



APPENDIX L

Air Quality Assessment
(BECA)

Report

Project Martha - Assessment of Environmental Effects of Discharges to Air

Prepared for Anderson Lloyd

Prepared by Beca Limited

13 March 2018



Revision History

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on behalf of	Beca Limited		

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Executive Summary

Oceana Gold (New Zealand) Limited (OGNZL) operates an open cut and underground gold mining operation at Waihi in the Waikato Region. At current mining and processing rates the existing consented mineral resource for the Waihi operation will be exhausted in late-2019. Ongoing exploration and mine optimisation has identified further mineral resources that can be economically recovered. The new activities, referred to as Project Martha, comprise the following inter-related elements:

- Martha Phase 4 pit (MP4); and
- The Martha Underground including the Rex orebody.

Project Martha will continue to use the existing facilities, including the Process Plant (mill and water treatment plants), Tailings Storage Facilities TSF1A and TSF2, the conveyor, ponds, access roads, and crushing plant and will also use the previously consented Cemented Aggregate Fill (CAF) plant. The mining and ore processing rates and the intensity of operations over the Project Martha site will be similar to recent activity levels at the Waihi mine. The project is expected to continue for approximately eleven years.

The nature of the air emissions from the mine will not change as a result of this project, as the type of activities carried out will be the same as those currently and previously undertaken. However, the location and scale of some of the individual air emission sources will change as a result of some of the new mine features.

The results of ambient air quality monitoring and the complaints history for the site demonstrate that any increase above background concentrations of deposited dust, total suspended particulate (TSP), fine particles less than 10 microns in diameter (PM₁₀) 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 and within the current resource consent and permitted activity limits. The concentrations of PM₁₀ measured in Waihi are comparable to concentrations in other small towns in the Waikato Region.

The assessment of potential effects described in this report has identified that there is a risk of sensitive receptors, located within 100m of the proposed activities being exposed to infrequent, short duration discharges of deposited dust and TSP during dry windy conditions. In order to mitigate this risk it is recommended that some additional mitigation measures are implemented on site when weather conditions are conducive to the generation of dust.

The concentrations of PM₁₀, respirable silica, nitrogen oxides (NO₂ and NO) and carbon monoxide (CO) are expected to remain within the National Environmental Standards for Air Quality (NESAQ), guideline values and current consent limits beyond the boundary of the mine.

The assessment of effects described in this report concludes that, providing OGNZL continues to use the methods currently used to minimise discharges to air and adopts the additional mitigation measures recommended in this report, the adverse effects of discharges to air from Project Martha will be adequately avoided and mitigated. As a result, the likelihood that these discharges will result in noxious, dangerous, offensive or objectionable effects is considered to be low. Overall, the potential adverse effects of the discharges to air resulting from Project Martha are expected to be less than minor.

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1 Introduction

Oceana Gold (New Zealand) (OGNZL), operates an open cut and underground gold mining operation at Waihi in the Waikato Region. At current mining and processing rates the existing consented mineral resource for the Waihi operation will be exhausted in late-2019. Ongoing exploration and mine optimisation has identified further mineral resources that can be economically recovered. The new activities, referred to as Project Martha, comprise the following inter-related elements:

- Martha Phase 4 pit (MP4); and
- The Martha Underground including the Rex orebody.

Project Martha will continue to use the existing facilities, including the Process Plant (mill and water treatment plants), Tailings Storage Facility 1A (TSF1A) and TSF2, the conveyor, ponds, access roads, and crushing plant and will also use the previously consented Cemented Aggregate Fill (CAF) plant. The mining and ore processing rates and the intensity of operations over the Project Martha site will be similar to recent activity levels at the Waihi mine. The project is expected to continue for approximately 11 years.

The discharges to air from the Process Plant were fully described, and the effects of the discharges assessed, during the application process for the Golden Link Project Area in 2012. A copy of the report prepared for that assessment is included in **Appendix A**¹ (Rolfe Report) As Project Martha does not include any major changes to the Process Plant this assessment does not include any further assessment of the effects of the discharges to air from this source.

Mining in Martha Pit has been in operation since 1988, although it is currently temporarily suspended following a rock fall on the north wall in 2015. The Favona Underground Mine commenced operation in 2004, the Trio Underground Mine in 2012 and the Golden Link Project Area (Correnso Underground Mine) in 2014.

OGNZL holds the resource consents for discharges to air shown in Table 1-1. Copies of these consents are included in **Appendix B**.

¹ Rolfe K "Newmont Waihi Gold: Air Quality Implications of Underground Mining in the Golden Link Project Area" March 2012.

Table 1-1 Current air discharge consents held by OGNZL

Consent Number	Consent Name	Expiry Date	Includes discharges to air from
109741	Favona Mine Project	31 December 2028	Mine portal, vent shafts and fugitive emissions from project area including dust, CO ₂ , blast fumes and exhaust fumes.
121697	Trio Underground Mine Project	31 December 2018	Vent shaft associated with the Trio Underground Mine Project
124859	Golden Link Project Area (Correnso)	16 July 2037	Dust and carbon dioxide arising from mining operations, including the Correnso shaft, emissions from the Process Plant including waste heat and water vapour, vehicle fumes and other minor and/or fugitive emissions associated with mining operations and smoke from burning tramp material adjacent to the TSFs.

Some of the proposed new activities will be outside the scope of the existing resource consents and are not activities which are permitted in the Waikato Regional Plan. These include the works on the north wall and the Martha Underground. Hence, a new resource consent is required for the air discharges that will result from the new mining activities under discretionary activity Rule 6.1.9.1 of the Waikato Regional Plan.

1.1 Purpose of Report

This report has been prepared by Beca Ltd (Beca) on behalf of OGNZL to support an Assessment of Environmental Effects (AEE) to accompany an application to the Waikato Regional Council for resource consent to discharge contaminants to air. It has been prepared in accordance with sections 88 and the Fourth Schedule of the Resource Management Act (RMA) and the relevant provisions of the Waikato Regional Plan. This report contains the following information:

- A brief summary of the current mining operation and those proposed, where they relate to discharges to air;
- A description of the nature of the discharges to air resulting from the existing and proposed activities;
- An assessment of the receiving environment in terms of the potential influences on the environmental effects of the emissions to air from the site;
- A summary of the current effects of the mining operation with respect to air quality;
- A description of the assessment methodology;
- An assessment of the potential effects of the proposed changes on air quality;
- A consideration of the National Environmental Standards for Air Quality (NES) and Ministry for the Environment Guidelines; and
- A summary of conclusions and findings of the investigation.

1.2 Limitations

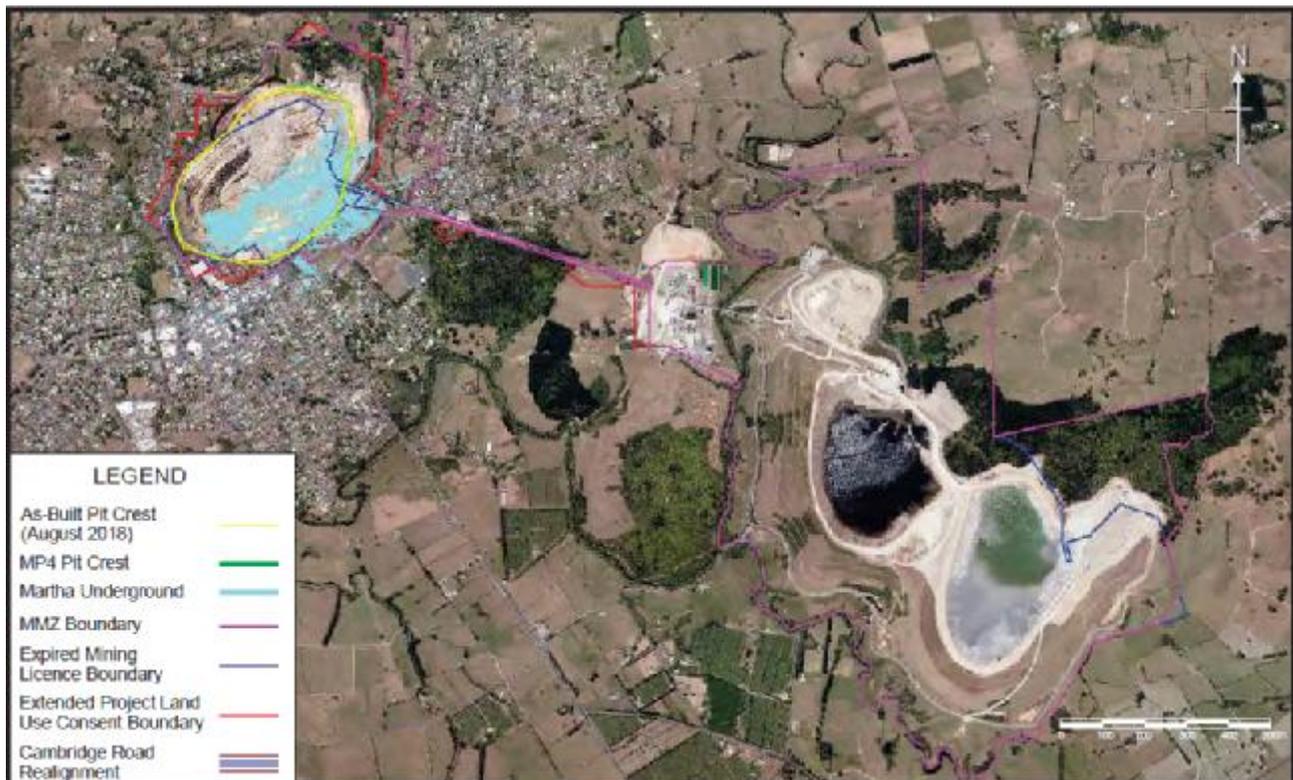
This report has been prepared by Beca for OGNZL. Beca has relied upon the information provided by OGNZL in completing this document. Unless otherwise stated, Beca has not sought to independently verify this information as provided. This report is therefore based upon the accuracy and completeness of the

information provided and Beca cannot be held responsible for any misrepresentations, incompleteness, or inaccuracies provided within that information. Should any new or additional information become available, this report will need to be reviewed accordingly.

2 Project Description

2.1 Overview

Project Martha involves a number of different elements which are interrelated. A full description of each aspect of the project is included in the Assessment of Environmental Effects report prepared by Mitchell Daysh (AEE). For the purposes of this report, each part of the project is summarised in the following sections focusing on the aspects of the project which are most relevant to air discharges. Figure 2-1 is an aerial photograph showing the various project elements and the project area.



2-1 Project Martha project area (source OGNZL)

2.2 Martha Underground

The Martha Underground project will mine ore from previously unmined ore blocks plus remnant mining blocks from the old Martha Mine. The Martha Underground includes mining of the Rex Underground ore body. There are no surface expressions related to the Rex Underground Mine. Existing facilities and infrastructure will be used including:

- Access through the Favona portal and Favona, Trio and Correnso development drives and use of the Trio vent shaft;
- The Favona stockpile area and the Polishing Pond stockpile area for stockpiling of ore, mined rock and imported crushed rock;
- The Favona administration, charge-house, magazine, laydown area and workshop buildings.

The Martha Underground project will commence in Year 1 with the development of the decline, stockpiling areas and return air accesses. During Year 1, 6 km of development will be carried out ramping up to 8 km of

sustainable development over Years 2 to 4 and declining through to Year 9 when all development will be completed.

The Martha Underground is expected to involve the removal of approximately 3.7 Mt of ore and approximately 1.6 Mt of rock. Existing stockpile areas will be used for the temporary storage of ore and rock removed and for the crushed rock and aggregate used for backfilling.

For the temporary storage of ore awaiting processing, it is proposed to use the existing “run of mine” (ROM) ore stockpile located close to the conveyor at the Favona portal. That stockpile can contain more than 100,000 tonnes of ore if necessary, but it is not expected that the stockpile will exceed this size. Some ore may be removed via the portals into the Martha Phase 4 (MP4) pit and hauled during open pit operating hours to the open pit crushing and conveying system and then delivered to the process plant by conveyor.

The Martha Underground will require a combination of rock and cemented aggregate fill (CAF) to backfill the stopes. Whenever possible, waste rock from the mine will remain underground and will be directly placed as backfill. During Years 1 and 2, there will be an excess of rock mined compared to backfill requirements. Some rock may be hauled to the surface and stockpiled close to the Favona portal in the Favona portal surge stockpile, or in the Polishing Pond Stockpile, to be returned later as underground backfill. The locations of the Favona Portal and the stockpiles are shown in Figure 2-2. In Years 3 to 10, rock for backfilling will be sourced from the Martha open pit and will be delivered either to the Favona Portal, via the crushing and conveyor system, or by a waste pass located close to the MP4 pit wall, or to a stockpile within the MP4 pit located adjacent to a portal.



Figure 2-2 Aerial photograph showing locations of Favona Portal and adjacent stockpiles (Source OGNZL)

Approximately 900,000 tonnes of cemented backfill will be required and this will be sourced from the previously consented CAF plant to be located in the Process Plant area. The cemented fill will require imported crushed rock from the local Waitawhata quarry, which will require some stockpile space. This facility is already consented as part of the Correnso project.

2.2.1 Mining activities

A non-entry remnant mining method, which uses remote drilling and loading is proposed for mining remnants of the old underground Martha Mine. In areas not previously mined, conventional modified Avoca stoping methods will be used as practised at the Favona and other underground Waihi mines over the last 14 years.

Blasting will be undertaken with practices typical of small blasthole development blasting. This approach is consistent with blasting undertaken for Favona, Trio and Correnso development and mining activities.

The Martha Underground will operate 24 hours a day, 7 days per week. The equipment that will be used is summarised in Table 2-1.

Table 2-1 Martha Underground Equipment

Equipment Type	Unit Requirement
Truck	4
LHD	4
Jumbo	4
Production Drill	3
Development Charge-up	1
Production Charge-up	1
Shotcrete spray	1
Shotcrete transmixer	1
Grader	1

2.2.2 Ventilation

Initially ventilation of the Martha Underground will be primarily through exhaust adits broken into the southwestern and southern pit walls with the main exhaust fans located inside the underground mine.

Permanent ventilation surface works and structures will consist of one fresh air portal (an intake) and one return air (exhaust) portal plus a return air ventilation shaft. The locations of the portals and vents are shown in Figure 2-3. The ventilation shaft and return air portal will discharge the emissions from development blasting and the operation of underground vehicles. The return air portal is already consented as a fresh air intake for the Martha Drill Drive Project but this will be altered to become an exhaust. The fresh air portal will also serve as an escapeway. There are no surface expressions required for the Rex Underground Mine.



Figure 2-3 Proposed surface ventilation structures associated with MUG in Martha Pit (Source OGNZL)

Twin independent ventilation circuits will be used. Each circuit is forecast to require a capacity of approximately 200 cubic metres per second (m^3/s) to allow for adequate productivity and flexibility from the mine. The exhaust fan associated with the new ventilation raise will be located underground.

The exhaust shaft permitted for the Correnso project may also be developed by raise borer from the surface into a drive from the Correnso mine to improve ventilation. The effects of the discharges to air from the Correnso project were discussed in the Rolfe Report, which is attached in **Appendix A**.

2.3 Martha Phase 4 Pit (MP4)

MP4 will cover open pit mining from development and mining through to final rehabilitation of the Martha Pit. The aspects of the project which are relevant to air discharges include the following:

- An extension of the pit boundaries in the north;
- Construction of a noise bund or noise control fence on the northern and north-western sides of the pit;
- Partial relocation/realignment of Bulltown and Cambridge Roads;
- Demolition or relocation of a domestic dwelling owned by OceanaGold;
- Open pit mining;
- North wall stabilisation works;
- Use of the existing and new facilities including the conveyor, Process Plant and RTSA; and
- Rehabilitation of the pit.

A conceptual plan of the MP4 pit is shown in Figure 2-4.



Figure 2-4 Conceptual plan of MP4 pit within the project area.

The only alterations to the boundaries of the pit walls associated with Project Martha will occur on the northern side of the pit. The boundaries on all other sides of the pit will not change.

MP4 will produce approximately 0.9 Mt of ore and 8 Mt of NAF (non-acid forming) and PAF (potentially acid forming) rock and is expected to take around 8 years to mine. All ore will be transported by conveyor to the ROM stockpile at the mill. Rock will be mainly transported by conveyor to either the Rock and Tailings Disposal Area, or to the Favona Portal stockpile for use as underground backfill. Some rock may be directly trucked to the underground mine via the portals established on the south wall or by dedicated fill passes.

Mining will commence in MP4 during Year 3. During Years 1 and 2, the following preparatory works will be carried out;

- Realign Bulltown and Cambridge Road to the north of the pit;
- Realign the road to the Explosives Magazine;
- Construct a new noise bund or noise control fence along Bulltown Road; and
- Relocate security fencing.

When complete, the pit will have an area of approximately 51 hectares and a depth of approximately 295 m. This can be compared to the current pit area of 49 hectares and an approximate depth of 275 m.

The various aspects of the scope of works for MP4 are illustrated in Figures 2-4 to 2-6.



Figure 2-5 MP4 Magazine Road relocation

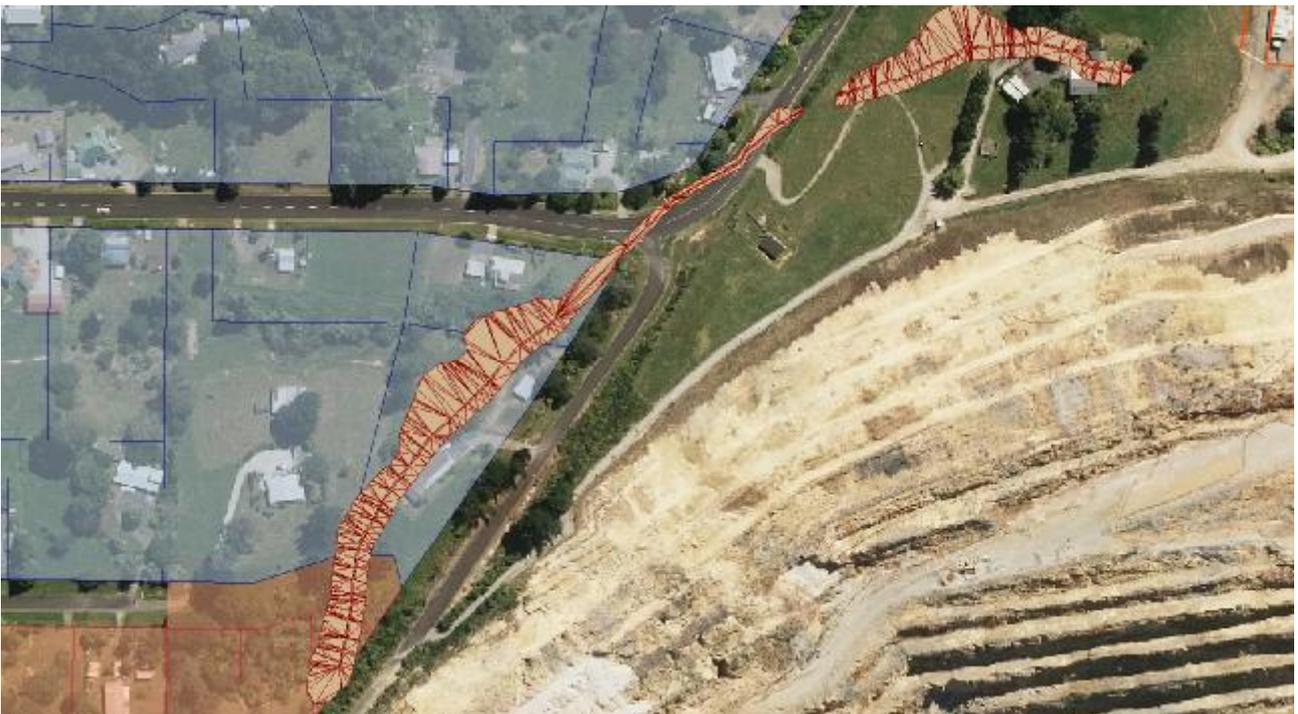


Figure 2-6 MP4 noise bunding



Figure 2-7 MP4 Bulltown and Cambridge Roads relocation

Mining of MP4 will be scheduled to supplement the mining in the Martha Underground to provide a constant feed to the mill and to provide backfill to the underground. OGNZL will decide, based on the prevailing economics at the time, whether to process the open pit feed in preference to the underground feed or, alternatively, to complete the underground in preference to complete the open pit.

2.3.1 Mining rate and hours of work

The maximum material movement from MP4 is expected to be 1.1 Mt per annum (Mtpa) but the pit is expected to usually operate at 0.8 Mtpa. The Martha Pit has traditionally operated over the last few years at a rate of 1.38 Mtpa hence, the expected mining rate for MP4 will be lower than previous levels and will require a much-reduced fleet compared to that which operated between 1988 and 2015.

The mine will continue to operate from 7am to 7pm, 5 days per week and for 5 hours on Saturday between 7am and 12 noon. The pit will not operate on public holidays or Sundays.

2.3.2 Mining activities

Ore and rock will be mined by conventional drill, blast, load and haul methods from the open pit. All ore and rock will be loaded via 50 or 110 tonne backhoe excavators into 50 or 85 tonne rear dump trucks and tipped directly into a jaw crusher, or a Stamler Breaker Station. Small quantities of ore and rock may be stockpiled close to the jaw crusher.

Except for selected rock that will be used to backfill stopes and historic voids in the underground, all ore and rock will be crushed. Ore will be conveyed to the process plant and placed in an existing 40,000t stockpile. A surge (Polishing Pond) stockpile is available close to the water treatment plant for excess ore. Rock will be conveyed to the rock and tailings disposal area (RTSA) load-out area for construction of the lift on the TSF2 embankment, disposal in permanent stockpiles on the TSF embankments, or to the Favona Portal stockpile for use as underground backfill.

Between Years 5 and 8, open pit rock may be hauled to the southern portal and stockpiled on the southern haul road within the MP4 pit before being hauled underground as backfill. A mobile crusher may be located on the southern haul road to crush open pit material to a suitable size for disposal in the stopes.

Blasting within the pit will be carried out using the same high level of control as has been used throughout the 30 years of mining in Martha Pit. It is likely that blasting will be undertaken using emulsion and electronic detonators. The maximum explosive quantity per blast hole is expected to be approximately 10kg. Best practices will be followed with respect to controlling potential environmental effects and fly rock, including a detailed Blast Management Plan.

The equipment that will be used for MP4 is shown in Table 2-2 and Table 2-3.

Table 2-2 MP4 equipment required for Years 3 to 4

Equipment Type	Average Unit Requirement	Peak Annual Unit Requirement
50t Excavators	1	1
Production Drills	2	2
Loaders	1	1
50 ADT Trucks	2	3
Charge-up Units	1	1
Graders	1	1
Service Vehicles	3	3
Light Vehicles	6	12

Table 2-3 MP4 equipment required for Years 4 to 8

Equipment Type	Average Unit Requirement	Peak Annual Unit Requirement
110t Excavators	1	1
Production Drills	2	4
Loaders	1	1
85t Trucks	3	4
Charge-up Units	1	1
Graders	1	1
Service Vehicles	3	3
Light Vehicles	6	12

2.4 Rock and Tailings Storage

2.4.1 TSF1A and TSF2

TSF1A is the active tailings storage facility at present and is expected to have 1.7 Mm³ of spare capacity following the current life of mine. Following a 5m crest raise on TSF2, it will provide a further 1.71Mm³ of tailings storage. No additional alterations to TSF1A or TSF2 are planned for Project Martha.

2.4.2 Rock storage

Rock mined from MP4 will be used to construct the 5m lift on the TSF2 and to backfill the underground mine. There will be a surplus of rock and this will be placed in either the already-permitted Central or Eastern Stockpiles. Any surplus material will be placed on the existing Northern Stockpile or as capping for TSF1A.

2.5 Process Plant

The existing mill and water treatment plant will continue to be used for Project Martha. For information regarding the processes used and the discharges to air from the existing Process Plant refer to **Appendix A**.

2.6 Production Rates

The generation of air discharges and the potential for adverse effects is proportional to the level of mining activity and the quantity of materials excavated, transported and handled in the mine. Total production (total tonnes of material extracted) at the mine during the past 15 years has varied between approximately 8Mt per year in 2001, when the Martha Pit was in full production, to less than 1Mt in 2015. The annual tonnage of material mined throughout the life span of Project Martha is projected to begin at approximately 0.5Mt in Year 1 and increase to up to 1.5Mt during Years 4 to 9, before decreasing to 0.1Mt in Year 11 when the project will be complete. The maximum production rate projected for MP4 of 1.17Mt will be significantly less than the previous maximum production rate of 8Mt and is similar to pre-2015 levels.

3 Environmental Setting

3.1 General Features of the Receiving Environment

Project Martha will be located predominantly within the general vicinity of the existing Waihi Gold Mine area, which extends from Waihi Township into the neighbouring rural area to the east of the town. The majority of the work will take place within or immediately adjacent to the Martha Pit.

The topography of the surrounding area is rolling terrain and, within the town, the topography is dominated by the existing Martha Pit. The existing TSFs are also a feature of the current landscape and these are similar in scale to the surrounding hills.

3.1.1 Air Quality Zoning

The Martha Pit is located within the Waihi Airshed as gazetted by the National Environmental Standards for Air Quality (NESAQ). The Process Plant and the Rock and Tailings Storage Area (RTSA) are located within the airshed comprised of all the rural areas within the Waikato Region that are not included in a specifically gazetted airshed. Figure 3-1 **Error! Reference source not found.** shows the boundaries of the Waihi Airshed.

Air quality within the Waihi Airshed is not classified as “polluted”, as defined in Regulation 17 of the NESAQ, as fine particulate (PM₁₀) concentrations have not been measured in the town by Waikato Regional Council (WRC) since 2012². The monitoring was suspended by WRC in 2012 as concentrations measured between 2008 and 2011 by the Council indicated that concentrations of PM₁₀ were well below the NESAQ 24-hour standard of 50µg/m³. This monitoring was carried out when the Martha Pit was operating and includes the contribution of the mine to ambient air quality in Waihi. The results of the PM₁₀ monitoring carried out by WRC compared to air quality guidelines are illustrated in Figure 3-2.

Air quality within the rural airshed is expected to be typical of other rural areas in New Zealand and well within the NESAQ criteria.

² Waikato Regional Council website <https://www.waikatoregion.govt.nz/environment/natural-resources/air/discharges-and-pollutants/fine-particle-levels-in-the-air/waihi-at-grey-road/> accessed on 17 May 2017.



Figure 3-1 Boundaries of the Waihi Airshed (Source: Waikato Regional Council) and location of monitoring station

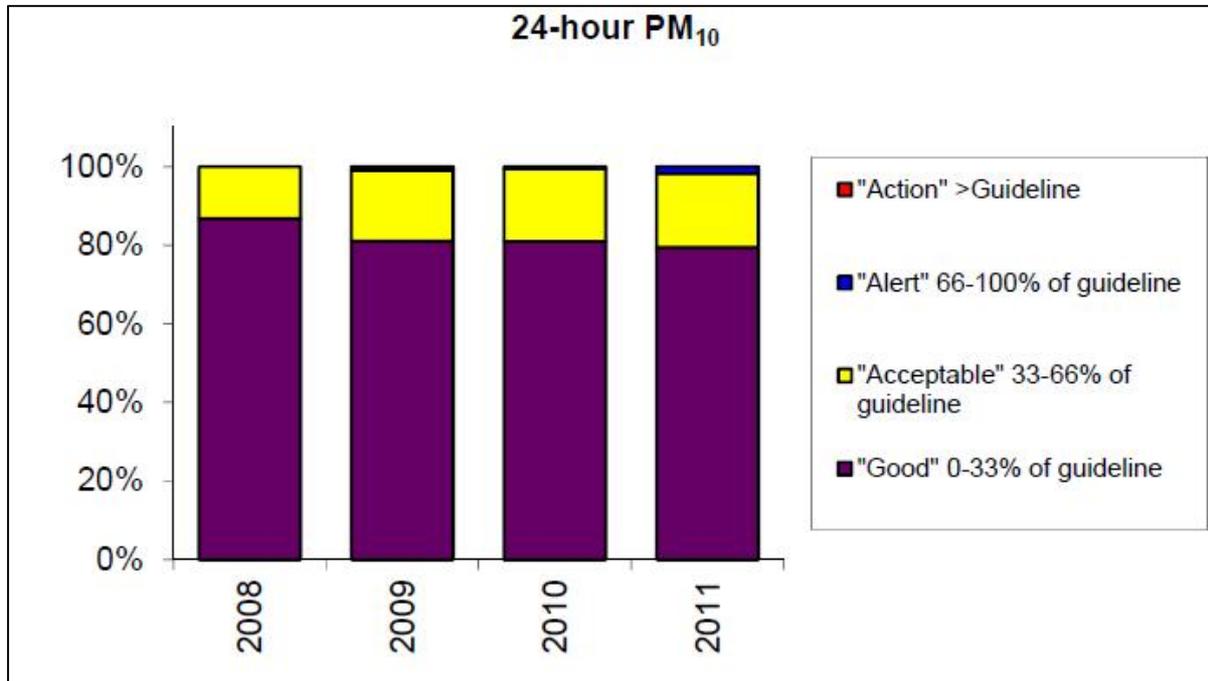


Figure 3-2 Comparison of PM₁₀ concentrations measured at the Waihi site from 2008 to 2011 to air quality indicator categories.³

³ Waikato Regional Council "Air quality monitoring report for Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turange – 2011" Technical Report 2012/06

3.1.2 Meteorology

OGNZL measures meteorological parameters at a climate station located at Barry Road (monitoring Site 6.63 Met Station) (refer to Figure 3-1).

A windrose of hourly average wind speed and directions for 2007 to 2017 is shown in Figure 3-3. The prevailing winds come from the west and west-southwesterly directions. The strongest winds also come from these directions. Secondary winds come from the northeast, and winds from all other directions are rare.

The average wind speed measured since 2007 is 3.7m/s and calms occur for 1.65% of the time. Winds which exceed 5m/s, which is the critical wind speed for the lifting of dust from unconsolidated surfaces, occur for approximately 31% of time.

Wind direction patterns are consistent throughout the year with spring having the highest average wind speeds and autumn the lowest. Seasonal windroses are provided in **Appendix C**.

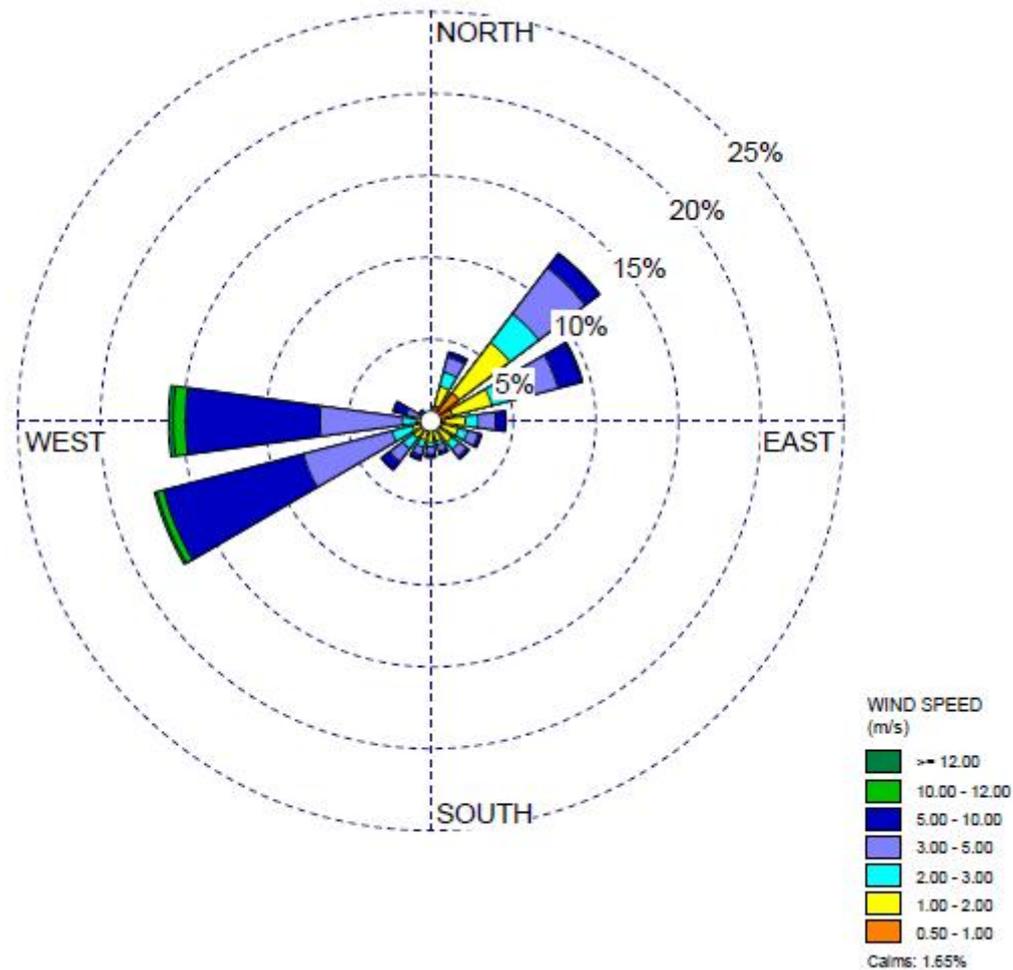


Figure 3-3 Hourly average wind speeds and directions for Waihi, 1 January 2007 – 31 December 2017 (data supplied by OGNZL)

3.1.3 Rainfall

The annual average rainfall measured by NIWA at Waihi between 1907 and 2017 is 2161mm⁴. July is on average, the wettest month and January the driest month. Figure 3-4 shows the average monthly rainfall for the last eleven years recorded by OGNZL and Figure 3-5 shows the average number of rain days per month measured at the NIWA Waihi climate station between January 2007 and December 2017⁵.

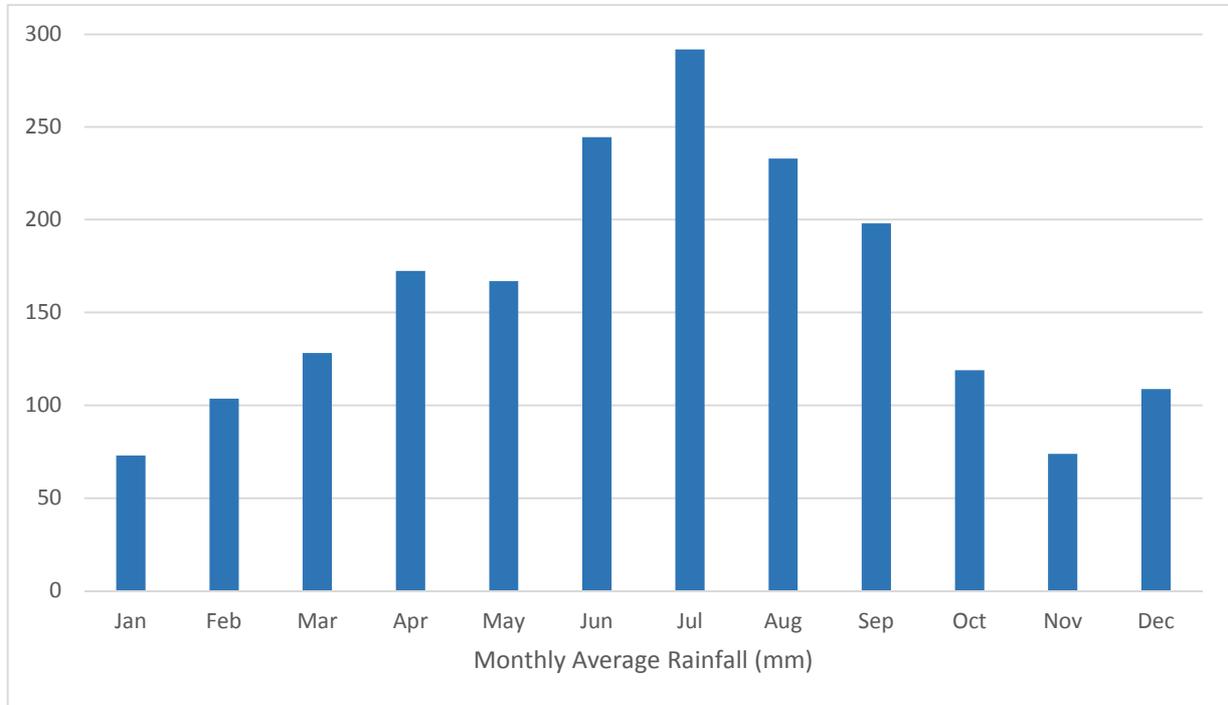


Figure 3-4 Monthly average rainfall January 2007 – December 2017 (mm)

⁴ Information sourced from the NIWA cliflo database

⁵ A rain day is defined as days when at least 1mm of rain is recorded.

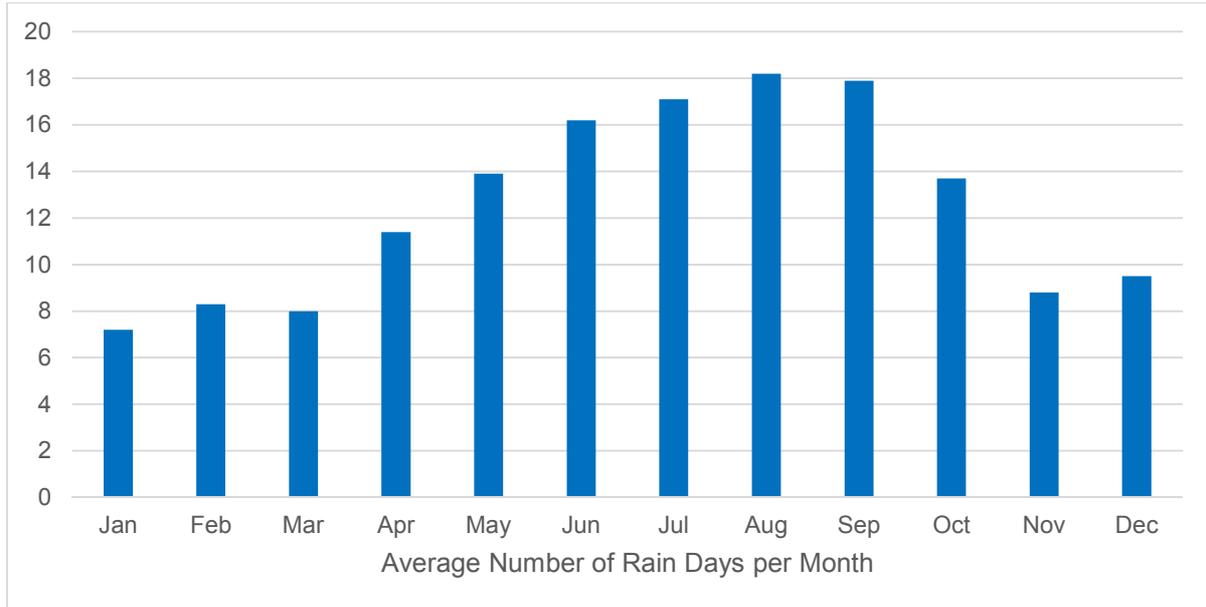


Figure 3-5 Average number of rain days per month measured at Waihi (January 2007 – December 2017)⁶

3.2 Martha Underground Mine

The surface features required for the Martha Underground include a fresh air portal, a return air portal and a return air ventilation shaft all to be located within the MP4 pit. The proposed locations of these structures are shown in Figure 2-3. The receiving environment surrounding the MP4 Pit is discussed in Section 3.3.

3.3 Martha Phase 4 Pit

The development of MP4 involves the extension of the pit boundaries along the northern extent of the pit and the construction of noise bunds. The proposed road realignment made necessary by the north wall push back encroaches onto some properties located on Bulltown Road and Cambridge Road and requires the demolition or relocation of one OGNZL owned dwelling located on Cambridge Road and the realignment of a section of Bulltown and Cambridge Roads. The closest privately-owned houses to the proposed works are located approximately 30m to the northwest of the proposed relocation of Bulltown and Cambridge Roads and 60 m to the northwest of the northern extent of the noise bund.

Figure 3-6 shows the properties located within approximately 200m of the north-western boundary of MP4 in the area where the pit boundaries will be extended, the Bulltown and Cambridge Roads realignment and the proposed noise bunds.

⁶ Information sourced from the NIWA cliflo database.



Figure 3-6 Locations of properties within 200m (approx.) of the proposed works

4 Air Quality Standards and Guidelines

4.1 National Environmental Standards and Guidelines for Ambient Air Quality

Ambient contaminant concentration predictions 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 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 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 fine particulates (PM₁₀), sulphur dioxide (SO₂), carbon monoxide (CO) and nitrogen dioxide (NO₂), 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 those concentration limits 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 this table.

Table 4-1 Relevant air quality assessment criteria

Contaminant	Averaging period	Threshold concentration	Number of permitted exceedences	Source
PM ₁₀	24-hour annual	50 µg/m ³	1	NESAQ
		20 µg/m ³	-	AAQG
CO	1-hour	30 mg/m ³	-	AAQG
	Running 8-hour	10 mg/m ³	1	NESAQ
NO ₂	1-hour	200 µg/m ³	9	NESAQ
	24-hour	100 µg/m ³	-	AAQG
Respirable silica	annual ⁸	3 µg/m ³	-	OEHHA

⁷ Ministry for the Environment, 2016, “*Good Practice Guide for Assessing Discharges to Air from Industry*”

⁸ The annual guideline for silica of 3 µg/m³ is approximately equivalent to a 24 hour average guideline of 9 µg/m³. To convert concentrations for different averaging periods the following equation is recommended by the MfE *Good Practice Guide for Atmospheric Dispersion Modelling* (2004) $C_{t1} = C_{t2} (t_2/t_1)^{0.2}$.

4.2 Dust Guidelines

In New Zealand, there are no environmental standards or guidelines for deposited dust or total suspended particulate (TSP). However, the Good Practice Guide for Assessing and Managing Dust (GPG Dust) recommends “trigger” levels for deposited dust and TSP which are intended to be used for proactive management of dust on site. They are not intended to be used for enforcement because exceedance of trigger levels does not necessarily infer an adverse effect offsite.⁹ The trigger levels are intended to apply beyond the site boundary.

The recommended GPG “trigger” value for deposited dust is 4g/m²/30 days above background concentrations. The GPG Dust notes that deposition rates of more than this trigger above background concentrations, in some industrial and sparsely populated areas may not cause nuisance, but conversely in sensitive residential areas dust concentrations in the order of 2g/m²/30 days above background levels may cause nuisance.

The GPG Dust suggests “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 (long term) dust only.

4.3 Resource Consent Trigger Levels

The current resource consents for the mining operation and mining licence (permitted activity) require trigger levels and limits for deposited dust, TSP and PM₁₀ to be included in the Air Quality Management Plan (AQMP) for the Martha, Favona, Trio and Correnso Mines. The trigger levels and limits included in the AQMP are shown in Table 4-3.

Table 4-3 AQMP trigger levels and limits

Contaminant	Trigger level/ Licence limit	Value	Averaging Period
TSP	Waihi trigger level	45µg/m ³	7 days
TSP	Mining Licence limit	100 µg/m ³	7 days
Deposited particulate	Waihi trigger level	4g/m ² /month	One month
Deposited particulate	Mining Licence limit	5g/m ² /month	One month

The consent trigger limits do not refer to deposited dust concentrations above background levels and therefore include the contribution of background sources of dust, which will be variable and outside the control of OGNZL. The consent trigger limits are therefore more conservative than the trigger limits recommended by the GPG Dust.

⁹ Ministry for the Environment “Good Practice Guide for Assessing and Managing Dust” 2016

The 7 day OGNZL TSP trigger level of $45\mu\text{g}/\text{m}^3$ is approximately equivalent to a 24 hour average concentration¹⁰ of $66\mu\text{g}/\text{m}^3$, which is comparable to the MfE daily guideline trigger value for areas with a high sensitivity to dust of $60\mu\text{g}/\text{m}^3$ (24 hour average).

The consent conditions require that when trigger levels are reached, OGNZL investigates the reasons for the high results and initiates any additional mitigation measures that are required.

Overall the current consent trigger levels are considered to be consistent with the recommendations of the MfE and with current good practice and it is recommended that they are adopted without change for Project Martha.

¹⁰ To convert concentrations for different averaging periods the following equation is recommended by the MfE *Good Practice Guide for Atmospheric Dispersion Modelling* (2004) $C_{t1} = C_{t2} (t_2/t_1)^{0.2}$.

5 Discharges and Associated Mitigation Methods

5.1 Overview

The nature of the emissions from Project Martha will be the same as the nature of the emissions from the existing Martha and underground mines. The potential total quantity of emissions will not change substantially above present levels and will be less than historic levels when the Martha Pit was in full production, as the mining rate is expected to be similar to recent levels. However, the location and scale of some of the individual emission sources will change as a result of some of the proposed new mine features.

OGNZL has an Air Quality Management Plan (AQMP) for the mine which includes the mitigation methods used to control the effects on the environment, including dust. A revised AQMP will be prepared which will detail the mitigation methods currently used by OGNZL, as well as any additional methods that are proposed to mitigate any requirements specific to Project Martha (refer to section 8).

The discharges to air from Project Martha will be generated from the following sources:

- Dust from surface mining activities such as earthworks, excavation, vehicle movements, unconsolidated surfaces and materials handling, the crushing and screening plant and the Cemented Aggregate Fill (CAF) plant;
- Construction of the new noise bunds along Bulltown Road;
- Construction of the section of Bulltown and Cambridge Roads that will be relocated;
- Products of combustion from vehicles on the surface;
- Products of combustion from vehicles and dust from underground mining activities that are discharged to air via the ventilation shafts;
- Contaminants produced from blasting both above the surface and underground and discharged to air via the ventilation shafts; and
- Rehabilitation of completed mine areas.

Each of these sources and their associated mitigation methods are discussed in the following sections of the report.

5.2 Dust from Surface Sources

5.2.1 Nature of dust

The predominant discharge from the proposed activities will be particulate matter. The particulate matter or dust will be comprised of a wide variety of size fractions. The larger settleable material is generally greater than 50µm in diameter and has the potential to create a nuisance due to soiling of surfaces and by causing irritation to the eyes and nose. Because it is relatively large in size, deposited particulate usually falls out of the air within a short distance (approximately 100 – 200m) from the source.

The finer fraction of dust is defined as suspended particulate and is commonly referred to as Total Suspended Particulate (TSP). This material is generally less than 20µm in diameter and can travel large distances downwind. The portions of TSP that pose the greatest potential risk to health are particulates less than 10µm in diameter (known as PM₁₀) and particulates less than 2.5µm in diameter (known as PM_{2.5}). The major source of the finer particulate in the atmosphere is combustion processes. The particulate generated from the surface mining activities is likely to be predominantly made up of the larger size fractions (greater than 10µm), but a portion will fall into the smaller size ranges.

The material mined at Waihi contains crystalline silica, and consequently the dust created during mechanical operations such as crushing processes will also contain a proportion of crystalline silica. Fine particles of crystalline silica (less than 10µm) that are able to 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.

5.2.2 Factors which influence dust generation

The major factors that influence dust emissions from surfaces are:

- Wind speed across the surface – the critical wind speed for pick-up of dust from surfaces without disturbances such as traffic is 5m/s: above 10m/s the pickup increases rapidly;¹¹
- The percentage of fine particles in the material on the surface;
- Moisture content of the material on the surface;
- The area of exposed surface; and
- Disturbances such as traffic, excavation, loading and unloading of materials.

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

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

It is possible to estimate the potential emissions of particulate matter from mining activities using emission factors developed primarily by the US Environmental Protection Agency (US EPA) and published in a number of publications including the US EPA AP 42 database.¹² However for fugitive dust sources, such as those associated with Project Martha, these emission factors have a large degree of uncertainty. For this assessment of potential effects, no attempt has been made to quantify the fugitive emissions from the mine as the scale and location of the dust sources will change constantly throughout the course of the project as new areas are mined and rehabilitated. Instead, the assessment method is based on comparing the existing and past effects of the mine with the potential effects of the new developments, taking into account any changes in the level of operation and the location of the developments in relation to the sensitive receptors.

5.2.3 Sources of particulates and proposed mitigation methods

The activities that will take place at the proposed surface mining sites that may generate dust are:

- Earthworks, including stripping of overburden and topsoil, mining of rock, construction and rehabilitation of roads and the noise bunds;
- Vehicle movements on unpaved surfaces;
- Loading, conveying and unloading of materials;
- Crushing and screening of rock and overburden;
- Operation of the CAF plant;
- Wind-generated dust from dry exposed surfaces such as roads and stockpiles; and

¹¹ Air and Waste Management Association "Air Pollution Engineering Manual" 2nd edition edited by Wayne T Davis, 2000.

¹² United States Environmental Protection Agency (USEPA) AP42 Emission Factor Database Chapter 13.

- Applying limestone to potentially acid forming overburden.

These activities are addressed in the following subsections along with a summary of the proposed dust mitigation methods.

Earthworks

The stripping of overburden, soil and rock from surface areas and the spreading of overburden and topsoil on rehabilitated land has the potential to generate significant quantities of dust if the process is not carefully controlled. Similarly, the construction of infrastructure such as roads, pit walls and noise bunds has the potential to generate significant quantities of dust if appropriate mitigation is not carried out.

To control dust from these activities, OGNZL proposes to continue to use the following methods which are described in the AQMP and successfully utilised at the mine at present:

- Keep exposed surface areas to a minimum and re-vegetate exposed areas as soon as practical;
- Use water sprays to keep surfaces damp where practicable and necessary; and
- Plan potentially dusty activities such as stripping and spreading of topsoil for days when weather conditions are predicted to be favourable.

The National Pollution Inventory for Mining published by the Commonwealth of Australia¹³ (NPI Manual) estimates that the use of water to control dust on stripping, hauling and loading and unloading activities can reduce the emissions of dust by 50%. The NPI Manual also estimates that re-vegetation of overburden stockpiles reduces their dust generation capacity by 99%.

Vehicles and Roads

Dust from heavy vehicles on haul roads, heavy vehicle traffic around the RTSA and general traffic around the proposed site works area all have the potential to be significant sources of dust if not adequately controlled. Dust from roads is controlled primarily by limiting the amount of fine particles exposed to the wind, keeping surfaces damp and controlling vehicle speeds. To achieve this, OGNZL proposes to use the following dust mitigation methods which are used successfully at the mine at present:

- Limit vehicle speeds on haul roads and access roads within the project area;
- Minimise haul distances;
- Transport rock and ore from MP4 to the Process Plant and the RTSA by conveyor wherever practicable;
- Keep roads and construction surfaces damp with water carts and/or fixed sprinklers when required;
- Maintain haul roads regularly by grading and laying of fresh rock/gravel;
- Utilise, where appropriate and cost effective, approved surface-binding agents for dust control on roads; and
- Require drivers to use the wheel wash facilities located at main exits to the site to prevent mud being tracked off site.

Speed controls on vehicles have an approximately linear effect on dust emissions¹⁴. OGNZL imposes speed limits on all haul roads and other access roads in and around the mine site that are appropriate for their use.

¹³ Commonwealth of Australia "National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 2.3" 2001.

¹⁴ Supra at 3

The number of vehicles used on site is expected to vary during the course of the project and may be slightly higher than recent numbers, although the number of vehicles is expected to be less than when both the Martha Pit and the underground mines were operating at peak production levels in the past. There is, therefore, some potential for the discharges of dust generated from vehicle movements to increase slightly. However, the vehicle movements will be spread out over the entire Project Martha site and providing that the management practices currently employed at the mine continue to be carried out diligently, the scale of the discharges are not expected to increase significantly above present levels.

Loading, conveying and unloading

The loading of material onto trucks and conveyors (and including the subsequent offloading), has the potential to generate dust. Trucks will be loaded with materials from the base of the Martha Pit and from areas where construction activities are occurring using excavators and loaders. The majority of mined materials will be unloaded onto the main conveyor, stockpiles within the pit or at the Process Plant, and onto areas that are being constructed or rehabilitated. The methods used by OGNZL to control dust from these activities include the following:

- Require machinery operators to minimise drop heights when unloading materials;
- Cover or shield conveyors in exposed locations to reduce drying effects and exposure to wind; and
- Dampen materials to be moved where practicable.

Exposed surfaces

Exposed surfaces such as those on stockpiles and noise bunds are all potential sources of dust unless they are controlled. The primary means of controlling dust from sources such as these is by revegetation wherever practical and keeping surfaces damp. Minimising the quantity of fine particles on the surfaces exposed to the wind also reduces the dust potential.

The methods used by OGNZL to minimise the generation of dust from exposed surfaces, and which will continue to be used for Project Martha, include the following:

- Keep operational areas around the pit, stockpiles and Process Plant damp using water tanker vehicles when required;
- Use water, where practicable to keep surfaces damp;
- Keep the height of open pit stockpiles below the level of the perimeter fences around the pit rims;
- Plant and maintain a sustainable vegetative cover on exposed areas of the upper open pit batters and benches;
- Use screens and fences to prevent wind-blow in dust prone areas; and
- Vegetate the outer walls of the noise bunds as soon as practicable after construction has been completed.

Crushing and screening plant

Crushing and screening of rock has the potential to generate dust. The most effective means of controlling dust generated from these activities is the use of water to keep the materials damp. To control the dust, OGNZL will use the following mitigation measures on the mobile crushing plant and on the existing plant:

- Use irrigation sprays on jaw crushers and conveyor transfer points to control the moisture content of materials;
- Minimise drop heights from the loading of raw materials into the feed hopper and from stacking of stockpiles; and

- Locate any mobile crushing and screening plant in MP4 within the pit and below the ground level of nearby terrain.

Drilling

Drilling rock surfaces has the potential to generate dust. The drilling rigs are fitted with dust collectors and bag filters, which are maintained in good condition in accordance with the manufacturer's recommendations. The drills use fluid lubrication and providing they are regularly maintained, produce negligible quantities of dust.

Cemented Aggregate Fill Plant

The discharges to air from the CAF plant will arise from the stockpiles associated with the plant, the surrounding yard areas and from the vent on the cement silo. Dust suppression will be provided by water sprays on the stockpile and the feed hopper and a bag filter on the cement silo discharge. The discharges to air from the CAF are consented under Consent Number 124859 for the Golden Link Project Area (Correnso).

Application of limestone to potentially acid forming rock

To neutralise the formation of acid from overburden OGNZL spreads crushed limestone on the surface of the rock stacks when necessary. Limestone includes a proportion of fine powder that can be easily carried in the wind. To minimise the spread of limestone onto neighbouring properties OGNZL will not apply limestone when winds are strong and blowing towards neighbouring properties.

5.3 Products of Combustion from Surface Vehicles

The operation of the vehicles used on site will generate the products of combustion, which include PM₁₀, nitrogen oxides (NO_x) and CO. The results of previous monitoring of ambient concentrations of air pollutants at the Martha Mine, including those associated with motor vehicles were discussed in the report prepared for the Golden Link Project Area consent applications entitled "*Air Quality Implications of Underground Mining in the Golden Link Project Area*".¹⁵ The conclusions from the discussion were:

- The results of ambient monitoring of air quality showed only minimal effects from vehicles associated with mine operations with most measurements well below the Ambient Air Quality Guidelines and the National Environmental Standards for Air Quality;
- Elevated concentrations of NO_x and a moderately elevated concentration of sulphur dioxide (SO₂) were recorded when a stockpile was being worked in 1993 within 10m of the monitoring site. Extrapolation of the data indicated that concentrations of both contaminants would be insignificant within about 50m of the activity; and
- Since the 1993 measurements were made, the sulphur content of fuel has been decreased by 95%, with a corresponding decrease in SO₂ emissions from vehicles.

The frequency and concentration of vehicle movements within the mine will be similar to recent levels and consequently, the concentrations of contaminants generated by the vehicles will also be similar. It is therefore expected that the effects of vehicle emissions on ambient air quality beyond the boundaries of the mine will be minimal.

¹⁵ Rolfe K "*Newmont Waihi Gold: Air Quality Implications of Underground Mining in the Golden Link Project Area*" March 2012.

5.4 Dust and Vehicle Emissions from Underground Activities

The underground mining will generate dust from excavation, materials handling and vehicle movements, as well as combustion products from vehicle emissions and discharges generated from blasting. All underground emissions will be discharged to air via the tunnel ventilation shafts. The nature of the discharges generated underground is the same as those generated by surface mining with the only difference being that the emissions will be exhausted from the ventilation raises as point sources, rather than as a diffuse source over the surface area of the mine. In cool calm conditions, the emissions from the ventilation raises can be visible as a plume of water vapour.

The Martha Underground will be ventilated through a new return air shaft and return air portal to be located in the MP4 Pit, and the existing Trio vent shaft.

Each ventilation circuit will have a design air flowrate of 200m³/s. The actual ventilation rates will vary depending on the level of activity in the mine, the volume of the mine and the number of working faces. The amount of ventilation provided will be sufficient to provide a safe working environment within the mine. This means that the concentration of all the contaminants will be required to be below the Workplace Exposure Standards (WES) set by Worksafe New Zealand (Worksafe), whenever there are people working underground. To ensure the concentration of contaminants within the underground mine is within the WES OGNZL carries out monitoring of the underground air quality on a regular basis.

Conditions within the underground mines are usually damp. However, if necessary any dust generated from excavation and materials handling will be controlled underground using water carts and sprayers to maintain the roads in a wet condition and muck piles will be watered down with hoses prior to placing the material into trucks for transport to the surface.

5.5 Emissions from Blasting

Blasting generates emissions of particulates, CO, NO_x and small quantities of SO₂. Blasting also produces dust generated from the shattering of rock. Blasting takes place within the pit and in the underground mines.

In the past, the primary explosive used at the mine was ANFO, (ammonium nitrate, fuel oil), which produces substantially higher levels of NO_x compared to emulsion explosives, which are now used almost exclusively at the mine.

The explosive used in the pit will be primarily emulsion explosives which are a mix of ammonium nitrate, fuel oil or diesel and emulsifiers. Diesel, which has a very low sulphur content compared to fuel oil and produces less SO₂ emissions, is favoured. The volumes of explosives used will vary significantly and will gradually increase as the project progresses.

The MP4 Pit will employ drill and blast techniques appropriate for use near to residential areas. Maximum explosive quantities per blast hole are expected to vary up to around 10 kilograms. Best practices will be followed with respect to controlling potential effects and fly rock, including the preparation of a detailed Vibration Management Plan.

The explosive used underground will be primarily bulk emulsion products, with approximately 10% being ANFO. Total usage is expected to average about 50-55t per month.

During blasting operations, the area of the mine 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. For underground blasts, the air quality within the mine is tested thirty minutes after the blast and cleared before personnel are permitted to re-enter.

The ventilation shafts will be located within MP4 and below the surface level of the pit (refer Figure 2-3).

5.5.1 Results of underground blast emission monitoring

Contaminant emissions from the Favona vent shaft were measured in August 2007 by Watercare Services Limited during a series of five blasts¹⁶. The concentration of particulate was measured using a US EPA Method 5 sampling train. The concentrations of CO, nitrogen oxide (NO) and NO₂ were monitored using a continuous combustion gas analyser which measures near instantaneous concentrations of each gas. The Watercare Services report did not specify how long each combustion gas test was conducted for, but assuming that they were conducted over the same period as the particulate emission tests, each test would have been conducted for a period of between 30 and 90 minutes. The average monitoring results reported by Watercare can therefore be compared approximately to the 1-hour average ambient NESAQ values for CO and NO₂. There are no ambient air quality standards or guidelines for NO.

Table 5-1 summarises the Watercare particulate emission test results for the Favona Vent Shaft.

Table 5-2 summarises the Watercare nitrogen oxides and CO emission test results averaged over 5 blast events.

Table 5-1 Summary of Watercare particulate emission test results for Favona Vent Shaft

Parameter	Average result
Stack flow rate	284,999 Nm ³ /hr
Particulate concentration	1.0mg/Nm ³
Particulate emission rate	0.282 kg/hr

Nm³ refers to volumes corrected to 0 degC, 1 atmosphere pressure and dry gas

Table 5-2 Summary of Watercare nitrogen oxides and CO emission tests for Favona Vent Shaft

Blast time	CO (ppm)		NO (ppm)		NO ₂ (ppm)		Weight of explosive used (kg)
	Average	Max	Average	Max	Average	Max	
Morning blast	1.22	5.00	0	0	0.03	0.3	557
Afternoon blast	1.28	3.00	0	0	0.09	0.5	345
Evening blast	1.35	4.00	0.01	1.00	0.0	0.2	536

AAQG for CO = 8 ppm (10mg/m³) (1-hour average) and NESAQ for NO₂ = 0.1ppm (200µg/m³) (1 hour average)

As expected, peak concentrations of both CO and NO₂ were elevated above the averages, but average concentrations were all less than the relevant AAQG and NESAQ values.

As the blasting in the Martha Underground will follow the same practices as used at Favona and the other underground mines, the reasonable expectation is that emissions from the new return air shaft and portal will be very similar to the results tabulated above. Concentrations of contaminants in the plume from the vents will be dispersed and diluted as the plume travels downwind and will be substantially less than the concentration in the discharge and the NESAQ and AAQG at locations where members of the public may be exposed. Consequently, the risk of emissions from vent shafts during blasting resulting in exceedances of ambient air quality standards or guidelines at off-site locations, is considered to be minimal.

¹⁶ Watercare Services Ltd "Newmont Waihi Gold, Particulate, Carbon Monoxide and Oxides of Nitrogen Emission Testing" August 2007.

5.5.2 Discharges from above-ground blasting

OGNZL has not carried out any specific monitoring of the discharges to air from above-ground blasting. The nature and quantity of the discharges will be the same as the discharges to air from underground blasting but the discharges will be dispersed into the atmosphere at the source. Concentrations of contaminants are expected to decrease rapidly with distance from the source and to be well below guideline levels where members of the public may be exposed. OGNZL manages and plans each blast taking into consideration the likely effects on nearby residents, the size of the blasts and weather conditions.

6 Existing Effects

6.1 Potential for Dust to Cause Adverse Effects

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

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

The GPG Dust¹⁷ notes that the potential for a dust discharge to cause an objectionable or offensive effect depends on the following characteristics of the dust fallout:

- The frequency of dust nuisance events;
- The intensity of events, as indicated by dust quantity and the degree of nuisance;
- The duration of each dust nuisance event;
- The offensiveness of the discharge having regard to the nature of the dust; and
- The location of the dust nuisance, having regard to the sensitivity of the receiving environment.

These factors are known as the FIDOL factors, and are also used in odour assessment to consider whether an odour discharge has caused an offensive or objectionable effect. Essentially, whether a dust discharge leading to dust deposition causes an offensive or objectionable effect depends on how frequent it is and how much dust is deposited.

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 the majority 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.

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 potential for TSP to cause health effects is usually the cause of most concern for nearby residents.

¹⁷ Ministry for the Environment: “*Good Practice Guide for Assessing and Managing Dust*” 2016.

6.2 OGNZL Air Quality Monitoring Programme

6.2.1 Overview

OGNZL and its 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 PM₁₀ and respirable silica has also been carried out biennially along with other specific monitoring of some contaminants. At present, OGNZL has a total of 13 permanent monitoring sites of which 9 are used to measure deposited dust and 6 are used to measure TSP. Meteorological parameters are measured at one location. The locations of the current monitoring sites are shown in Figure 6-1 and a description of each site is provided in Table 6-1.

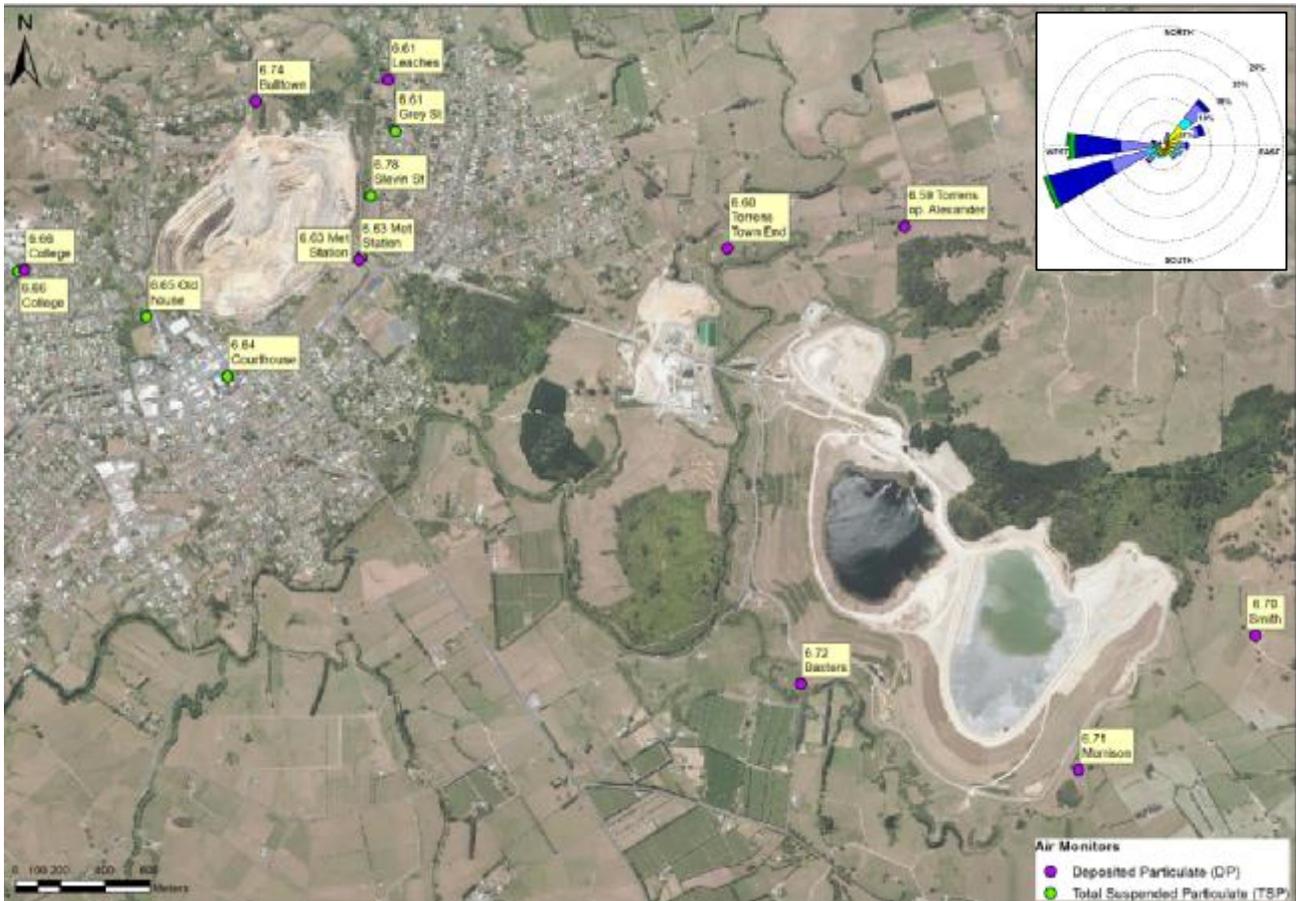


Figure 6-1 Locations of air quality and meteorological monitoring sites overlaid with a site windrose (Source OGNZL)

Table 6-1 Description of 2017 permanent monitoring sites

Site No	Description	Location	Contaminants monitored	Comments
6.59 (Torrens, Alexander)	Alexanders, Golden Valley	North of development site	Deposited dust	Rural area, 2450m east of Martha Pit, and 930m north east of processing plant. Representative of rural background levels.
6.60 (Torrens, Town End)	Torrens, Golden Valley	North of mill	Deposited dust	Rural area, 1710m east of pit, 250m northeast of Process Plant.
6.61 (Leaches)	OGNZL Leaches	North-north east of Martha Pit	Deposited dust	Semi-rural area. 540m north-north east of pit, downwind of the northwest face of the Martha Pit in prevailing winds.
6.61 (Grey St)	OGNZL Grey street (TSP site)	Northeast of Martha Pit	TSP	Semi-rural area. 210m north-north east of Martha Pit, downwind in prevailing winds.
6.63 (Met Station/Office)	OGNZL Met Station/office Barry Road	Southeast of Martha Pit	Deposited dust, TSP and meteorology	Parkland, 140m east of Martha Pit, downwind in prevailing winds.
6.64 (Courthouse)	Court House, Haszard Street	South of Martha Pit	TSP	Commercial area 310m south of Martha Pit. Not downwind of pit. Representative of urban background levels.
6.65 (Old House)	Moresby Avenue	Southwest of Martha Pit	TSP	Urban area, 75m south west of Martha Pit. Downwind of pit in secondary winds
6.66 (College)	Waihi College, Rata Street	West of Martha Pit	Deposited dust and TSP	Urban area, 630m west of Martha Pit, Upwind of pit in prevailing wind conditions. Representative of urban background levels.
6.70 (Smith)	Smith's Farm, Baxter Road	East of TSF1A	Deposited dust	Rural area, 260m east of TSF1A. Downwind of TSF1A in prevailing winds
6.71 (Morrison)	Morrison's Farm, Trig Road	Southeast of TSF1A	Deposited dust	Rural area, 270m southeast of TSF1A. Downwind of TSF1A embankments during prevailing winds.
6.72 (Baxter Rd)	Ruddock's Farm, Baxter Road	West of TSF1A	Deposited dust	Rural area, 330m southwest of TSF2 and 580m west of TSF1A. Downwind of TSF1A and 2 in secondary winds.
6.78 (Slevin St)	Cnr Grey & Slevin Streets	East of Martha Pit	TSP	Parkland 150m east of pit. Downwind of Martha Pit in prevailing winds.
6.00 (Bulltown)	Bulltown Road	North of Martha Pit	Deposited dust	New site added in January 2017, Bulltown Road, 140m north of Martha Pit, not downwind of pit.

6.2.2 Monitoring methods

Deposited dust

Deposited dust is measured by means of a dust gauge that captures dust settling from the air over a fixed surface area over a prescribed period of time, usually 30 days or a month. The dust is removed from the gauge, filtered and weighed and the results reported in terms of the dust collected per unit area per unit of time, e.g. g/m²/30days.

TSP

OGNZL measures TSP using High Volume samplers (HiVols). HiVols measure TSP concentrations by drawing a measured volume of air through a filter for a known period of time and then weighing the dust collected on the filter. The most common measurement period is 24 hours, however, OGNZL exposes each filter for a period of 7 days.

6.2.3 Summary of monitoring results

The following sections summarise the results of the ambient air monitoring programme for the period January 2000 to December 2017. More detailed data is included in **Appendix D**.

Deposited dust

Table 6-2 summarises the long term average, maximum, minimum and median values for deposited dust for each of the current monitoring sites. The distribution of the monthly deposition rates at each monitoring site is illustrated in Figure 6-2 by box and whisker plots. The “boxes” in the figure show the median, upper quartile and lower quartile monthly deposition rates (i.e. the 50th, 75th and 25th percentiles) recorded at the monitoring sites. The ‘whiskers’ show the highest and lowest deposition rates observed during the monitoring, excluding outlier values. The outliers are shown in the figure as circles.

The variations in monthly deposition rates over the monitoring period are shown in Figure 6-3.

Table 6-2. Distribution of the monthly average deposited dust (g/m²/30days), January 2000 - December 2017

Monitoring Locations	Average	Maximum	Minimum	Median
6.59 (Torrens Alexander)	0.85	3.08	0.11	0.74
6.60 (Torrens Town End)	0.85	2.76	0.14	0.76
6.61 Leaches (Grey Street)	1.07	3.3	0.21	0.92
6.63 (Met Station/Office)	1.24	4.73	0.17	1.15
6.66 (College)	0.77	2.16	0.05	0.70
6.7 (Smith)	0.96	11.66	0.19	0.78
6.71 (Morrison)	1.18	5.23	0.19	1.03
6.72 (Baxters Road)	0.79	3.14	0.07	0.64
6.00 Bulltown Rd*	0.69	1.46	0.22	0.64

*Monitoring data from January 2017 in this location

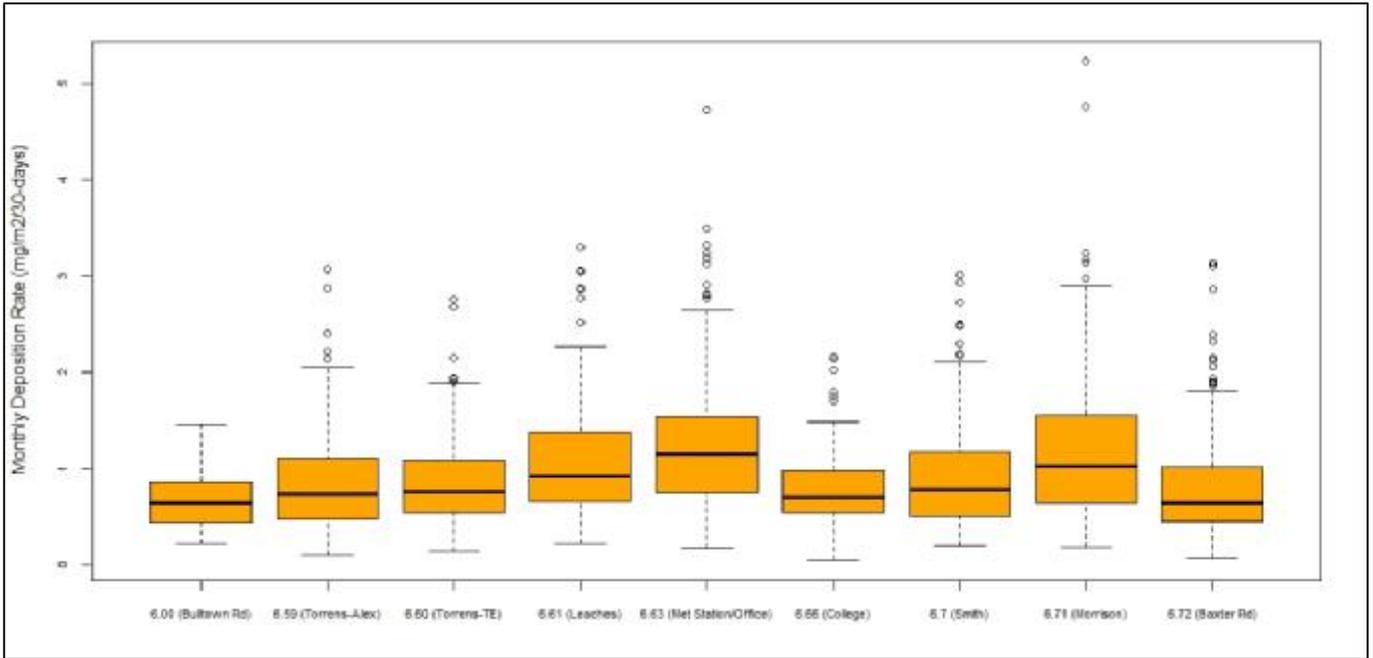


Figure 6-2 Box and whisker plot of monthly average deposited dust monitoring data (January 2000 – December 2017)

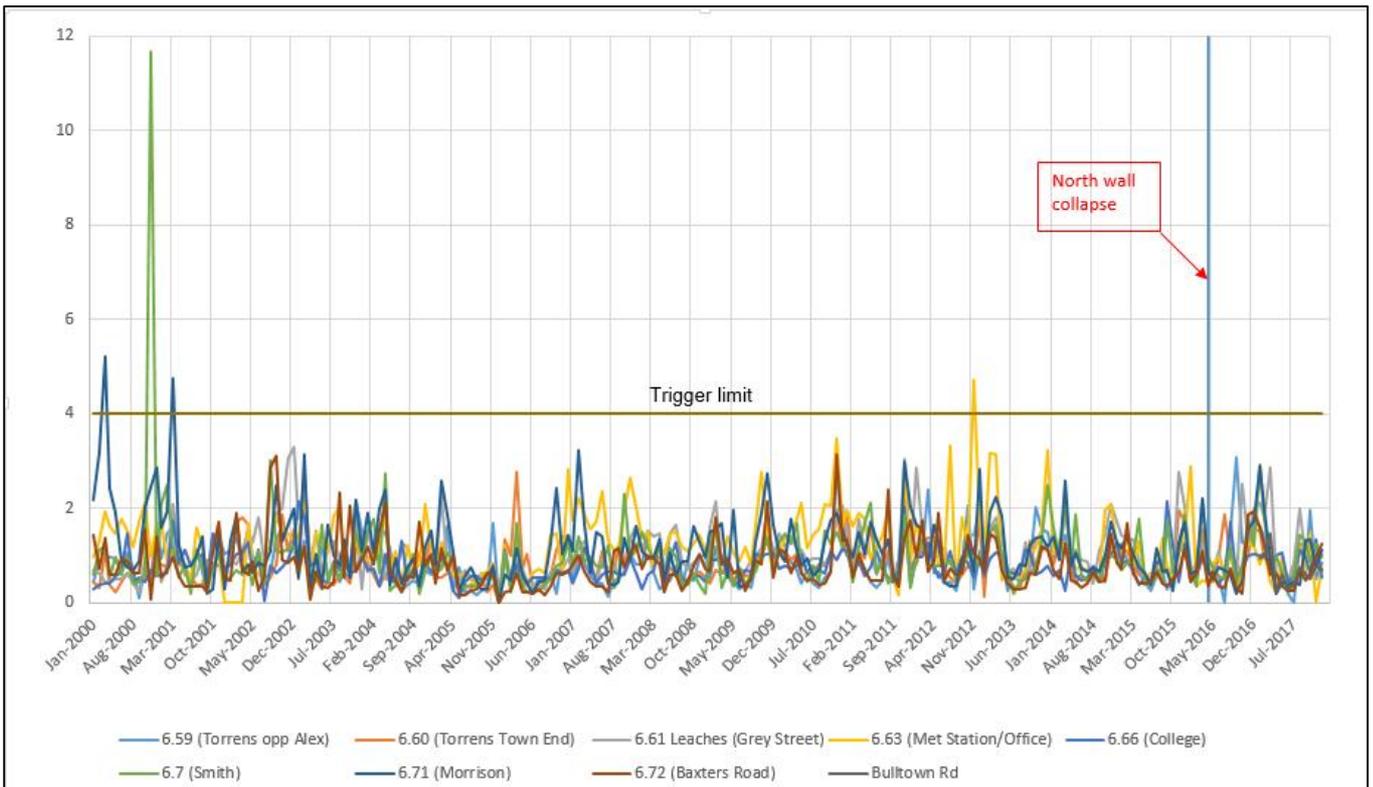


Figure 6-3. Monthly average deposited dust monitoring data (January 2000 – December 2017)

The deposited dust monitoring results show that for the majority of time, deposited dust levels are below the MfE GPG and consent trigger levels of 4g/m²/30 days. Concentrations have exceeded the trigger level on 4 occasions since January 2000 – twice at Site 6.71 (Morrison), and once at both Site 6.63 (Office) and Site 6.7 (Smith). Figure 6-3 shows the exceedance recorded at Site 6.7 (Smith) which appears to be an extreme outlier value and may be the consequence of an abnormal event. This outlier value was omitted from the

data for the statistical analysis. Only one exceedance at Site 6.63 (Office) has been recorded since March 2001.

The MfE GPG notes¹⁸ that “*general dust deposition levels in New Zealand range from about 1 – 4 g/m²/30 days. Background concentrations are usually less than 1 g/m²/30 days but there are also areas (such as Central Otago) where the natural dust levels can be up to 10 times this amount*”. The dust levels measured in the vicinity of the mine are therefore within the range of typical dust levels measured in New Zealand.

A statistical analysis of the monthly deposited dust rates recorded at each of the sites was conducted using a pairwise Wilcoxon Rank Sum test¹⁹. The test compares the deposition rate recorded at each monitoring site against all the other sites in a pair-wise manner²⁰. The test was used to assess whether there was a statistical difference between the distribution (and median) of the deposition rates recorded at each of the different sites. The methodology and results for this analysis are provided in **Appendix E**.

Sites 6.60 (Torrens, Town End) and 6.59 (Torrens, Alexander) are both located in rural areas and are not downwind of the mining operation in either the prevailing or secondary wind conditions. Dust levels measured at these sites are considered to be representative of background levels. No significant statistical difference was detected between the distributions of the site’s deposition rates²¹. The results indicate that deposition levels observed at these sites are similar to each other.

No statistical difference was also found between the distribution and median values of deposited dust measured at Sites 6.66 (College), 6.72 (Baxters), 6.70 (Smith), and 6.00 (Bulltown) and the two background sites (i.e. sites 6.60 (Torrens Town End) and 6.59 (Torrens Alexandra)). The results suggest that the dust levels recorded at Sites 6.66 (College), 6.72 (Baxters), 6.70 (Smith) and 6.00 (Bulltown) are not significantly different from background levels. At these locations, site sources do not appear to have a measureable effect on deposited dust levels.

The highest long term average dust deposition rates have been recorded at Sites 6.63 (Met Station/Office), 6.71 (Morrison), and 6.61 (Leaches). The dust deposition rates at these sites are on average all statistically higher than those recorded at the other monitoring stations, and the two background monitoring stations.

Site 6.63 (Met Station/Office) located approximately 140m to the east of the Martha Pit, is downwind of the mine in the prevailing winds and would be expected to be the monitoring site most impacted by dust from the pit. Site 6.71 (Morrison) is located approximately 270m to the southeast of TSF1A and is only downwind of the TSF1A in northerly quarter winds, which are infrequent. It is possible that the higher than background concentrations of dust recorded by this gauge may be due to the application of lime to paddock-dumped rock and embankment construction activities carried out on the south eastern side of the TSF1A.

Site 6.61 (Leaches), is located approximately 550m north-northeast of Martha Pit and is only downwind of the north-western edge of the pit in prevailing winds. The monitoring site is not downwind of the majority of Martha Pit in the prevailing winds and it is beyond the distance at which deposited dust would normally be expected to be transported in the wind.

¹⁸ Ministry for the Environment “*Good Practice Guide for Assessing and Managing Dust*” 2016

¹⁹ The Wilcoxon Rank Sum test is a non-parametric test. The test was used because the distribution of the site deposition rates were determined to be non-normal.

²⁰ The Holm method was used to adjust the predicted p-value to account for the change in the probability of a significant difference being detected due to the number of statistical tests which are performed during this procedure.

²¹ A test score p-value of <0.05 was used to determine whether a difference was statistically significant.

Summary

On average, deposition rates are highest at the Site 6.63 (Met Station/Office). The median deposition rate at this site is approximately 0.4g/m²/30-days higher than the median deposition rate observed at the background sites, or approximately 10% of the MfE guideline value of 4g/m²/30 days. The median deposition rate at Sites 6.71 (Morrison) and 6.61 (Leaches) are respectively 0.1g/m²/30-days and 0.2g/m²/30-days higher than the median deposition rate recorded at the background monitoring site, or less than 8% of the MfE guideline. Overall, the observed differences, while statistically significant, are comparatively small when compared to the trigger level.

The monitoring results indicate that dust deposition rates are relatively low at all of the sites and are generally comparable to local background levels. Slightly higher average deposition rates are observed at Sites 6.63 (Met Station/Office), 6.71 (Morrison) and 6.61 (Leaches), which may be indicative of Sites 6.6 (Office) and 6.71 (Morrison) proximity to the site activities. The reason for the slightly higher than average deposition rates at Site 6.61 (Leaches) is unclear but is unlikely to be due to the mining activity due to the distance between the site and the Martha Pit and the direction of the prevailing winds. The MfE guideline and consent trigger levels have only infrequently been exceeded at any of the sites during the previous 17 year monitoring period, which indicates that dust deposition levels in the vicinity of the site are considered to be within acceptable levels, (refer to Table 6-3).

Table 6-3. Summary of analysis of monthly dust-deposition data (January 2000 – December 2017)

Monitoring Site	Summary of Results
6.59 (Torrens opp Alex)	Deposition rates are <u>representative of rural background levels</u> . Deposition rates are not expected to be impacted by mining operations.
6.60 (Torrens Town End)	Deposition rates are <u>representative of rural background levels</u> . Deposition rates are not expected to be impacted by mining operations.
6.61 Leaches (Grey Street)	Deposition rates are on average statistically <u>slightly higher</u> than background levels.
6.63 (Met Station/Office)	Deposition rates are on average statistically <u>slightly higher</u> than background levels. The higher deposition rates are potentially due to the site's proximity to and downwind location from Martha Pit.
6.66 (College)	Deposition rates are <u>not</u> statistically significantly different from background levels.
6.7 (Smith)	Deposition rates are <u>not</u> statistically significantly different from background levels.
6.71 (Morrison)	Deposition rates are on average statistically <u>slightly higher</u> than background levels.
6.72 (Baxters Road)	Deposition rates are <u>not</u> statistically significantly different from background levels.
6.00 (Bulltown)	Deposition rates are <u>not</u> statistically significantly different from background levels.

6.2.4 Comparison of deposited dust concentrations with annual production rates

The annual average deposited dust levels measured at Site 6.63 (Met Station/Office) are compared with the annual tonnage of material handled at the mine in Figure 6-4. The deposited dust levels measured at a site are dependent on the level and type of activity in proximity to the site and meteorological conditions,

however, the graph in Figure 6.4 demonstrates that annual average dust deposition levels have varied at Site 6.63 (Met Station/Office), generally in accordance with production rates, especially since 2005.

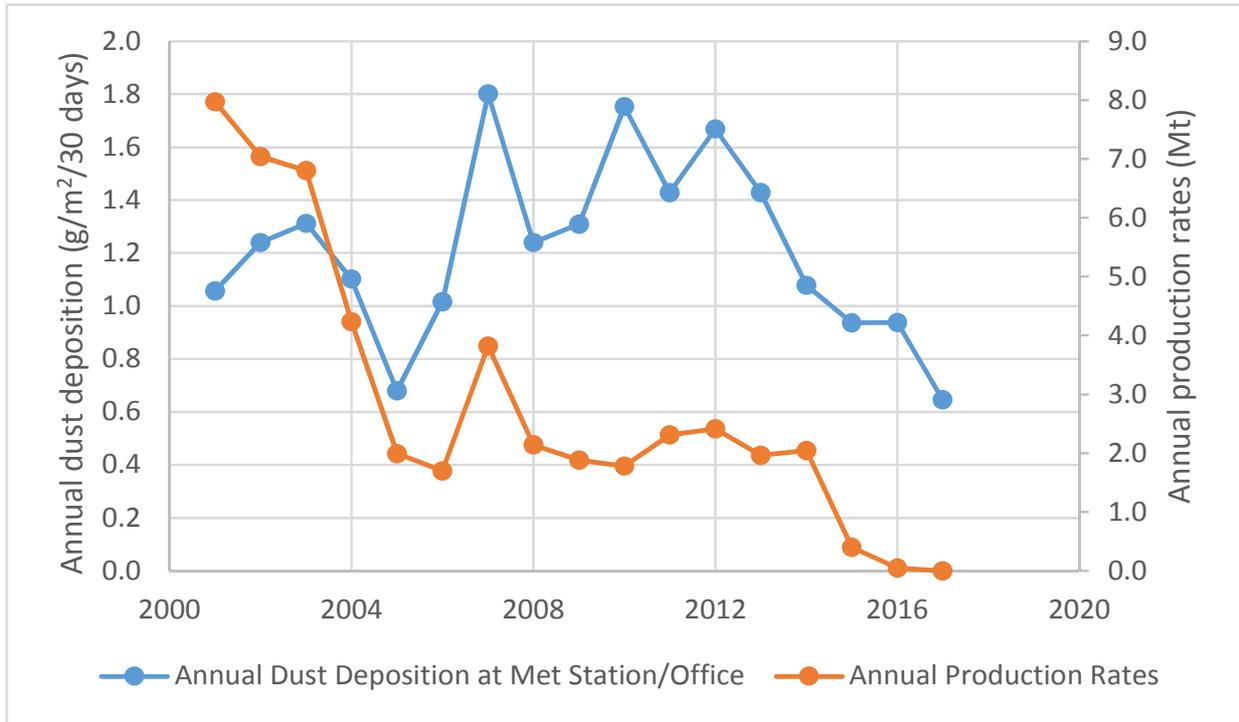


Figure 6-4 Annual average dust deposition at Site 6.63 (Met Station/Office) compared to annual tonnage of material handled.

6.2.5 Total Suspended Particulate (TSP) monitoring data

Table 6-4 summarises the average, maximum, minimum and median, 7 day average TSP concentrations for the period January 2005 and December 2017. The distribution of the 7 day average TSP concentrations are shown in Figure 6-5 by box and whisker plots. Figure 6-6 shows the time series of the 7 day average TSP data over the monitoring period.

Table 6-4. Distribution of 7 day average TSP concentrations (µg/m³)

Distribution of monthly monitored TSP Concentrations 2005-2017 (µg/m³)				
Monitoring Location	Average	Maximum	Minimum	Median
6.61 (Grey Street)	12.3	43.6	0.5	11.5
6.63 (Met Station/Office)	15.9	84.9	0.3	13.9
6.64 (Courthouse)	12.7	61.6	0.2	12.1
6.65 (Old House)	11.1	33.2	0.2	10.5
6.66 (College)	10.7	56.6	0.6	10.6
6.78 (Slevin St)	13.02	46.2	1.2	12.5

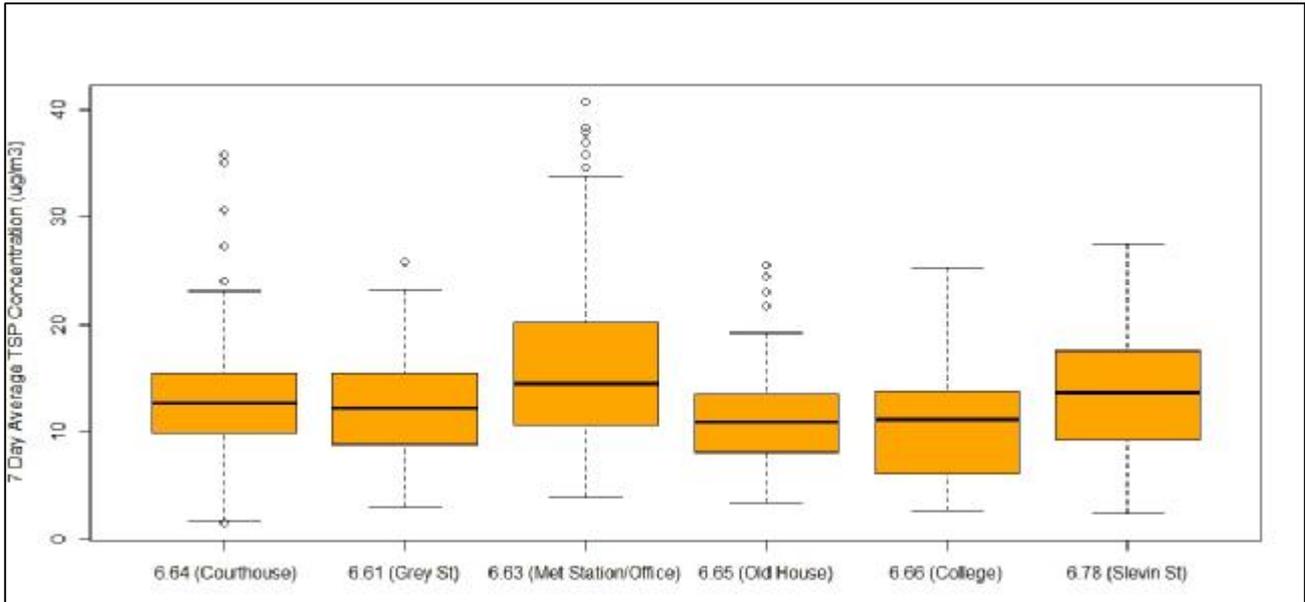


Figure 6-5 Box and whisker plot of 7 day average TSP concentrations ($\mu\text{g}/\text{m}^3$) monitoring data (January 2005 – December 2017)

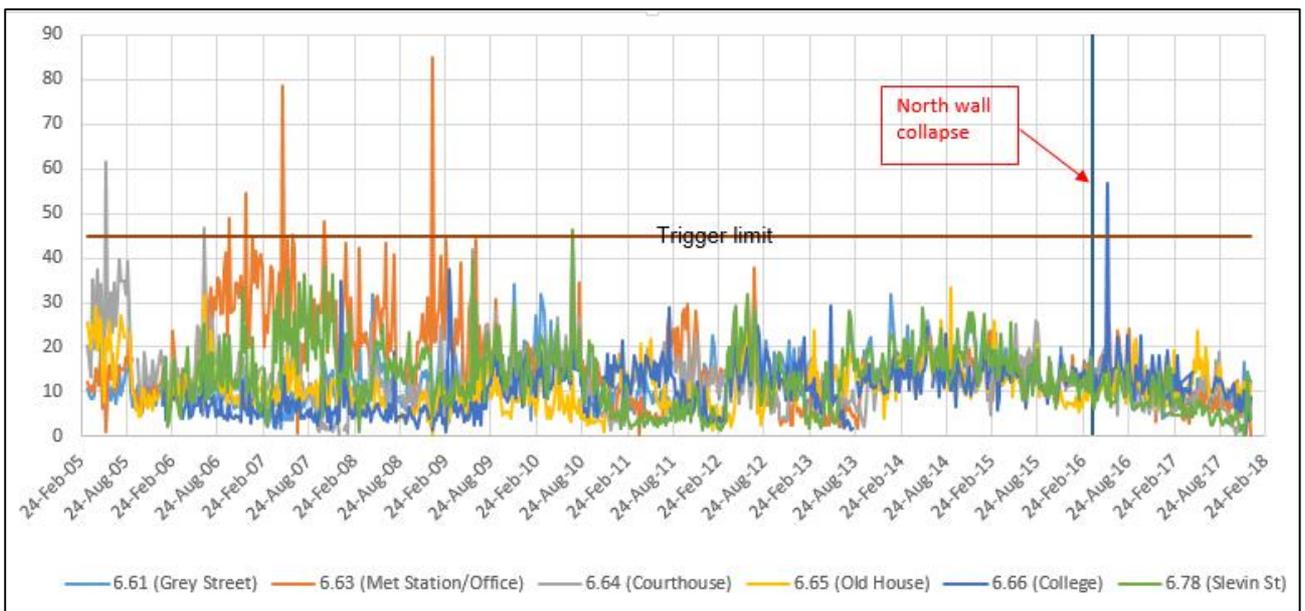


Figure 6-6. 7 day average TSP concentrations (March 2005 – December 2017)

The results of monitoring show that TSP concentrations are generally below the OGNZL trigger limit of $45\mu\text{g}/\text{m}^3$ (7 day average), except for 10 exceedances that have been recorded during the monitoring period. Six of these exceedances occurred at Site 6.63 (Met Station/Office), three at Site 6.64 (Courthouse), and one at the Site 6.66 (College). Only one exceedance of the trigger level has occurred since October 2011 (at Site 6.66 (College)).

TSP concentrations have not exceeded the mining licence limit of $100\mu\text{g}/\text{m}^3$ at any of the monitoring sites since monitoring began.

A statistical analysis of the 7-day average TSP concentrations recorded at each of the sites was conducted using a pairwise Wilcoxon Rank Sum test. The test compares the 7-day average TSP concentration recorded at each monitoring site against all the other sites in a pair-wise manner. The test was used to assess

whether there was a statistical difference between the TSP concentrations recorded at any of the sites. The methodology and results for this analysis are provided in **Appendix E**.

Sites 6.65 (Old House) and 6.66 (College)

TSP concentrations are on average lowest at Site 6.66 (College) site. The College site is located 630m west of the Martha Pit and upwind of the mine in prevailing wind conditions. The College is located on the edge of Waihi with rural land to the west, north and northeast. There are residential properties to the east and south of the site. The concentrations recorded at the site are considered to be representative of background levels in the rural residential areas surrounding Waihi.

A higher than typical TSP concentration of $57\mu\text{g}/\text{m}^3$ was recorded at Site 6.66 (College) on 3 June 2016. On this day, winds were predominantly from the east (and blowing from the direction of Martha Pit) but were light (less than 5m/s). Between midday and 6pm, the winds were slightly stronger (up to 7m/s) and were blowing from the southeast. Due to the distance between the monitoring site and the low wind speeds from the east recorded for the majority of the day, it is considered unlikely that dust from the mine was the predominant cause of the higher than normal concentrations. It is more probable that this concentration was due to a localised source, probably located to the southeast of the monitor and is considered to be an outlier.

The results of the Wilcoxon Rank Sum test indicate that there is no statistically significant difference between the TSP concentrations measured at the Site 6.65 (Old House) and those measured at the Site 6.66 (College) site. Site 6.65 (Old House) is located relatively close to the mine (i.e. 75m to the southwest) and downwind in secondary wind conditions. The statistical test results indicate that mining activities do not appear to make a significant contribution to TSP concentrations at this location.

TSP concentrations at the sites 6.65 (Old House) and 6.66 (College) are on average statistically lower than those recorded at the other sites.

Site 6.63 (Met Station/Office)

On average, the highest TSP concentrations were recorded at the Site 6.63 (Met Station/Office). The results are consistent with where the peak dust deposition rates also occur. The higher concentrations can likely be attributed to the site's proximity to the Martha Pit, and its downwind location in the predominant wind direction. TSP concentrations at the site are on average approximately $5\mu\text{g}/\text{m}^3$ higher than those recorded at the sites that appear to be unaffected by mining activities (i.e. 6.65 (Old House) and 6.66 (College)). However, TSP levels at Site 6.63 (Met Station) have not exceeded the trigger level of $45\mu\text{g}/\text{m}^3$ since 2009.

Site 6.78 (Slevin Street), 6.64 (Courthouse) and 6.61 (Grey Street)

The distribution of TSP concentrations recorded at the 6.78 (Slevin St), 6.64 (Courthouse) and 6.61 (Grey Street) site are all statistically similar. On average, the TSP concentrations at the sites are higher than those recorded at Sites 6.65 (Old House) and 6.66 (College) but lower than those recorded at Site 6.63 (Met Station).

The higher average TSP concentrations recorded at the 6.78 (Slevin St), relative to background levels, may in part be attributed to mining activities due to its proximity to the mine and downwind location in the predominant wind direction.

Mining activities may at times also contribute to TSP concentrations at Site 6.61 (Grey Street) since it is also located downwind of the Martha Pit in the prevailing wind direction. However, the site is located further from the mine than Site 6.78 (Slevin St) and the contribution from any mine activities to pollutant levels would be expected to be lower.

Site 6.64 (Courthouse) is located in the Waihi commercial area approximately 310m south of Martha Pit. The site is downwind of the pit for less than 5% of the time. Mining activities are therefore not expected to be a

significant contributor to the TSP levels at this site. The higher TSP concentrations recorded at the site (compared to sites unaffected by mining), are therefore expected to be associated with other emission sources (e.g. transport sources, home heating emissions) and can be considered to be representative of background concentrations in Waihi Township. The three exceedances recorded at Site 6.64 are not expected to be associated with emissions from the mine.

Summary

Overall, the monitoring results would suggest that Martha Pit mining activities may have an impact on TSP concentrations at the sites located close to the pit, however at distances of between 150m and 250m the impact of the mine becomes less significant and TSP levels are expected to be similar to levels recorded in other parts of Waihi that are not impacted by the mine.

Table 6-5 summarises the results of the TSP monitoring data analysis.

Table 6-5. Summary of analysis of TSP monitoring data (January 2000 – December 2017)

Monitoring Site	Summary of Results
6.61 (Grey Street)	Concentration <u>slightly higher</u> than background concentrations. Mining activities a possible contributor to TSP levels. Similar levels to those at Sites 6.64 (Courthouse), and 6.78 (Slevin St).
6.63 (Met Station/Office)	<u>Highest average concentrations above background levels</u> , closest proximity and downwind of Martha Pit. Mining activities a likely contributor to TSP levels.
6.64 (Courthouse)	Concentration <u>slightly higher</u> than background concentrations. Mining unlikely to be a significant contributor to TSP levels. Similar levels to those at Sites 6.61 (Grey St), and 6.78 (Slevin St).
6.65 (Old House)	<u>Representative of background/baseline levels</u> . Not significantly different from Site 6.66 (College) levels.
6.66 (College)	<u>Representative of background/baseline levels</u> . Not significantly different from Site 6.65 (Old House) levels.
6.78 (Slevin St)	Concentration <u>slightly higher</u> than background concentrations. Mining activities a possible contributor to TSP levels. Similar levels to those at Sites 6.61 (Grey St), and 6.64 (Courthouse).

6.2.6 Comparison of annual average TSP concentrations with annual production rates

The annual average TSP concentrations measured at Site 6.63 (Met Station) are compared with the annual tonnage of material handled at the mine in Figure 6-7. The graph in Figure 6-7 demonstrates that annual average TSP concentrations have varied at Site 6.63 (Met Station/Office), with production rates to some degree, but also illustrates that annual average TSP concentrations are also likely to be influenced by sources other than the mine. This is particularly evident for 2015 and 2016 when production effectively ceased in April 2015 but annual average TSP concentrations remained at similar levels to 2014. This is not unexpected as the measured TSP concentrations will include sources such as domestic heating and vehicle emissions within Waihi, which are unrelated to mining activities.

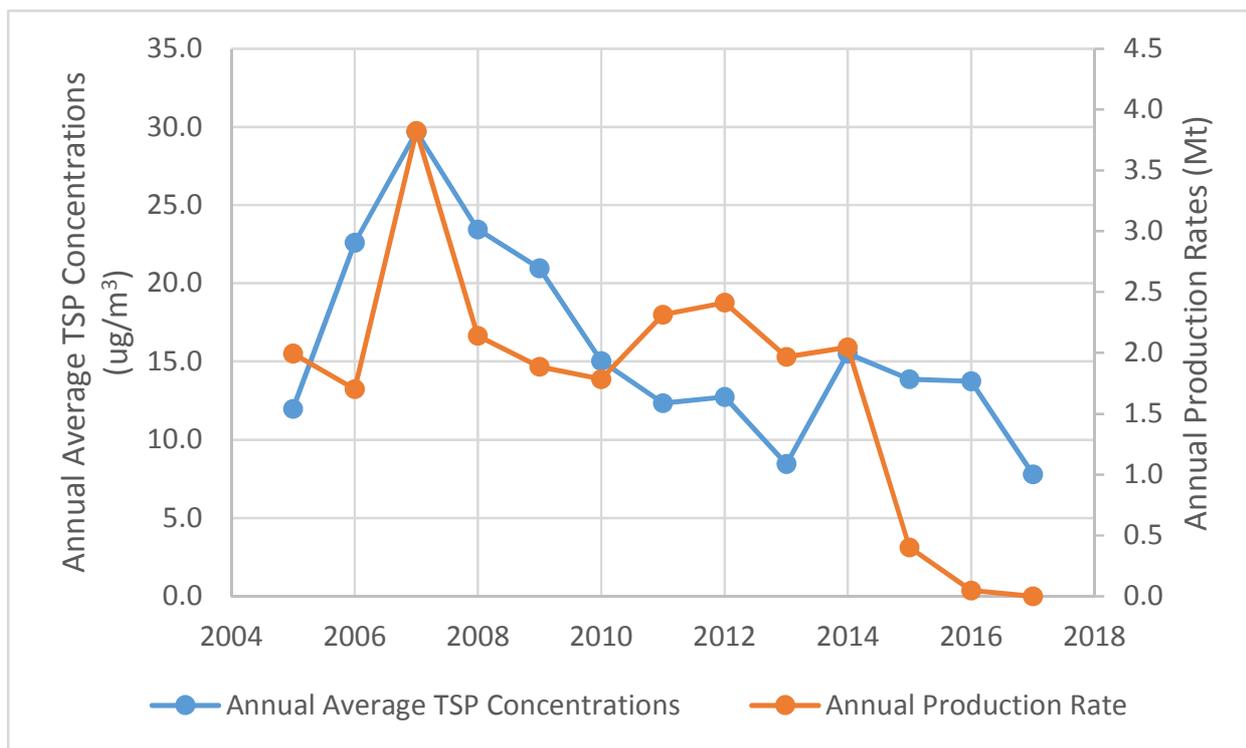


Figure 6-7 Annual average TSP concentration compared to annual tonnage of materials moved

PM₁₀ and Silica

OGNZL monitored the 24-hour average ambient concentrations of PM₁₀ and respirable silica, every two years, for periods of approximately four months, up until the end of 2014. The monitoring programme was suspended in 2015, with the agreement of WRC, when mining in the Martha Pit stopped. This monitoring was undertaken at various sites in Waihi and using a number of different monitoring methods. Consequently, not all sets of monitoring results are directly comparable. However, the results of the monitoring consistently demonstrated that the concentrations of PM₁₀ and respirable silica were well within health-based guidelines and standards at all the monitored sites.

Continuous monitoring of PM₁₀ concentrations was also carried out by WRC for three years between 2008 and 2011 at the site shown in Figure 3-1 **Error! Reference source not found.** During the monitoring period, PM₁₀ concentrations did not exceed the NESAQ threshold of 50 µg/m³. Respirable silica concentrations did not exceed the 24 hour guideline value²² of 9µg/m³ and monitoring was subsequently ceased as the WRC considered that ambient air quality within the Waihi Airshed did not pose any significant potential health risks.

Table 6-6 summarises the results of ambient PM₁₀ and respirable silica monitoring reported by OGNZL in 2014 (the last year that the monitoring was carried out).

²² Derived from the Office of Environmental Health Hazard Assessment (OEHHA) Noncancer Chronic Reference Exposure Level (REL) of respirable crystalline silica of 3 µg/m³ (annual average).

Table 6-6 PM₁₀ and silica monitoring results²³

Year	PM ₁₀ (µg/m ³) (24 hour average)		Respirable Silica (µg/m ³) (24 hour average)	
	Range	Average	Range	Average
2000/1	<d – 27.0		<d – 1.1	
2003	7.3 – 34.8		<d – 6.2	
2005	5.9 – 40.7	19.2	<d – 10.0 ^a	
2007	0.4 – 39.4	13.4	0.1 – 4.2	0.9
2009	9.7 – 37.2	18.6	0.1 – 1.7	0.9
2011/12	9.1 – 29.8	17.0	<d – 2.1	0.5
2014	6.4 – 17.6	12.0	0.1 – 2.6	1.0

<d = less than detection

^a 2005 report considered that the maximum result was spurious.

6.3 Underground Vent Monitoring

The monitoring of emissions from the underground vents during blasting is discussed in Section 5.5.1.

6.4 Complaints and Compliance History

OGNZL records all complaints it receives regarding dust, smoke and blasting odours. Figure 6-8 illustrates the number of dust complaints received by OGNZL each year since 2000. 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.

²³ Table taken from “Waihi Gold Annual Air Monitoring Report, 2014”.

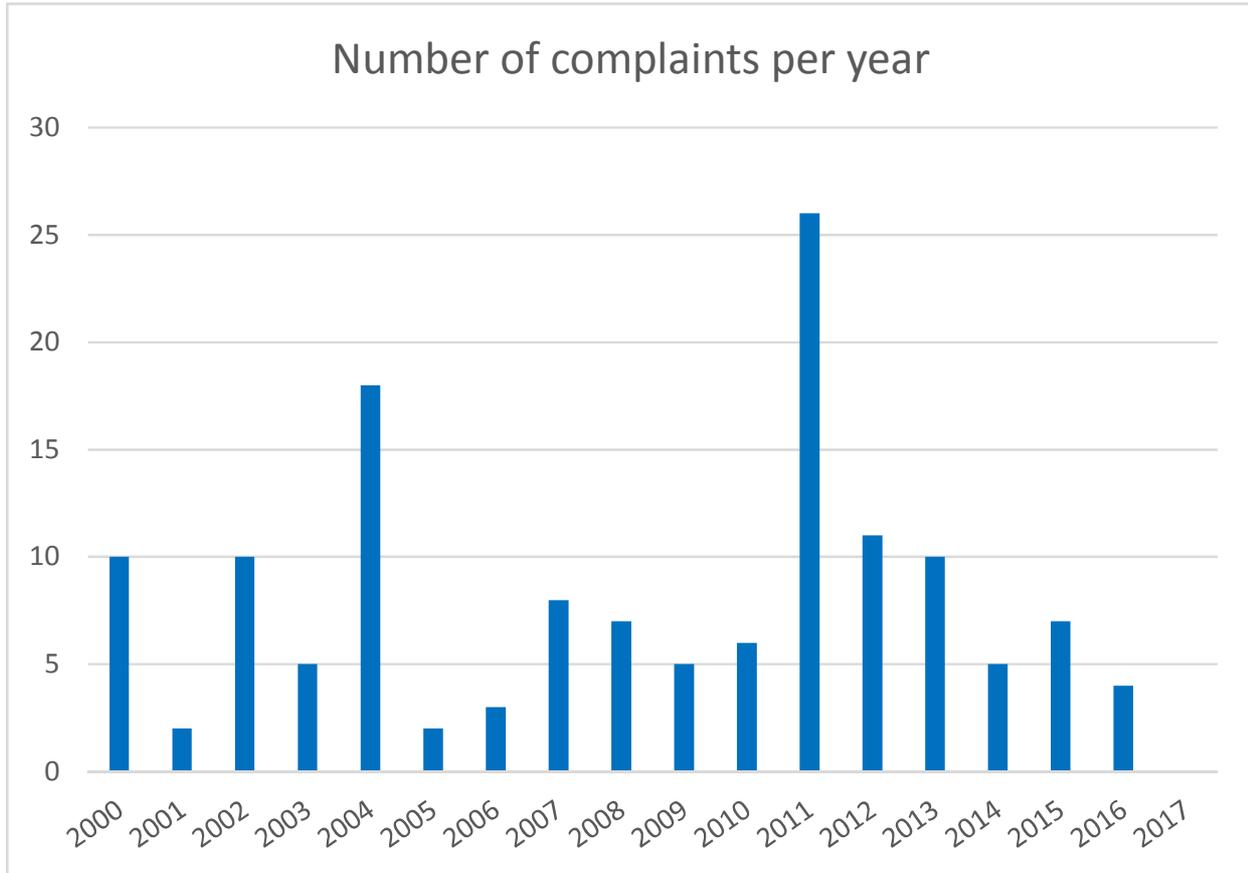


Figure 6-8 Number of dust complaints received each year

The historical complaints data demonstrates that in most years the number of complaints received is less than 10 which is considered to be a moderate to low level for an activity of this size located within a sensitive receiving environment. During 2004 and 2011, the number of complaints was higher, with 18 complaints being received in 2004 and 26 in 2011. No dust-related complaints were received in 2017.

6.4.1 2004 dust complaints

The Annual Air Monitoring Review for 2004²⁴ noted that all of the complaints were from one complainant located in Roycroft Street and were received in the early months of the year. Roycroft Street is located approximately 320m to the east of Martha Pit. The complainant was concerned about dust on surfaces in her home and the health of her family and alleged that dust emissions from the mine, crusher, stockpile area and haul roads were visible from her home.

In response to these complaints, OGNZL initiated some additional ambient air quality monitoring in Roycroft Street which continued for a period of 12 months and some additional dust mitigation measures. The results of the monitoring demonstrated that both deposited dust levels and TSP concentrations measured at the Roycroft Street site were well within the consent trigger limits and were less than the values recorded at the routine monitoring sites, 6.61 (Grey Street) and 6.63 (Office).

²⁴ Rolfe, K, "Annual Air Monitoring Review", 2004, prepared for Newmont Waihi Operations/Waihi Gold Mining Company Ltd.

The additional dust mitigation implemented included the installation of a sprinkler system in the crusher area and an increased frequency of watering roads and high activity areas and more frequent use of water cannons on stockpiles during dry summer periods.

6.4.2 2011 dust complaints

The Annual Air Monitoring Report for 2011 noted that of the 26 complaints that were received during the year; 20 related to the Martha open pit operations, 5 concerned the RTSA and one concerned the Processing Plant area. The complaints were received from 18 complainants. The majority of complaints were received after a proposed mine development plan was announced to the public and a community consultation programme was conducted. Following the consultation, 12 complaints were received. The complaints were attributed to a very dry and windy November combined with a water cart breakdown for 36 hours and no sprinklers being used on a temporary portable crusher. The report noted that all monitored dust levels were higher than normal during the month including those upwind of the mine.

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.

6.4.3 Complaints about smoke and blast emissions

At times, complaints have been received regarding odours and smoke from blast emissions and fires. In 2004, in response to a series of 3 complaints in February relating to blast odours, a notification system was established. 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 pit. No substantiated complaints regarding blasting odours have been received since 2005. Since 2004, 6 complaints have been recorded regarding smoke from fires, with the last substantiated complaint being received in 2009.

6.5 Summary of Current and Past Effects

The results of ambient air quality monitoring and the complaints history for the site demonstrate that any increase above background concentrations of deposited dust, TSP, PM₁₀ and silica measured at sites in the vicinity of the mining operation are small and well below the relevant standards and guidelines recommended by MfE and within the current resource consent and mining licence limits.

It should be noted, however, 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 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 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.

Overall, it is considered that past and current adverse effects resulting from the discharges to air from the Waihi mining operation are no more than minor.

7 Potential Effects on the Environment of Project Martha

7.1 Approach to Assessment of Effects

For Project Martha, the effects of the existing Waihi Gold Mine activity have been assessed by analysing the last 17 years of available environmental monitoring data discussed in Section 6.2. For applications such as this, assessment methods which involve the calculation of emission rates from fugitive sources and the likely downwind concentrations of contaminants using dispersion modelling are impractical as it is very difficult to estimate emission rates and model the effects of the emissions, as the scale and locations of the sources change frequently, as well as the local topography. Consequently, where these constraints are present, qualitative methods should be used.

The likelihood of the discharges to air from Project Martha resulting in adverse effects on sensitive receptors are estimated based on the historic and existing effects of mining at Waihi and the likely changes to the scale and location of the emissions. The likelihood of each of the project features resulting in adverse effects on the nearest sensitive receptors has been assessed taking into account the location of the receptor in relation to the potential sources of dust, the likely frequency of potential impacts and the likely severity of any 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 in Table 7-1²⁵.

Table 7-1 Risk factors assigned to each sensitive receptor group

Risk Factors	Less than 50m from works	Between 50m and 100m from works	Between 100m and 200m of 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

7.2 Potential Nuisance Effects of Deposited and Suspended Dust

The proposed Project Martha will bring mining activities in closer proximity to a small number of properties on Bulltown and Cambridge Roads. The closest houses are located approximately 30m from the proposed works associated with the relocation of Bulltown and Cambridge Roads and approximately 60m from the proposed new noise bund. The works associated with relocation of the roads and the construction of the noise bunds will be completed in a relatively short timeframe (approximately 6 months) and these houses will not be downwind of the pit in the prevailing or secondary wind directions (refer to Figure 7-1). The works involved with the relocation of the roads will be typical of other road works and will be small scale compared to mining activities.

²⁵ The risk matrix is 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.

Winds from the south-easterly quarter that exceed 5m/s and which could blow dust from the new noise bunds and road relocation works, towards the properties located within 200m of the proposed works, occur for approximately 3.7% of time, which is infrequent. Consequently, the risk of these properties being adversely affected by dust generated during the construction phase of the project is considered to be moderate to low due to their close proximity to the site.

During active mining operations the closest houses will be approximately 70m from the crest of MP4 and will not be downwind of the mine during the prevailing and secondary wind conditions. Work on the upper benches near the crest of MP4, which is beyond the boundary of the current permit boundaries, will take approximately 8 months to complete. Following completion of these works the mining activity will move progressively away from the crest for the remainder of the project. Consequently, the risk of the closest properties to MP4 being adversely affected by dust during mining operations is considered to be low.

Due to the close proximity of some of the properties to the proposed works, there is a chance that infrequent and short term dust events may occur when works are taking place in close proximity to houses, which may have the potential to cause offensive or objectionable effects for short periods. In order to mitigate the risk of adverse effects occurring in this area, especially during dry and windy conditions some additional mitigation measures are recommended, which are explained in Section 8.

Providing OGNZL implements the recommended mitigation measures and continues to use the current dust control methods that have been demonstrated to be effective at the current operations, the risk of any adverse effects that may arise due to dust from the proposed Project Martha on these properties can be adequately avoided and mitigated.



Figure 7-1 Locations of properties within 200m of MP4 overlaid with a windrose

7.3 Potential Health Effects of Fine Particulates, Respirable Silica, Combustion Emissions from Vehicles and Blast Emissions

The ambient air monitoring carried out by OGNZL and WRC of PM₁₀ and respirable silica concentrations and combustion emissions from vehicles, at various locations within Waihi and in the vicinity of the mine, has

shown that the concentrations of these contaminants are well below the relevant guideline and standard concentration limits.

Additionally, the monitoring carried out by OGNZL of the discharges to air from an underground mine vent shaft during blasting demonstrated that the average emissions of NO, NO₂, CO discharged from the vent were all below ambient air quality guideline and standards. The vent shafts associated with Project Martha will be located within the MP4 pit, more than 130m below the surface, and several hundreds of metres from sensitive locations. As the contaminants in the plume from the vents will be dispersed and diluted in the plume as it travels downwind, the ambient concentrations of contaminants beyond the boundary of the site, where members of the public may be exposed, are expected to be negligible.

The overall scale of the mining operation at Waihi will not increase and the current mitigation measures will continue to be used, consequently the emission rates and ambient concentrations of the contaminants from these sources are also expected to remain similar to recent and current levels and less than past peak levels.

The realignment of Cambridge/Bulltown Road will bring the road slightly closer to some houses. The numbers and types of vehicles using the road will not change and hence the emissions from traffic will also not change. Any effects of the realignment on ambient air quality in the vicinity of these houses is expected to be negligible.

Consequently, it is considered that the discharges to air of PM₁₀ and respirable silica from the proposed activities can be adequately avoided and mitigated and the risk that of adverse health effects occurring will be negligible.

7.4 Summary of Potential Effects

The assessment of potential effects has identified that there is a low to moderate risk of sensitive receptors located within 200m of the proposed works being exposed to a small increase in deposited dust and TSP concentrations above presently consented levels as a result of Project Martha, although concentrations are not expected to exceed standard and guideline values. In order to mitigate the risk of short term dust events causing adverse effects on sensitive locations in close proximity to the proposed works, it is recommended that some additional mitigation is carried out when works are being undertaken near the closest residences in dry and windy weather.

The concentrations of PM₁₀, respirable silica, NO₂, NO and CO are not expected to exceed NESAQ, guideline values and current consent limits beyond the boundary of the mine.

Overall, providing OGNZL continues to use the dust mitigation measures currently used at the mine (refer to Section 5) and implements the recommended additional mitigation measures described in Section 8, the likelihood of discharges to air creating adverse effects that are noxious, dangerous, offensive or objectionable beyond the boundary of the mine due to Project Martha and the currently consented mine activities is considered to be low.

8 Proposed Mitigation Measures

8.1 Current Mitigation Measures

The mitigation measures currently used to control dust at the mine will continue to be used. These methods are described in the AQMP prepared by OGNZL and are summarised in section 5.2.3. Similarly it is recommended that the consent conditions included in the current consents for the mine are included in any new consent that is granted.

8.2 Additional Mitigation Measures

Although it is expected that the risk of dust generated by Project Martha creating adverse effects on the majority of properties located in the vicinity of the Project Martha works is low, for some properties located within 100m of the proposed construction works there is a moderate risk that short term adverse effects may result especially during dry windy conditions. To mitigate this risk it is recommended that the following wind speed trigger levels for reviewing and ceasing work are included as additional mitigation measures in the AQMP. The trigger levels are based on levels recommended in the GPG Dust and are summarised in Table 8-1.

Table 8-1 Trigger values for wind speeds for works taking place within 200m of sensitive receptors located within 100m of the project boundaries.

Trigger methods	Trigger Values (measured at the on-site monitoring station)	Actions
Wind Speed Alert	Hourly average wind speeds exceed 5 m/s as measured at Site 6.63 (Met Station/Office) and winds are blowing towards sensitive receptors located within 100m of the boundary of the project boundaries.	Dust sources and dust control measures will be reviewed and additional dust control methods shall be implemented as required to ensure adverse effects do not result beyond the boundary of the mine.
Wind Speed Alarm	<ul style="list-style-type: none"> ■ Gust wind speeds (two minute average or less) exceed 10 m/s as measured at Site 6.63 (Met Station/Office) during two consecutive ten minute periods and winds are blowing towards sensitive receptors within 100m of the project boundaries. ■ Works may recommence when wind gusts (two minute average or less) are less than 7.5 m/s as measured at Site 6.63 (Met Station/Office) during the previous two consecutive ten minute periods. 	All potentially dust-generating activities will cease within 200m of sensitive receptors located within 100m of the project boundaries except for dust control activities.

For the purposes of this requirement, a sensitive receptor includes the following:

- Privately-owned residences, rest homes, marae

- Schools, kindergartens and child care facilities
- Commercial, retail businesses.

9 Conclusion

OGNZL is proposing to extend the life of the Waihi mining activities by developing Project Martha which includes the MP4 pit and the Martha Underground mine. Project Martha does not include any changes to the operation or discharges to air from the Processing Plant or other areas of the existing operation.

The assessment of effects described in this report concludes that, providing OGNZL continues to use the methods currently used to minimise discharges to air, along with the additional mitigation measures recommended in this report, the discharges to air from Project Martha 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.

Overall, the potential effects of the discharges to air resulting from Project Martha are expected to be less than minor.

Appendix A

Golden Link Project Area Report



NEWMONT WAIHI GOLD:

AIR QUALITY IMPLICATIONS OF
UNDERGROUND MINING IN THE
GOLDEN LINK PROJECT AREA

Kevin Rolfe
Independent Air Quality Management Specialist

March 2012

EXECUTIVE SUMMARY

1. **A** potential environmental consequence of the operation of a gold mine, including associated activities, is that air quality can be affected. Effective measures to manage those activities are required to avoid, remedy or mitigate such effects. This is especially so if the activities are in close proximity to a township.
2. **THE** Martha Open Pit Mine has been in operation since 1988, and the Favona Underground Mine since 2004. The Trio Underground Mine is scheduled to commence production in 2012.
3. **IT** is now proposed to extend the underground mining in what has been named the Correnso Underground Mine. The Correnso Mine is within the Golden Link Project Area.
4. **THE** Golden Link Project Area is located beneath the eastern residential area of Waihi. The Correnso Underground Mine will involve mining in part of that area, approximately mid-way between the Martha Open Pit and the Favona Underground Mine. Future mining may occur within the Golden Link Project Area.
5. **POTENTIAL** sources of emissions from mining in the Golden Link Project Area are the Correnso Mine vent shaft (which includes emissions from blasting, mining and operation of underground vehicles); aboveground vehicle movements; stockpiling of ore and waste rock; ore and rock crushing, screening and conveying; handling of backfill rock and aggregate; operation of the processing plant; and tailings disposal. All these activities other than the vent shaft and the handling of backfill rock and aggregate are currently being undertaken and are consented as part of the Martha, Favona, and/or Trio operations.
6. **THIS** report provides assessments of the potential air quality effects of the Correnso Underground Mine. Each of those assessments finds that the effects can be managed to comply with the conditions of existing discharge permits, which have proven to be effective in avoiding or mitigating effects on the Waihi environment. In particular, an assessment of discharges from the Correnso vent shaft finds the effects of discharges will be insignificant. This conclusion is expected to be applicable to discharges from the vent shaft associated with any mining in the Golden Link Project area.

7. **THE** results of the ambient air monitoring programme over a 29-year period (since before the Martha Mine commenced) have shown a high level of compliance with air quality criteria.
8. **A** comparison of PM₁₀ concentrations measured by the Waikato Regional Council shows the air quality in Waihi compares favourably with eight other urban areas in the Waikato. All of those areas experience air quality issues in winter time from domestic heating, but Waihi is the only one with a large open pit mine within the urban area.
9. **THE** Correnso Underground Mine is scheduled to commence development in July 2013, while production at the Trio Mine winds down. Production at the Correnso Mine will commence in 2015, which coincides with completion of Trio. The phasing of production at the Favona, Trio and Correnso mines, with Correnso replacing Favona/Trio, means that the nature of the discharges to air do not significantly change (other than the location of the vent shaft and the addition of a cement batching plant) and production will continue for a longer period.
10. **ALL** above ground activities associated with the Correnso Underground Mine are located within the Martha Extended Project, the Favona, or the Trio project areas. Therefore no additional consent for discharges to air is required. The location of the new cement batching plant at the Favona portal stockpile is covered by the discharges to air consent issued for the Favona Underground Mine.
11. **THE** discharges to air consent granted at the time of consenting the Martha Mine Extended Project (Discharge Permit 971281), which will cover the vent shaft for the Correnso Underground Mine and activities within the processing and tailings disposal areas, expires on 15 July 2017 and therefore a new consent is required from that date. Crushing and screening at the Martha Mine will cease in 2017, following completion of the layback to the east wall of the pit. Apart from work to rehabilitate the site, that will bring to an end those activities at the Martha Pit with a potential to produce dust emissions.

INTRODUCTION

12. **THE** operation of a gold mine, including associated activities, can affect air quality. Effective measures to manage air quality are required to prevent such effects, especially if the activities are in close proximity to a township.
13. **WHEN** the Martha Open Pit Mine was first proposed, in the early 1980s, potential air quality effects on the local community were a matter of concern. A comprehensive air quality monitoring network was established in 1982 and monitoring commenced prior to the start of construction of the Martha Mine in 1988 to monitor background levels.
14. **OVER** the years the operators of the Martha Mine, including Newmont Waihi Gold, have demonstrated a strong commitment to environmental management, and have achieved a high level of compliance with air quality criteria.
15. **IN** 2004 the mining operations in Waihi were expanded to include the Favona Underground Mine, and from 2012 the underground mining will extend to the Trio Underground Mine, located west of the Favona mine.
16. **NEWMONT** Waihi Gold now proposes to further extend underground mining beneath the eastern residential area of Waihi, approximately mid-way between the Martha Open Pit and the Favona Underground Mine. The current proposal has been named the Correnso Underground Mine and is located within the Golden Link Project Area, within which future underground mining will be provided for.
17. **THIS** report addresses the potential air quality effects of the Correnso Underground Mine within the Golden Link Project Area (and any future underground mining proposal within that area) from both underground and aboveground activities.
18. **APPROPRIATE** indicators of the air quality situation are the results of the ambient air quality monitoring programme in and around Waihi. The results for 2010 and trends in the monitoring results are presented.
19. **THE** experience over the past seven years of the effects on air quality of the Favona Underground Mine is especially relevant.

MINE OPERATIONS

20. **ACCESS** to the Correnso ore body will be from the Favona and Trio declines. Ventilation for Correnso is also to be provided from the Trio Mine. A schematic of the Correnso Underground Mine, indicating those points of access, is shown in Figure 1.

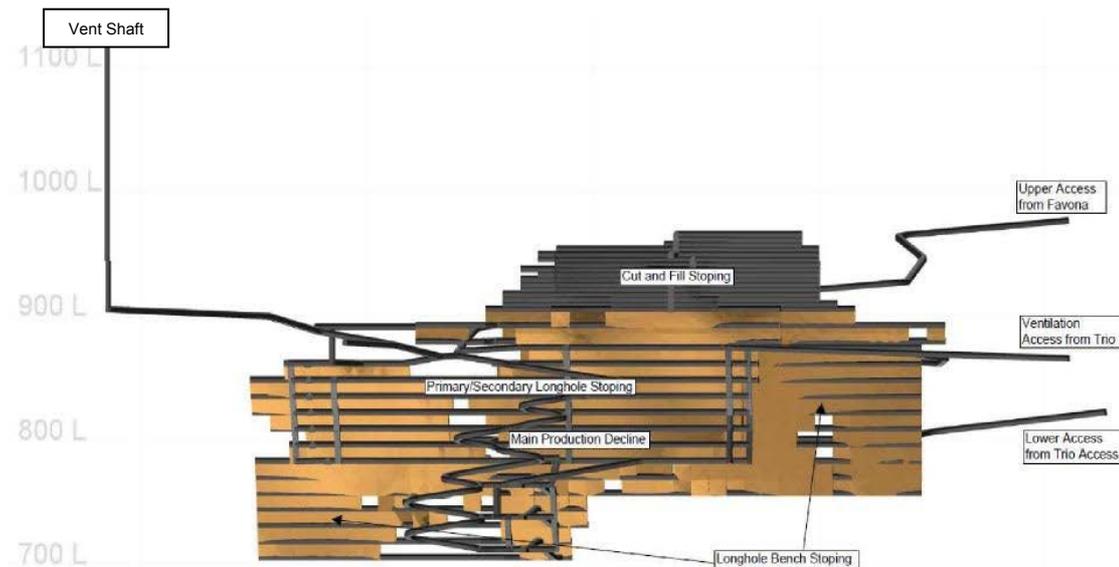


Figure 1: Schematic of the Correnso Underground Mine

21. **AS** shown in Figure 1 a vent shaft will be constructed as part of the Correnso Underground Mine. With three access points from Favona and Trio, no separate escapeways will be necessary.
22. **THE** Correnso Underground Mine is scheduled to commence development in July 2013, when the Trio Mine is in full production. Production at the Correnso Mine will commence in 2015, which coincides with completion of Trio. It is expected that Correnso will operate for about seven years.
23. **THE** Correnso Underground Mine will involve the processing of ore through the existing Waihi processing plant. It is estimated that about 2,500,000 tonnes of ore will be processed, which could produce approximately 650,000 ounces of gold.

24. **WHEREAS** the Favona and Trio Mines use only the Avoca benching method of mining, the Correnso Underground Mine will use a combination of mining methods at different elevations and locations. However, the use of different mining methods is not expected to significantly affect the overall quantities of discharges to air.
25. **FOR** the Correnso Underground Mine there will be a significant increase in the number of blasts per year, compared with Favona or Trio. However, there will only be a minor increase in the proportion of time there will be blasting discharges from the vent shaft. That is because blasting only occurs for short periods, a maximum of three times a day.
26. **OTHER** differences of the Correnso Underground Mine, compared with Favona and Trio, are the requirements of bringing crushed waste rock from the Martha Mine and aggregate from a nearby quarry (the latter to provide material for cemented aggregate fill) for backfilling. The aggregate rock will be crushed at the quarry and be delivered to the site by truck and made into cement aggregate fill via a cement batching plant located near the processing plant.

SOURCES OF EMISSIONS

27. **AS** an underground mine, with both underground mining and aboveground storage, processing and disposal activities, the Correnso Underground Mine, and any other underground mining in the Golden Link Project Area, will have the following potential sources of emissions:
- from the vent shaft;
 - vehicle movements;
 - stockpiling of ore and waste rock;
 - ore and rock crushing, screening and conveying;
 - handling of backfill rock and aggregate;
 - the processing plant operations; and
 - tailings disposal.
28. **THE** vent shaft associated with the Correnso Underground Mine will discharge the emissions from blasting, mining, and operation of underground vehicles. This report provides a quantitative assessment of the effects of those discharges.
29. **VEHICLE** movements for the Correnso Underground Mine will be both underground and aboveground, and are assessed in this report. The underground emissions are included in the discharges from the vent shaft, referred to above. On-site movements of vehicles above ground will be similar to those of the Favona and Trio Underground Mines, associated with the processing facilities area and the tailings disposal.
30. **ALSO** assessed in this report are the potential air quality implications of stockpiling associated with the Correnso Underground Mine. These largely involve the placement of crushed rock from the Martha mine for backfilling of Correnso.
31. **THE** ore crushing, screening and conveying equipment will be the similar to that used for Martha Mine and the Favona and Trio Underground Mines. The potential air quality implications of those activities are assessed in this report. The handling of the backfill rock and aggregate is also assessed.

32. **ALSO** similar to the current situation with the Martha and Favona Mines will be the utilisation of the processing plant. An assessment of the potential air quality implications of utilisation of the processing plant is included in this report.

33. **THE** Correnso Underground Mine will involve the placement of additional tailings in Tailings Storage Facility 1A (but no additional facility construction beyond that already proposed and consented). The potential air quality implications of the tailings storage are addressed in this report.

VENT SHAFT

Appearance

34. **THE** Correnso Underground Mine will involve a vent shaft. Figure 2 shows the vent shaft for the Favona Underground Mine. It is likely the Correnso vent shaft will be of a similar appearance, although not visible to the public due to its location behind the Grey Street noise bund.



Figure 2: Likely Appearance of the Vent Shaft

Location

35. IT is proposed that the ventilation drive from the underground workings of the Correnso Mine will be about 900 metres in length and the shaft will surface near the north east corner of the Martha Open Pit Mine and behind the Grey Street noise bund. The proposed location of the vent shaft is shown in Figure 3. It is in the area covered by Discharge Permit 971281.

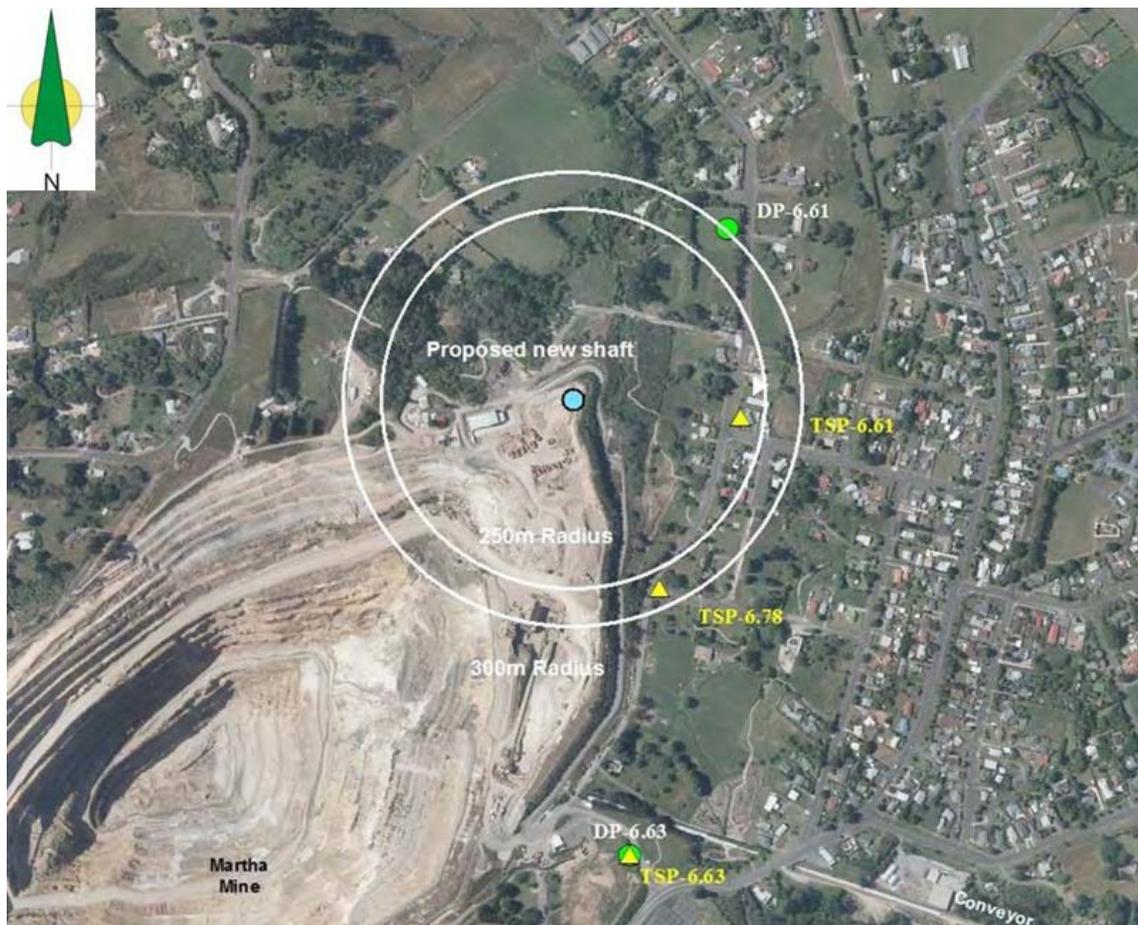


Figure 3: Location of the Correnso Vent Shaft, along with air quality monitoring sites¹

36. **FIGURE 3** is informative in that it shows where residential properties are located within 250-300 metres of the vent shaft. That distance is the likely maximum extent of influence of emissions from the vent shaft. The locations of the residential properties that are within and adjoining that area are to the east and south east. It is proposed to place the vent shaft behind the noise bund, and so it will not actually be visible at those properties.

¹ TSP refers to suspended particulate monitoring and DP to deposited particulate monitoring.

37. **IN** terms of the wind directions that may transport discharges from the vent shaft, they are, respectively, from the west to the north-west (3 sectors).
38. **FIGURE 4** gives a wind rose for the period January 2000 to September 2011. The prevailing winds, especially light winds likely to give rise to maximum concentrations, are from the north-east. Winds from the west are fairly common, and occur about 14% of the time, whereas those from the west-north-west and the north-west are much less common (a total of less than 5%).

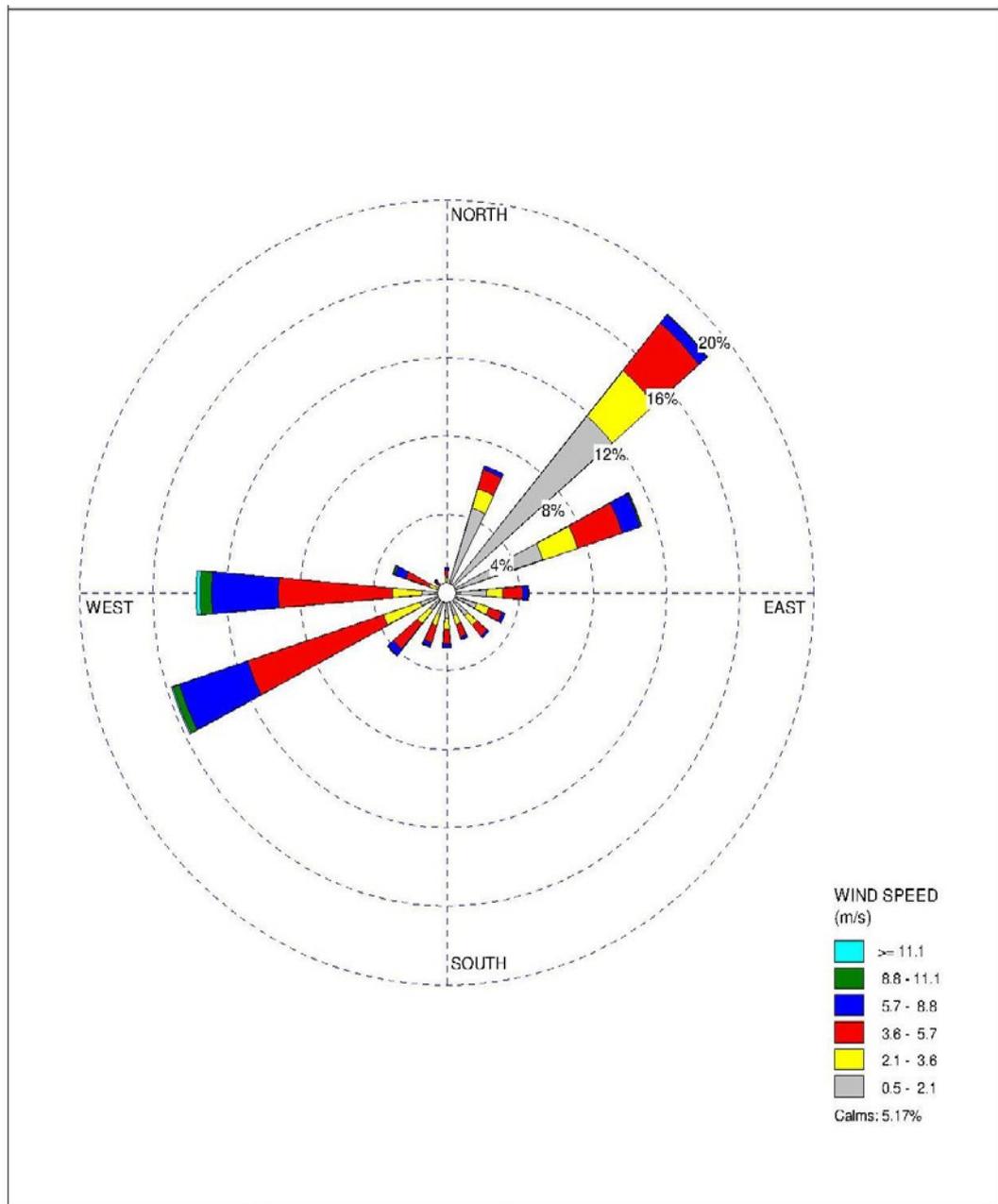


Figure 4: Waihi Wind Rose January 2001 to September 2011

39. **NOTWITHSTANDING** the frequency (or infrequency) of the wind directions toward residential properties, it is important to note that the assessment in a following section of this report is wind direction neutral. That is, it assesses the maximum ground level concentrations of contaminants irrespective of the direction the wind may carry discharges from the vent shaft.

Emissions from the Vent Shaft

40. **EMISSIONS** from the vent shaft include those from blasting, mining and operation of underground vehicles. The next subsection of this report assesses the potential effect of those emissions, based on estimates of discharge quantities.
41. **IT** is fortunate there are both emission testing and occupational data for the Favona Underground Mine that can be used to provide estimates of emission concentrations from the Correnso vent shaft. The emission testing was carried out in August 2007, and is recorded in a report² dated September 2009.
42. **THE** focus of the testing was discharges of particulate matter, carbon monoxide, and nitrogen oxides during blasting. The maximum measured emission concentrations, converted to micrograms per cubic metre, are given in Table 1 (next page).
43. **THE** concentrations are converted to discharge rates, in grams per second, using a design volumetric gas flow rate for the Correnso vent shaft of 225 cubic metres per second³. The averaging time for the discharge quantities is one hour, which equates with the assessment criteria used.
44. **A** substantial record of occupational exposure (personal monitoring) data for respirable dust, respirable silica, and diesel exhaust has been recorded for the Favona Underground Mine in an internal Newmont Waihi Gold report, and this has been made available⁴. The maximum measured concentrations are given in Table 1 (next page).

² "Particulate, Carbon Monoxide and Oxides of Nitrogen Emission Testing, August 2007", a report by WaterCare Laboratory Services – Air Quality Group, September 2009.

³ Email from Brendon Smith, Senior UG Long term Planning Engineer, Newmont Mining Corporation, Subiaco, Western Australia, 21 October 2011.

⁴ Personal communication with Andy Schmidt, Safety Manager, Newmont Waihi Gold, 22 December 2009.

45. **THE** occupational concentrations measured are converted to discharge rates, i.e., grams per second, using the design volumetric flow rate for the Correnso vent shaft of 225 cubic metres per second.
46. **THE** averaging time for these discharge quantities is eight hours, and, again, this equates with the assessment criteria used for those contaminants. The assumption is made that the maximum concentrations measured by personal sampling provide an estimate of the maximum concentrations in the vent shaft.

Table 1: Discharge quantities

Contaminant	Maximum measured discharge concentration ($\mu\text{g}/\text{m}^3$)	Maximum discharge rate (g/s) ³	Averaging time
total suspended particulate ¹	2,000	0.45	1-hour
carbon monoxide	5,900	1.3	1-hour
nitrogen dioxide	940	0.21	1-hour
respirable ² dust	700	0.16	8-hour
respirable silica	20	0.0045	8-hour
diesel exhaust	110	0.025	8-hour

Notes:

¹ Assumed to be PM₁₀

² This is the occupational definition of respirable, which is equivalent to PM₄

³ The design volumetric flow rate for the Correnso vent shaft is 225 m³/s

Assessment of Vent Shaft Emissions

47. **WHAT** follows is an assessment of the effects of the estimated vent shaft discharges for the Correnso Underground Mine. The analysis is wind direction neutral, in that the maximum predicted ground level concentrations apply irrespective of the direction the wind may carry those emissions. The conservatism in the assessment is such that it is likely to be applicable to discharges from the vent shaft for any mining in the Golden Link Project Area.

48. **ALTHOUGH** it is the presence of domestic residences, or similar sensitive land users such as schools, hospitals, etc. that will determine the potential effects of the discharges, the purpose of this assessment is to provide a comparison between the maximum concentrations and appropriate assessment criteria.
49. **PARTICULAR** care is taken to arrive at appropriate assessment criteria for the predicted effects of discharges from the proposed vent shaft. The assessment criteria for discharges measured from the Favona vent shaft are a combination of the National Environmental Standards for Air Quality and the Ambient Air Quality Guidelines. The criteria are converted to 1-hour averaging time.
50. **FOR** the discharges based on occupational exposures the assessment criteria are a combination of the national environmental standard for PM₁₀ and the California reference exposure levels. The California occupational definition of “respirable” is equivalent to PM₄, and so the National Environmental Standard is converted from PM₁₀ to PM₄, and adjusted from 24-hour to 8-hour exposure times.
51. **THE** California Office of Environmental Health Hazard Assessment reference exposure levels provide assessment criteria for respirable silica and diesel exhaust based on chronic exposure levels by inhalation. They are recognised internationally as being of a high standard and the New Zealand Good Practice Guide (GPG) for Assessing Discharges to Air from Industry⁵ recommends their use.
52. **THE** GPG has an “order of priority” of criteria, namely: national environmental standards for air quality, national ambient air quality guidelines, regional objectives, World Health Organization air quality guidelines, California reference exposure levels, and United States Environmental Protection Agency inhalation reference concentrations and unit risk factors.
53. **THE** chronic reference exposure levels are adjusted from annual to 8-hour exposure times.
54. **THE** assessment criteria are given in Table 2 (next page).

⁵ “Good Practice Guide for Assessing Discharges to Air from Industry”, Ministry for the Environment, June 2008.

Table 2: Assessment criteria

Contaminant	Concentration ($\mu\text{g}/\text{m}^3$)	Averaging time	Reference source
total suspended particulate ¹	90	1-hour	NZ NES ² for PM ₁₀ adjusted from 24-hour to 1-hour ³
carbon monoxide	30,000	1-hour	NZ AAQG ⁴ for CO
nitrogen dioxide	200	1-hour	NZ NES for NO ₂
respirable ⁵ dust	40	8-hour	NZ NES for PM ₁₀ , adjusted to PM ₄ and from 24-hour to 8-hour ⁶
respirable silica	10	8-hour	California OEHHA REL ⁷ , adjusted from annual to 8-hour ⁸
diesel exhaust	20	8-hour	California OEHHA REL, adjusted from annual to 8-hour

Notes:

¹ Assumed to be PM₁₀

² National Environmental Standard

³ 24-hour concentrations are converted to 1-hour by multiplying by $(24/1)^{0.2}$

⁴ Ambient Air Quality Guideline

⁵ This is the California occupational definition of respirable, which is equivalent to PM₄, and is assumed to be about 2/3rds of PM₁₀

⁶ 24-hour concentrations are converted to 8-hour by multiplying by $(24/8)^{0.2}$

⁷ Office of Environmental Health Hazard Assessment reference exposure level by inhalation

⁸ Annual concentrations are converted to 8-hour by multiplying by $(365 \times 24/8)^{0.2}$

55. TABLE 3 (next page) gives maximum predicted ground level concentrations, and a comparison of those against the assessment criteria. For all contaminants the predicted concentrations are less than the assessment criteria by a wide margin, between 18 and 2,000 times. Hence the conclusion is that the environmental health effects of discharges from the Correnso vent shaft will be insignificant. This conclusion is likely to be applicable to discharges from the vent shaft for any mining in the Golden Link Project Area.

Table 3: Ground level concentrations

Contaminant	Maximum predicted ground level concentration ($\mu\text{g}/\text{m}^3$) ¹	Assessment criteria ($\mu\text{g}/\text{m}^3$)	Ratio predicted concentration to assessment criteria (and inverse)
total suspended particulate ²	5.1	90	0.057 (18x)
carbon monoxide	15	30,000	0.00050 (2,000x)
nitrogen dioxide	2.4	200	0.012 (83x)
respirable ³ dust	1.2	40	0.030 (33x)
respirable silica	0.034	10	0.0034 (290x)
diesel exhaust	0.19	20	0.0095 (100x)

Notes:

¹ The maximum ground level concentration ($\mu\text{g}/\text{m}^3$) for 1-hour concentrations is found from:

$$= \text{maximum emission rate (g/s)} / (7.77 \times u \text{ (m/s)} \times H^2 \text{ (m}^2)) \times 10^6$$

and for 8-hour concentrations is found from:

$$= \text{maximum emission rate (g/s)} / (11.8 \times u \text{ (m/s)} \times H^2 \text{ (m}^2)) \times 10^6$$

where u = wind speed at plume height = 4.5 m/s

H = plume height = vent height + momentum plume rise

vent height = 8 m

momentum plume rise = $3 \times (v \times d / u)$

where v = efflux velocity (m/s)

$$v = 225 / \pi \times d^2 / 4$$

where d = diameter at point of exit = 4.5m

$$v = 14.1 \text{ m/s}$$

momentum plume rise = 42 m

and $H = 8 + 42 = 50 \text{ m}$

² Assumed to be PM_{10}

³ This is the California occupational definition of respirable, which is equivalent to PM_4

56. **THERE** are elements of conservatism in the assessment of the effects of discharges from the Correnso vent shaft, including:

- maximum measured emission concentrations from the vent shaft of the Favona Underground Mine are used;
- the dispersion formulae predict 'worst case' maxima concentrations; and

- no allowance is made for the relatively low frequency of winds toward most of the residential properties potentially affected by discharges from the vent shaft (that is, the predominant wind direction is from the north-east, away from those properties).

57. THE principal discharges from a vent shaft are from blasting (both development blasting and production blasting). The number of blasts from 2007 to 2011 (actual, at Favona) and 2012 to 2020 (predicted, for Trio then Correnso) are given in Table 4. Although the data shows a significant increase in the number of blasts per year for Correnso, compared with Favona or Trio, there will only be a minor increase in the proportion of time there will be blasting discharges from the vent shaft. That is because blasting only occurs for short periods, a maximum of three times a day. The assessment above assumes that the maximum, short-term discharges occur continuously. The typical blasting charge quantity is not expected to change (increase or decrease).

Table 4: Frequency of Underground Blasting⁶

Year	Underground Mine in Use	Number of Production Blasts	Number of Development
2007	Favona	45	2,059
2008	Favona	203	1,011
2009	Favona	126	1,303
2010	Favona	189	1,591
2011	Favona/Trio	104	1,533
2012	<i>Trio</i>	<i>249</i>	<i>2,371</i>
2013	<i>Trio/Correnso</i>	<i>385</i>	<i>1,849</i>
2014	<i>Trio/Correnso</i>	<i>344</i>	<i>1,448</i>
2015	<i>Correnso</i>	<i>240</i>	<i>2,489</i>
2016	<i>Correnso</i>	<i>527</i>	<i>2,774</i>
2017	<i>Correnso</i>	<i>547</i>	<i>2,708</i>
2018	<i>Correnso</i>	<i>409</i>	<i>1,894</i>
2019	<i>Correnso</i>	<i>312</i>	<i>653</i>
2020	<i>Correnso</i>	<i>194</i>	<i>297</i>

⁶ Email of 20 February 2012 from Malcolm Lane, Newmont Waihi Gold.

VEHICLE MOVEMENTS

58. **ATMOSPHERIC** concentrations of air pollutants at the Martha Mine, including those associated with motor vehicles, were measured and reported⁷ in 1993⁸. The monitoring was carried out over a ten week period and involved continuous measurements of carbon monoxide, nitrogen oxides, sulphur dioxide, wind speed and direction. Two monitoring sites were used, one within the Martha Mine operations, close to the eastern end of the pit, and the other about 600 metres away in Waihi township.
59. **THE** results of the monitoring showed only minimal effects from vehicle movements associated with the mine operations, with most measurements well below the New Zealand Ambient Air Quality Guidelines⁹. For example, the maximum 1-hour average for carbon monoxide was 1.9 mg/m³, compared with the air quality guideline of 30 mg/m³. Similarly, the maximum 1-hour average concentration of nitrogen dioxide was 94 µg/m³, compared with the air quality guideline (and now National Environmental Standard) of 200 µg/m³.
60. **TO** put those concentrations into context, they are no greater than what would be expected to be measured near State Highway 2 within Waihi township. Also, the measurements were made when only the Martha Mine was operative, and so the assessment is conservative when applied to the operation of underground mines.
61. **THE** only elevated results were recorded when a stockpile was being worked within 10 metres of the monitoring site. This produced elevated levels of nitrogen oxides and a moderate amount of sulphur dioxide. Extrapolation of the data indicated that the levels of air pollutant gases would be insignificant at about 50 metres away from the activity.
62. **THAT** conclusion is consistent with other studies of vehicles air pollution reported elsewhere. Since the time of the 1993 measurements there has been about a 95% decrease in the sulphur content of diesel, with a concomitant decrease in the sulphur dioxide emissions from individual diesel vehicles.

⁷ Edmunds, C.J., and Hally V.M., "Monitoring of Ambient Air Quality at Waihi", a report prepared for the Waihi Gold Mining Company Limited by the Institute of Environmental Science & Research Limited, September 1993.

⁸ These data may appear dated but, given the results obtained, there has been no need for the expenditure to update them.

⁹ "Ambient Air Quality Guidelines", Ministry for the Environment, May 2002.

- 63. WITH** access to the Correnso ore body to be via the Favona and Trio workings, the locations of vehicle movements above ground associated with the processing facilities area and the tailings disposal for the Correnso Underground Mine will be similar to those of the Favona and Trio Underground Mines. The frequency of those on-site vehicle movements will also be similar. The measures to mitigate any effects of those vehicle movements will continue as now.
- 64. THERE** will also be truck movements associated with the bringing in of crushed aggregate from a nearby quarry. This matter is discussed in more detail in the section below on the handling of the aggregate. The route of the truck movements will be well removed from the urban area of Waihi, and so the air quality effects will be less than minor.

STOCKPILES

65. **STOCKPILING** is a potential source of dust emissions. For the Correnso Underground Mine, and for any other mining in the Golden Link Project Area, existing stockpile areas will be used for the temporary storage of ore and waste rock removed, and for the crushed rock and aggregate for backfilling.
66. **THERE** are stockpiles covered by the discharges to air consent granted at the time of the Martha Extended Project (Discharge Permit 971281) and by the Discharge Permit 109741 granted at the time of consenting the Favona Project. The latter will continue for the life of Correnso (and the comprehensive consent), but those discharges covered by Discharge Permit 971281 will require a new consent commencing at the expiry of the existing discharge permit.
67. **THE** Correnso Underground Mine is expected to involve the removal of about 2,500,000 tonnes of ore and about 1,000,000 tonnes of waste rock. As indicated in Table 5, the peak quantities of waste rock occur in 2015, whereas peak quantities of ore occur in 2017. Stockpiles of both will be required.

Table 5: Quantities of Ore and Waste Rock

	2013	2014	2015	2016	2017	2018	2019	2020
Ore	0	34,187	270,658	545,309	669,312	557,234	277,042	185,934
Waste rock	86,232	247,313	305,010	238,756	91,905	18,904	6,789	2,981

68. **THE** locations of the stockpiles are shown in Figure 5. For the temporary storage of ore awaiting processing, it is proposed to use the existing 'run of mine' ore stockpile located close to the conveyor. That stockpile currently contains about 40,000 tonnes of ore, although it can contain in excess of 100,000 tonnes if necessary. It is not expected the ore stockpile will exceed its current size.
69. **WHEREVER** possible, waste rock from the Correnso Underground Mine will remain underground and be directly placed as backfill. However for the early stages of the Project it will be necessary to provide temporary storage of waste rock awaiting the availability of voids for backfilling. It is proposed to use the Favona portal surge stockpile for that temporary storage. That stockpile is located in the south west corner of the aerial view of Figure 5.



Figure 5: Locations of the Stockpile Areas

- 70.** **IN** addition to the waste rock from the Correnso Underground Mine there will be another 1,000,000 tonnes of waste rock from the Martha Mine that will be used for backfilling Correnso. This will be crushed at Martha and transferred to the polishing pond stockpile area. It is proposed that the transfer will commence as soon as (and assuming) consents are granted for Correnso. Crushing and conveying at the Martha Open Pit is expected to cease in 2017.
- 71.** **THE** polishing pond stockpile area is located in the north-east corner of the aerial view in Figure 5. It is currently empty, but it has been used for stockpiling ore and waste rock in the past. The stockpile area has a capacity of about 1,000,000 tonnes, and this is considered adequate for the stockpiling of Martha waste rock. Use of the waste rock for backfilling will commence in 2018.

- 72.** A final requirement for stockpiling is the aggregate for the cement aggregate fill (CAF), brought in from a nearby quarry. The aggregate will be crushed at the quarry and delivered in 25 tonne loads by truck. It is anticipated that about 3 days of aggregate will be stockpiled. This is equivalent to only about 2,300 tonnes. It is proposed that the aggregate stockpile, and the batching plant to manufacture the CAF, will be located in the Favona portal surge stockpile area.
- 73.** **FOR** the stockpiling of ore, waste rock and aggregate for the Correnso Underground Mine or future underground mining within the Golden Link Project Area, Newmont Waihi Gold will need to continue to apply dust management practices that have been shown to be successful in the past. These measures include limiting the height of stockpiles, having the material wet when discharging onto stockpiles and the use of agricultural irrigation sprays during periods of dry weather. The locations of the stockpiles are such that, provided those dust management practices are followed, the air quality effects of the stockpiling will be less than minor.

ORE AND ROCK CRUSHING, SCREENING AND CONVEYING

- 74. THE** crushing, screening and conveying of ore can be a potential source of dust emissions. The annual production of ore from the Correnso Underground Mine is expected to be typically less than average production volumes for the Martha and Favona/Trio Mines.
- 75. THE** Correnso ore, and ore from any other mining in the Golden Link Project Area, is to be crushed at the processing plant, in a continuation of what is currently the situation for the Favona ore and soon to be for the Trio ore. As indicated in Table 5 (three pages back) it is estimated that the total quantity of Correnso ore to be processed will be about 2,500,000 tonnes.
- 76. ALTHOUGH** no rock from the Correnso Underground Mine will be crushed, the 1,000,000 tonnes of waste rock from Martha to be used for backfilling Correnso will be crushed at the Martha Mine before transfer to the polishing pond stockpile. Crushing and screening at the Martha Mine will cease in 2017, following completion of the layback to the east wall of the pit. Apart from work to rehabilitate the site, that will bring to an end those activities at the Martha Pit with a potential to produce dust emissions.
- 77. DUST** suppression measures at the crushing and screening using water sprays and screen barriers are currently practiced, and these will need to continue. A high level of vigilance is required to ensure systems are working correctly. Provided those dust management practices are followed, the air quality effects of the crushing, screening and conveying will be less than minor.

HANDLING OF BACKFILL ROCK AND AGGREGATE

78. AS indicated previously, the crushed waste rock from the Martha Mine to be used for backfilling Correnso will be transferred to the Favona portal surge stockpile area (covered by Discharge Permit 109741). From there it will be transported into Correnso for the backfilling of voids, as required. Table 6 gives an indicative schedule for the backfilling.

Table 6: Correnso Backfill Schedule

Material	2015	2016	2017	2018	2019	2020
Cement aggregate fill	143,665	229,302	144,239	11,299	5,310	4,834
Crushed waste rock from Martha	0	0	0	372,163	344,615	282,358

79. TABLE 6 also provides an indicative schedule for the backfilling of Correnso with cement aggregate fill (CAF). This is expected to be mainly in the first half of the mine operation, and involve a total quantity of CAF of about 540,000 tonnes. The aggregate for the CAF will come from a nearby quarry, that of H.G. Leach Limited, Waitawheta. It is proposed the crushed aggregate will be transported from the quarry to Newmont Waihi Gold by truck and trailer units in 25 tonne loads.

80. BASED on transport on 5 days per week (261 days per year), for 10 hours per day, there will be 2-4 deliveries per hour during the peak CAF demand period in 2016. The proposed ca. 10 kilometre route for the transport involves sealed minor country roads (i.e., McLean Road, Waitawheta Road, Frankton Road, Crean Road, crossing State Highway 2, Baxter Road) to the entrance to the processing and waste disposal area of Newmont Waihi Gold. That is, the route of the truck movements is well removed from the urban area of Waihi. The location of the route is such that the air quality effects of the transport of aggregate will be less than minor.

81. **CAF** is to be manufactured at a standard, relatively small, batching plant. Such plants, used for concrete manufacture, are common. With no fuel burning involved, the only potential discharge to air is particulate matter (dust). Figure 6 provides a photograph of a typical plant.
82. A mobile unit is proposed of a capacity of about 25 tonnes of CAF per hour. The batching plant, and its accompanying aggregate stockpile, will be located in the Favona portal surge stockpile area. That location is covered by Discharge Permit 109741.
83. **DUST** suppression will be provided by water sprays at the aggregate stockpile and at the feed hopper, and a bag filter unit on the cement silo. These are standard, and effective, dust control measures and so the air quality effects of the batching plant will be less than minor.



Figure 6: Photograph of a Typical Batching Plant¹⁰

¹⁰ Source: Brochure of Aran International Pty Limited Modumix Plant (www.aran.com.au)

PROCESSING PLANT OPERATIONS

- 84. OPERATIONS** at the processing plant, for removal of gold and silver from ore from the Correnso Underground Mine, or ore from any other mining in the Golden Link Project Area, will be similar to those for the Martha, Favona and Trio ores. Sodium cyanide is used in the processing plant to extract gold from the ore.
- 85. THE** processing plant is covered by the discharges to air consent granted at the time of consenting the Martha Extended Project (Discharge Permit 971281). This consent expires on 15 July 2017 and therefore a new consent is required for those activities from that date.
- 86. POTENTIAL** sources of emissions at the processing plant include from cyanide unloading and use, from the gold room stack and from operation of the carbon regeneration furnace. It is not expected there will be any changes to the quantity of cyanide unloaded and used, the operations at the gold room, and the frequency of operation of the carbon regeneration furnace.

Cyanide Unloading and Use

- 87. CONDITION 10** of Discharge Permit 971281 has an emission limit for emissions of particulate cyanide from the scrubber at the cyanide debagging plant, and condition 11 refers to emission testing of the discharge at least once a year. Those conditions became largely superfluous with a change to operational procedures.
- 88. PREVIOUSLY** there was a potential for particulate cyanide emissions from the area where cyanide briquettes were de-bagged and added to a mixing tank. These emissions were controlled with a water scrubber. However now a majority of the sodium cyanide is transported to site in isotainers where it is mixed into solution in the transport container thereby reducing the opportunity for airborne emissions. That is, the water scrubber is infrequently used.
- 89. THE** Waikato Regional Council agreed in 2002 that testing of the particulate cyanide emissions can cease, as long as there is not a return to the bag supply method on a regular basis. It is the intention of Newmont Waihi Gold to continue with the use of isotainers for transport of the majority of the sodium cyanide. So, the potential for emission problems associated with the debagging process has largely been removed.

90. **THERE** is a potential for hydrogen cyanide to be emitted from the leaching process and from liquid wastes, if the pH of the liquid drops below 7. Lime is added to the ore prior to crushing, and the leaching process is strictly controlled with probes which trigger an alarm if the pH is less than 10. These measures have proven to successfully avoid the potential discharge.
91. **ROUTINE** testing for occupational exposure levels of hydrogen cyanide is carried out daily at a variety of locations around the processing plant, to ensure that the processes are adequately controlled. Newmont Waihi Gold will continue to carry out those tests. There is a negligible possibility of off-site concentrations of cyanide.

Gold Room Stack

92. **THE** gold room is that part of the processing plant where a sludge containing metals including gold and silver, along with added fluxes, are put into a melting furnace. The furnace reaches a temperature of 1,200 degrees Celsius, and after several hours of melting the molten gold is poured into moulds. Captured fumes from the furnace are discharged from the gold room stack.
93. **THERE** is no emission limit for the gold room stack in the conditions of Discharge Permit 971281. However, discharges of metals from that stack have been measured. The emission testing was carried out in March 2009, and is recorded in a report¹¹ dated April 2009.
94. **OF** the metals tested, eight have air quality criteria and the results of their testing are reported here. Those metals are arsenic, cadmium, chromium, lead, manganese, mercury, nickel, and selenium. The emission testing was carried out over a period of 4 hours of production at the gold room. The emission concentrations, in micrograms per cubic metre, and the mass emission rates, in grams per day, are given in Table 7 (next page).
95. **WHAT** follows is an assessment of the significance of those discharges. As with the vent shaft discharges, the analysis is wind direction neutral, in that the maximum predicted ground level concentrations apply irrespective of the direction the wind may carry those emissions.

¹¹ "Selected Metals Emission Testing March 2009", a report by WaterCare Laboratory Services – Air Quality Group, April 2009.

Table 7: Discharge quantities

Metal	Measured discharge concentration ($\mu\text{g}/\text{m}^3$)¹	Measured discharge rate (grams per day)²
Arsenic	0.027	0.010
Cadmium	0.13	0.050
Chromium	0.35	0.13
Lead	0.51	0.18
Manganese	0.39	0.14
Mercury	9.6	3.6
Nickel	3.5	1.3
Selenium	24	8.6

Notes:

¹ The concentrations are corrected to 0°C, 1 atmosphere pressure and a dry gas basis. A microgram (μg) is 10^{-6} of a gram.

² The measured volumetric flow in the stack was 4.23 m^3/s , corrected to 0°C, 1 atmosphere pressure and a dry gas basis.

96. THE assessment criteria are given in Table 8 (next page). They are a combination of the New Zealand ambient air quality guidelines, the United States Environmental Protection Agency inhalation reference unit risk factors and national ambient air quality standards, the World Health Organization air quality guidelines, and the California reference exposure levels by inhalation. All of those criteria are recommended for use by the Ministry for the Environment¹².

¹² "Good Practice Guide for Assessing Discharges to Air from Industry", Ministry for the Environment, June 2008.

Table 8: Assessment criteria

Metal	Concentration ($\mu\text{g}/\text{m}^3$)	Averaging time	Reference source
Arsenic	0.0055	annual	NZ AAQG ¹
Cadmium	0.0060	annual	US EPA unit risk factors ²
Chromium	0.0011	annual	NZ AAQG
Lead	0.15	annual	US EPA NAAQS ³
Manganese	0.15	annual	WHO AQG ⁴
Mercury	0.030	annual	California OEHHA REL ⁵
Nickel	0.40	annual	California OEHHA REL
Selenium	20	annual	California OEHHA REL

Notes:¹ Ambient Air Quality Guideline² These unit risk factors apply specifically to inhalation³ National Ambient Air Quality Standard⁴ Air Quality Guidelines⁵ Office of Environmental Health Hazard Assessment reference exposure level by inhalation

97. TABLE 9 (next page) gives maximum predicted ground level concentrations, and a comparison of those against the assessment criteria. For all of the metals the predicted concentrations are less than the assessment criteria by a wide margin, between 26 and 7,100 times. Hence the conclusion is that the environmental health effects of discharges from the gold room stack are insignificant.

Table 9: Ground level concentrations

Metal	Predicted ground level concentration ($\mu\text{g}/\text{m}^3$)^{1,2,3}	Assessment criteria ($\mu\text{g}/\text{m}^3$)	Ratio predicted concentration to assessment criteria (and inverse)
arsenic	0.000032	0.0055	0.00059 (1,700x)
cadmium	0.000016	0.0060	0.0027 (370x)
chromium	0.000039	0.0011	0.036 (28x)
Lead	0.000057	0.15	0.00038 (2,600x)
manganese	0.000045	0.15	0.0030 (3,300x)
mercury	0.0011	0.030	0.038 (26x)
Nickel	0.00041	0.40	0.010 (100x)
selenium	0.0028	20	0.00014 (7,100x)

Notes:

¹ The predicted 24-hour average concentration ($\mu\text{g}/\text{m}^3$) is found from:

$$= \text{emission rate (g/d)} \times 51.3 \times h^{-2.18}$$

where h = plume height (m)

² No plume rise is assumed, because of the presence of a flow restriction cap on the stack. Hence, h = stack height = 8m¹³

³ These are annual average concentrations. The 24-hour average concentrations are converted to annual averages by multiplying by $(24/365)^{0.2}$

Carbon Regeneration Furnace

98. THE carbon which has been used for gold recovery is periodically regenerated by heating in a furnace. The furnace is fired on LPG, and has the potential to cause smoke emissions.

¹³ Email of 3 February 2012 from Russell Squire, Environmental Officer, Newmont Waihi Gold.

- 99. THERE** is no emission limit for the carbon regeneration process in the conditions of Discharge Permit 971281. However, annual emission testing have was carried out between 1996 and 2002, to check that the process does not cause excessive particulate (i.e., smoke) emissions.
- 100. CONCENTRATIONS** of particulate matter measured at the carbon regeneration furnace were in the range 2.4 to 7.6 mg/m³. The results were fairly consistent, and low. For comparison, emission tests at small industrial boilers typically measure 50 to 250 mg/m³.

TAILINGS DISPOSAL

- 101. THE** disposal of tailings from the Correnso Underground Mine will continue as for the Martha, Favona and Trio Mines at Storage Facility 1A. Activities associated with tailings disposal are covered by Discharge Permit 971281. This consent expires on 15 July 2017 and therefore a new consent is required for those activities from that date.
- 102. CONSENTS** for the Trio Underground Mine Project provided for an increase in the crest height of Tailings Storage Facility 1A to 177.25mRL, which is scheduled to be completed during the construction season of 2013-2014, with rehabilitation scheduled to be completed during the 2014-2015 construction season. It is estimated that following placement of the Martha and Trio tailings there will be a remaining capacity in Storage Facility 1A of 3.1 million tonnes. As the quantity of tailings from the Correnso Underground Mine is 2.0 million tonnes no further increase in height of the tailings storage facility will be required.
- 103. THERE** are activities associated with tailings disposal that are a potential source of dust emissions. Vigilance is required to prevent dust emissions, particularly in the drier summer months and especially in windy conditions. The network of dust deposition monitors around the tailings areas is for the purpose of assessing the air quality impact of activities at those areas. These monitors are referred to in the next section of this report.
- 104. NEWMONT** Waihi Gold has a good record of responding with corrective measures if the tailings areas are suspected to be a source of dust emission problems. In 2001, following measurements of elevated dust concentrations attributed to emissions from the Tailings Storage Facility 1A, hydroseeding and planting in the waste disposal area was accelerated, involving 4.7 hectares of revegetation or grassing, and some 8,500 native trees and shrubs.
- 105. THE** haul roadway to the tailings areas has on occasions been a source of dust emissions. In 2000, following the receipt of complaints and higher than usual measured dust deposition concentrations, a sprinkler system was installed on the haul road.

- 106.** A water cart is regularly used for dust suppression on unsealed roadways. In recent times trial applications of a polyvinyl acetate (PVA) based surfactant (called Soil Sement) and a Magnesium Chloride additive (called D20) have been carried out, with limited success.¹⁴
- 107.** **ANOTHER** matter requiring vigilance is the application of lime to potentially acid forming rock used in the construction of the tailings storage facilities (an activity similar to adding lime or fertiliser to farm pasture). On occasions emissions of lime have occurred, and this has been misconstrued as haul road dust. Hence, the application of lime at the tailings storage area should not be carried out in windy conditions.
- 108.** **ANY** dust issues with the tailings storage will become evident at the dust deposition monitors located in the vicinity of the storage areas. Provided any dust problems that occur are addressed by Newmont Waihi Gold in a proactive manner, as they have been to date, the air quality effects of tailings disposal will be less than minor.

¹⁴ Email of 28 March 2011 from Russell Squire, Environmental Officer, Newmont Waihi Gold.

AIR QUALITY MONITORING PROGRAMME

- 109. EARLIER** sections of this report have made reference to the ambient air quality monitoring programme in and around Waihi. The programme is described in this section. Monitoring data that is relevant to the expected effects of emissions from activities at the Correnso Underground Mine (and any other future underground mining proposal within the Golden Link Project Area), based on experiences of the Favona Underground Mine, is given in the next section.
- 108. NEWMONT** Waihi Gold operates an ambient air monitoring programme for dust in and around Waihi. There are two types of dust routinely measured, suspended particulate and deposited particulate. These measurements are made to distinguish between different sizes of dust particles, and different effects. There is overlap between the size fractions measured by the two types of routine monitoring.
- 109. SUSPENDED** particulate – this refers to particles that can remain suspended in the air for significant periods of time, ranging from several minutes for the larger particles through to several days for very fine material. Elevated levels can affect visual air quality and can also have effects on human health, generally by irritating the eyes, mucous membranes and skin. The measurement method involves sucking air through a filter and determining the weight of dust collected from a measured volume of air. The equipment samples particles up to about 50 microns in size, and typically about 20 microns.
- 110. DEPOSITED** particulate – this refers to particles that settle out of the air, that is, they are greater than about 20 microns. The primary effect is a nuisance one, in that particles may show up as a deposit on clean surfaces such as window ledges, cars, washing, etc. Measurement is by a collection jar or gauge, which simply collects the dust settling over a fixed surface area over a period of time.
- 111. THE** dust generated from the Newmont Waihi Gold operations is mostly what is called nuisance dust, and this is what is measured by the routine monitoring programme. It is visible (which occurs when particles are greater than about 20 microns in size), it can be annoying to some, but it is not a health hazard per se. Figure 7 (on the next page) shows the relevant size fractions of particles. For comparison there are representations of human hair, about 50 microns in diameter, and finest beach sand, about 90 microns in diameter.

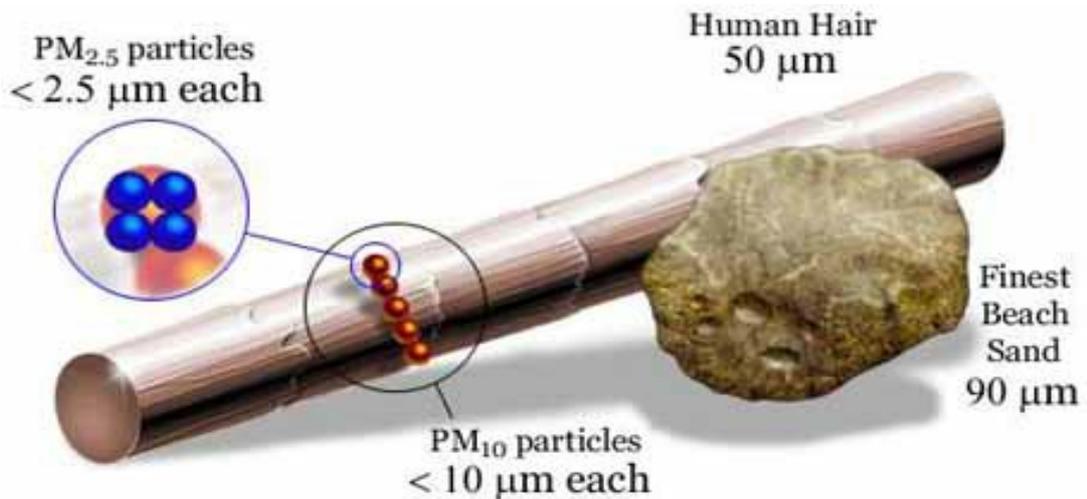


Figure 7: Diagram of Different Size Fractions of Particles

112. **IN** addition to the routine ambient air quality monitoring programme carried out by Newmont Waihi Gold, inhalable particulates, or PM₁₀ (particles less than 10 microns), are measured for a few months every two years. This is in compliance with a condition of consent in Discharge Permit 971281. These particles are invisible, but because they are small enough to be inhaled they can affect human health. The crystalline silica contents of the particles are also measured, which also is a matter related to potential health effects.
113. **THE** most recent study¹⁵, carried out in two campaigns of eight days each from 31 March to 4 June and 17 October to 30 November 2009 at the Grey Street monitoring site (6.61), obtained similar results to previous measurements. That is, a low occurrence of concentrations of human health significance to the local community. A further study commenced on 22 November 2011 and is planned to continue until March 2012.
114. **THE** National Environmental Standard¹⁶ for PM₁₀, which is set to protect against health effects, is 50 μg/m³, 24-hour average. The two yearly studies referred to above have typically measured average concentrations less than 20 μg/m³, 24-hour average. The 2009 monitoring found a daily average PM₁₀ concentration of 18.6 μg/m³ and a range of 9.7 to 37.2 μg/m³.

¹⁵ 2009 Annual Air Quality Monitoring Report, Newmont Waihi Gold Limited, March 2010.

¹⁶ Resource Management (National Environmental Standards for Air Quality) Regulations 2004, SR 2004/309, 6 September 2004, reprint as at 1 June 2011.

115. **MEASURED** concentrations of crystalline silica are very low. The 2009 monitoring found a daily average concentration of $0.9 \mu\text{g}/\text{m}^3$, and a range of 0.1 to $1.7 \mu\text{g}/\text{m}^3$. These can be compared with an air quality criterion for crystalline silica is $8 \mu\text{g}/\text{m}^3$, 24-hour average.
116. **HENCE**, for the effects of Newmont Waihi Gold operations on the local community, the health based considerations of the National Environmental Standard for PM_{10} are not relevant because the concentrations are low. It is the potential to cause nuisance dust effects that are prevailing, and for these trigger levels are set in the Air Quality Management Plan. These should remain the primary focus of the routine ambient air monitoring programme.
117. **SINCE** January 2008 the Waikato Regional Council has operated a PM_{10} monitor co-located (albeit at about a 2 metre lower elevation) with the Grey Street monitoring site (6.61). As Figure 8 demonstrates, there is a good correlation between the results of the continuous (every day) Waikato Regional Council PM_{10} monitoring and the Newmont Waihi Gold seven-day suspended particulate monitoring.

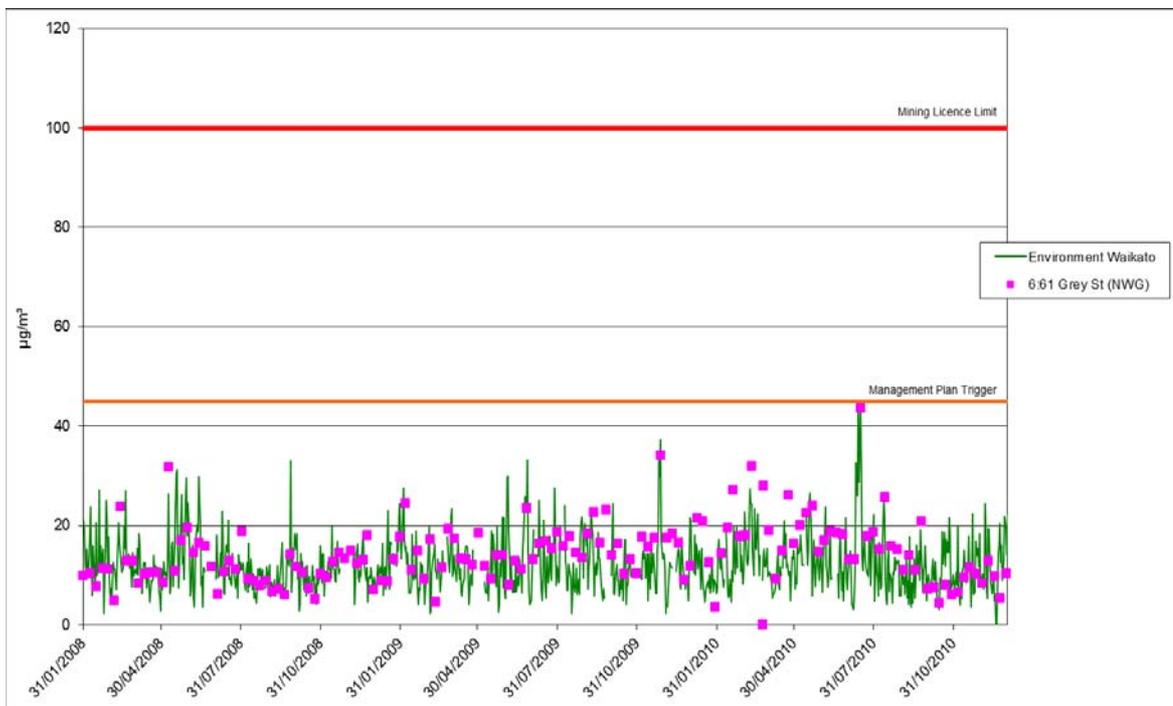


Figure 8: Comparison of PM_{10} and Suspended Particulate at the Grey Street site

Monitoring Sites

- 118. THE** ambient air monitoring programme was first set up in 1982, with seven sites in and around Waihi. Additional sites were added in 1984 to 1987, and again (with minor rationalisation of some sites) in 1995 to 1997. Although two sites were decommissioned in 2000, there remained a total of twenty one monitoring sites in use at the beginning of the 2001 calendar year.
- 119. A** review of the ambient air monitoring programme in 2001¹⁷ recommended that the monitoring at eight sites in Waihi and one site each in Katikati and Paeroa cease at the end of that year. All of the recommendations were supported by the Waikato Regional Council, and were implemented. The criterion used was that monitoring should cease at a site when it was clear that useful information with respect to the air quality effects on the local community was no longer being obtained. The decommissioned Katikati and Paeroa sites, which measured deposited particulate had shown similar levels to those in Waihi township.
- 120. TWO** other sites, involving the measurement of suspended particulate at Katikati and Paeroa, were decommissioned in November 2005 and August 2006, respectively. Dust concentrations measured at those sites were, for the ten years they operated, were generally similar to those at equivalent sites in Waihi. However, especially if the PM₁₀ monitoring by the Waikato Regional Council at the Grey Street monitoring site (6.61) is to cease, suspended particulates monitoring at Katikati and Paeroa may be recommissioned.
- 121. DETAILS** of the eleven air quality monitoring sites continuing in use in and around Waihi are given in Table 10, and their locations are given in Figure 9 (both on the next page). The ambient air monitoring programme remains comprehensive.
- 122. THE** ambient air quality monitoring programme provides an excellent time series of results, covering the period from prior to development of the Martha Mine, the construction of Martha, the operation of Martha through its various stages, the operation of the Favona Underground Mine, and most recently the development of the Trio Underground Mine. That is, a total period of 29 years.

¹⁷ Rolfe, Kevin, "Proposals to Rationalise the Ambient Air Monitoring in and around Waihi", a report prepared for Waihi Gold Mining Company Limited, September 2001.

Table 10: Description of Routine Monitoring Sites

Site No	NZMS 260 Grid Ref	Description	Suspended Particulate (SP) and/or Deposited Particulate (DP)
6.59	648 200	Alexanders, Golden Valley	DP
6.60	641 200	Torrens, Golden Valley	DP
6.61	626 207	WGMC (Leaches), Grey St	SP and DP
6.63	625 199	WGMC Met Station, Barry Rd	SP and DP
6.64	619 195	Court House, Haszard Street	SP
6.65	617 198	Moresby Avenue	SP
6.66	610 199	Waihi College, Rata Street	SP and DP
6.70	658 176	Smiths Farm, Trig Road	DP
6.71	653 174	Morrisons Farm, Trig Road	DP
6.72	644 179	Ruddocks Farm, Baxter Road	DP
6.78	624 202	Cnr Grey & Slevin Streets	SP

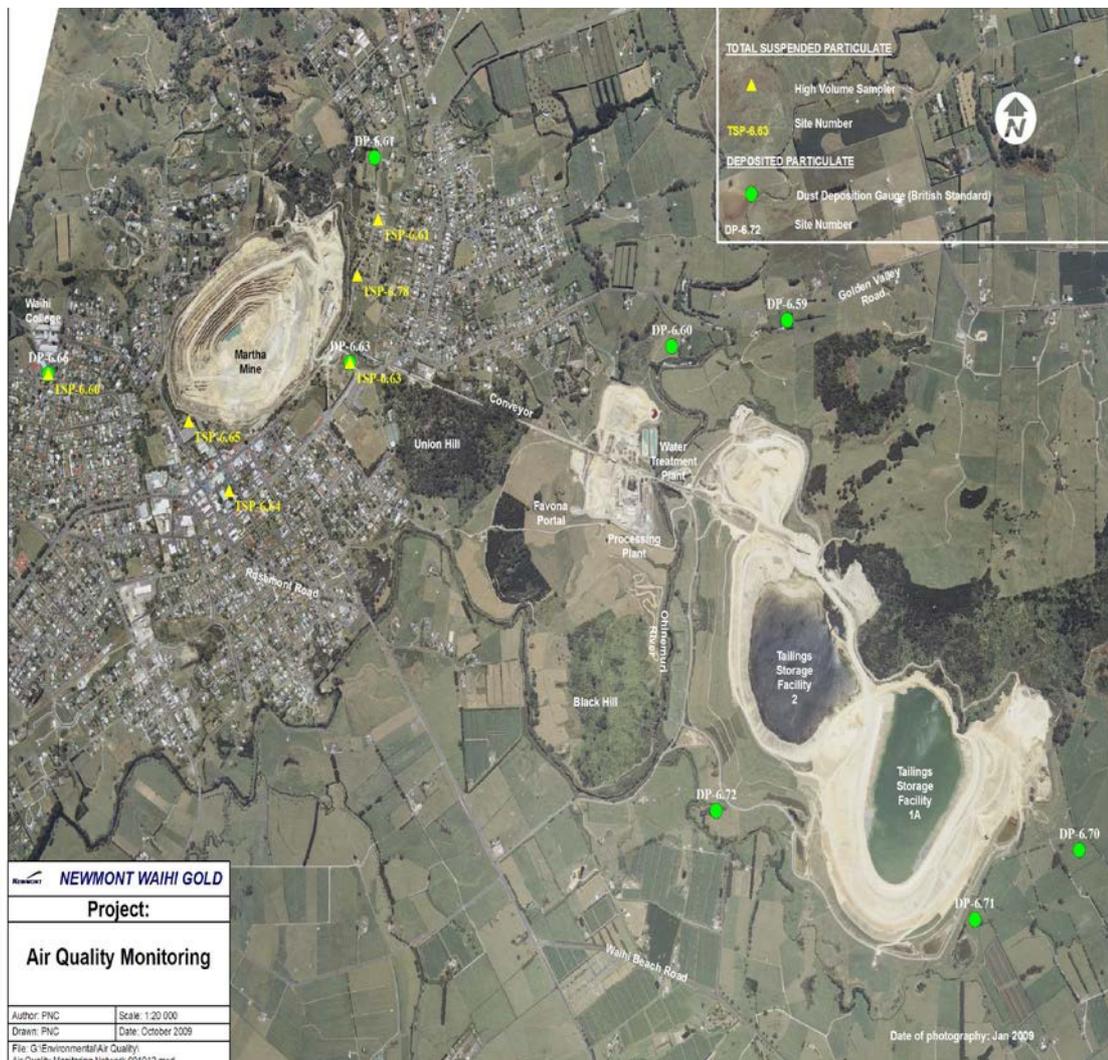
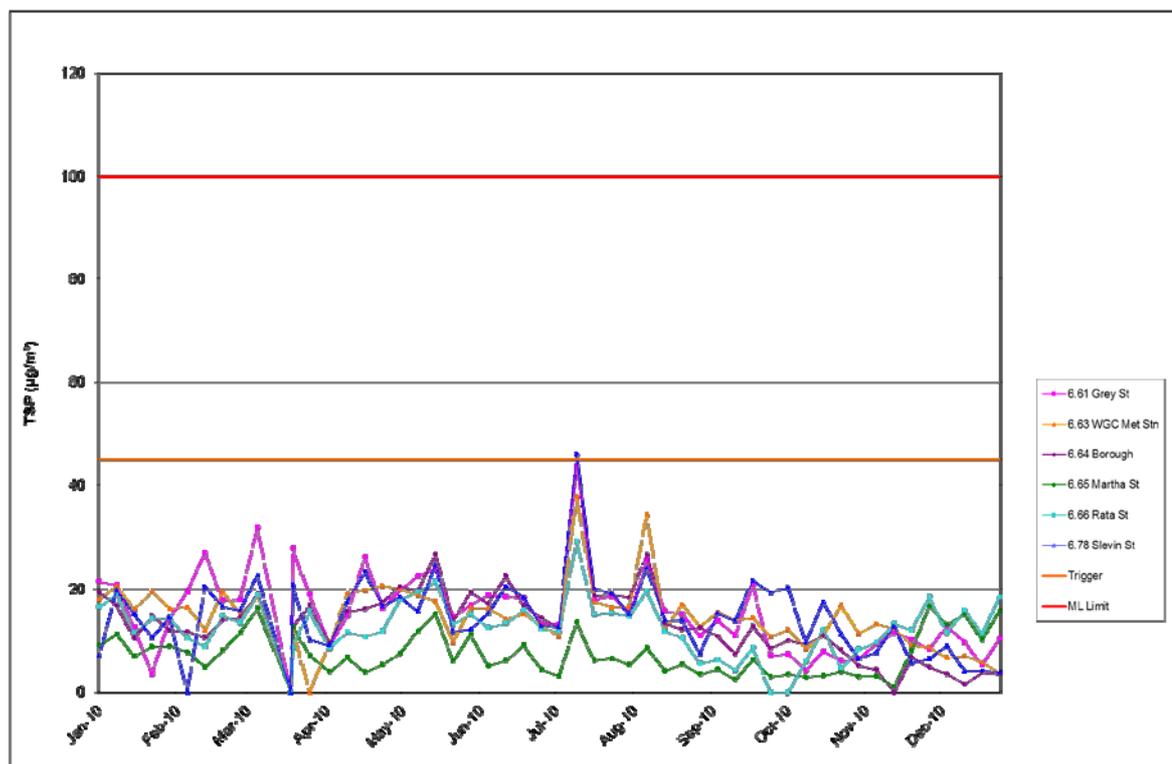


Figure 9: Air Quality Monitoring Sites

2010 Monitoring Data

123. FIGURE 10 gives the results of ambient air monitoring for suspended particulates in Waihi for 2010. There were two exceedances of the Air Quality Management Plan trigger level of $45 \mu\text{g}/\text{m}^3$, seven day average, at the Slevin Street (6:78) and Borough/Court House (6:64) sites, respectively. The concentrations measured were $46.2 \mu\text{g}/\text{m}^3$ and $45.9 \mu\text{g}/\text{m}^3$. Both exceedances occurred on the week ended 16 July 2010, and were most likely caused by discharges of particulate matter from domestic solid fuel heating during a period of cold weather and low wind speeds. The results for the Grey Street (6:61), WGC Met Stn (6.63), and Rata Street (6.66) sites were similarly elevated above normal during that week, at $43.6 \mu\text{g}/\text{m}^3$, $37.9 \mu\text{g}/\text{m}^3$, and $29.2 \mu\text{g}/\text{m}^3$. Trends in the results of the suspended particulates monitoring are discussed below.



Note: “ML Limit” in Figures 10 to 13 refers to that in Mining Licence 32 2388. It is given for comparative purposes only.

Figure 10: Suspended Particulates Monitoring for 2010

124. **FIGURE 11** gives the results of ambient air monitoring for deposited particulates in Waihi for 2010. There were no exceedances of the Air Quality Management Plan trigger level of 4 g/m² per month (which is equivalent to 133 mg/m² per day). Highest results were measured at most sites during dry weather in November. Trends in the results of the monitoring are discussed below.

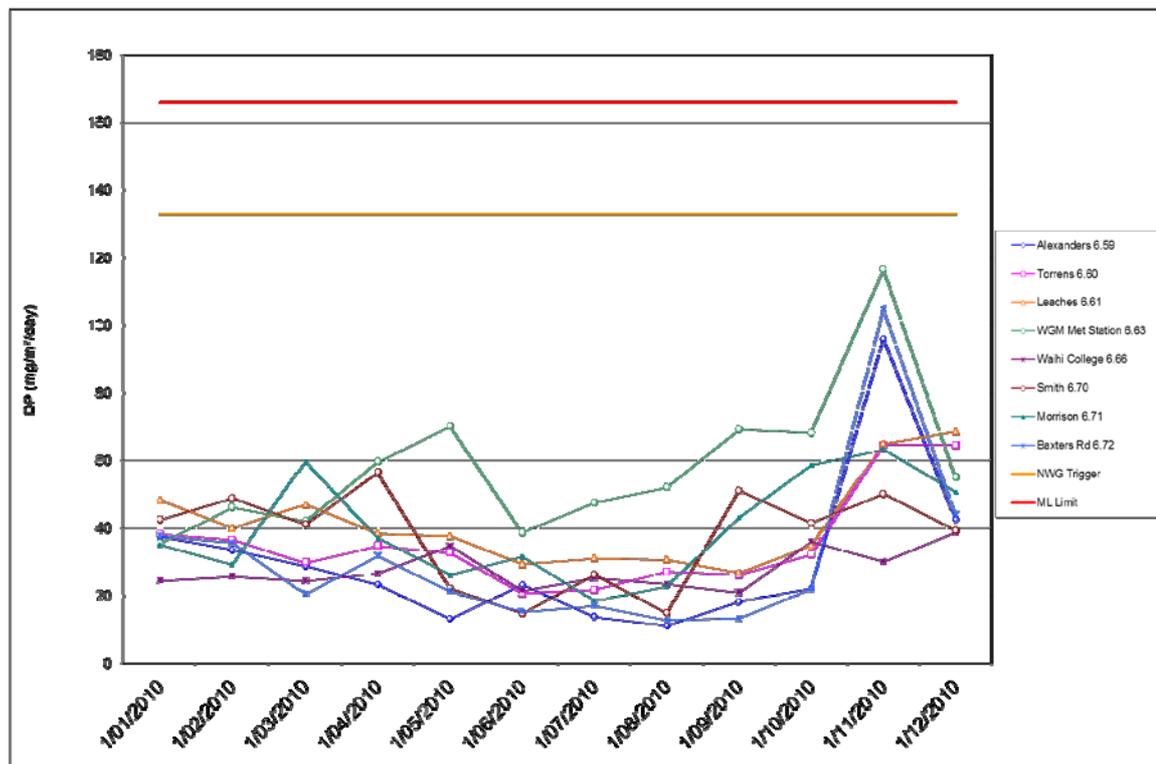


Figure 11: Deposited Particulates Monitoring for 2010

Trends in Monitoring Results

125. **FIGURE 12** (next page) gives the trends in suspended particulates monitoring for 2005 to 2010. There has been no significant change over that period, with only occasional elevated concentrations at sites within the residential areas of Waihi in mid-winter. Those elevated results are generally associated with cool evenings and light winds, and hence are most likely caused by particulate matter discharges from domestic solid fuel heating.

126. **FIGURE 13** (next page) gives the trends in deposited particulates monitoring for 2001 to 2010. Again, there has been no discernible change over that period, with the normal seasonal variation of higher concentrations during periods of drier weather.

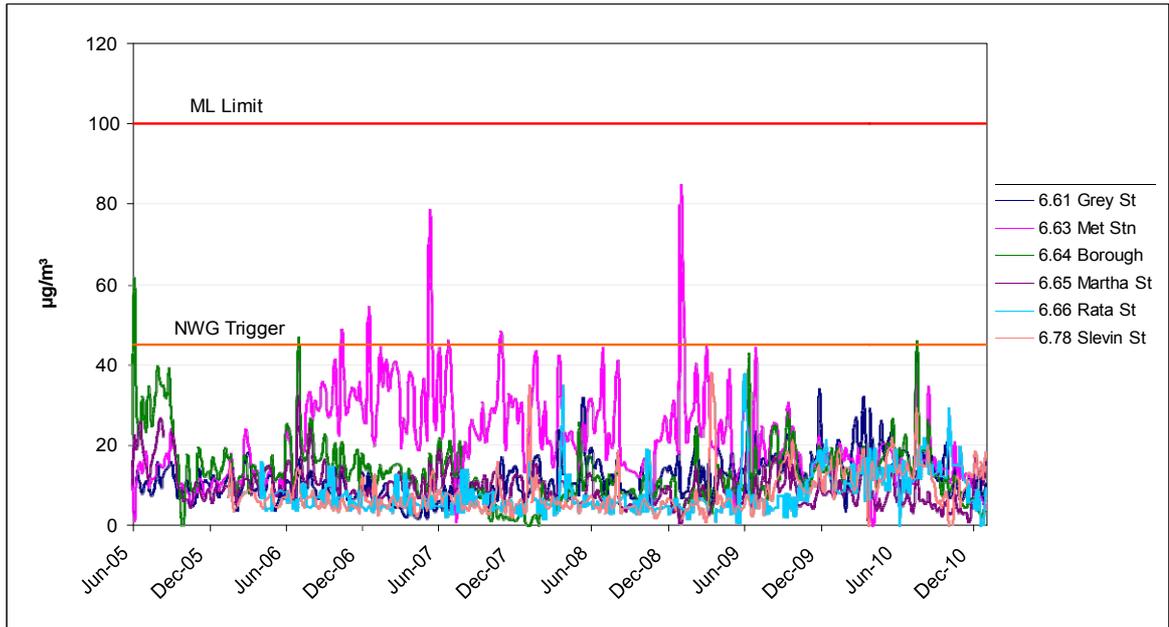


Figure 12: Trends in Suspended Particulates Monitoring 2005 to 2010

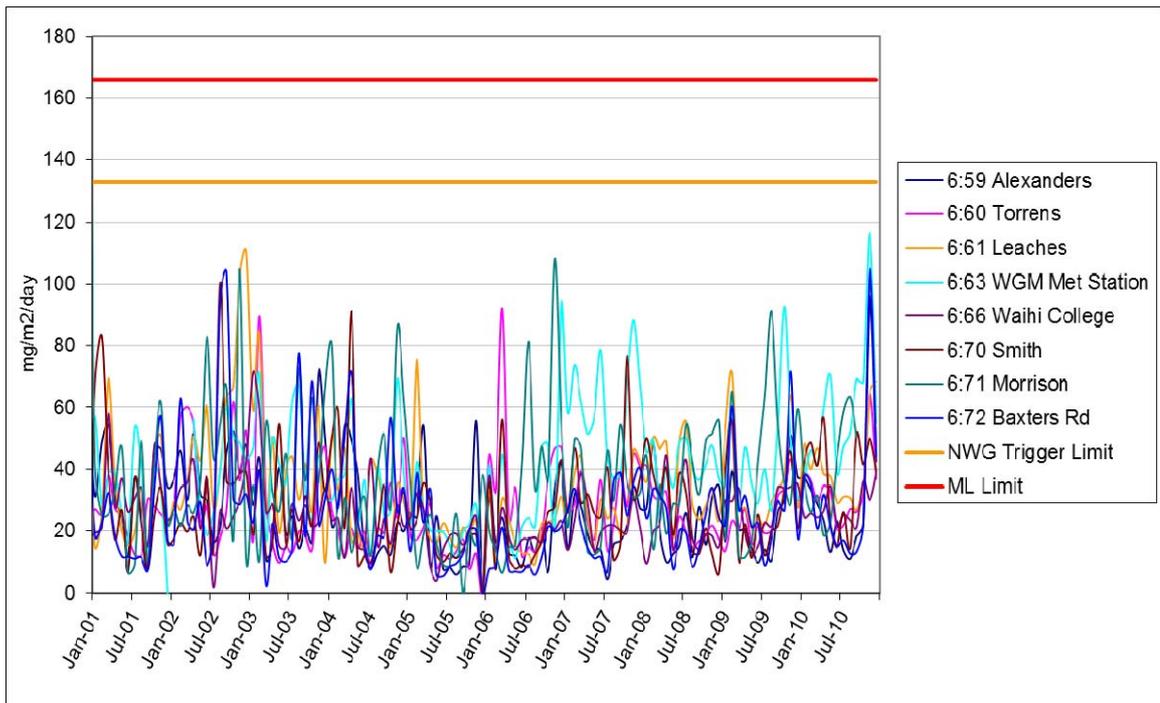


Figure 13: Trends in Deposited Particulates Monitoring 2001 to 2010

127. FROM 1995 to 2006 there was air quality monitoring for suspended and deposited particulates in Katikati and Paeroa. The purpose of that monitoring was to collect data on air quality in nearby towns that did not have mining activities. The concentrations measured were similar to those measured, then and now, at equivalent sites in Waihi.

- 128. THE** general conclusion of the analyses of the trends in monitoring results is that there is no evidence of a deterioration in air quality as a result of the mining activities in Waihi.
- 129. ANOTHER** useful comparison is the published results of PM₁₀ monitoring by the Waikato Regional Council in nine Waikato urban areas (Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi). As mentioned previously, the Council has since January 2008 operated a PM₁₀ sampler, co-located with the Newmont Waihi Gold monitor at the Grey Street site (6.61). Figure 14 is a photograph of the Waikato Regional Council monitor, with the Newmont Waihi Gold monitor at a higher elevation above.



Figure 14: The Waikato Regional Council PM₁₀ Monitor, Grey Street, Waihi

- 130. IN** Table 8 (next page) the 2010 data for the Waikato Regional Council PM₁₀ monitoring are given. These show that concentrations measured in Waihi are either similar to or lower than those measured in the other eight urban areas. That is, the air quality in Waihi compares favourably with elsewhere in the Waikato region.

Table 8: Summary of Waikato PM₁₀ Monitoring Results for 2010¹⁸

Urban Area	Annual Average Concentration	Maximum 24-hour Concentration	Number of Results > 50 µg/m ³
Hamilton	13 µg/m ³	30 µg/m ³	0
Tokoroa	18 µg/m ³	99 µg/m ³	16
Taupo	14 µg/m ³	55 µg/m ³	1
Te Kuiti	16 µg/m ³	56 µg/m ³	3
Matamata	13 µg/m ³	40 µg/m ³	0
Putaruru	14 µg/m ³	53 µg/m ³	1
Ngaruawahia	13 µg/m ³	29 µg/m ³	0
Waihi	12 µg/m ³	45 µg/m ³	0
Turangi	10 µg/m ³	32 µg/m ³	0

131. THE current air quality monitoring programme is appropriate to assess the air quality effects of the Correnso Underground Mine, and any other mining in the Golden Link Project Area, and ongoing operations at the processing and tailings disposal areas. It should continue without change. The emphasis of the programme should remain on the measurement of nuisance dust. As Figure 3 (on page 9) indicates, there are air quality monitors located within 300 metres of the proposed site of the vent shaft and near where people live. To assess potential health effects on the local community, the two yearly surveys of inhalable particulates, and their crystalline silica content, should continue.

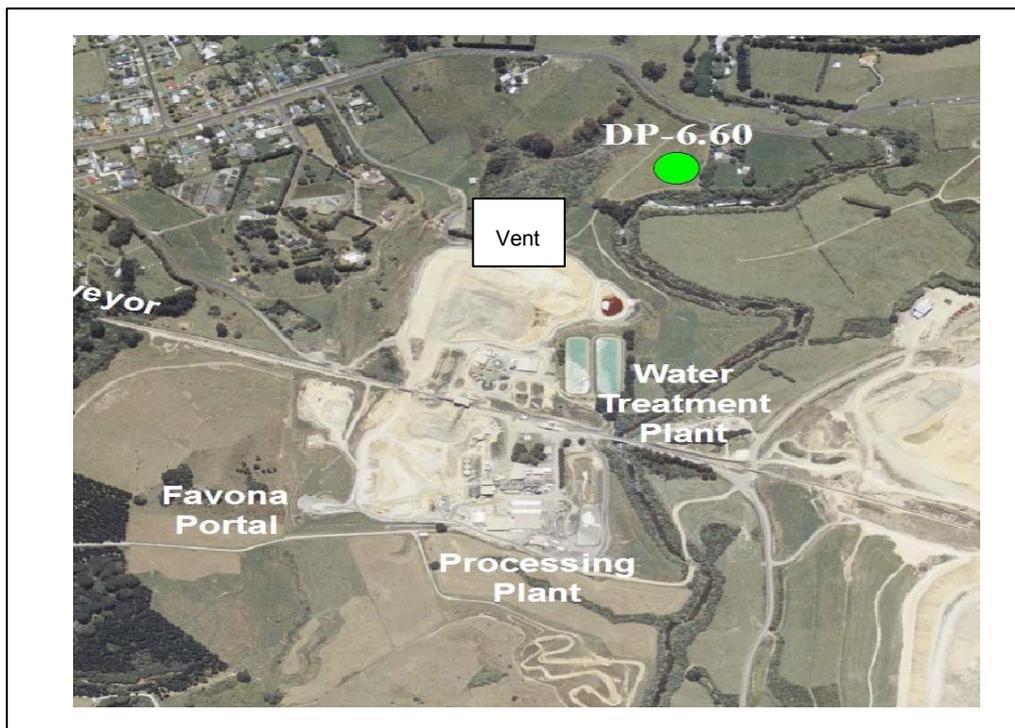
¹⁸ "Air Quality Monitoring Report for Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi – 2010", Waikato Regional Council Technical Report 2011/07, March 2011.

AIR QUALITY MONITORING NEAR THE FAVONA VENT SHAFT

132. **THERE** is a long-standing deposited particulate monitor, part of the comprehensive ambient air monitoring programme in and around Waihi, the results of which are directly relevant to the Correnso Underground Mine. Its location is shown in Figure 15. The monitor, labelled DP-6.60, is less than 150 metres downwind, in a south-westerly wind direction, from the Favona vent shaft.

133. **THE** monitoring results are directly relevant to four of the activity categories at Favona that are of interest with respect to the Correnso Underground Mine, and any other mining in the Golden Link Project Area, viz.:

- the vent shaft (which includes emissions from blasting, mining and the operation of underground vehicles);
- aboveground vehicle movements;
- the stockpiling of ore and waste rock; and
- the processing plant.



The aerial view is oriented north-south.

Figure 15: Location of the Favona vent relative to Deposited Particulate monitor 6.60

134. **THE** results of the deposited particulate monitoring at site DP-6.60 for 2001 to 2010 are given in Figure 16.

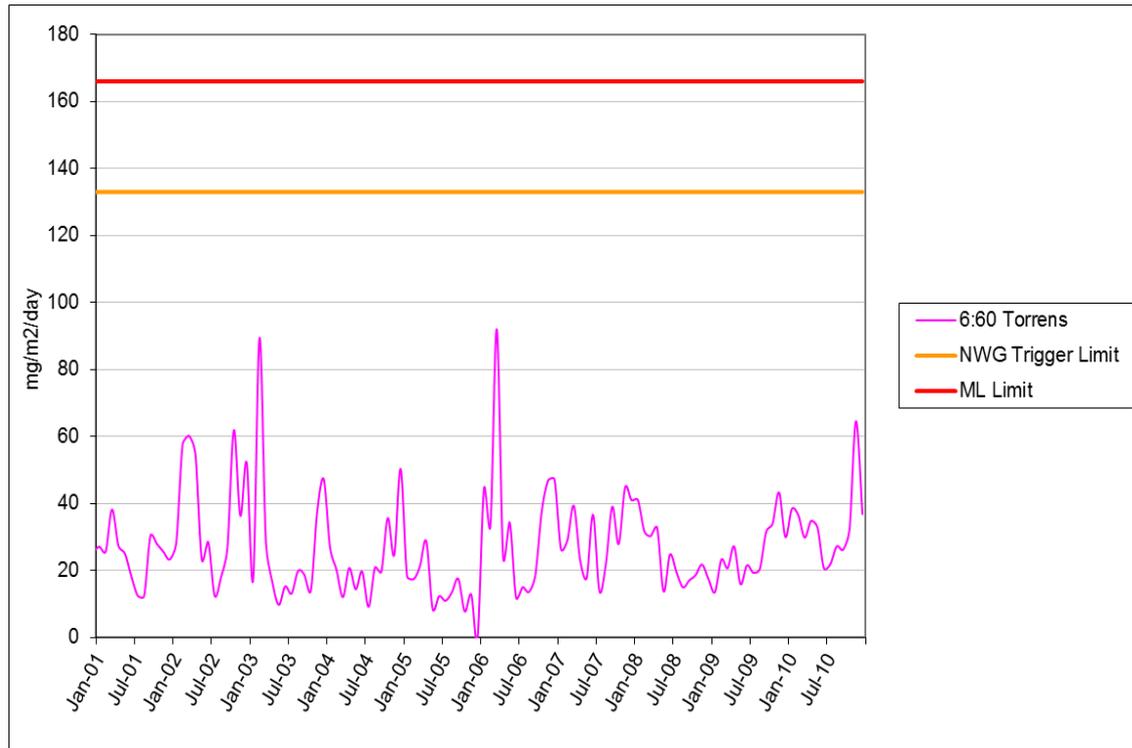


Figure 16: Results of Deposited Particulate monitoring at site 6.60, 2001 to 2010.

135. BASED on those results, it is concluded that the operations at the Favona Underground Mine since 2004 have had no discernible effect on the levels of deposited particulate measured at that site. The trigger level referred to is equivalent to that given in the Air Quality Management Plan (discussed below), that is, 4 g/m² per month. All of the results over the period 2001-2010 are less than the trigger level, which is well below the mining licence compliance levels.

CONSENTING

Discharges to Air Consents

136. **EMISSIONS** to air from activities associated with the Martha Mine, the Favona Underground Mine, and the Trio Underground Mine are subject to Discharge Permits of the Waikato Regional Council.
137. **DISCHARGE** Permit 971281 was granted by the Environment Court in October 1999, by way of a Consent Order, and expires on 15 July 2017. It has 14 conditions. Discharge Permit 109741 was issued in May 2004 at the time of consenting the Favona Underground Mine project and expires on 31 December 2028. It has 11 conditions. Discharge Permit 121442 was granted when consenting the Trio Underground Mine and was issued in December 2010 and expires on 31 December 2028. It has 9 conditions.
138. **BECAUSE** the vent shaft for the Correnso Underground Mine is to be located within the area covered by Discharge Permit 971281 and involves discharges to air covered by that consent, no additional consent is required to enable Correnso to commence operations. However the consent expires in 2017 and needs to be replaced with a new consent to cover discharges from the Correnso vent shaft and activities in the processing and tailings disposal areas.
139. **HENCE** discharges to air from the Correnso Underground Mine can be fully covered by the existing Discharge Permits, subject to a new consent being granted for the vent shaft and activities in the processing and tailings disposal areas, to commence at the expiry of Discharge Permit 971281, i.e., 15 July 2017.
140. **THIS** is because the discharges from the vent shaft and above ground activities resulting from the Correnso Underground Mine, and any other mining in the Golden Link Project Area, will be not significantly different to those arising from the present activities of the Favona Mine and the soon to commence activities of the Trio Mine.

Air Quality Management Plan

141. CONDITION 9 of Discharge Permit 971281 requires:

The consent holder shall develop an Air Quality Management Plan to the satisfaction of the Waikato Regional Council.

The Plan shall specifically include the following:

Ambient air monitoring programmes for deposited particulate matter, total suspended particulate matter, PM₁₀ (particulate matter smaller than ten microns) and particle size distribution studies (including silica content). The ambient air monitoring programmes shall include specification of location, frequency and methods for sampling and analysis of contaminants under each programme.

142. CONDITION 6 of Discharge Permit 109741 requires:

Prior to the exercise of this consent, the consent holder shall prepare an Air Quality Management Plan and submit this to the Council for its written approval. The Plan shall, as a minimum, specifically include the following:

- (a) Description of the air quality control objectives.*
- (b) Details of the site operation and maintenance practices to be implemented to meet these objectives and the conditions of this consent, and to ensure that emissions from the mining operations, particularly from stockpiles, ventilation shafts, unsealed areas, and from other sources, are minimised.*
- (c) A programme to monitor emissions from the mine ventilation stack(s).*
- (d) A programme to monitor ambient air for deposited and suspended particulate matter.*

Also:

The monitoring programmes shall include specification of location, frequency and methods for sampling and analysis.

143. SIMILARLY, condition 6 of Discharge Permit 121442 requires:

Prior to the exercise of this consent, the consent holder shall prepare an Air Quality Management Plan and submit this to the Council for its written approval. The Plan shall, as a minimum, specifically include the following:

- (i) Description of the air quality control objectives.*
- (ii) Details of the site operation and maintenance practices to be implemented to meet these objectives and the conditions of this consent, and to ensure that emissions from the ventilation shafts are minimized.*
- (iii) A programme to monitor ambient air for deposited and suspended particulate matter.*

Also:

The Plan shall provide details of monitoring to be undertaken including location, frequency and methodology of sampling and all analysis to be undertaken and the trigger levels with which the monitoring data will be assessed against.

- 144. THE** Air Quality Management Plan has become the guiding document with respect to day-to-day air quality management at the Martha and Favona mines, and it soon will be for the Trio mine.
- 145. THE** Discharge Permits make it clear that if there is conflict or inconsistency between the conditions of consent and the provisions of the Air Quality Management Plan then the conditions of the Discharge Permit shall prevail.
- 146. THE** three Discharge Permits require the Air Quality Management Plan to be reviewed by the consent holder, and updated if necessary. The permit for the Martha Mine requires those reviews to be at least once every two years, and that has been done. Any updated Plan is to be forwarded to the Waikato Regional Council for approval.
- 147. AN** initial Air Quality Management Plan for the Martha Mine Extended Project was prepared in 1999, and it has been updated six times since then. The operative 2010 version¹⁹ covers the Martha Mine, the Favona Underground Mine and the Trio Development Project. A draft 2011 version covering the Martha, Favona and Trio Mines has been prepared, as it will be needed early this year before the Trio Mine commences operation.
- 148. THE** Discharge Permits include the concept of “trigger levels” rather than ambient air quality guidelines. The trigger levels are set at about two-thirds the level of previous ambient air quality guidelines, and they are recorded in the Air Quality Management Plan.
- 149. THE** following ambient air “trigger levels” are specified in the Air Quality Management Plans:
- suspended particulate 45 µg/m³, averaged over seven days
 - deposited particulate 4 g/m², averaged over one month

¹⁹ M Burroughs & R Squire: “Air Quality Management Plan (Martha & Favona Mines, & Trio Development)”, Newmont Waihi Gold Limited, November 2010.

- 150. THOSE** trigger levels have been found to be appropriate for the air quality management of discharges from the Martha and Favona Mines, and they are included in the draft Air Quality Management Plan covering the Trio Mine. At concentrations below the trigger levels the effects of discharges to air on the local community can be considered acceptable. Hence continued use of an Air Quality Management Plan and the same trigger levels are recommended.
- 151. IT** will be necessary for a future update of the Air Quality Management Plan, say in late 2014 (prior to commencement of mining at Correnso), to cover the Correnso Mine and any other future underground mining in the Golden Link Project Area.

National Environmental Standards for Air Quality

152. **REGULATION** 17 of the Resource Management (National Environmental Standards for Air Quality) Regulations 2004²⁰ may be relevant to the re-consenting of the discharges covered by Discharge Permit 971281, and so it is addressed here.
153. **REGULATION** 17(1) requires that *a consent authority must decline an application for a resource consent (the **proposed consent**) to discharge PM₁₀ if the discharge to be expressly allowed by the consent would be likely, at any time, to increase the concentration of PM₁₀ (calculated as a 24-hour mean under Schedule 1) by more than 2.5 micrograms per cubic metre in any part of a polluted airshed other than the site on which the consent would be exercised.*
154. **THE** most important words here are “*polluted airshed*”. Regulation 17(4)(a) states that *an airshed becomes a polluted airshed on and from 1 September 2012 or any later day if, for the immediately prior 5-year period, .. the airshed’s average exceedances of PM₁₀ .. was more than 1 per year.* The method of calculation of the average exceedances per year is specified in Regulation 16D, and *is the number of exceedances of PM₁₀ .. in the 1 or more 12-month periods for which the airshed had meaningful PM₁₀ data in the relevant 5-year period, divided by the number of those 12-month periods.*
155. **EMISSIONS** from Newmont Waihi Gold operations discharge into the Waihi Airshed, which has been gazetted by the Waikato Regional Council and is shown in Figure 17 (next page). Compliance monitoring for PM₁₀ by the Council commenced on 31 January 2008. The Waihi Airshed is most unlikely to be deemed a polluted airshed, on 30 January 2013 or any later date.
156. **BASED** on available data, from 31 January 2008 to 15 June 2011 (shown in Figure 7 above), no exceedances of the PM₁₀ national standard have been measured at the monitoring station. Hence for the re-consenting of the discharges to air consent for the Correnso vent shaft and activities in the processing and tailings disposal areas it can be concluded that Regulation 17 of the National Environmental Standards for Air Quality does not apply.

²⁰ The Regulations were amended on 1 June 2011 by the *Resource Management (National Environmental Standards for Air Quality) Amendment Regulations 2011*.



Figure 17: The Waihi Airshed, as gazetted by the Waikato Regional Council

CONCLUSIONS

- 157.** A quantitative assessment of the potential environmental health effects of discharges from the Correnso vent shaft (which includes emissions from blasting, mining and operation of underground vehicles) finds that they will be insignificant. Insignificant effects can also be expected for discharges from the vent shaft from any future underground mining within the Golden Link Project Area.
- 158.** **THE** effects of emissions from aboveground vehicle movements associated with the Correnso Mine, and any future vehicle movements within the Golden Link Project Area, will be less than minor.
- 159.** **STOCKPILING** associated with the Correnso Mine, and any future underground mining within the Golden Link Project Area is not expected to be an air quality issue, but any dust issues that may arise will need to be addressed in a proactive way.
- 160.** **PROVIDED** appropriate dust management practices are followed, the air quality effects of ore and rock crushing, screening and conveying associated with the Correnso Underground Mine, and any future mining within the Golden Link Project Area, will be less than minor. This includes the handling of backfill rock and aggregate and the manufacture of cement aggregate fill at the batching plant for the Correnso Underground Mine.
- 161.** **OPERATION** of the processing plant for the ore from the Correnso Underground Mine will be similar to that for the Favona and Trio Underground Mines and the Martha Mine, and so the air quality significance of those activities will continue to be in full compliance with Discharge Permit 971281. Operations in the processing plant are not proposed to change and therefore it would be appropriate for the new consent to have the same (or similar) conditions to Discharge Permit 971281.
- 162.** **THE** results of the ambient air quality monitoring, which has now operated for 29 years, show little variation in the concentrations measured in and around Waihi, and certainly there is no evidence of any deterioration in the air quality as a result of mining operations. In particular, the recent results of deposited particulates monitoring in the vicinity of the Favona vent shaft, the processing plant, and the ore and waste rock stockpiling areas show there have been no dust issues associated with any of those activities.

- 163.** A comparison of PM₁₀ concentrations measured by the Waikato Regional Council at eight other urban areas in the Waikato shows the air quality in Waihi compares favourably with these other urban areas.
- 164.** AS for the future of the Newmont Waihi Gold ambient air quality monitoring programme in Waihi, no changes are recommended, and the emphasis should continue to be on the measurement of nuisance dust. To assess potential health effects on the local community, the two yearly surveys of inhalable particulates, and their crystalline silica content, should continue.
- 165.** **DISCHARGES** from the vent shaft and above ground activities resulting from the Correnso Underground Mine will not be significantly different to those arising from the present activities of the Favona Mine and the soon to commence activities of the Trio Mine. The location of the new cement batching plant at the Favona portal stockpile is covered by the discharges to air consent issued for Favona, and operation of this plant will have less than minor effects.
- 166.** **BECAUSE** the vent shaft for the Correnso Underground Mine is to be located within the area covered by Discharge Permit 971281 no additional consent is required, but the Martha Mine needs to be reconcented with a replacement consent commencing from the expiry date of 15 July 2017.
- 167.** **HENCE** discharges to air from the Correnso Underground Mine can be fully covered by the existing consents (Discharge Permits 971281, 109741 and 121442), and assuming a new consent is granted to replace the Martha Mine Permit at its expiry in 2017.
- 168.** **CRUSHING** and screening at the Martha Mine will cease in 2017, following completion of the layback to the east wall of the pit. Apart from work to rehabilitate the site, that will bring to an end those activities at the Martha Pit with a potential to produce dust emissions.



Kevin Rolfe

10 March 2012

Appendix B

Current Consents for Discharges to Air



Resource Consent Certificate

Resource Consent Number: 109741

File Number: 61 25 21A

***Pursuant to the Resource Management Act 1991, the Waikato Regional Council
hereby grants consent to:***

Welcome Gold Mines Ltd & Auag Resources Ltd	Waihi Gold Company Ltd
P O Box 190	PO Box 190
WAIHI 2984	Waihi 3641

(hereinafter referred to as the Consent Holder)

Consent type: Discharge permit

Consent subtype: Discharge to air

Activity authorised: To discharge contaminants to air from the mine portal, vent shaft(s) and project area (fugitive emissions) being dust, CO₂, blast fumes and exhaust fumes.

Location: Baxter Rd - Waihi

Map Reference: NZMS 260 T13:636-195

Consent duration: Granted for a period expiring 31 December 2028.

Subject to the conditions overleaf:

CONDITIONS**General**

1. This consent is subject to the conditions listed in Schedule One –General Conditions.
2. There shall be no particulate matter or gaseous emissions (including odour) in the discharge that gives rise to objectionable adverse effects (as defined in Section 6.4 of the Proposed Waikato Regional Plan – Decisions Version dated February 2002), at or beyond the boundary of the subject property.

Should a discharge occur that causes an objectionable adverse effect, the consent holder shall provide a written report to the Waikato Regional Council (the “**Council**”) within five days of being notified of such by the Council. The report shall specify:

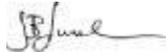
- (a) the cause or likely cause of the event and any factors that influenced its severity;
- (b) the nature and timing of any measures implemented by the consent holder to avoid, remedy or mitigate any adverse effects; and
- (c) the steps to be taken in future to prevent recurrence of similar events.

Emission Controls

3. Stockpiles shall be managed to minimise particulate emissions from this source. Methods may include but are not limited to: covering, grassing, sheltering from prevailing winds, or wetting.
4. Exposed yard surfaces and roadways shall be kept damp, or otherwise treated or maintained, as necessary to minimise particulate discharges to air, including during non-work hours.
5. No chemical dust suppressants or additives shall be used without prior written approval from the Council

Air Quality Management Plan

6. Prior to exercise of this consent, the consent holder shall prepare an Air Quality Management Plan and submit this to the Council for its written approval. The Plan shall, as a minimum, specifically include the following;
 - (a) Description of the air quality control objectives.
 - (b) Details of the site operation and maintenance practices to be implemented to meet these objectives and the conditions of this consent, and to ensure that emissions from mining operations, particularly from stockpiles, ventilation shafts, unsealed areas, and from other sources, are minimised.
 - (c) A programme to monitor emissions from the mine ventilation stack(s).
 - (d) A programme to monitor ambient air for deposited and suspended particulate matter.

 09/04/10

Unless otherwise agreed in writing by Waikato Regional Council, the Plan, in particular those parts of the Plan that relate to the ambient monitoring programme, shall include “real time” monitoring and be consistent with the recommendations included in the report to the Council entitled “*Favona Underground Mine, Waihi, Report to: Environment Waikato - Assessment of Air Quality Aspects*” dated October 2003 and prepared by Sinclair Knight Merz Ltd. The monitoring programme shall include specification of location, frequency and methods of sampling and analysis.

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed by the consent holder at least once every two years and updated if

necessary. Any updated Plan shall be promptly forwarded to the Council for approval and once approved the amended Plan shall be implemented in place of the previous version.

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In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Air Quality Management Plan, then the conditions of this consent shall prevail.

Monitoring

7. The consent holder shall, as a minimum, undertake monitoring in accordance with the methodology defined in the Air Quality Management Plan, prepared pursuant to condition 6 above.

Reporting

8. The consent holder shall provide to the Council a written annual report each year that addresses at least the following:
 - (a) A summary of the results of the monitoring required by this consent,
 - (b) Any environmentally important trends arising from the monitoring programme,
 - (c) Comment on compliance with all conditions,
 - (d) Any reasons for non-compliance or difficulties in achieving compliance with the conditions of this resource consent,
 - (e) Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the up-coming year to improve environmental performance in relation to the activities included in this consent.

The report shall be forwarded in a format acceptable to the Council.

9. In addition to the annual report required pursuant to condition 8 above, the consent holder shall forward to the Council the results of any ventilation stack emission monitoring within one month of the results becoming available.

Complaints

10. If any complaints are received by the consent holder regarding dust, odour or other contaminants, the consent holder shall notify the Council of those complaints as soon as practicable. When/if complaints are received, the consent holder shall record the following details in a complaint log:
 - (a) type and time of complaint;
 - (b) name and address of complainant (if available);
 - (c) location from which the complaint arose;
 - (d) wind direction at the time of complaint;
 - (e) the likely cause of the complaint;
 - (f) the response made by the consent holder; and
 - (g) action taken or proposed as a result of the complaint.

The complaint log shall be made available to the Council at all reasonable times and a copy shall be forwarded to the Council at six monthly intervals.

Reviews

11. The Council may, within three months of the anniversary of the commencement of this consent and annually thereafter, serve notice on the consent holder under section 128 of the Resource

Management Act 1991, of its intention to review the conditions of this resource consent in the event that:

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- (a) relevant national guidelines or standards or regional guidelines are established or amended; or
- (b) the exercise of this consent causes an objectionable adverse effect (see condition 2 of this consent).

Costs associated with any review shall be borne by the consent holder.

*Dated at Hamilton this **13** day of **April 2004***

*For and on behalf of the
Waikato Regional Council*

A handwritten signature consisting of the letters 'DP' followed by a horizontal line and a large, sweeping flourish that extends to the right.

.....

SCHEDULE ONE – GENERAL CONDITIONS

The granting of consents (109741 to 109746 inclusive) is subject to the following conditions, which shall apply to each individual consent.

General

1. Except as otherwise provided for by subsequent conditions of this consent, all activities to which this consent relates shall be undertaken generally in accordance with the information contained in the Assessment of Environmental Effects (August 2003) and supporting technical documents submitted by the consent holder in support of the applications for the consents for the Favona Underground Mine.
2. This consent shall not be exercised until such time as documentation is provided to the Waikato Regional Council (the “**Council**”) confirming that the holder of the existing resource consents that authorise the operation of the Martha mine (the “Martha consents”), in particular those consents that relate to discharges from the silt ponds, discharges from the collection ponds, discharges from the water treatment plant and the series of consents that relate to the tailings storage facility, has provided permission for the holder of this consent to utilise the Martha consents for the purpose of the operation of the Favona underground mine.

Commencement

3. The consent holder shall notify the Council in writing at least two weeks in advance of the first exercise of this consent.

Rehabilitation Plan

4. The consent holder shall prepare a Rehabilitation Plan covering all areas that may be affected by the Favona Underground Mine. This Plan shall be submitted to the Council for written approval prior to the exercise of this consent. The Plan shall set out details on flooding of the workings, plugging of the decline, landscaping, rehabilitation of the polishing pond stockpile area, planting, fencing, and ongoing maintenance and may be the same Plan that is required pursuant to condition 27 of the land-use consent granted by the Hauraki District Council. The Plan shall be in alignment with the Rehabilitation Plan prepared for the Martha consents.

The consent holder may amend the Plan at any time. No amendments shall be made to the Plan without the written approval of the Council. Unless otherwise agreed in writing by the Council, the consent holder shall undertake the rehabilitation works in accordance with the most recent version of the approved Rehabilitation Plan.

Liaison Officer

5. Prior to exercising of this consent, the consent holder shall appoint a person (the “Liaison Officer”), subject to the approval of the Hauraki District Council and the Waikato Regional Council (the “**Councils**”), to liaise between the consent holder, the community and the Councils. The Liaison Officer shall have sufficient delegated power to be able to deal immediately with complaints received and shall be required to investigate those complaints as soon as possible after receipt. The Liaison Officer shall be appointed for the duration of this consent. The name of the Liaison Officer together with the contact phone numbers for that person shall be publicly notified in local newspapers by the consent holder prior to the exercising of this consent and at least once a year thereafter.

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Bond

6.1 Unless otherwise agreed in writing by the Waikato Regional Council and the Hauraki District Council (the “**Councils**”), the consent holder shall provide and maintain in favour of the Councils a rehabilitation bond to

- (a) secure compliance with the conditions of this consent and to enable any adverse effect on the environment resulting from the consent holder’s activities and not authorised by a resource consent to be avoided, remedied, or mitigated;
- (b) secure the completion of rehabilitation and closure of the activities authorised by this consent in accordance with the approved Rehabilitation Plan;
- (c) ensure the performance of any monitoring obligations of the consent holder under this consent.

6.2 The bond shall be in a form approved by the Councils and shall, subject to these conditions, be on the terms and conditions required by the Councils.

6.3 The bond shall provide that the consent holder remains liable under the Resource Management Act 1991 for any breach of the conditions of consent which occurs before expiry of this consent and for any adverse effects on the environment which become apparent during or after the expiry of the consent.

6.4 Unless the bond is a cash bond, the performance of all of the conditions of the bond shall be guaranteed by a guarantor acceptable to the Councils. The guarantor shall bind itself to pay for the carrying out and completion of any condition in the event of any default of the consent holder, or any occurrence of any adverse environmental effect requiring remedy.

6.5 The amount of the bond shall be fixed prior to the exercise of this consent and thereafter at least annually by the Councils who shall take into account any calculations and other matters submitted by the consent holder which are relevant to the determination of the amount. The amount of the bond shall be advised in writing to the consent holder at least one month prior to the review date.

6.6 The amount of the bond shall include:

- (a) the estimated costs (including any contingencies necessary) of rehabilitation and closure in accordance with the conditions of this consent, on completion of the operations proposed for the next year;
- (b) any further sum which the Councils consider necessary to allow for remedying any adverse effect on the environment that may arise from the exercise of this consent;
- (c) the estimated costs of monitoring, in accordance with the monitoring conditions of this consent, until the consent expires; and
- (d) any further sum which the Councils consider necessary for monitoring any adverse effect on the environment that may arise from the exercise of this consent including monitoring anything which is done to avoid, remedy, or mitigate an adverse effect.

6.7 Should the consent holder not agree with the amount of the bond fixed by the Councils then the matter shall be referred to arbitration in accordance with the provisions of the Arbitration Act 1996. Arbitration shall be commenced by written notice by the consent holder to each of the Councils advising that the amount of the bond is disputed, such notice to be given by the consent holder within two weeks of notification of the amount of the rehabilitation bond. If the parties cannot agree upon an arbitrator within a week of receiving the notice from the consent holder, then an arbitrator shall be appointed by the President of the Institute of Professional Engineers of New Zealand. Such arbitrator shall give an award in writing within 30 days after his or her appointment, unless the consent holder and the Councils agree that time shall be

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extended. The parties shall bear their own costs in connection with the arbitration. In all other respects, the provisions of the Arbitration Act 1996 shall apply. Pending the outcome of that arbitration, and subject to condition 6.8, the existing bond shall continue in force. That sum shall be adjusted in accordance with the arbitration determination.

6.8 If, for any reason other than default of the Councils, the decision of the arbitrator is not made available by the 30th day referred to above, then the amount of the bond shall be the sum fixed by the Councils, until such time as the arbitrator does make his/her decision. At that stage the new amount shall apply. The consent holder shall not exercise this consent if the variation of the existing bond or new bond is not provided in accordance with this condition.

6.9 The bond may be varied, cancelled, or renewed at any time by agreement between the consent holder and the Councils provided that cancellation will not be agreed to unless a further or new bond acceptable to the Councils is available to replace immediately that which is to be cancelled (subject however to the condition below as to release of the bond on the completion of the rehabilitation).

6.10 The Councils shall release the bond on the completion of the rehabilitation. This means when the rehabilitation has been completed in accordance with the approved Rehabilitation Plan and demonstrated to be successful, to the satisfaction of the Councils

6.11 All costs relating to the bond shall be paid by the consent holder.

6.12 This consent shall not become operative unless and until the consent holder provides the bond to the Councils.

6.13 These conditions form an integrated whole and are not severable.

(Note: The bond covers only those elements of the Favona Underground Mine not already subject to the rehabilitation bond imposed by the land use and resource consents granted for the Martha Mine Extended Project.)

Review

7. The Council may, within three months of the anniversary of the commencement of this consent and annually thereafter, serve notice on the consent holder under section 128 of the Resource Management Act 1991, of its intention to review the conditions of this resource consent for the following purposes:

- (a) to review the effectiveness of the conditions of this resource consent in avoiding, or mitigating, any adverse effects on the environment from the operation and, if considered appropriate by the Council, to avoid, remedy or mitigate such effects by way of further or amended conditions; and/or
- (b) if necessary and appropriate, to require the holder of this resource consent to adopt the best practicable option to remove, or reduce, adverse effects on the environment resulting from the exercise of this consent in particular if the Settlement, De-watering and Water Quality Monitoring Report identifies significant variance from the predicted post closure effects; and/or
- (c) review the monitoring requirements in light of the results obtained from monitoring in preceding years.

Costs associated with any review shall be borne by the consent holder.

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Administration

The consent holder shall pay to the Council any administrative charge fixed in accordance with section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with regulations made under section 360 of the Resource Management Act.

Resource Consent Certificate

Resource Consent: 121697

File Number: 61 51 53A

Pursuant to the Resource Management Act 1991, the Waikato Regional Council hereby grants consent to:

Waihi Gold Company Ltd
(Trading as Newmont Waihi Gold)
PO Box 190
Waihi 3641

(hereinafter referred to as the Consent Holder)

Consent Type: Discharge permit

Consent Subtype: Discharge to air

Activity authorised: To discharge contaminants to air from a vent shaft associated with the Trio Underground Mine Project

Location: Trio Underground Mine Project, Baxter Road, Waihi

Map Reference: NZMS 260 T13:639-193

Consent Duration: This consent will commence on the date of decision notification and expire on 31 December 2028

Subject to the conditions overleaf:

General

1. This consent is subject to all the general conditions listed in Schedule One – General Conditions.
2. If any non-compliance with the conditions of this consent occurs, the consent holder shall notify the Waikato Regional Council as soon as practicable and no later than 24 hours after the consent holder becomes aware that the event has occurred.
3. This consent shall not be exercised unless and until resource consent number 121447 has either been surrendered or has expired.
4. There shall be no particulate matter or gaseous emissions (including odour) in the discharge that gives rise to objectionable adverse effects (as defined in Section 6.4 of the Operative Waikato Regional Plan), at or beyond the boundary of the subject property.

Should a discharge occur that causes an objectionable adverse effect, the consent holder shall provide a written report to the Waikato Regional Council (the “**Council**”) within five days of being notified of such by the Council. The report shall specify:

- (i) the cause or likely cause of the event and any factors that influenced its severity;
- (ii) the nature and timing of any measures implemented by the consent holder to avoid, remedy or mitigate any adverse effects; and
- (iii) the steps to be taken in future to prevent recurrence of similar events.

Lapse Period

5. This consent shall lapse unless given effect to 5 years following the commencement of this consent under section 116 of the Resource Management Act 1991.

Air Quality Management Plan

6. Prior to exercise of this consent, the consent holder shall prepare an Air Quality Management Plan and submit this to the Council for its written approval. The Plan shall, as a minimum, specifically include the following;
 - (i) Description of the air quality control objectives.
 - (ii) Details of the site operation and maintenance practices to be implemented to meet these objectives and the conditions of this consent, and to ensure that emissions from the ventilation shaft are minimized.
 - (iii) A programme to monitor ambient air for deposited and suspended particulate matter.

The Plan shall take into account report supplied as part of the application to the Waikato Regional Council entitled “*Air Quality Implications of the Trio Underground Mine Project*” dated July 2010, prepared by Kevin Rolfe. The Plan shall provide details of monitoring to be undertaken including location, frequency and methodology of sampling and all analysis to be undertaken and the trigger levels with which the monitoring data will be assessed against.

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed by the consent holder and updated if necessary. Any updated Plan shall be promptly forwarded to the Council for approval and once approved the amended Plan shall be implemented in place of the previous version.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Air Quality Management Plan, then the conditions of this consent shall prevail.

Advice Note: Compliance with this condition shall be assessed through the updates supplied of the existing Air Quality Management Plan required as part of consent number 109741

Monitoring

7. The consent holder shall, as a minimum, undertake monitoring in accordance with the methodology defined in the Air Quality Management Plan, prepared pursuant to condition 6 above.
8. The consent holder shall provide to the Council a written annual report each year that addresses at least the following:
 - (i) A summary of the results of the monitoring required by this consent,
 - (ii) Any environmentally important trends arising from the monitoring programme,
 - (iii) Comment on compliance with all conditions,
 - (iv) Any reasons for non-compliance or difficulties in achieving compliance with the conditions of this resource consent,
 - (v) Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the up-coming year to improve environmental performance in relation to the activities included in this consent.

The report shall be forwarded in a format acceptable to the Council.

Complaints

9. If any complaints are received by the consent holder regarding dust, odour or other contaminants, the consent holder shall notify the Council of those complaints as soon as practicable. When/if complaints are received, the consent holder shall record the following details in a complaint log:
 - (i) type and time of complaint;
 - (ii) name and address of complainant (if available);
 - (iii) location from which the complaint arose;
 - (iv) wind direction at the time of complaint;
 - (v) the likely cause of the complaint;
 - (vi) the response made by the consent holder; and
 - (vii) action taken or proposed as a result of the complaint.

The complaint log shall be made available to the Council at all reasonable times and a copy shall be forwarded to the Council at six monthly intervals

For and on behalf of the

121697

Waikato Regional Council

A handwritten signature in black ink, appearing to read 'JP' followed by a surname that is partially obscured by a horizontal line. The signature is written in a cursive style.

.....

Advice notes

1. This resource consent does not give any right of access over private or public property. Arrangements for access must be made between the consent holder and the property owner.
2. This resource consent is transferable to another owner or occupier of the land concerned, upon application, on the same conditions and for the same use as originally granted (s.134-137 RMA).
3. The reasonable costs incurred by Waikato Regional Council arising from supervision and monitoring of this/these consents will be charged to the consent holder. This may include but not be limited to routine inspection of the site by Waikato Regional Council officers or agents, liaison with the consent holder, responding to complaints or enquiries relating to the site, and review and assessment of compliance with the conditions of consents.
4. Note that pursuant to s332 of the RMA 1991, enforcement officers may at all reasonable times go onto the property that is the subject of this consent, for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
5. If you intend to replace this consent upon its expiry, please note that an application for a new consent made at least 6 months prior to this consent's expiry gives you the right to continue exercising this consent after it expires in the event that your application is not processed prior to this consent's expiry.

SCHEDULE ONE – GENERAL CONDITIONS TRIO UNDERGROUND MINE PROJECT

Resource consents **121694, 121695, 121696, and 121697** are subject to the following general conditions, which are applicable to all consents unless specified otherwise within the consent.

General

1. Except as otherwise provided for by subsequent conditions of consent, all activities to which this consent relates shall be undertaken generally in accordance with the information contained in the document titled “**Applications to Environment Waikato for Resource Consent and Assessment of Environmental Effects for the Trio Underground Mine Project**” dated August 2010 and “**Report: Trio Underground Mine – Geochemistry of Ore and Tailings**”, dated 25 August 2010 and recorded as document 1753601 and 1753600 on the Waikato Regional Council’s document system for the Trio Underground Mine Project.
2. The consent holder shall notify the Council in writing, at least two weeks prior to the first exercise of this consent.

Liaison Officer

3. Prior to the exercising of this consent, the consent holder shall appoint a person (the “Liaison Officer”), and any replacement person subject to the approval of the Hauraki District Council and the Waikato Regional Council (the “Councils”), to liaise between the consent holder, the community and the Councils. The Liaison Officer shall have sufficient delegated power to be able to deal immediately with complaints received and shall be required to investigate those complaints as soon as possible after receipt. The Liaison Officer shall be appointed for the duration of this consent. The name of the Liaison Officer together with the contact phone numbers for that person shall be publicly notified in local newspapers by the consent holder prior to the exercising of this consent and at least once a year thereafter.

Rehabilitation Plan

4. The consent holder shall prepare a Rehabilitation Plan covering all areas that may be affected by the construction and use of the workings associated with the Trio Mine Project. This plan shall be submitted to the Waikato Regional Council for written approval prior to the exercise of this consent.

4.1 The Plan shall be in two parts:

- Part A shall describe the programme of progressive rehabilitation (including re-vegetation and backfilling) that is proposed for the site for the following twelve months, should closure not be proposed during that period; and shall report on any such works undertaken during the previous year.
- Part B shall :
 - (a) describe the proposed method of final rehabilitation and closure should closure occur within the following 12 months;
 - (b) include an assessment of any residual risk that the site would pose to the environment and the neighbouring community should closure occur within the following 12 months; and
 - (c) include a programme for monitoring of the site following closure, and list all maintenance works likely to be necessary at the closed site for the foreseeable future.

4.2 Review

The Plan shall be reviewed and updated annually and the concepts shall be described in more detail as appropriate.

The consent holder shall submit the Plan, and each annual review and update thereof, to the Peer Review Panel (as required by the Martha Extended Project) for its review. The consent holder shall then submit the peer reviewed Plan to the Waikato Regional Council for approval.

4.3 Implementation

The consent holder shall implement Part A of the approved Plan and shall implement Part B of the approved Plan in the event of closure occurring.

4.4 Rehabilitation Plans associated with the Martha Extended Project and Favona Mines

The Rehabilitation Plan may also include any other information that the consent holder wishes, and may be combined with the Rehabilitation Plan(s) associated with the Martha open pit and Favona underground mines.

Annual Work Programme

5. Prior to the exercise of this consent, and annually thereafter, the consent holder shall prepare and submit to the Waikato Regional Council an Annual Work Programme detailing the works proposed associated with the Trio Mine for the following twelve months.

The Annual Work Programme shall include the following:

- (i) Mining operations proposed for the following twelve months
- (ii) Description of the sequencing of works, and description of the environmental procedures to be adopted during construction and the maintenance and management of facilities.
- (iii) Proposed progressive rehabilitation and revegetation of the active areas of the mine operation.

The Annual Work Programme shall be forwarded in a form acceptable to the Council and may also include any other information that the consent holder wishes, and may be combined with any other document which the consent holder is required to produce.

Bond

6. Unless otherwise agreed in writing by the Councils, the consent holder shall provide and maintain in favour of the Councils a rehabilitation bond to:

- (i) secure compliance with the conditions of this consent and to enable any adverse effect on the environment resulting from the consent holder's activities and not authorised by a resource consent to be avoided, remedied, or mitigated;
- (ii) secure the completion of rehabilitation and closure of the activities authorised by this consent in accordance with the Rehabilitation Plan approved by the Councils;
- (iii) ensure the performance of any monitoring obligations of the consent holder under this consent.

6.1 The bond shall be in a form approved by the Councils and shall, subject to these conditions, be on the terms and conditions required by the Councils.

6.2 The bond shall provide that the consent holder remains liable under the Resource Management Act 1991 for any breach of the conditions of consent which occurs before expiry of this consent and for any adverse effects on the environment which become apparent during or after the expiry of the consent.

6.3 Unless the bond is a cash bond, the performance of all of the conditions of the bond shall be guaranteed by a guarantor acceptable to the Councils. The guarantor shall bind itself to pay for the carrying out and completion of any condition in the event of any default of the consent holder, or any occurrence of any adverse environmental effect requiring remedy.

- 6.4 The amount of the bond shall be fixed prior to the exercise of this consent or as otherwise agreed and thereafter at least annually by the Councils who shall take into account any calculations and other matters submitted by the consent holder which are relevant to the determination of the amount. The amount of the bond shall be advised in writing to the consent holder at least one month prior to the review date. The annual review of the Trio Underground Mine rehabilitation bond shall be undertaken concurrently with the annual reviews for the Martha Mine and the Favona Underground Mine while their bond requirements remain in force.
- 6.5 The amount of the bond shall include:
- (i) the estimated costs (including any contingencies necessary) of rehabilitation and closure in accordance with the conditions of this consent, on completion of the operations proposed for the next year;
 - (ii) any further sum which the Councils consider necessary to allow for remedying any adverse effect on the environment that may arise from the exercise of this consent;
 - (iii) the estimated costs of monitoring, in accordance with the monitoring conditions of this consent, until the consent expires; and
 - (iv) any further sum which the Councils consider necessary for monitoring any adverse effect on the environment that may arise from the exercise of this consent including monitoring anything which is done to avoid, remedy, or mitigate an adverse effect.
- 6.6 Should the consent holder not agree with the amount of the bond fixed by the Councils then the matter shall be referred to arbitration in accordance with the provisions of the Arbitration Act 1996. Arbitration shall be commenced by written notice by the consent holder to each of the Councils advising that the amount of the bond is disputed, such notice to be given by the consent holder within two weeks of notification of the amount of the rehabilitation bond. If the parties cannot agree upon an arbitrator within a week of receiving the notice from the consent holder, then an arbitrator shall be appointed by the President of the Institute of Professional Engineers of New Zealand. Such arbitrator shall give an award in writing within 30 days after his or her appointment, unless the consent holder and the Councils agree that time shall be extended. The parties shall bear their own costs in connection with the arbitration. In all other respects, the provisions of the Arbitration Act 1996 shall apply. Pending the outcome of that arbitration, and subject to condition 6.7, the existing bond shall continue in force. That sum shall be adjusted in accordance with the arbitration determination.
- 6.7 If, for any reason other than default of the Councils, the decision of the arbitrator is not made available by the 30th day referred to above, then the amount of the bond shall be the sum fixed by the Councils, until such time as the arbitrator does make his/her decision. At that stage the new amount shall apply. The consent holder shall not exercise this consent if the variation of the existing bond or new bond is not provided in accordance with this condition.
- 6.8 The bond may be varied, cancelled, or renewed at any time by agreement between the consent holder and the Councils provided that cancellation will not be agreed to unless a further or new bond acceptable to the Councils is available to replace immediately that which is to be cancelled (subject however to the condition below as to release of the bond on the completion of the rehabilitation).
- 6.9 The Councils shall release the bond on the completion of the rehabilitation. This means when the rehabilitation has been completed in accordance with the approved Rehabilitation Plan and demonstrated to be successful, to the satisfaction of the Councils
- 6.10 All costs relating to the bond shall be paid by the consent holder.

- 6.11 This consent shall not be exercised unless and until the consent holder provides the bond to the Councils.
- 6.12 These conditions form an integrated whole and are not severable.

Note: The bond covers only those elements of the Trio Underground Mine Project not already subject to the rehabilitation bond imposed by the land use and resource consents granted for the Martha Mine Extended Project, and Favona and Trio Development Underground Mine Projects.

Review

- 7 The Waikato Regional Council may within the six month period following the anniversary of the commencement of this consent and annually thereafter, serve notice on the consent holder under section 128 of the Resource Management Act 1991, of its intention to review the conditions of this resource consent for the following purposes:
- (i) to review the effectiveness of the conditions of this resource consent in avoiding, or mitigating, any adverse effects on the environment from the operation and, if considered appropriate by the Council, to avoid, remedy or mitigate such effects by way of further or amended conditions; and/or
 - (ii) if necessary and appropriate, in relation to discharges of contaminants, to require the holder of this resource consent to adopt the best practicable option to remove, or reduce, adverse effects on the environment resulting from the exercise of this consent; and/or
 - (iii) review the monitoring requirements in light of the results obtained from monitoring in preceding years

Costs associated with any review shall be borne by the consent holder.

Change to Consent

- 8 The consent holder may apply to the Council for a change or cancellation of any of the conditions of this consent in accordance with section 127 (1)(a) of the Resource Management Act 1991 at any time.

Administration

- 9 The consent holder shall pay to the Council any administrative charge fixed in accordance with section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with regulations made under section 360 of the Resource Management Act.

Resource Consent Certificate

Resource Consent: AUTH124859.01.02

File Number: 61 54 92A

Pursuant to the Resource Management Act 1991, the Waikato Regional Council hereby grants consent to:

Waihi Gold Company Limited
PO Box 190
Waihi 3641

(hereinafter referred to as the Consent Holder)

Consent Type: Discharge permit

Consent Subtype: Discharge to air

Activity authorised: Discharge contaminants into the air relating to all activities within the Golden Link Project Area. This includes dust and carbon dioxide arising from mining operations, emissions from the Process Plant including waste heat and water vapour, vehicle fumes, and other minor and/or fugitive emissions associated with mining operations; and within Area D only, smoke from burning of tramp material (including vegetation and surplus packaging)

Location: Golden Link Project Area Areas L and M and including areas A-K (as identified on Waihi Gold Company Plan No.T70725A dated 25 July 1997)

Spatial Reference: NZTM 1851702 E 5858472 N

Consent Duration: This consent shall commence on the date stated in condition 2 and expire twenty years from the date of commencement

Subject to the conditions overleaf:

General

1. This consent is subject to the conditions listed in Schedule One – General Conditions.
2. This consent shall commence on 16 July 2017.
3. If any non-compliance with the conditions of this consent occurs, the consent holder shall notify the Waikato Regional Council as soon as practicable and no later than 24 hours after the consent holder becomes aware that the event has occurred.
4. There shall be no particulate matter or gaseous emissions (including odour) in the discharge that gives rise to objectionable adverse effects (as defined in Section 6.4 of the Operative Waikato Regional Plan), at or beyond the boundary of the subject property.
5. Should a discharge occur that causes an objectionable adverse effect, the consent holder shall provide a written report to the Waikato Regional Council (the “**Council**”) within five days of being notified of such by the Council. The report shall specify:
 - (i) the cause or likely cause of the event and any factors that influenced its severity;
 - (ii) the nature and timing of any measures implemented by the consent holder to avoid, remedy or mitigate any adverse effects; and
 - (iii) the steps to be taken in future to prevent recurrence of similar events.
6. Vehicle wheel washing facilities shall be provided at the entrances to the mine site and waste disposal area. The wheel washing facilities shall be well maintained and shall be used by all vehicles exiting the site as required, to minimise the tracking of particulate matter off-site.
7. Access roads to the mine site and the waste disposal area (but excluding internal access roads) shall be bitumen sealed (or to an equivalent standard approved by Waikato Regional Council). Sealing shall take place as soon as practicable upon exercise of this consent and/or as part of any access road construction that is required. Sealed surfaces shall be kept as clean and free of accumulations of dust as practicable.
8. Stockpiles shall be managed to minimise particulate emissions from this source. Methods may include but are not limited to: covering, grassing, sheltering from prevailing winds, or wetting.
9. Exposed yard surfaces and roadways shall be kept damp as necessary to minimise particulate discharges to air, including during non-work hours.
10. No chemical dust suppressants or additives shall be used without prior written approval from the Waikato Regional Council.

Air Quality Management Plan

11. Prior to exercise of this consent, the consent holder shall prepare an Air Quality Management Plan and submit this to the Council for its written approval. The Plan shall, as a minimum, specifically include the following;
 - (i) Description of the air quality control objectives.
 - (ii) Details of the site operation and maintenance practices to be implemented to meet these objectives and the conditions of this consent, and to ensure that emissions from mining operations, particularly from stockpiles, unsealed roadways, the processing plant and Waste Disposal Area, and the ventilation shaft are minimized.

- (iii) Ambient air monitoring programmes for deposited particulate matter, total matter and PM₁₀ (particulate matter smaller than ten microns) and particle size distribution studies (including silica content).
- (iv) A programme to monitor emissions from the vent shaft.
- (v) Trigger levels for deposited particulate matter, total suspended particulate matter and PM₁₀ (particulate matter smaller than ten microns). When these are exceeded the consent holder shall investigate and report on the reason for the exceedence and identify corrective action to prevent a repeat occurrence, where possible.

The Waikato Regional Council may review these trigger levels pursuant to section 128(1)(a) only in the event that:

- The National Environmental Standards for Air Quality (as amended 2011) are amended; or
 - Relevant standards or regional guidelines are established or amended; or
 - A discharge authorised by this consent causes an objectionable or offensive effect (see condition 3 above).
- (vi) Procedures for the use of wheel washes to prevent dust tracking off-site.
 - (vii) Procedures for revegetation of benches and batters at the mine site, waste disposal area embankments, stockpiles and other bare surface areas as appropriate.
 - (viii) Details of the site operation and maintenance practices to be implemented, particularly in relation to the stockpiles, haul-ways, and access roads, to keep dust emissions to a minimum.

The Plan shall be consistent with report supplied as part of the application to the Waikato Regional Council entitled "*Air Quality Implications of Underground Mining in the Golden Link Project Area*" dated March 2012 prepared by Kevin Rolfe. The Plan shall provide details of monitoring to be undertaken including location, frequency and methodology of sampling and all analysis to be undertaken and the trigger levels with which the monitoring data will be assessed against.

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed by the consent holder and updated if necessary. Any updated Plan shall be promptly forwarded to the Council for approval and once approved the amended Plan shall be implemented in place of the previous version.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Air Quality Management Plan, then the conditions of this consent shall prevail.

Monitoring

12. The consent holder shall undertake monitoring of fine particulate and silica (or quartz) particle size distribution in accordance with the methodology defined in the Air Quality Management Plan, and shall report the results of such monitoring in writing to the Waikato Regional Council not less than once every two years, unless otherwise approved in writing by the Waikato Regional Council.
13. The consent holder shall, as a minimum, undertake monitoring in accordance with the methodology defined in the Air Quality Management Plan, prepared pursuant to condition 11 above.
14. The consent holder shall provide to the Council a written annual report each year that addresses at least the following:

- (i) A summary of the results of the monitoring required by this consent,
- (ii) Any environmentally important trends arising from the monitoring programme,
- (iii) Comment on compliance with all conditions,
- (iv) Any reasons for non-compliance or difficulties in achieving compliance with the conditions of this resource consent,
- (v) Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the up-coming year to improve environmental performance in relation to the activities included in this consent.

The report shall be forwarded in a format acceptable to the Council.

Complaints

15. If any complaints are received by the consent holder regarding dust, odour or other contaminants, the consent holder shall notify the Council of those complaints as soon as practicable. When/if complaints are received, the consent holder shall record the following details in a complaint log:

- (i) type and time of complaint;
- (ii) name and address of complainant (if available);
- (iii) location from which the complaint arose;
- (iv) wind direction at the time of complaint;
- (v) the likely cause of the complaint and any factors that influenced its severity;
- (vi) the response made by the consent holder; and
- (vii) action taken or proposed as a result of the complaint including the steps to be taken in future to prevent recurrence of similar events.

The complaint log shall be made available to the Council at all reasonable times and a copy shall be forwarded to the Council at six monthly intervals

*For and on behalf of the
Waikato Regional Council*



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Advice notes

1. This resource consent does not give any right of access over private or public property. Arrangements for access must be made between the consent holder and the property owner.
2. This resource consent is transferable to another owner or occupier of the land concerned, upon application, on the same conditions and for the same use as originally granted (s.134-137 RMA).
3. The consent holder may apply to change the conditions of the resource consent under s.127 RMA.
4. The reasonable costs incurred by Waikato Regional Council arising from supervision and monitoring of this/these consents will be charged to the consent holder. This may include but not be limited to routine inspection of the site by Waikato Regional Council officers or agents, liaison with the consent holder, responding to complaints or enquiries relating to the site, and review and assessment of compliance with the conditions of consents.
5. Note that pursuant to s333 of the RMA 1991, enforcement officers may at all reasonable times go onto the property that is the subject of this consent, for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
6. If you intend to replace this consent upon its expiry, please note that an application for a new consent made at least 6 months prior to this consent's expiry gives you the right to continue exercising this consent after it expires in the event that your application is not processed prior to this consent's expiry.

SCHEDULE ONE – GENERAL CONDITIONS

Resource consents **124859 - 124864 (inclusive)** are subject to the following general conditions, which are applicable to all consents.

General

1. Except as otherwise provided for by subsequent conditions of consent, all activities to which this consent relates shall be undertaken generally in accordance with the information contained in the document titled “**Golden Link Project including the Correnso Underground Mine: Application for WRC for resource consent and AEE Volumes 1 and 2**” dated June 2012 and the s92 further information recorded as documents 2214077, 2214082 and 2265673 on the Waikato Regional Council’s document system for the Golden Link Project.
2. The consent holder shall notify the Council in writing, at least two weeks in advance of the first exercise of this consent.

Annual Work Programme

3. The consent holder shall, within six months after the commencement of this consent and annually thereafter, prepare and submit to Council for information, an Annual Work Programme that outlines the anticipated activities to be performed during the following year and the management systems under which those activities will be undertaken. The Annual Work Programme shall include the following :
 - (i) Mining operations proposed for the forthcoming year.
 - (ii) Description of the sequencing of works, and description of the environmental procedures to be adopted during construction and the maintenance and management of facilities.
 - (iii) Proposed progressive rehabilitation and revegetation of the active areas of the mine operation.

The Annual Work Programme may also include any other information that the consent holder wishes, and may be combined with any other document which the consent holder is required to produce.

Liaison Officer

4. Within two weeks of the exercising of this consent, the consent holder shall appoint a person (the “Liaison Officer”), and any replacement person subject to the approval of the Hauraki District Council and the Waikato Regional Council (the “Councils”), to liaise between the consent holder, the community and the Councils. The Liaison Officer shall have sufficient delegated power to be able to deal immediately with complaints received and shall be required to investigate those complaints as soon as possible after receipt. The Liaison Officer shall be appointed for the duration of this consent. The name of the Liaison Officer together with the contact phone numbers for that person shall be publicly notified in local newspapers by the consent holder prior to the exercising of this consent and at least once a year thereafter.

Rehabilitation Plan

5. The consent holder shall prepare a Rehabilitation Plan covering all areas that may be affected by the construction and use of the workings associated with the underground mining within Area L of the Golden Link Project Area. This plan shall be submitted to the Waikato Regional Council and the Hauraki District Council (the “Councils”) for written approval prior to the exercise of this consent. The Plan shall set out details on backfilling and flooding the underground workings, backfilling the vent shaft and access decline, and removal of surface infrastructure. The consent holder may amend the Plan at any time. No amendments shall be made to the Plan without the written approval of the Councils.

Unless otherwise agreed in writing by the Councils, the consent holder shall undertake the rehabilitation works in accordance with the approved Rehabilitation Plan.

Bond

6. Unless otherwise agreed in writing by the Councils, the consent holder shall provide and maintain in favour of the Councils a rehabilitation bond to:
 - (ii) secure compliance with the conditions of this consent and to enable any adverse effect on the environment resulting from the consent holder's activities and not authorised by a resource consent to be avoided, remedied, or mitigated;
 - (iii) secure the completion of rehabilitation and closure of the activities authorised by this consent in accordance with the Rehabilitation Plan approved by the Councils;
 - (iv) ensure the performance of any monitoring obligations of the consent holder under this consent.
7. The bond shall be in a form approved by the Councils and shall, subject to these conditions, be on the terms and conditions required by the Councils.
8. The bond shall provide that the consent holder remains liable under the Resource Management Act 1991 for any breach of the conditions of consent which occurs before expiry of this consent and for any adverse effects on the environment which become apparent during or after the expiry of the consent.
9. Unless the bond is a cash bond, the performance of all of the conditions of the bond shall be guaranteed by a guarantor acceptable to the Councils. The guarantor shall bind itself to pay for the carrying out and completion of any condition in the event of any default of the consent holder, or any occurrence of any adverse environmental effect requiring remedy.
10. The amount of the bond shall be fixed prior to the exercise of this consent or as otherwise agreed and thereafter at least annually by the Councils who shall take into account any calculations and other matters submitted by the consent holder which are relevant to the determination of the amount. The amount of the bond shall be advised in writing to the consent holder at least one month prior to the review date.
11. The amount of the bond shall include:
 - (i) the estimated costs (including any contingencies necessary) of rehabilitation and closure in accordance with the conditions of this consent, on completion of the operations proposed for the next year;
 - (ii) any further sum which the Councils consider necessary to allow for remedying any adverse effect on the environment that may arise from the exercise of this consent;
 - (iii) the estimated costs of monitoring, in accordance with the monitoring conditions of this consent, until the consent expires; and
 - (iv) any further sum which the Councils consider necessary for monitoring any adverse effect on the environment that may arise from the exercise of this consent including monitoring anything which is done to avoid, remedy, or mitigate an adverse effect.
12. Should the consent holder not agree with the amount of the bond fixed by the Councils then the matter shall be referred to arbitration in accordance with the provisions of the Arbitration Act 1996. Arbitration shall be commenced by written notice by the consent holder to each of the Councils advising that the amount of the bond is disputed, such notice to be given by the consent holder within two weeks of notification of the amount of the rehabilitation bond. If the parties cannot agree upon an arbitrator within a week of receiving the notice from the consent holder, then an arbitrator shall be appointed by the President of the Institute of Professional Engineers of New Zealand. Such arbitrator shall give an award in writing within 30 days after his or her appointment, unless the consent holder and the Councils

agree that time shall be extended. The parties shall bear their own costs in connection with the arbitration. In all other respects, the provisions of the Arbitration Act 1996 shall apply. Pending the outcome of that arbitration, and subject to condition 8.8, the existing bond shall continue in force. That sum shall be adjusted in accordance with the arbitration determination.

13. If, for any reason other than default of the Councils, the decision of the arbitrator is not made available by the 30th day referred to above, then the amount of the bond shall be the sum fixed by the Councils, until such time as the arbitrator does make his/her decision. At that stage the new amount shall apply. The consent holder shall not exercise this consent if the variation of the existing bond or new bond is not provided in accordance with this condition.
14. The bond may be varied, cancelled, or renewed at any time by agreement between the consent holder and the Councils provided that cancellation will not be agreed to unless a further or new bond acceptable to the Councils is available to replace immediately that which is to be cancelled (subject however to the condition below as to release of the bond on the completion of the rehabilitation).
15. The Councils shall release the bond on the completion of the rehabilitation. This means when the rehabilitation has been completed in accordance with the approved Rehabilitation Plan and demonstrated to be successful, to the satisfaction of the Councils
16. All costs relating to the bond shall be paid by the consent holder.
17. This consent shall not be exercised unless and until the consent holder provides the bond to the Councils or provides such sureties as may be acceptable to the Councils until the bond is received.
Note: The bond covers only those elements of the Golden Link Project not already subject to the rehabilitation bond imposed by the land use consent and resource consents granted for the Martha Mine Extended Project and Favona and Trio Underground Mine Projects.
18. These conditions form an integrated whole and are not severable.

Review

19. The Waikato Regional Council may within the six month period following the anniversary of the commencement of this consent and annually thereafter, serve notice on the consent holder under section 128 of the Resource Management Act 1991, of its intention to review the conditions of this resource consent for the following purposes:
 - (i) to review the effectiveness of the conditions of this resource consent in avoiding, or mitigating, any adverse effects on the environment from the operation and, if considered appropriate by the Council, to avoid, remedy or mitigate such effects by way of further or amended conditions; and/or
 - (ii) if necessary and appropriate, in relation to discharges of contaminants, to require the holder of this resource consent to adopt the best practicable option to remove, or reduce, adverse effects on the environment resulting from the exercise of this consent; and/or
 - (iii) review the monitoring requirements in light of the results obtained from monitoring in preceding years

Costs associated with any review shall be borne by the consent holder.

Change to Consent

20. The consent holder may apply to the Council for a change or cancellation of any of the conditions of this consent in accordance with section 127 (1)(a) of the Resource Management Act 1991 at any time.

Administration

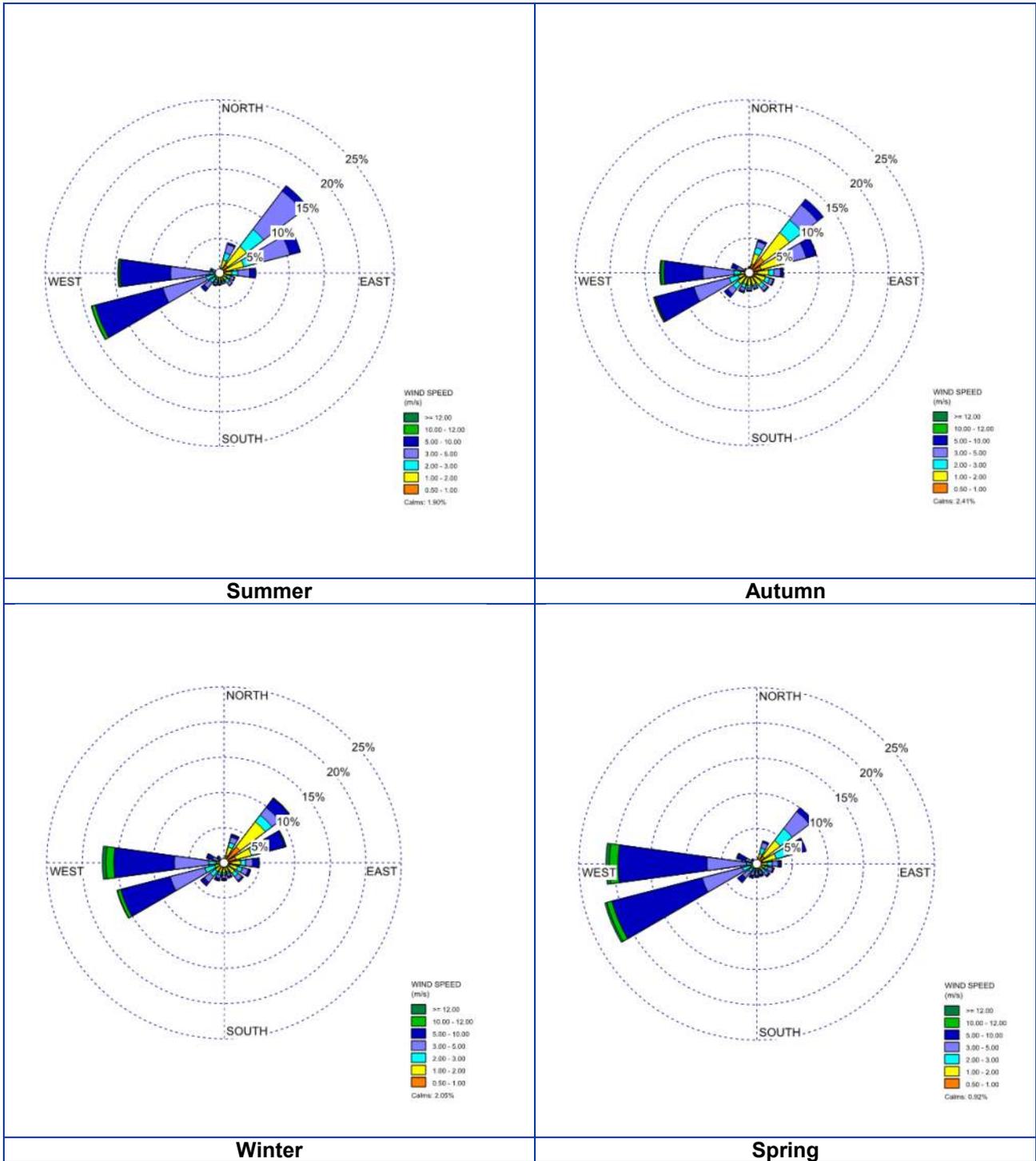
21. The consent holder shall pay to the Council any administrative charge fixed in accordance with section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with regulations made under section 360 of the Resource Management Act.

Appendix C

Seasonal Wind Roses



Seasonal Windroses



Appendix D

Dust Monitoring Results



Table D 1 Annual averages of monthly deposited dust monitoring data for each monitoring site (g/m²/30 days) (January 2000 – December 2017)

Year	6.59 (Torrens Alexander)	6.6 (Torrens Town End)	6.61 (Leaches Grey St)	6.63 (Met Station/Office)	6.70 (Smith)	6.71 (Morrison)	6.72 (Baxter Rd)	6.66 (College)
2000	0.8	0.5	0.6	1.5	1.6	2.1	0.9	0.6
2001	1.0	0.7	0.9	1.1	1.0	1.3	0.6	0.9
2002	1.1	1.2	1.6	1.2	1.0	1.3	1.2	0.9
2003	0.9	0.8	1.2	1.3	0.8	1.2	0.8	0.9
2004	0.7	0.7	0.9	1.1	0.9	1.2	1.0	0.7
2005	0.6	0.5	0.8	0.7	0.6	0.9	0.5	0.6
2006	0.6	1.0	0.6	1.0	0.7	0.9	0.4	0.6
2007	0.6	0.9	0.9	1.8	1.0	1.2	0.8	0.7
2008	0.7	0.7	1.1	1.2	0.8	1.0	0.7	0.7
2009	0.7	0.8	1.1	1.3	0.8	1.3	0.9	0.8
2010	0.9	1.0	1.2	1.8	1.1	1.2	0.9	0.8
2011	0.8	1.1	1.2	1.4	1.0	1.4	1.0	0.8
2012	0.9	1.0	1.3	1.7	0.9	1.1	1.0	0.9
2013	1.0	0.9	1.1	1.4	1.0	1.2	0.8	0.8
2014	0.9	0.8	1.2	1.1	1.0	1.1	0.7	0.7
2015	0.8	0.9	1.1	0.9	1.0	0.9	0.7	0.9
2016	1.2	1.0	1.1	0.9	0.9	0.9	0.7	0.8
2017	0.9	0.9	1.2	0.8	0.9	1.1	1.0	0.7

Table D2 Annual average TSP concentrations ($\mu\text{g}/\text{m}^3$) for each monitoring site (January 2005 – December 2017)

Year	6.61 (Grey Street)	6.63 (Met Station)	6.64 (Courthouse)	6.65 (Old House)	6.78 (Slevin St)	6.66 (College)
2005	10.4	12.0	23.6	15.4		
2006	9.6	22.6	15.9	11.1	13.8	6.7
2007	7.2	29.7	9.9	10.2	20.1	5.8
2008	11.9	23.4	8.9	7.2	15.1	6.0
2009	15.0	21.0	13.6	9.0	14.8	9.3
2010	15.8	15.0	13.7	7.5	15.0	13.1
2011	8.9	12.3	13.3	10.6	4.6	12.4
2012	16.7	12.8	10.7	9.8	12.8	12.5
2013	10.9	8.5	11.8	12.8	12.0	10.2
2014	18.6	15.5	15.0	14.7	18.6	13.7
2015	15.4	13.9	14.6	13.2	14.8	13.1
2016	11.6	13.7	11.6	11.3	10.2	14.8
2017	9.0	7.8	7.2	12.0	10.2	5.9

Appendix E

Results for Statistical Analysis of Dust Deposition Monitoring Data



A non-parametric Wilson Rank Sum test was carried out to determine whether there are any differences between the distribution of 7 day average TSP concentration data collected between Jan 2005 – April 2017 from the different monitoring locations. The P values were adjusted by the Holm method. Table C3 summarises the results of the test. P values lower than 0.05 are highlighted in blue. These values indicate that there is statistical evidence to indicate there is a difference between the TSP concentrations recorded at the two monitoring sites.

Table C4. P-values resulting from statistical analysis of 7 day average TSP concentrations data (Jan 2005-April 2017)

	Slevin Street 6.78	Met Station 6.63	Courthouse 6.64	Old house 6.65	College 6.66	Grey Street 6.61
Grey Street 6.61	0.2	0.0017	0.461	0.09	0.0017	-
College 6.66	1E-05	5.82E-10	0.0006	0.41	-	
Old House 6.65	0.0012	9.8E-08	0.009	-		
Courthouse 6.64	0.41	0.008	-			
Met Station 6.63	0.2	-				
Slevin Street 6.78	-					