGMAV	Lateral turbulence format (0 = read sigma-theta, 1 = read sigma-v)	1
IMIXCTDM	Mixing heights read option (0 = predicted, 1 = observed)	0
XMXLEN	Slug length (met grid units)	1
XSAMLEN	Maximum travel distance of a puff/slug (met grid units)	1
MXNEW	Maximum number of slugs/puffs release from one source during one time step	99
MXSAM	Maximum number of sampling steps for one puff/slug during one time step	99
NCOUNT	Number of iterations used when computing the transport wind for a sampling step that includes gradual rise	2
SYMIN	Minimum sigma-y for a new puff/slug (m)	1
SZMIN	Minimum sigma-z for a new puff/slug (m)	1
SZCAP_M	Maximum sigma-z allowed to avoid numerical problem in calculating virtual time or distance (m)	5000000
SVMIN	Minimum turbulence velocities sigma-v (m/s)	0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.37, 0.37, 0.37, 0.37, 0.37, 0.37
SWMIN	Minimum turbulence velocities sigma-w (m/s)	0.2, 0.12, 0.08, 0.06, 0.03, 0.016, 0.2, 0.12, 0.08, 0.06, 0.03, 0.016
CDIV	Divergence criterion for dw/dz across puff (1/s)	0, 0
NLUTIBL	TIBL module search radius (met grid cells)	4
WSCALM	Minimum wind speed allowed for non-calm conditions (m/s)	0.5
XMAXZI	Maximum mixing height (m)	3000
XMINZI	Minimum mixing height (m)	50
TKCAT	Emissions scale-factors temperature categories (K)	265., 270., 275., 280., 285., 290., 295., 300., 305., 310., 315.
PLX0	Wind speed profile exponent for stability classes 1 to 6	0.07, 0.07, 0.1, 0.15, 0.35, 0.55

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters		
Parameter	**Description**	**Value**
PTG0	Potential temperature gradient for stable classes E and F (deg K/m)	0.02, 0.035
PPC	Plume path coefficient for stability classes 1 to 6	0.5, 0.5, 0.5, 0.5, 0.35, 0.35
SL2PF	Slug-to-puff transition criterion factor (sigma-y/slug length)	10
FCLIP	Hard-clipping factor for slugs (0.0 = no extrapolation)	0
NSPLIT	Number of puffs created from vertical splitting	3
IRESPLIT	Hour for puff re-split	0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0
ZISPLIT	Minimum mixing height for splitting (m)	100
ROLDMAX	Mixing height ratio for splitting	0.25
NSPLITH	Number of puffs created from horizontal splitting	5
SYSPLITH	Minimum sigma-y (met grid cells)	1
SHSPLITH	Minimum puff elongation rate (SYSPLITH/hr)	2
CNSPLITH	Minimum concentration (g/m**3)	0
EPSSLUG	Fractional convergence criterion for numerical SLUG sampling integration	0.0001
EPSAREA	Fractional convergence criterion for numerical AREA source integration	1E-006
DSRISE	Trajectory step-length for numerical rise integration (m)	1.0
HTMINBC	Minimum boundary condition puff height (m)	500
RSAMPBC	Receptor search radius for boundary condition puffs (km)	10
MDEPBC	Near-surface depletion adjustment to concentration (0 = no, 1 = yes)	1

INPUT GROUP: 13 -- Point Source Parameters		
Parameter	**Description**	**Value**
NPT1	Number of point sources	2
IPTU	Units used for point source emissions (e.g., 1 = g/s)	1
NSPT1	Number of source-species combinations with variable emission scaling factors	0
NPT2	Number of point sources in PTEMARB.DAT file(s)	0

INPUT GROUP: 14 -- Area Source Parameters		
Parameter	**Description**	**Value**
NAR1	Number of polygon area sources	0
IARU	Units used for area source emissions (e.g., 1 = g/m**2/s)	1
NSAR1	Number of source-species combinations with variable emission scaling factors	0
NAR2	Number of buoyant polygon area sources in BAEMARB.DAT file(s)	0

INPUT GROUP: 15 -- Line Source Parameters		
Parameter	**Description**	**Value**
NLN2	Number of buoyant line sources in LNEMARB.DAT file	0

INPUT GROUP: 15 -- Line Source Parameters		
Parameter	**Description**	**Value**
NLINES	Number of buoyant line sources	0
ILNU	Units used for line source emissions (e.g., 1 = g/s)	1
NSLN1	Number of source-species combinations with variable emission scaling factors	0
NLRISE	Number of distances at which transitional rise is computed	6

INPUT GROUP: 16 -- Volume Source Parameters		
Parameter	**Description**	**Value**
NVL1	Number of volume sources	0
IVLU	Units used for volume source emissions (e.g., 1 = g/s)	1
NSVL1	Number of source-species combinations with variable emission scaling factors	0
NVL2	Number of volume sources in VOLEMARB.DAT file(s)	0

INPUT GROUP: 17 -- FLARE Source Control Parameters (variable emissions file)		
Parameter	**Description**	**Value**
NFL2	Number of flare sources defined in FLEMARB.DAT file(s)	0

INPUT GROUP: 18 -- Road Emissions Parameters		
Parameter	**Description**	**Value**
NRD1	Number of road-links sources	0
NRD2	Number of road-links in RDEMARB.DAT file	0
NSFRDS	Number of road-links and species combinations with variable emission-rate scale-factors	0

INPUT GROUP: 19 -- Emission Rate Scale-Factor Tables		
Parameter	**Description**	**Value**
NSFTAB	Number of emission scale-factor tables	0

INPUT GROUP: 20 -- Non-gridded (Discrete) Receptor Information		
Parameter	**Description**	**Value**
NREC	Number of discrete receptors (non-gridded receptors)	929
NRGRP	Number of receptor group names	0

CALPUFF View - Source Parameters
MS Excel - Lakes Format
V_2.0

Parameters	Units	Description
Type =		POINT, AREA, AREA_POLY, AREA_CIRC, VOLUME, or LINE, LINE_VOLUME, LINE_AREA, ROAD
ID =		Source ID up to 8 characters
Desc =		Optional description
SourceID_Prefix =		Text prefix up to 8 characters long for generated LINE_VOLUME and LINE_AREA sources
Base_Elev =	[m]	Source base elevation above mean sea level
Height =	[m]	Release height above ground
Diam =	[m]	Stack diameter or AREA_CIRC radius (POINT and AREA_CIRC only)
Exit_Vel =	[m/s]	Exit velocity (POINT only)
Exit_Temp =	[K]	Exit temperature (POINT only)
Moment_Flux =		Momentum flux factor (POINT only) - If blank 1 is used
Length_X	[m]	X Side Length (AREA only)
Length_Y	[m]	Y Side Length (AREA only)
Rotation Angle	[deg]	Rotation Angle (AREA only)
SigmaY =	[m]	Initial sigma Y (POINT, VOLUME and ROAD only, optional for POINT)
SigmaZ =	[m]	Initial sigma Z (POINT, all AREA, VOLUME and ROAD only, optional for POINT)
Configuration		LINE_VOLUME configuration: Separated, Adjacent or Separated2W
LineVolumeType		LINE_VOLUME type: None, Surface-Based, Elevated, Elevated Building
LineVolumeHeight	[m]	Plume Height or Building Height for LINE_VOLUME source
SO2 =	project emission units	Emission rate for species SO2 (change name for different species)
…	project emission units	Add columns for additional emission rates with species name as the header (e.g., TOLUENE, etc.)
Num_Coords =		Number of coordinate pairs (POINT = 1, VOLUME = 1, LINE = 2, AREA = 1, AREA_POLY >= 3, CIRCLE AREA = 1)
X1 =	[m]	X coordinate of source location [m]
Y1 =	[m]	Y coordinate of source location [m]
X2 =	[m]	Secondary X coordinate of source location [m] (AREA_POLY and line sources only)
Y2 =	[m]	Secondary Y coordinate of source location [m] (AREA_POLY and line sources only)
X3 =	[m]	Additional X coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA, ROAD only)
Y3 =	[m]	Additional Y coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA, ROAD only)
X4 =	[m]	Additional X coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA, ROAD only)
Y4 =	[m]	Additional Y coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA, ROAD only)
X5 =	[m]	Additional X coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA, ROAD only)
Y5 =	[m]	Additional Y coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA, ROAD only)
Line_MXNSEG =		Maximum number of segments for each line (LINE source only)
Line_NLRISE =		Number of distances used to tabluate plume rise (LINE source only)
Line_FPRIMEL =	[m**4/s**3]	Average buoyance parameter (LINE source only)
Line_XL =	[m]	Building Length (LINE source only)
Line_HBL =	[m]	Building Height (LINE source only)
Line_WBL =	[m]	Building Width (LINE source only)
Line_WML =	[m]	Line Source Width (LINE source only)
Line_DXL =	[m]	Separation between buildings (LINE source only)
Base_Elev_m	[m]	Base Elevation for LINE_VOLUME, LINE_AREA, ROAD Nodes
Rel_Height_m	[m]	Release height for LINE_VOLUME, LINE_AREA Nodes

Type	ID	Desc	SourceID_Prefix	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Moment_Flux	PM10	NOX	Num_Coord	X1	Y1
				[m]	[m]	[m]	[m/s]	[K]						
POINT	VENT_8	Vent 8		215.32	8	5.5	16	20	1	0.34	1.04	1	395634	5871084
POINT	VENT_9	Vent 9		285.36	8	5.5	16	20	1	0.34	1.04	1	395608	5870436

B

Appendix B – Draft Air Quality Management Plan

Waihi North Project – Wharekirauponga Underground Mine - DRAFT Air Quality Management Plan

Prepared for Oceana Gold (New Zealand) Ltd

Prepared by Beca Limited

24 February 2025

Creative people together transforming our world

Revision History

Revision Nº	Prepared By	Description	Date
A	Graeme Jenner	First draft for client review	19 January 2021
B	Graeme Jenner	Second Draft incorporating client review comments	4 February 2021
C	Mathew Noonan and Graeme Jenner	Third draft incorporating updated project description	8 July 2021
D	Mathew Noonan and Graeme Jenner	Fourth draft incorporating updated project description	16 December 2021
E	Mathew Noonan and Graeme Jenner	Fifth draft incorporating updated project description	24 February 2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Mathew Noonan and Graeme Jenner		24 February 2025
Reviewed by	Rhys Kevern		24 February 2025
Approved by			24 February 2025
on behalf of	Beca Limited		

Contents

Appendices

1 Introduction

1.1 Background

OceanaGold New Zealand Ltd (OGNZL) operates an open cut and underground gold mining operation at Waihi in the Waikato Region.

Ongoing exploration of the Wharekirauponga orebody, which lies approximately 11 km northwest of the mine Processing Plant, has identified mineral resources that OGNZL wishes to mine.

OGNZL proposes to establish a new underground mine beneath Department of Conservation land (Coromandel Forest Park), two decline tunnels to the orebody from OGNZL land at Willows Road, an ore transport tunnel connecting with the existing Processing Plant in Waihi town and associated surface infrastructure on OGNZL land at Willows Road to enable development of the Wharekirauponga Underground Mine (WUG). These new activities will form a key element of the Waihi North Project (WNP) which will allow OGNZL to extend ore production until 2036.

The work involves activities that could generate nuisance dust at the nearest privately owned dwellings on Willows Road if not adequately managed.

1.2 Purpose

The purpose of this draft Air Quality Management Plan (AQMP) is to provide a framework for the management and mitigation of discharges of dust from the Willows Road site work. The AQMP provides supporting information to the application made by OGNZL for an air discharge consent at the site under the Fast track Approvals process. The AQMP will be updated and finalised following granting of consent.

The AQMP is a working document and will be regularly reviewed and revised (if required) as site activities progress.

1.3 Air Quality Control Objectives

The air quality control objectives of this AQMP are to:

- Mitigate dust emissions from all operations
- Ensure compliance with resource consent conditions, including maintaining the air quality monitoring program
- Manage point and non-point source air emissions to protect human health and the environment
- Monitor areas of community concern
- Ensure that other emissions are within Workplace Exposure Standards and are not objectionable or offensive
- Respond quickly to complaints and non-compliances and to communicate mitigation undertaken
- To continue to identify best practicable options and investigate and trial new methods, products and technologies to further minimise and mitigate the adverse effects of dust.

1.4 Guidance Documents

This AQMP has been prepared to comply with OGNZL's Environmental Compliance Standard (see **Appendix A**) and is consistent with the AQMP prepared by OGNZL for the Martha, Favona. Trio and

Correnso Mines[1]. The AQMP has also been prepared in accordance with Appendix 4 of the *Good Practice Guideline for Assessing and Managing Dust* (GPG Dust)[2] that describes the items that should be included in a dust management plan.

1.5 Resource Consent

The site activities are subject to the conditions included in Consent **xxx**, granted by xxx on **yyy**. A copy of Consent **xxx** is attached as **Appendix B.**

[1] OceanaGold NZ Ltd (2016) *Air Quality Management Plan (Martha, Favona, Trio and Correnso Mines*) WAI-200-PLN-012 (Revision 6.4 November 2019)

[2] Ministry for the Environment. *2016. Good Practice Guide for Assessing and Managing Dust. Wellington:* Ministry for the Environment. (November 2016). Publication No. ME 1277.

2 Project Description and Surrounding Environment

2.1 Overview

The new tunnels and mine will be developed by drilling and blasting using modern drilling jumbos, rock loading units and supporting equipment.

The key features of the project that may affect air quality for a limited period, particularly during construction, are shown on the site plan and the plan showing the tunnel alignments and ventilation shaft locations (see **Appendix C).** These include:

- Topsoil stripping and storage
- Tunnel portals
- Rock stack and clean and dirty water collection ponds
- Site access and haul roads
- Explosive magazines/emulsion storage
- Heliipad
- Mine ventilation system and raises
- Noise earth bunds
- Package sewage treatment plant and soakaway area
- Rehabilitation.

Development of these features will involve earthworks and storage of material during construction, which could produce dust under dry, windy weather conditions.

There will be no crushing or other processing of the excavated rock at the Willows Road site.

2.2 Site Meteorological Conditions

There is no long-term meteorological data available for the Willows Road site. However, the nearest climate station operated by OGNZL at Barry Road in Waihi, provides a good indication of likely wind conditions at the site. The windrose (see **Figure 1**) shows hourly average windspeed and directions for the years 2017 to 2024. The prevailing and strongest winds come from the west and south-westerly directions. Weaker secondary winds come from the northeast and occur for approximately 10.6% of the time, while winds from other directions are rare.

The average wind speed measured in the 2017 – 2024 period was 2.6 m/s and calms occurred for 10.6% of the time. Winds which exceed 5 m/s from the southwest to west, which is the critical wind speed for the lifting of dust from unconsolidated surfaces, occurred for approximately 15.6% of the time.

The local topography at the site is complex and is likely to influence local wind conditions. The site may be sheltered to some extent from the prevailing southwest to westerly winds, but these may also be channelled in a more north-westerly direction down the gully between the two steep hills on the southerly and northern sides of the site. These local variations in wind direction may result in winds blowing across the site being deflected towards several privately owned houses near the eastern/southeastern boundaries of the site on Willows Road (specifically 121 and 122 Willows Road).

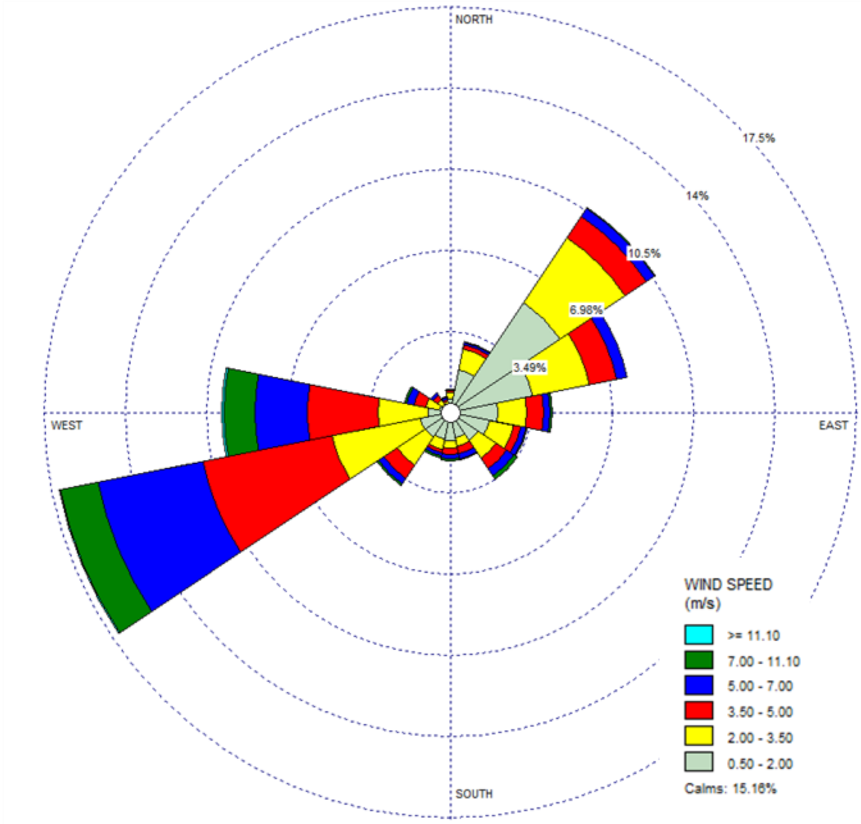

Figure 1 Windrose showing hourly average wind speed and directions at the OGNZL Barry Road Climate Station (April 2017 to April 2024

2.3 Sensitive Receptors

2.3.1 Human receptors

The risk from dust emissions depends on the proximity of receptors to dust generating activities and the frequency and duration of meteorological conditions that are conducive to the transport of dust (ie dry conditions with strong winds in the direction of receptors).

There are several sensitive human receptors (dwellings) in the vicinity of the boundary of the Willows Road project area (see plan in **Appendix C**). The main land use in the vicinity of the site is pastoral farming and the only current sources of air contaminants are those typical of rural areas such as unsealed roads, unvegetated fields and domestic heating.

The nearest dwelling at 132 Willows Road is owned by OGNZL. Privately owned dwellings (at 111A - 111B Willows Road) are located approximately 145 m to the east and southeast of the likely largest potential dust source i.e. the 3ha topsoil stockpile area at its closest point. Another privately owned dwelling at 122 Willows Road lies a little further from the topsoil area (approximately 245m from the areas at its closest point). The topsoil stockpile is only likely to be source of dust during strong dry wind conditions and while being formed. Once established and vegetated it should cease to be a significant source of dust.

The closest noise earth bund is located approximately 109 m to the west northwest of the dwelling at 122 Willows Road at its closest point. However, the noise bund is a relatively small source of dust compared with the topsoil stockpile area. The bund will only be a potential source of dust during construction and until such time that a vegetation cover is established.

There are also a group of dwellings located to the southwest of the project area on Highland Road. The magazine access road lies at least 350 m to the northeast of these dwellings on Highland Road at its closest point.

The rock stack and the mine haul road from the mine portal are located approximately 400 m to the northwest of the OGNZL owned house and 500 m from the nearest privately owned dwellings on Willows Road at their closest points. The portal and nearest ventilation raise are located at least 650 m to the northwest of the closest privately owned dwelling on Willows Road and 700 m to the north of the nearest dwelling on Highland Road.

2.3.2 Ecological receptors

Construction of the tunnel ventilation system and raises will occur within areas of native forest within the DoC estate (Coromandel Forest Park). Native vegetation will be treated as sensitive to dust and accumulation of dust avoided as far as practicable.

The general area of the proposed tunnel vent raises (vents) includes habitat for an endangered frog species (Archey's frog).

3 Responsibilities

3.1 Overview

OGNZL as the holder of Consent **xxx** has responsibility to ensure that all statutory requirements and consent conditions are complied with and that all site activities are carried out in accordance with the requirements of the AQMP.

3.2 General Manager

The General Manager has overall responsibility to ensure that legal and other requirements in this AQMP are fulfilled and the appropriate resources are available.

3.3 Health, Safety and Environment Manager

The Health, Safety and Environment Manager is responsible for:

- Fulfilment of all site monitoring and reporting requirements under the air discharge consent and this Plan
- Developing, implementing and maintaining the site air quality management programme identified in this Plan
- Identifying and communicating all site mitigation actions identified in this Plan (in conjunction with the Company Liaison Officer)
- Review of this Plan on at least an annual basis, or sooner if required by changing site activities.

3.4 Site Supervisors

Site Supervisors are responsible for:

- Ensuring that site air emission controls are maintained and utilised
- Ensuring that all site employees are aware of the requirements of this Plan and are inducted and trained in air quality management and mitigation procedures
- Ensuring that appropriate site maintenance procedures and conditions of contracts with air quality implications are supervised and enforced.

3.5 Company Liaison Officer

The Company Liaison Officer is responsible for responding to complaints and liaising with the community. The Company Liaison Officer has delegated authority to require that site mitigation measures be undertaken to meet consent requirements and respond to any complaints received from the community.

3.6 Site Services Manager/Underground Manager/Contractors

The Site Services Manager and Underground Manager have delegated responsibility for overseeing any surface and underground contractors ensuring compliance with regulatory requirements. All site Contractors are subject to a prequalification assessment to ensure that they have effective environmental and external relations procedures in place. Contracts with OGNZL include "*Special Conditions for Environmental Protection and External Relations Procedures*" which includes reference to site consents that must be complied with.

3.7 Contractors

All contractors working on site are responsible for ensuring that their activities comply with the requirements of the AQMP and the directions of the Site Supervisor.

4 Complaints Response

4.1 Overview

Complaints may be referred by one or more of Waikato Regional Council, a member of the public or a member of the site team. The Health, Safety and Environment Manager is responsible for ensuring suitably qualified personnel are available to respond to complaints at all times. It is the responsibility of the Company Liaison Officer to respond to and follow up all complaints regarding dust.

For the duration of the project, a Complaints Register will be maintained by the Company Liaison Officer and forwarded to the Consents Compliance Manager at the Waikato Regional Council on request.

4.2 Actions to be Carried out Following Receipt of a Complaint

As soon as possible after receipt of a complaint, the Health, Safety and Environment Manager will:

- Undertake a site inspection and note all dust generating activities taking place and the mitigation methods being used
- Visit the area from where the complaint originated to ascertain if dust is still a problem (as soon as possible ie within 2 hours, where practicable). If it becomes apparent that there may be a source of dust other than from the project site, it is important to verify this (take photos of the source and emissions)
- Liaise with the Site Supervisors and Company Liaison Officer and if necessary, undertake any remedial actions to prevent any recurrence of the problem.

As soon as possible after initial investigations have been completed, the Company Liaison Officer will contact the complainant to explain any problems found and remedial actions taken.

As soon as practicable following receipt of a complaint, the Company Liaison Officer will notify the Consents Compliance Manager, Waikato Regional Council. The following details will be logged in the Complaint Register:

- Type and time of complaint
- Description of emission (constant/intermittent; duration, time of day)
- Name and address of complainant (if available)
- Location from which the complaint arose
- Wind direction and wind speed at the time of complaint based on monitored wind speed (or alternatively estimate from the Beaufort Scale[3] in **Appendix D**)
- The likely cause of the complaint
- The response made by the consent holder
- The action taken or proposed as a result of the complaint.

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[3] The Beaufort Scale is a system for estimating wind strengths without the use of instruments, based on the effects wind has on the physical environment. The behaviour of smoke, waves, trees, etc., is rated on a 13-point scale of 0 (calm) to 12 (hurricane).

5 Induction and Training

It is the responsibility of the Site Supervisor to implement an induction and on-going training programme for all staff and contractors. The purpose of this programme is to make all personnel working on site aware of, and understand, the purpose and requirements of the AQMP, the air discharge consent conditions and the ramifications of a failure to comply with these requirements.

The training programme for all staff and contractors will include at least the following aspects:

- Responsibilities for carrying out the work on site in a manner which does not result in adverse effects on the environment and local residents and in accordance with resource consent conditions
- The potential legal ramifications of adverse environmental effects occurring as a result of the project and non-compliance with resource consent conditions
- The minimum requirements for dust control for all activities on site
- The requirements to monitor weather and visually inspect the site for dust discharges, assess the adequacy of dust control methods and implement additional dust control methods when required
- The actions to be taken in an extreme dust and weather event
- The actions to be taken if a complaint is received from the public or consent authority.

Additional training will be provided to water cart drivers and site supervisors, in assessing whether sufficient water has been applied for effective dust suppression.
Staff and contractors will be regularly updated on any changes or amendments to the AQMP or improvements in site air quality management.

6 Dust Sources and Risks

6.1 Nature of Dust

Dust is comprised of a wide range of size fractions. The larger settleable material (generally greater than 50 µm in diameter) can soil surfaces and cause irritation to eyes and the nose. However, because it is relatively large, settleable material is usually deposited onto the ground in open areas within a short distance (approximately 100 - 200 m) from the source.

Dense vegetation acts as a filter to dust emissions, with dust being captured on the leaves. Consequently, where earthworks are carried out in areas of bush, dust is unlikely to penetrate more than 10-20m from the source.

The finer fractions of dust (commonly referred to as total suspended particulate or TSP), are generally less than 20 µm in diameter and can be transported larger distances downwind. The portions of TSP that pose the greatest risk to health are those less than 10 µm in diameter (known as PM_{10}) and particulates less than 2.5 µm in diameter (known as $PM_{2.5}$). The major source of finer particulate (i.e., $PM_{2.5}$) in the atmosphere is from the products of combustion. While most of the particulate generated from the site surface activities will be larger fractions (i.e. greater than 10 µm), a portion will fall into the smaller size ranges.

Material to be excavated at the site may contain crystalline silica. Consequently, the dust created during any mechanical processes will also contain a proportion of crystalline silica. Fine particles of crystalline silica (less than 10 µm) that can be inhaled deep into the lungs, known as respirable silica, can cause significant adverse human health effects (silicosis) if people are exposed to concentrations above recommended guideline levels over extended periods of time. Mechanical crushing is not proposed at the project site but some minor amounts of finer dust, that may contain crystalline silica, may still be generated at the rock stacks and during materials handling and from vehicle movements on unpaved roads.

6.2 Dust Sources

The activities that have the potential to generate dust at the site include.

- Earthworks and topsoil stripping and storage
- Construction of tunnel portals
- Construction of rock stack and collection ponds
- Construction of site access and haul roads
- Construction of tunnel ventilation system and raises
- Construction of noise earth bunds
- Rehabilitation of surface areas after development of the tunnel.

6.3 Dust Generation Factors

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

- Wind speed across the surface (the critical wind speed for dust pick-up from surfaces without disturbances such as traffic is 5m/s - above 10m/s the pick-up increases significantly)
- The percentage of fine particles in the material on the surface
- Moisture content of the material
- The area of exposed surface
- Vehicle movements on unconsolidated surfaces.

6.4 Risks from Dust

The assessment of air discharge effects[4] has identified that in the absence of appropriate mitigation, there is a moderate to high risk of infrequent, short duration adverse dust effects from the 3ha topsoil stockpile area at the privately owned dwelling at 121 Willows Road and a moderate risk at the dwelling at 122 Willows Road. There is also a lower risk of exposure to an increase in dust is a result of other nearby surface construction earthworks (particularly noise bunds).

The risk of dust generated from other site activities, such as rock stack and tunnelling, adversely affecting residences in the proximity of the project is considered to be low.

While the risk of dust adversely affecting native flora and fauna is considered very low, the generation of dust will be minimised during the construction of the ventilation raise using the mitigation methods described in Section 7.

[4] Beca Ltd, 2021; *WNP Air Discharges – Exploration and Connection Tunnels*

7 Dust Mitigation and Monitoring

7.1 Mitigation

OGNZL will use the following methods to control dust from site activities:

7.1.1 Earthworks, topsoil stripping and storage

- Keep exposed areas to a minimum and re-vegetate as soon as practicable
- Use water to dampen surfaces where practicable and necessary
- Plan potentially dusty activities such as stripping and spreading of topsoil for days when low wind conditions are predicted.

7.1.2 Vehicles and roads

- Limit vehicle speeds on haul and access roads around the site
- Seal the most used access roads (the main entrance road to the site will be sealed)
- Minimise haul distances as far as practicable
- Regularly grade unsealed roads and keep laid with fresh gravel/rock
- Use approved surface binding agents for dust control where practicable and cost-effective
- Require traffic to use wheel wash facilities located at main exits to prevent mud and debris being tracked offsite
- Use battery powered vehicles and equipment on site where practicable.

7.1.3 Loading and unloading topsoil and rock

- Require machinery operators to minimise drop heights when unloading topsoil and rock to stockpiles and rock stack
- As far as practicable, dampen topsoil before it is moved.

7.1.4 Exposed surfaces (topsoil/rock stockpiles; noise bund and yard areas)

- As far as practicable, keep operational areas around stockpiles damp using water carts
- Plant and maintain sustainable vegetation cover on topsoil stockpiles and the noise bund (grassed or hydroseeded) to prevent erosion and dust generation
- Seal the yard areas surrounding the most trafficked areas
- Use screens and fences, if practicable, in dust prone areas.

7.1.5 Tunnelling (portals and ventilation system)

- Dampen exposed surfaces and muck piles using water carts
- Limit vehicle speeds
- Use electric powered vehicles and equipment where practicable
- Monitor underground air quality (ie particulates, CO, NOx) to ensure that Workplace Exposure Standards (2020) set by Worksafe NZ are met.

7.2 Monitoring Programme

Ongoing visual monitoring of dust across the site will be undertaken during construction and operation of the project. Weather forecasts will be checked daily (wind and rainfall) to assist with planning site activities and dust controls.

Table 1 outlines the site dust monitoring programme that will be implemented when surface infrastructure is being installed and during operations. It should be noted that in the instance of strong winds, observations of dust moving off-site or a complaint, the monitoring will be undertaken more regularly.

Table 1 - Dust Monitoring Programme

Monitoring Activities	Frequency
Check weather forecasts for strong winds and rainfall	Daily
Observe weather conditions via observations site weather station	Daily and as conditions change
Check TSP readings (see trigger values and actions in Table 8-2)	Daily and Hourly in winds over 5m/s (as per site weather station).
Inspect dust generating activities (earthworks, internal roads and stockpiles) to ensure dust emissions are effectively controlled. Complete dust inspection log.	Daily and as new activities are commenced.
Inspect water carts to ensure equipment is functioning effectively	Weekly, otherwise Daily when operating
Monitor dust generating activities	In winds over 5 m/s (as per site weather station)

7.3 Weather and TSP Monitoring Station

A weather and dust (TSP) monitoring station will be located in the vicinity of the OGNZL- owned dwelling (see **Figure 2**) which measures meteorological information and total suspended particulate (TSP). The purpose of this monitoring is to measure short term (< 1 hour) dust concentrations and wind conditions. Telemetry will provide alarms to site supervisors when trigger levels (TSP concentration limits or winds above 5 m/sec) are exceeded with the outputs of the instruments used to trigger additional dust control measures. During dry weather conditions, winds above 10 m/sec are a signal for contributing dust generating activities to cease until conditions improve.

Based on information obtained at the monitoring station, the wind speed and TSP trigger levels will be applied for reviewing and temporarily ceasing work. These trigger levels are based on levels recommended in the Good Practice Guideline - Dust and are summarised in **Table 2**.

The monitoring will continue until at least vegetation is fully established on topsoil stores and the noise bunds and the construction of the surface infrastructure is complete.

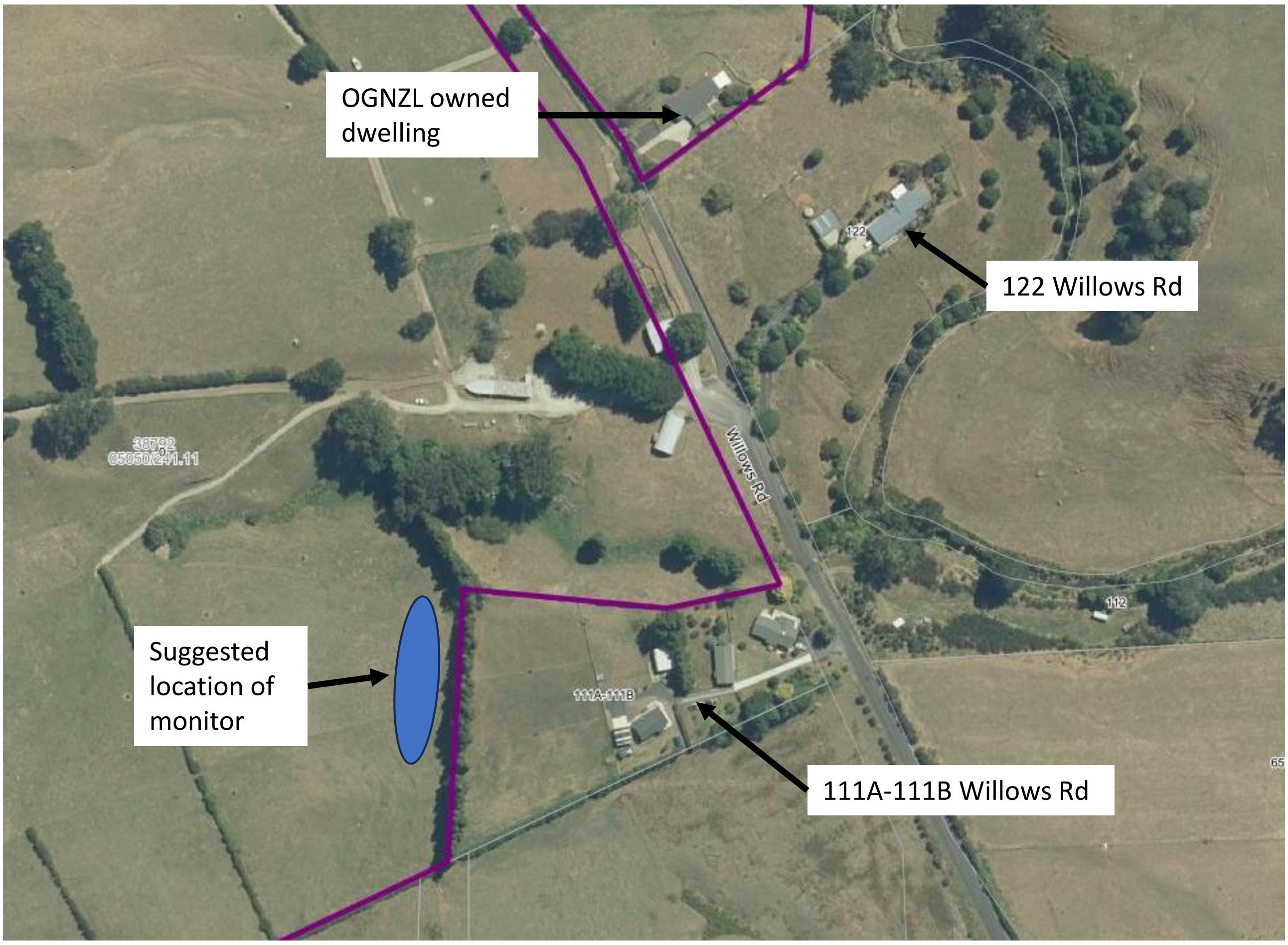


Figure 2. Plan showing location of weather monitoring station

Table 2 Trigger values for TSP concentrations and wind speeds

Item	Trigger	Action
TSP Alert	TSP concentration (1-hour average) **exceeds 170 µg/m^3.**	Dust sources and dust control measures within 200 m of sensitive receptors on Willows Road will be reviewed and additional dust control methods shall be implemented if necessary, as detailed in the site AQMP.
TSP Alarm	TSP concentration (1-hour average) **exceeds 200 µg/m^3** Or TSP concentration (24-hour average) **exceeds 60 µg/m^3**	Contributing dust generating activities will cease within 200 m of sensitive receptors on Willows Road except for dust control activities as detailed in the AQMP.
Wind Speed Alert	Rolling hourly average wind speeds **exceed 5 m/s** and winds are blowing towards sensitive receptors.	Dust sources and dust control measures within 200 m of sensitive receptors on Willows Road will be reviewed and additional dust control methods shall be implemented if necessary, as detailed in the site AQMP.

Wind Speed Alarm (note does not apply during rain events)	Rolling hourly average wind speeds **exceed 7.5 m/s** and winds are blowing towards sensitive receptors.	Contributing dust-generating activities will cease within 200 m of sensitive receptors on Willows Road except for dust control activities as detailed in the site AQMP.

8 Reporting

The Site Supervisor will complete a daily dust inspection log form and maintain the record on site. The following information will be recorded:

- Any dust control equipment malfunctions and any remedial actions taken
- Results of visual inspections of dust emissions and dustfall (refer Section 7.2)
- General weather conditions (eg windy/calm, warm/cool, rain/dry); (refer Section 7.2)
- Frequency of water cart/sprinkler (as appropriate) use.

Air quality monitoring data is kept in a database and reviewed as it is entered against applicable trigger levels and consent limits. OGNZL will notify the Consents Compliance Manager, Waikato Regional Council of any non-compliance as soon as practicable.

Results from monitoring and other air quality matters including any complaints/responses and subsequent mitigation will be summarised in an Annual Air Quality Monitoring Report and submitted to the Consents Compliance Manager, Waikato Regional Council.

The Annual Air Quality Monitoring Report will:

- Summarise all relevant air quality data/information for the previous calendar year as required by consent
- Summarise any trends arising from the monitoring programme
- Comment on consent compliance and any difficulties in achieving compliance with consent conditions
- Describe any additional mitigation or works undertaken (or proposed) to improve air quality performance will be described.

9 Review

The site AQMP will be reviewed at least annually by the Health, Safety and Environment Manager to ensure that the procedures and controls are up to date. More frequent updating of the Plan may occur in response to a change in site activities, or in response to a complaint or consent non-compliance.

The review will consider:

- Compliance to date with consent conditions and AQMP requirements
- Any significant changes to site activities or methods since the previous review
- Any changes to key site roles and responsibilities since the previous review
- Results of inspections, monitoring, and reporting procedures associated with the management of site air quality
- Any comments or recommendations from the Waikato Regional Council regarding site operations
- Unresolved complaints and/or any remedial actions undertaken in response to complaints.

Site staff will be informed of any significant changes through regular communication processes. The updated AQMP will be forwarded to the Consents Compliance Manager, Waikato Regional Council.

A

Appendix A – OGNZL Environmental Compliance Standard

Environmental Performance Standards
Doc ID OGC-450-STD-019-0

Operational Environmental Standards

7 Air Quality

Purpose

To ensure effective control measures and monitoring programs are implemented by Business Units to manage emissions and mitigate air quality impacts, to the environment and to comply with relevant regulatory requirements.

Minimum Standards

7.1 Business Unit shall document systems and processes that demonstrate how air quality is monitored and managed to meet relevant regulatory requirements as a minimum.

7.2 Baseline air quality conditions shall be characterised prior to the construction of new facilities and extensions to existing facilities.

7.3 Business units shall identify all affected external receivers and applicable air quality criteria to be achieved.

7.4 Business Units shall identify all point source and diffuse source forms of air emissions for the mine life cycle including construction, operation and closure.

7.5 Business Units that emit mercury and mercury compounds to air from point sources are to demonstrate the use of controls aligned to best available techniques and best environmental practices (Minamata Convention).

7.6 Document the operational controls to be implemented to minimise dust generation from the Business Unit to avoid or mitigate impacts on the local community.

7.7 Plant and facilities shall be designed, constructed and operated with appropriate air emission controls in order to comply with the host country's applicable laws and regulations.

7.8 Risk assessments shall be conducted to identify the risk exposure associated with air quality and the effectiveness of implemented controls.

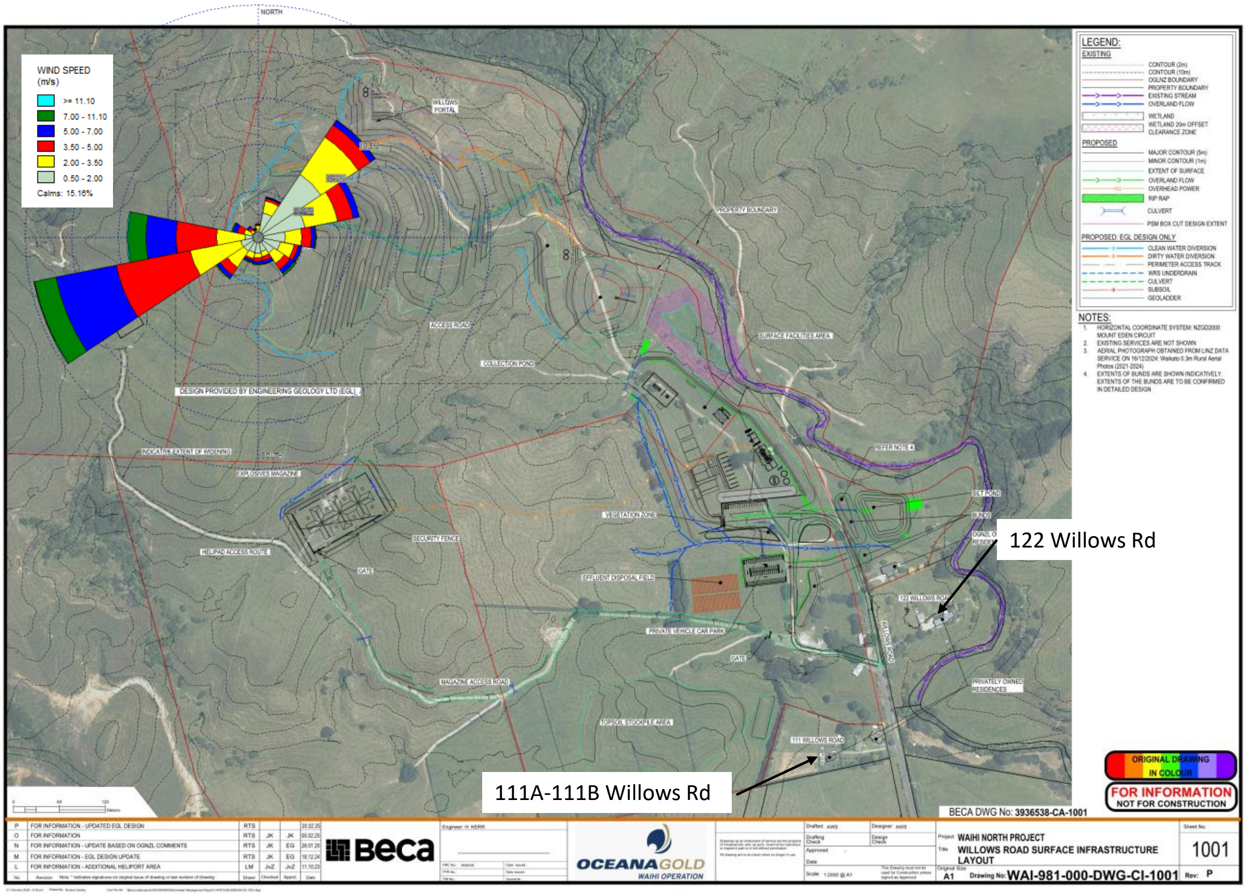
7.9 Monitoring systems and programs shall be established to ensure Business Units operate in compliance, including a mechanism for assessing air quality monitoring results against the relevant air quality criteria.

B

Appendix B – Resource Consent

C

Appendix C – Site Plan Showing Locations of Sensitive Receptors


NORTH
WIND SPEED (m/s)
>= 11.10
7.00 - 11.10
5.00 - 7.00
3.50 - 5.00
2.00 - 3.50
0.50 - 2.00
Calms: 15.16%
122 Willows Rd
111A-111B Willows Rd
111 WILLOWS ROAD
ORIGINAL DRAWING IN COLOUR
FOR INFORMATION NOT FOR CONSTRUCTION
BECA DWG No: 3936538-CA-1001
Project WAIHI NORTH PROJECT
Title WILLOWS ROAD SURFACE INFRASTRUCTURE LAYOUT
Sheet No. 1001
Scale 1:2000 @ A1
Original Size A1
Drawing No: WAI-981-000-DWG-CI-1001
Rev: P
P FOR INFORMATION - UPDATED EGL DESIGN
O FOR INFORMATION
N FOR INFORMATION - UPDATE BASED ON OGNZL COMMENTS
M FOR INFORMATION - EGL DESIGN UPDATE
L FOR INFORMATION - ADDITIONAL HELIPORT AREA
Beca
OCEANAGOLD WAIHI OPERATION

D

Appendix D – Beaufort Scale

Beaufort Wind Scale

Wind Force	Description	km/h	mph	knots	Specifications
0	**Calm**	<1	<1	<1	Smoke rises vertically
1	**Light Air**	1-5	1-3	1-3	Direction shown by smoke drift but not by wind vanes
2	**Light Breeze**	6-11	4-7	4-6	Wind felt on face; leaves rustle; wind vane moved by wind
3	**Gentle Breeze**	12-19	8-12	7-10	Leaves and small twigs in constant motion; light flags extended
4	**Moderate Breeze**	20-28	13-18	11-16	Raises dust and loose paper; small branches moved.
5	**Fresh Breeze**	29-38	19-24	17-21	Small trees in leaf begin to sway; crested wavelets form on inland waters.
6	**Strong Breeze**	38-49	25-31	22-27	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
7	**Near Gale**	50-61	32-38	28-33	Whole trees in motion; inconvenience felt when walking against the wind.
8	**Gale**	62-74	39-46	34-40	Twigs break off trees; generally impedes progress.
9	**Strong Gale**	75-88	47-54	41-47	Slight structural damage (chimney pots and slates removed).
10	**Storm**	89-102	55-63	48-55	Seldom experienced inland; trees uprooted; considerable structural damage
11	**Violent Storm**	103-117	64-72	56-63	Very rarely experienced; accompanied by widespread damage.
12	**Hurricane**	118 plus	73 plus	64 plus	Devastation