



# Management Plan

## Air Quality (Martha, Favona, Trio & Correnso Mines)

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## 1. INTRODUCTION

OceanaGold (New Zealand) Ltd operates gold mines at Macraes and Waihi. This document describes the systems and procedures for air quality management at the company's Waihi operations (OGNZL). These relate to the Martha Open Pit, and the Favona, Trio & Correnso/SUPA Underground Mines and ensure that all operations are effectively monitored and managed, and that there are no objectionable adverse effects on air quality.

Emissions to air from the various mining activities are specifically covered by Resource Consents:

- Martha Mine; Resource Consent 971281, which was issued by the Waikato Regional Council (WRC) in March 1998. *(NB. This resource consent expired in 2017 and was superseded by Resource Consent 124859).*
- Favona Underground Mine; Resource Consent 109741.
- Trio Mine Development; Resource Consent 121447 *(NB: As Resource Consent 121697 supersedes this consent (and the two cannot be exercised together), this was surrendered in 2013).*
- Trio Underground Mine; Resource Consent 121697.
- Golden Link Project Area (Correnso/SUPA); Resource Consent 124859.

This Air Quality Management Plan ('Plan') is prepared to meet condition 6 of Resource Consent 109741, condition 6 of Resource Consent 121697 and condition 11 of Resource Consent 124859. Because the existing dust monitoring network provides data for ambient conditions (which includes the combined effects of Martha, Favona, Trio & Correnso/SUPA), this Plan is able to describe air quality management for all operations.

The Plan has developed over the years, with versions focused on the activities at the time. Early plans focused on the Martha Mine only. The 2006 Plan was a review of the Martha operation and a means of meeting the conditions prior to exercising the Favona Underground Mine consents. The 2010 Plan included requirements of the air discharge consent for the Trio Development Project, and the 2011 Plan met the requirements of the Trio Underground Mine consents. This revision is to comply with the required biennial review and to incorporate the requirements for the Correnso and SUPA Mines.

## 2. LEGAL REQUIREMENTS

The relevant conditions of the Air Discharge Consents for Martha, Favona, Trio, and Correnso are attached as Appendix A. While there are some differences in the consent conditions between the various mining operations, fundamentally the conditions require the following:

- No objectionable effects of particulate matter beyond the site boundary,
- WRC notification as soon as possible when a non-compliance occurs,
- Vehicle washing facilities, sealing of roads, stockpile management to minimize particulate emissions, dampening of roadways and yards as necessary,
- Development of an Air Quality Management Plan to detail air quality management objectives, the measures to be taken to meet those objectives, and air quality monitoring programmes including trigger levels for dust,
- Annual reporting, and,
- Complaints management.

This Plan is also prepared to comply with OceanaGold's Technical Standards (Appendix E), which also emphasises compliance with legal requirements.

### **3. AIR QUALITY ASPECTS**

#### **3.1 Waihi Operations**

##### **Martha**

The Martha Mine is an open pit operation that commenced construction in 1987. Mining at Martha was planned to cease in 2010, however mining was extended for an additional 5 years to complete the Eastern Layback Project. During this project, in April 2015, a slip on the north wall triggered the suspension of mining. In January 2016, limited excavation recommenced in order to gain access for further investigation, but this was also suspended when a larger slip compromised further work in April 2016. Following further investigation, a remedial cutback was initiated aimed at unloading the crest area. Continuous air quality monitoring has been ongoing throughout this period.

##### **Favona**

The Favona Underground ore bodies are located north and east of the existing processing plant. Site preparation works were conducted from late 2004, with the subsequent construction of the Favona Exploration Decline in 2005. The placement of potentially acid forming (PAF) material on the polishing pond stockpile in 2006 marked the first exercise of the Favona Underground Mine consents. Mining of Favona has now been effectively completed.

##### **Trio**

The Trio Underground Mine commenced production in June 2012, and was the main focus of production for two years before effectively concluding production mining in 2014. Potential remains for further mining, but this depends on groundwater management and the overall mining sequence of other operations.

##### **Correnso/SUPA**

The Correnso Underground Mine project began late 2013. Depending on the extent of the underground mine, two developments may be undertaken that have distinct air quality considerations in addition to the current Underground operation:

- If the underground works extend beyond the effective ventilation of the Trio ventilation shaft, another ventilation shaft may need to be constructed within the noise bund of the open pit.
- If mining seeks to exploit the uppermost zones of the ore body, cement aggregate fill (CAF) may be utilised to provide effective backfilling.

Although consents for the additional ventilation shaft and the CAF plant have been obtained, the current Correnso mining plans do not require their construction. If Correnso mining plans progress to a stage where either is required, this Plan will be revised and the air quality implications evaluated and addressed.

SUPA is an extension of Correnso towards the west. As the work utilises the Correnso infrastructure (ventilation and vehicle fleet) and there is no increase in mining rate, no significant change to air discharges were involved in the SUPA project.

##### **MDDP**

The Martha Drill Drive Project branches off the SUPA project and extends under the south wall of the Martha Pit. There is consideration to break into the open pit for ventilation, but if this happens the breakthrough will be an intake and the air flow will be into the workings. Discharge from all underground workings will continue to discharge from the Union Hill vent shaft.

## **3.2 Mining Activities**

As a consequence of mining, dust can be produced from drilling, blasting, ripping, grading, loading, haulage, tipping, crushing, conveying, and general vehicle movements. Dust can also be generated from exposed areas and stockpiles. Other mining air emissions include combustion gases (carbon monoxide and dioxide, nitrogen oxides and sulphur dioxide), directly from blasting and via exhaust emissions from machinery. Appendix B contains further information on air pollutants and their effects.

The nature of underground mining is such that the off-site air quality implications are less than for open-cast mining. Emissions produced underground are not subject to the vagaries of the weather and are exhausted through the ventilation shaft. Other emissions relating to underground mining are from short-haul stockpiling activities near the portal.

Near-mine exploration will be ongoing while the current mining continues. Should any nearby ore body be proven viable, extensions to the open pit and/or underground operations are likely to be pursued. If an extension to mining is pursued, this Plan will be reviewed to determine if any changes to effects or monitoring need to be captured and the Plan updated if necessary.

## **3.3 Waste Rock Embankment Operations**

Waste rock from Martha mining is used to construct the Tailings Storage Facilities (TSFs). Complaints arising from this activity are less frequent than pit activities due to the rural location of the TSFs, but the elevated and exposed nature of the TSFs bring other considerations. The TSFs are highly visible to the surrounding land and vigilance is still necessary, particularly in the drier summer months and especially in windy conditions. Lime being broadcast on potentially acid forming waste rock used in the TSFs construction is sometimes misconstrued as haul road dust.

Topsoil stripped from the footprints of the TSFs and waste rock stockpiles has been stockpiled, shaped and revegetated. These topsoil stockpiles do not pose any air quality issues while they are in this state, but care is required when they are re-handled for rehabilitation.

## **3.4 Milling Operations**

Areas north and east of the processing plant are utilised for stockpiling areas in preparation for milling and backfilling. Separate stockpiles are required for each source as they require different treatments to optimise gold recovery and are therefore processed in campaigns. Currently there is no Martha ore stockpile. A waste stockpile is maintained for backfilling the underground workings. As with other active stockpile on site, these stockpiles have the potential to generate dust (especially in dry, windy conditions).

Another source of dust is from the lime silos located over the conveyor lines to feed the SAG mill and TSF Waste Loadout. In practice, dust from the lime silos has not caused complaints from off site.

Other potential emissions include cyanide gas from the leach tanks and CN dust from its infrequent use in solid form at the CN storage and mixing facility in the processing plant. Cyanide is toxic to humans in both the gaseous and particulate forms.

Fine particulates from the carbon regeneration and gold room furnaces may occur. However particulate emission tests show the effects to be insignificant off site.

## **3.5 Drilling/Exploration Activities**

Drilling occurs in and around the Waihi District, generally under contract, for geotechnical purposes and for exploration to extend operations. Complaints about air emissions from exploration are rare as only diamond drilling is undertaken in residential areas and such drilling utilises fluid lubrication. Reverse Circulation (RC) drilling is used for less than 10% of exploration

drilling, uses bag filters on its cyclone for dust suppression, and is restricted to areas further from residences due to the noise it generates.

### **3.6 Controlled Burns**

Burning of waste materials is conducted in four main activity areas:

- Green-waste stockpiled at Baxter Road tramp disposal area.
- In-situ vegetation stockpiles in areas where land has been cleared in preparation for site development or amenity area development.
- Tramp waste on the Northern Stockpile area.
- Destruction of hazardous goods packaging (wooden pallets and packaging and plastic liners) on the Northern Stockpile area.
- Occasional burning of demolition material.

When a controlled season is in force, all burning is subject to fire permits. Standard fire permit conditions include:

- No person shall burn, or permit or suffer to be burnt, any matter or thing in such a manner as to be offensive.
- Notify neighbours if a burn is in town or near their residence.

### **3.7 Ventilation Shafts**

The Underground Mines have two ventilation shafts; the Favona shaft adjacent to the ore stockpiles at the processing plant, and the Trio shaft situated within regenerating forest on the western side of Union Hill. Only the Trio shaft has operational vent fans (the Favona shaft has had its fans removed and acts as a minor air inlet).

Ventilation fans draw stale air out of the Underground workings via the Union Hill shaft and fresh air into the mine via the portal or the Favona shaft. In practice, the portal is the main source of fresh air, with the Favona vent opened only slightly to facilitate air flow to specific parts of the Underground. Fresh air drawn around the Underground is blown into mining headings to ensure safe working conditions at the faces.

Air emissions from the Correnso & Trio Underground Mines are discharged from the Trio ventilation shaft, at a rate of 215 m<sup>3</sup>/sec. The Trio shaft exhausts waste products resulting from mining activities, including dust generated from rock handling and the combustion residues from diesel machinery exhausts and blasting (i.e. particulate, carbon monoxide, oxides of nitrogen, oxides of sulphur, and hydrogen sulphide).

## **4. AIR QUALITY CONTROL OBJECTIVES**

The air quality control objectives are:

- To mitigate dust emissions from all operations.
- Ensure compliance with resource consents, including maintaining the air quality monitoring programme.
- To manage point and non-point source air emissions to be protective of human health and the environment.
- To monitor areas of community concern.
- To ensure that other emissions are within Workplace Exposure Standards and are not objectionable or offensive.
- To respond promptly to complaints and non-compliances and to communicate mitigating actions taken.
- To continue to identify best practicable options, and investigate and trial new methods, products and technologies to minimize and mitigate effects.

## **5. AIR QUALITY MANAGEMENT**

### **5.1 Responsibilities**

The General Manager is responsible to ensure legal and other requirements in this Plan are fulfilled. Department Managers and Supervisors are responsible for ensuring that emission controls are maintained and utilised, and maintenance procedures and conditions of contracts with air quality implications are supervised and enforced.

The Environmental Manager ensures:

- fulfilment of all monitoring and reporting requirements under the consents and this Plan,
- that the Plan is reviewed every two years,
- that air management programmes identified in this Plan are developed, implemented and maintained where appropriate, and,
- that mitigation actions are identified and communicated where necessary.

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

The contracts between OGNZL and its contractors require operations to be carried out in compliance with all regulatory authorisations as they relate to the operation. Contractors are subject to a "Pre-Qualification Assessment" to ensure they have effective environmental and external relations procedures. Contracts with OGNZL contain "Special Conditions for Environmental Protection and External Relations Procedures" which includes reference to consents that the contractors must comply with. The OGNZL Site Services Manager has delegated responsibility for overseeing any surface contractors and ensuring compliance with regulatory requirements.

### **5.2 Emission Control and Maintenance Procedures**

#### **5.2.1 Dust**

##### **5.2.1.1 General**

The following methods are, and will continue to be, used for dust control on site:

- Water tanker vehicles are used on a regular basis when necessary for dampening down active operational areas around the pit, stockpiles, the processing plant and waste disposal areas. Fine material generated by road construction and haulage is kept damp.
- Wheel wash facilities to prevent mud being tracked off site are located at both the pit and waste disposal areas. Where vehicles have driven through muddy areas, drivers are required to use the wheel washing facilities before leaving the site.
- Dust collectors and bag filters are used on RC exploration rigs and the blast hole drill rigs in the open pit. Diamond drilling is more common for exploration drilling; this utilises fluid lubrication and produces negligible dust.
- Modern blasting techniques limit dust generation in the open pit, e.g. good quality 'stemming' of blast holes to prevent excessive fly-rock, gas and dust generation from the blast holes. The relatively small size of open pit blasts also mitigates air emissions.
- Irrigation sprays are used when necessary at jaw crushers and conveyor transfer points. Conveyors in exposed locations are roofed which reduces drying effects and exposure to gusts.
- Open pit stockpiles are maintained at heights below the level of the perimeter fence around the pit rim.
- Hydroseeding and selective planting of exposed areas of the upper open pit batters and benches (i.e. above the eventual lake level) has been carried out, with maintenance and enhancement ongoing. Trials are ongoing to determine the best

species/maintenance regime to keep a sustainable vegetative cover. Public walking tracks around the pit rim have been gravelled.

- Rehabilitation of final batters at the waste disposal site and long-term stockpiles is undertaken as soon as surfaces are available and weather is appropriate. (*Revegetation in the pit and on the waste disposal site is more fully detailed in the Rehabilitation & Closure Plan, which is updated annually*).
- Screens and fences are used to prevent wind-blow in dust prone areas (e.g. lime silos).
- Water carts and sprayers are used where necessary underground to maintain the roads in a wet condition, and muck piles are watered down with hoses prior to placing the material into trucks.
- Conservative speed limits reduce dust disturbance from passing vehicles. The most commonly used access roads have been sealed.
- OGNZL has trialled approved surface binding agents for dust control and will utilise new technologies where they are successful, cost effective and authorised by WRC.

#### **5.2.1.2 Drilling**

For exploration drilling, diamond drilling or RC drilling is used. Diamond drilling utilises fluid lubrication and produces negligible dust. For RC drilling, a bag filter on the cyclone separation system is used for dust suppression.

#### **5.2.1.3 Stockpile Management**

Material being conveyed is kept damp by the sprayers in the crushers and transfer stations; this reduces dust generation during transport and when being discharged onto stockpiles. Agricultural irrigation sprays can be used on stockpiles around the mill during the summertime when dust is more of an issue. Grassing of long term stockpiles (e.g. topsoil) is also be carried out where possible; this includes the topsoil stockpile that was relocated alongside Bulltown Rd in 2017 as part of the North Wall Remedial Cut.

The large stockpile containing unsuitables from the Pumphouse relocation project was formed up and revegetated as a noise bund for the stability cutback. It is envisaged that it may be removed in the future so that the material can be used for final rehabilitation. Excavated unsuitable material associated with the Martha East Layback has also been placed in the Brickfield Rd subsidence area and revegetated. Some of this material has been used for pit rehabilitation & landscaping, with the likelihood for more use in the future.

### **5.2.2 Blasting Emissions**

In addition to dust emissions, blasting results in the emissions of gases. These include carbon monoxide, nitrogen oxides, and sulphur compounds (such as sulphur dioxide). OGNZL requires contractors to use good international practice to minimise potential impacts of blasting. The primary explosive used, ANFO emulsion (ammonium nitrate, fuel oil/diesel and emulsifiers), produces relatively low emissions of those gases. Diesel, which has lower sulphur content than fuel oil and produces less sulphur emissions, is favoured in the open pit and underground.

Management of the effects from blasting in the open pit and underground is reviewed by OGNZL daily. Pending blasts are discussed and consideration given to the likely effects on nearby residents. Adverse weather conditions, and sleeping shots (where explosives have been in the ground overnight and tend to give off more fumes when fired) may require liaison with any concerned residents.

### **5.2.3 Cyanide Emissions**

#### **5.2.3.1 Particulate Emissions.**

Solid cyanide is predominantly transported to site in Isotainers™. It is mixed into solution in the transport container at site, thereby reducing the opportunity for airborne emissions - i.e. a water scrubber is not required for isotainer deliveries.

Previously, sodium cyanide was primarily brought on to the site in the form of bags of briquettes. With this process, some dust is emitted during the debagging process, as the briquettes are added to water in a mixing tank. These emissions are controlled with a water scrubber. This system is now only utilised as a backup when Isotainer deliveries are delayed and accounts for less than 5% of the site cyanide input.

#### **5.2.3.2 Performance Testing and Maintenance.**

Emissions from the venturi scrubber were previously tested once a year to confirm satisfactory performance. Because the use of the debagging plant is now infrequent, and the low results of emission tests, approval was received from Environment Waikato (now WRC) in 2002 to discontinue the emission testing at the debagging plant (unless OGNZL goes back to the dry bag method of delivery on a routine basis).

#### **5.2.3.3 Cyanide Vapour Emissions.**

Hydrogen cyanide emissions from the leaching process and any downstream liquid wastes are not significant. Significant emissions would only occur if the pH of the liquid drops below 7. Lime is added to the ore prior to crushing, and the process is strictly controlled to maintain a pH of above 10, with probes set to trigger an alarm if the pH drops below this level.

Management of pH levels and monitoring for hydrogen cyanide gas is primarily undertaken for worker safety (refer Sections 6.4 and 6.5 for monitoring procedures). Cyanide vapour emissions off site are negligible as a consequence of this at-source management.

#### **5.2.4 Other Mill Emissions**

Within the mill area, specific processes are subject to air emission treatment measures. These measures are predominantly for the protection of employees, with limits set by the Department of Labour's Workplace Exposure Standards, but the effect is that emission levels off-site are also well below any unsafe levels. These processes include:

- Fumes from above the drying ovens (which may contain elevated metals) are drawn through a water scrubber prior to discharge to air.
- A scrubber around the hydrochloric acid delivery area draws air through a lime filter, which effectively neutralises acid fumes.

#### **5.2.5 Vehicle Emissions**

Regular inspection, maintenance and tuning of all vehicles used on site ensures that vehicle emissions are kept to a minimum. This is in the best interests of both OGNZL and contractors as efficient engines prolong vehicle life and minimise fuel costs. Thiess operate a comprehensive maintenance programme to ensure that all mobile equipment and light vehicles are serviced as required. OGNZL has a contract with Goldfields Automotive to service its mobile equipment and light vehicles.

### **6. AIR QUALITY MONITORING**

OGNZL carries out, and will continue to carry out, various air monitoring related activities as follows:

- continuous total suspended particulate and deposited particulate dust monitoring at a network of sites around the operation
- measurements of cyanide gas concentrations in the air at the treatment plant
- personnel monitoring for worker exposure to air emissions
- pH monitoring of tailings which provides a measure of cyanide emissions
- a register of all complaints regarding air quality (and other environmental matters)

- visual monitoring of vehicle emissions and scheduled servicing to ensure emissions are within acceptable levels
- occasional testing of particulate emissions from the carbon regeneration furnace and gases from the gold room stack
- meteorological data, including wind speed and direction, rainfall, temperature, solar radiation, relative humidity and evaporation.

Information on each of the monitoring programmes is given below.

## 6.1 Particulate Monitoring

Appendix C shows the locations of the dust monitoring sites. The OGNZL dust monitoring programme is one of the most extensive dust monitoring programmes in New Zealand, and it provides an excellent record of air quality data collected over more than 20 years.

The dust monitoring programme complies with the requirements of the Discharge to Air Consent (Consent # 971281) for Martha operations. Because this consent included emissions monitoring from the mill and tailings facilities, the existing monitoring sites also cover the requirements for the Discharge to Air Consents for the Favona, Trio & Correnso Mines.

There are two types of dust measurement in OGNZL's continuous dust monitoring programme – total suspended particulate (TSP) and deposited particulate (DP). TSP is determined by drawing a measured volume of air through a filter and then weighing the dust collected over seven days. DP is measured by means of a special funnel over a collection bucket which simply collects the dust settling on a fixed surface area over a month.

A number of procedures are used to ensure the quality of the dust monitoring programme. Some of these, such as equipment set-up and data checking, are an integral part of the routine activities and standardised through regularly updated SOPs. Other "external" procedures are used to ensure the overall quality of the work:

- |                                  |  |
|----------------------------------|--|
| • Air volume meter calibrations: | All gas meters are calibrated annually   |
| • Balance calibrations:          | Laboratory balances used for weighing filters are calibrated and checked annually  |
| • Procedure reviews:             | General review of laboratory and field procedures is carried out from time to time to ensure that the recommended methods are being followed correctly |

The Environmental Manager is responsible for ensuring the above checks are undertaken. Records are kept of calibrations and reviews.

In addition to the OGNZL network, dust monitoring sites were installed at Katikati and Paeroa in 1995 to collect data from nearby towns without mines. These control sites were decommissioned in August 2006 with the approval of Environment Waikato after providing consistent results for comparison with the OGNZL data. In mid-2012 TSP and DP monitoring stations were re-instated at new locations in Katikati and Paeroa as a discretionary activity to gather further regional information. The sites were decommissioned in September 2013.

In late 2016, issues were identified with two of the network's air quality monitors (Rolfe, 2017).

- The 'Old House' TSP monitor (TSP6.65) was mounted on top of a garage roof, with unsatisfactory access, and had become progressively more overshadowed by large trees. A nearby location was identified that provided safe access, an open location and more representative sample inlet height. With WRC acceptance of OGNZL rationale, this monitor was relocated in March 2017.
- The 'Smith' DP monitor (DP6.70) is located east of the Tailings Storage Facility (TSF) on a hillside alongside a farm track that is slippery in wet weather and dusty in dry conditions. A proposed alternate location nearer to the TSF was identified, on flat ground with safe

access and no tracks alongside. With WRC acknowledgement, parallel monitoring was established in late 2016 to determine if dust levels at the alternate location was not significantly different. After 11 month's results, the alternate location returned levels (average 30.1, min 7.3, max 74.4 mg/m<sup>2</sup>/d) very comparable to the original location (average 32.3, min 7.4, max 59.2 mg/m<sup>2</sup>/d). With the approval of this Plan, the original DP6.70 monitoring location will be discontinued.

### **6.1.1 Limits and Trigger Levels**

The results of the ambient air monitoring are compared with the following levels:

Total Suspended Particulate (TSP):

- OGNZL trigger level, 45 µg/m<sup>3</sup>, averaged over seven days.
- MfE recommended trigger level (or control limit) of 80 µg/m<sup>3</sup> (24-hour average).

Deposited Particulate (DP):

- OGNZL trigger level, 4 g/m<sup>2</sup>/month, averaged over one month, (equivalent to 133 mg/m<sup>2</sup>/day [for a 30-day month]).
- MfE recommended trigger limit of 4 g/m<sup>2</sup>/30 days (above background concentrations).
- .

When internal trigger levels are exceeded, OGNZL investigates and reports on the reason for the exceedance and, where appropriate, identifies corrective actions to prevent a recurrence. This provides for intervening action to avoid a breach of the higher externally recognised limits.

There are no National Environmental Standards for TSP or DP. It is noted that the MfE recommends a TSP trigger level (or control limit) of 80 µg/m<sup>3</sup> (24-hour average) be applied to individual dust sources in sensitive (residential) areas (MfE 2001). Irrespective of the control limit, OGNZL's trigger limit of 45 µg/m<sup>3</sup> (averaged over seven days, and inclusive of background levels) is proposed to be maintained as the primary indicator of an air quality issue. This level has only been exceeded twice in the last five years; the highest being 46.2 µg/m<sup>3</sup>. Exceedances of the trigger are investigated and reported in Annual Air Quality Monitoring Report. This provides an interim level to investigate air quality issues well before the MfE recommended limit is threatened.

In a similar way, OGNZL has been conservatively recognising the MfE recommended trigger limit of 4 g/m<sup>2</sup>/30 days and not factoring in background levels. No changes to the trigger levels or limits for DP are proposed.

## **6.2 Personnel Exposure Monitoring**

OGNZL has an annual monitoring programme that assesses the occupational health work environmental exposures to workers during the course of their daily work. Lapel-mounted samplers are attached to mining personnel (including contractors) with various air pumps, heads and filters. Work roles are divided into similar exposure groups and samples are taken based on the hazards associated with a particular group which include:

- Respirable dust and quartz
- Inhalable metals (welders and gold room smelters only)
- Diesel particulates (underground personnel only)
- Volatile organic compounds (conveyor belt maintenance only)

Health and Safety personnel oversee the monitoring of personnel and ensure the results are recorded into the site's InHealth database. Individual sample results are discussed with each employee. At the end of each year the sample results are reviewed and reported to site. Upon

review of this data, the annual personnel sampling schedule is created and the Significant Exposure Reduction plan is updated.

### **6.3 Cyanide Particulate Emission Testing**

Condition 11 of the Discharges to Air Consent required annual testing of the emissions of particulate cyanide from the scrubber fitted to the debagging unit on the Process Plant. The tests were arranged by the Mill Manager, in about August of each year. With the majority of the sodium cyanide now mixed in isotainers (as described in section 4.3.3), this requirement has become superfluous and the emission testing has been discontinued with the agreement of WRC. If the dry bag method of unloading is again used on a regular basis, the annual testing of particulate emissions will be reinstated.

### **6.4 Cyanide Concentrations in Air (Processing Plant)**

Monitoring for cyanide gas at the processing plant consists of several systems, with a high degree of replication and reassurance:

- Fixed cyanide (HCN) gas monitors take measurements continuously in the following locations: SAG Mill discharge, Ball Mill feed, Ball Mill discharge, Thickener overflow, 10" cyclones, Leach Tank 1A, Cyanide Mixing Shed, Elution Area, and the Gold Room.
- Manual samples are taken twice per 12-hour shift at the following locations; Cyanide Mixing Shed, Tails pumps, the top and bottom of the Elution Area, and at Leach Tanks 1A, 5 and 11. All readings are recorded on a log sheet.
- Three mill operators wear personal monitors for HCN during the course of their shifts.

The electronic monitors are calibrated six-monthly by OEM (Drager) representatives and are fitted with electronic alarms. A first audible alarm triggers at 4.7ppm HCN and a second audible alarm at 10ppm HCN. While these levels are to mitigate exposures within the workplace, it also ensures on-site management is such that cyanide gas levels off-site are well below any unsafe levels.

Further details about cyanide gas management are also included in the OGNZL Cyanide Management Plan (WAI-451-PLN-002).

### **6.5 Cyanide in Tailings**

The determination and control of cyanide in process solutions is an automated process undertaken using a cyanide analyser which controls the concentration of free cyanide in the leach tanks to a predetermined set-point.

In addition to this automated control, process operators take samples every two hours from the Leach and CIP tanks, determining pH and free cyanide, and recording the data in a log sheet.

### **6.6 Carbon Regeneration Furnace**

Particulate emission tests were carried out, approximately annually, on the Carbon Regeneration Furnace. This is not a specific requirement of the current air emissions consent, but was a condition of previous statutory requirements. Due to the low particulate emissions from the Carbon Regeneration Furnace, this monitoring has now ceased. Particulate monitoring is still conducted on a regular basis in relation to health and safety.

### **6.7 Complaints Register**

OGNZL maintains a register of complaints regarding environmental matters, and has done so since 1987. The register is held by the Company Liaison Officer, who is responsible for responding to complaints, and it gives details of each complaint received by the company and

any follow up action. Summaries of the air quality related complaints are included in the Annual Air Monitoring Reports and six-monthly complaint reports to WRC and Hauraki District Council.

## **6.8 Vehicle Exhaust Gases**

The impact of vehicle exhaust gases such as carbon monoxide, sulphur dioxide and the oxides of nitrogen were monitored at Martha mine in 1993. The measurements were made using continuous analysers, and results showed only minimal impacts from vehicle movements associated with the mine operations, with most results well below relevant air quality guidelines. No future measurements are proposed but, if required, would be carried out using comparable techniques.

OGNZL requires that its vehicles, and those of contractors, are maintained to a prescribed schedule and standard. Audits are undertaken to ensure this happens. This ensures that machinery is kept in efficient running order which also mitigates excessive exhaust gases.

## **6.9 Particle Size and Quartz Analysis**

Condition 12 of the Discharge to Air Consent for Martha operations (971281) requires the consent holder to undertake fine particulate and silica (or quartz) particle size distribution in accordance with the methodology defined in the Air Quality Management Plan, and reporting such monitoring in writing to WRC not less than once every two years.

A review of monitoring results indicated limited value in continuing with PM10 and Silica monitoring, based on years of compliant monitoring by both OGNZL and WRC, ongoing TSP and DP monitoring, and the limited dust generating activities in the pit at the time. In December 2015, OGNZL requested from WRC permission to suspend PM10 and Silica monitoring, and a response from WRC granted permission to suspend monitoring pending significant changes in potential dust generating activities.

At the time of writing, no significant new dust sources are foreseen for the pit activities. The re-entry activities are small scale (using relatively few machines, small blasts and light trucks) and all resource exploration is planned to be diamond drilling which generates minimal dust.

Both DP and TSP monitoring will continue unchanged, and it is expected that any issue with PM10 or silica is likely to be indicated by an increase in the coarser dust fractions. In addition, personnel monitoring for respirable dust (effectively PM10) and silica will also indicate if there is any reason for concern.

## **6.10 Ventilation Shaft**

Monitoring the emissions from the underground ventilation shaft was recommended by the report entitled "Favona Underground Mine, Waihi, Report to: Environment Waikato – Assessment of Air Quality Aspects" (dated October 2003) and is a requirement of Condition 6(c) of the Favona Discharge to Air Consent. In August 2007, Watercare Services Ltd conducted emission testing on the Favona ventilation shaft during blasting operations. Samples were tested for particulate emissions, carbon monoxide, nitrogen dioxide and nitric oxide. A report describing the results was prepared by Watercare and forwarded to WRC.

The results of this testing are considered representative of shaft emissions during routine blasting activities (which is when air emissions are likely to be worst). Unless there is a significant change to operational procedures (e.g. explosive type), or as directed by WRC, no further monitoring of vent emissions is proposed.

## **6.11 Meteorological Data**

In conjunction with the various specific air quality monitoring programmes, OGNZL also maintains a comprehensive weather station near the Martha Pit. This station monitors wind (speed, direction and gusts), air temperature, rainfall, humidity and solar radiation.

## **6.12 Other Monitoring**

### **6.12.1 Favona Real-Time Monitoring**

Although real-time monitoring continues to be undertaken in relation to general mining activities (as discussed in Section 6.9), OGNZL has not initiated recognised real-time monitoring of air quality specifically in relation to Favona mining activities. OGNZL contends that other air quality monitoring to date (refer Sections 6.1, 6.9, and 6.10) provides enough support to conclude that emissions specifically from Favona have not generated sufficient additional emissions to warrant a more intensive real-time monitoring programme. Also, given that there is now negligible mining activity in vicinity of the Favona Vent Shaft, real-time monitoring in respect to Favona is considered unnecessary.

Following review of the 2011 Air Quality Management Plan, WRC advised that real time monitoring of air quality in relation to the Favona mining activities is not required, but that this position will be reassessed at the 2013 review of the air quality management plan. The need for real-time monitoring was reassessed in the 2013 and 2016 reviews of the air quality management plan with conclusions that “emissions specifically from Favona have not generated additional emissions to require intensive real-time monitoring.

Regardless of whether real-time monitoring will be required or not, OGNZL will continue to carry out monitoring of total suspended particulate and deposited particulate throughout the life of the mining operations, including that of Favona, Trio & Correnso/SUPA Mines.

### **6.12.2 Gold Room Stack Emission Testing**

In order to quantify emissions for the purposes of internal and corporate reporting, and to ensure workplace safety, occasional testing of specific emission sources is undertaken. On 13 December 2011, Watercare Services Ltd conducted emission testing on the gold room stack during a period of smelting, the time when emissions would be expected to be highest. Samples were tested for 20 selected metals.

Although the emissions data was for internal reporting purposes, comparison was also made with the Department of Health’s Workplace Exposure Standards. Emission levels for all the metals tested were less than the specified standards.

## **7. REPORTING**

Data from monitoring is kept in a database, and reviewed against applicable trigger levels and consent limits as it is entered. OGNZL will notify WRC as soon as practicable upon becoming aware of any non-compliance.

Results from the air monitoring programme and other air quality matters are summarised in Annual Air Quality Monitoring Reports prepared by OGNZL and submitted to WRC. The requirement for the annual reports is specified in condition 13 of the Discharge to Air Consent for Martha operations, condition 8 of Discharge to Air Consent for the Favona Underground Mine, condition 8 of Discharge to Air Consent for the Trio Underground Mine and condition 14 of Discharge to Air Consent for the Golden Link Project Area (Correnso).

The reports summarise all relevant air quality information for the previous calendar year, including the results of the monitoring as required by the consents, any environmentally important trends arising from the monitoring programme, comment on compliance with all conditions, any reasons for non-compliance or difficulties in achieving compliance with the conditions of the resource

consents, and any works that have been undertaken (or that are proposed to be undertaken) to improve air quality performance.

In addition to the Annual Air Monitoring Reports, reports on discrete monitoring projects as required by the consents are submitted to WRC as they are completed.

## **8. REVIEW**

The contents of this Plan shall be reviewed and updated at least once every two years to ensure that the material continues to be relevant and up to date. The updated Plan is forwarded to WRC for approval.

Notwithstanding scheduled reviews, significant 'change management' may necessitate a review of the Plan to acknowledge impacts on air quality. The change management process requires an assessment of impacts and implications relating to air quality.

The next review will be in 2019, or earlier if significant changes are proposed.

## **9. REFERENCES**

- Graham, B W, August 1993: Waihi Gold: Dust Monitoring Review. Unpublished independent review.
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- Environment Waikato, 3 July 2009: Consent Compliance Audit – Martha Mine, Waihi. Letter to Newmont Waihi Gold.
- Ministry for the Environment, 2001: Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions.
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- Watercare Services Limited, April 2009: Newmont Waihi Gold Ltd, Selected Metals (Gold Room Stack) Emission Testing, March 2009. Unpublished report for Newmont Waihi Gold.
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- Rolfe, K, October 2016: Relocation of two air quality monitors at Waihi: an independent assessment. Unpublished report for OceanaGold NZ Ltd

## Appendices

### **Appendix A      Relevant Resource Consent Conditions**



## **Resource Consent Conditions: Favona Mine Project, Resource Consent Number 109741, Discharge to Air**

### Activity authorised:

To discharge contaminants to air from the mine portal, vent shaft(s) and project area (fugitive emissions) being dust, CO<sub>2</sub>, blast fumes and exhaust fumes.

### Consent duration:

Granted for a period expiring 31 December 2028.

Subject to the following conditions:

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### General

1. This consent is subject to the conditions listed in Schedule 1 – 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 Waikato Regional Council.

### Air Quality Management Plan

6. 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 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.

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 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

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:
  - (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.

## Resource Consent Conditions: Trio Underground Mine Project, Resource Consent Number 121697, Discharge to Air

### Activity authorised:

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

### Consent duration:

Granted for a period expiring 31 December 2028.

Subject to the following conditions:

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### General

1. This consent is subject to the 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 the event has occurred.
3. This consent shall not be exercised unless and until resource consent number 121447 has been either 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 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 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 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:
  - (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.

## **Resource Consent Conditions: Golden Link Project Area (Correnso), Resource Consent Number 124859, Discharge to Air**

### **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 PM<sub>10</sub> (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 PM<sub>10</sub> (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.

## **Appendix B      Air Pollutants and Their Effects**

## **Particulate Matter**

The term particulate matter is a generic one that encompasses other more commonly used terms such as dust, smoke, aerosols, haze and fallout. Airborne particulate matter can arise from a wide variety of sources including combustion processes (especially coal and wood burning), motor vehicle emissions, vehicle movements on sealed or unsealed roads, agricultural activities, quarries, road and building construction, as well as numerous industrial operations. There are also natural sources of particulate matter including volcanoes, sea spray, plant and animal matter (e.g. pollens and fungal spores) and wind blown dust and dirt.

The health and environmental effects of airborne particles are largely determined by particle size. This is also reflected in different methods of measurement. There are two types of dust measurement in the OGNZL programme, suspended particulate and deposited particulate. These measurements are made to distinguish between different sizes of dust particles, and different effects, as follows:

Suspended particulate 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 method used for measuring suspended particulate involves sucking air through a filter and determining the weight of dust collected from a measured volume of air. The method samples particles up to about 100 microns in size. The size fraction less than 10 microns (PM<sub>10</sub>) is referred to as inhalable particulate. Because those particles are small enough to be inhaled, they can affect human health.

While for general urban air quality situations levels of inhalable particulate are set, to protect against health effects, for the operations at Martha Mine suspended particulate (and deposited particulate) are more relevant, and levels are set to protect against nuisance dust effects.

Deposited particulate refers to particles that settle out of the air, that are greater than about 10 to 20 microns. The primary effect is a nuisance one, in that particles may show up as a deposit on clean surfaces such as cars, window ledges, washing, etc. Measurement is by means of a collection jar or gauge, which simply collects the dust settling over a fixed surface area over a period of time.

## **Cyanides**

Compounds containing the cyanide group are used and/or readily formed in many industrial processes including the manufacture of synthetic fibres, electroplating and heat treatment of metals, mining and the chemical process industries. Sodium cyanide is used in the Processing plant at Martha Mine and may be discharged into the air in the form of sodium cyanide dust or hydrogen cyanide vapour.

Cyanides are extremely toxic to humans (Workplace Exposure Standard - 10mg/m<sup>3</sup>), although this is mainly an issue for health and safety within the plant because of the potential exposure levels. In the environment cyanides have a high acute toxicity to aquatic life and to birds and mammals. The main environmental concern is with liquid discharges, but discharges of large quantities of cyanide dust could also cause similar problems.

Cyanides are rapidly degraded in the environment by oxidation, and are therefore non-persistent and do not accumulate.

## **Blasting and Vehicle Emissions**

The main pollutants present in blasting and vehicle emissions are carbon monoxide, nitrogen oxides and sulphur compounds (such as sulphur dioxide). The potential health effects of each of these are summarised below.

### Carbon Monoxide (CO)

Carbon monoxide is formed as a product of incomplete combustion in the burning of fossil fuels. The main source in most parts of New Zealand is motor vehicle emissions, and as such elevated levels are mainly found in areas of significant traffic congestion, particularly at busy intersections on inner-city streets. Carbon monoxide emissions from industrial combustion sources are usually of little concern because of the reasonably good level of control achieved in the combustion process.

CO is a poisonous gas that acts by displacing oxygen from the blood (Short Term Exposure Limit (STEL) 200ppm/15min). Prolonged exposure at moderate levels can lead to symptoms such as headaches and dizziness. At lower levels it is often monitored as a general indicator for objectionable concentrations of vehicle exhaust fumes. The presence of CO in emissions from blasting results from the limited air present at the point of detonation of the ammonium nitrate and fuel oil/diesel (ANFO) mix.

### Nitrogen Oxides (NOx)

Nitrogen oxides is the term used to describe a mixture of two gases, nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>). These are formed in most combustion processes by oxidation of the nitrogen present in combustion air. NO is the primary emission product but this is then oxidised to NO<sub>2</sub> in ambient air. As with CO, motor vehicles are the major source of NOx in most parts of the country, although power stations and other large combustion sources may be significant localised sources as well. Domestic fires are another source of concern in areas such as Christchurch, during periods of poor atmospheric dispersion in the winter months.

The main health effects of NOx are due to NO<sub>2</sub>, which is a respiratory irritant (STEL 5ppm/15min). Nitric oxide, NO, is quite innocuous in this regard (Workplace Exposure Standard 25ppm/8hrs). In major urban areas (eg, Los Angeles) both gases are a concern as precursors for photochemical smog, which is produced from the reaction of NOx with hydrocarbons under the influence of sunlight. Globally, NO<sub>2</sub> is also a contributor to acid rain.

The presence of NOx in emissions from blasting results from both the reduction of the nitrate in the ANFO explosive and the oxidation of nitrogen in the combustion air.

### Sulphur Dioxide (SO<sub>2</sub>)

Sulphur dioxide is mainly produced by the burning of fossil fuels. The primary sources are coal (<0.5 -3.0% sulphur), fuel oil (< 0.5% sulphur) and diesel oil (0.3% sulphur). There is no significant sulphur in natural gas, petrol, or in wood. A number of industrial processes can also produce sulphur dioxide emissions, while volcanoes are a major natural source.

Sulphur compounds in emissions from blasting and motor vehicles are the result of the sulphur content of the diesel fuel used.

The primary effect of SO<sub>2</sub> is as a respiratory irritant (STEL 5ppm/15min), although on a global scale it is also of concern in the production of acid rain.



## **Appendix C      Dust Monitoring Locations**



OGNZL operates an ambient air monitoring programme for dust in and around Waihi. It should be noted that while the programme was designed with the mine operations specifically in mind, the site distribution is such that most of the monitors can be affected by other sources in the area as well.

The monitoring programme was initially set up in 1982, with seven sites. Additional sites were added in 1984 to 1987, and again (with some rationalisation of sites) in 1995 to 1997, until 24 sites were being monitored in 1998. As a result of reviews and analysis of data, sites were progressively rationalised and decommissioned over the next ten years, with twelve sites now constituting the permanent network.

It still remains an extensive dust monitoring programme. The locations of the monitoring sites are shown in the following table.

<b>Site No.</b>	<b>NZMS 260 Grid Ref</b>	<b>Description</b>	<b>Total Suspended Particulate (TSP) and/or Deposited Particulate (DP)</b>
6.59	648 200	Alexanders, Golden Valley	DP
6.60	641 200	Torrens, Golden Valley	DP
6.61	626 207	Waihi (Leaches), Grey St	TSP and DP
6.63	625 199	OGNZL Met Station, Barry Rd	TSP and DP
6.64	619 195	Court House, Haszard Street	TSP
6.65	617 198	Moresby Avenue	TSP
6.66	610 199	Waihi College, Rata Street	TSP and DP
6.70	661 181	TSF-East	DP
6.71	653 174	Morrisons Farm, Trig Road	DP
6.72	644 179	Ruddocks Farm, Fisher Road	DP
6.74	620 207	Bulltown Rd	DP
6.78	624 202	Cnr Grey & Slevin Streets	TSP

In addition to the permanent network, OGNZL also installs discretionary DP monitors at various locations in response to issues and complaints. These monitors are managed in the same procedure as the permanent network, with results being compared with those from the longer running monitors. It should be recognised that some of these monitors have to be placed in less than ideal locations to get in close proximity to a concerned resident's property – as such, these monitors have a higher tendency to be adversely affected by erratic wind patterns, vegetation, and residential emissions (roadways, gardens, fires).



# Air Quality Monitoring Network





## **Appendix D      Environment Compliance Standard**

### **9.1      Air Quality**

#### **Purpose**

To monitor for air quality affected by operational activities and to manage emissions in order to protect employee health, the environment and to comply with relevant regulatory requirements.

#### **Minimum Standard**

- 9.1.1      Business Units shall identify point source and diffuse source forms of air emissions for the mine life cycle including construction, operation and closure.
- 9.1.2      Baseline air quality conditions shall be characterised prior to construction of new facilities that may be the source of air emissions.
- 9.1.3      Business Units must apply for and maintain all required permits/licences for point source air emissions and shall operate in compliance with statutory conditions specified. In the absence of host country requirements or guidelines, AS/NZ Standards for ambient air quality shall be applied.
- 9.1.4      Wherever there may be significant changes to air emissions, the Business Unit must determine the requirement for any licence / permit changes. Processes shall be implemented to ensure this occurs prior to any modifications or upgrades being made, including consultation with site environmental personnel and regulatory authorities.
- 9.1.5      Plant and facilities shall be designed, constructed and operated with appropriate air emission controls in order to comply with the host country's applicable laws and regulations.
- 9.1.6      Monitoring, inspection and maintenance programs shall be in place to ensure air emission controls are maintained and operating correctly to comply with statutory requirements.