BEFORE THE PANEL **FTAA-2507-1089**

UNDER THE	**FAST TRACK APPROVALS ACT 2024** (“**Act**”)
IN THE MATTER OF	an application for approvals by Matakanui Gold Limited to establish, operate, rehabilitate and ultimately close an open pit and underground gold mining operation known as the Bendigo-Ophir Gold Project

STATEMENT OF EVIDENCE OF REX SUNDE

9 APRIL 2026

INTRODUCTION

Qualifications and experience

1. My full name is Rex Istvan Sunde

2. I am a viticulture consultant. I hold a B.Hort (Massey, 1979)

Purpose and scope of evidence

3. The purpose of my evidence is to:

   a. Assess the potential impact of a proposed goldmining operation on nearby vineyard and winemaking activities.

4. The scope of my evidence includes:

   a. To consider the short and long-term risks from arsenic contaminated dust settling in local vineyards in terms of vineyard soil health, vine health, impact on terroir, and winemaking, including methods of winery management and market access considerations.

Expert witness code of conduct

5. I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's 2023 Practice Note. While this is not an Environment Court hearing, I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

EVIDENCE

Assessment of the Effect of the Proposed Bendigo-Ophir Opencast Mines on Viticulture, Winemaking and Market Access, for Nearby Vineyards and Wineries, in Relation to Potential Arsenic Contamination

Rex Sunde, Artisan Organics Ltd, principal author, with input from New Zealand Winegrowers on winemaking and market access. Peer reviewed by Seth Laurenson and Ross Wise MW of Bragato Research Institute
April 2026

Preamble

Matakanui Gold Limited have made application to the Environmental Protection Agency for Fast-Track approval to mine gold at the Bendigo-Ophir gold project. This proposed project sits adjacent to established grape growing and winemaking operations.

The Bendigo-Ophir gold deposits are associated with elevated levels of Arsenic (*As*). There is concern that *As* contamination from the mining operation may negatively impact grape growing, winemaking and market access for wine products.

I have been asked to evaluate:

- The potential impact on viticulture from *As* contaminated dust.
- Describe any means of mitigation within vineyards, should contamination occur.
- Assess the potential impact on winemaking and market access from *As* contaminated grapes, and any means of elimination, minimisation or mitigation within the winery.
- Provide commentary on the possible impact of *As* accumulation in the vineyard over the life of the mine.

As a first approach, I identified the types of *As* that are likely to be found within the site and generally in NZ. I needed to be sure that the mineralogy found in NZ could be compared with data and behaviours in overseas reports. The most abundant types follow:

Arsenopyrite (FeAsS) — the principal arsenic-bearing sulphide in the ore.

Arsenian pyrite (pyrite with significant As substituting into the FeS_2 structure) — commonly associated with mesothermal/ orogenic gold systems in Otago and reported in regional work.

Realgar (AsS) and orpiment (As_2S_3) — observed as secondary/near-surface sulphide alteration minerals in drill cores and summaries for the Bendigo–Ophir area.

Secondary arsenates (e.g., scorodite and other Fe–As oxides/oxy-hydroxides) — expected/recorded in oxidised gossan/near-surface weathering zones in Otago goldfields more generally (and reported from other nearby Otago localities); these phases form during weathering of arsenopyrite/arsenian pyrite, and control short-term *As* plant availability and soil mobility.

It appears that worldwide, similar mineral species will be found, with behaviour of each species being dictated by local environmental conditions, but with largely consistent behaviours being reported in all published material. The viticulture and winemaking will be dealt with in three distinct sections.

1. Potential contamination of grapes in the vineyard.
2. Accumulation of *As* in the vineyard soil over the life of the mines.
3. Impact on winemaking and market access.

***As* Contamination in the Vineyard**

This section considers the potential for contamination via wind-blown dust arriving directly from the mine site and access roads.

Plant availability and uptake of *As* between pH 4 and 9 is very low, with availability and uptake increasing dramatically <pH4 and >pH9. This is a generalisation for most plants that is also applicable to grapevines.

When Arsenopyrite weathers or oxidises, the *As* is released into the environment as *AsIII (arsenite) or AsV (arsenate)* The arsenite form is significantly more toxic than the arsenate form. Specific soil conditions determine which form of *As* is present. For the purposes of this report I refer to total *As*. The arsenite/arsenate forms are interchangeable, with arsenite being present under anaerobic and reductive conditions and arsenate present under aerobic and oxidative conditions.

Grapevines are very unlikely to grow successfully in conditions where elevated *As* availability is of any significance, (<pH4.0 or >pH9.0). These elevated *As* availability and uptake conditions are also very unlikely to occur in the rhizosphere of Central Otago (CO) vineyards.

Redox conditions in the rhizosphere have a significant effect on the mineral form of *As*:

- Strongly reductive conditions favour the more soluble *AsIII* form. These strongly reductive conditions are unlikely to be experienced during the growing season when roots will be active.
- Iron, Manganese, and Calcium bind *As* strongly and may encapsulate *As* mineral forms. These elements in reactive ionic form are sufficiently abundant in CO to act as a buffer or backstop against *As* uptake.
- Organic matter and clay bind/adsorb *As* strongly. CO soils typically have relatively low organic matter, but many sites have moderate clay levels. I can expect the organic matter and clay in CO soils to give further protection from available *As* uptake.

Where small amounts of *As* are taken up by vines, the great majority of this is transported within the vine to the roots and older leaves. In all studies I have been able to find, negligible amounts of *As* finds its way to berries via the vascular system.

Taking the above into consideration, I consider there to be little risk to the winegrowers of CO from grape or <u>wine contamination</u> by *As* via the soil. To be clear, *As* contaminated dust that arrives and becomes part of the rhizosphere, presents low risk in any one season, as it will be very poorly available to grapevines due to the reasons given above, and the tiny amounts that do enter the vine rarely reach the berries*.

There remains the possibility of *As* contaminated dust arising from the Project, being deposited directly onto the grapes. I understand that Williams Water and Land Advisory will be making comment on management of dust within the Project. I have addressed the management of grapes with contaminated dust in the winemaking section of this report.

There also remains the possibility of *As* entering the vineyard and winery ecosystem via groundwater, either from bores or overland flow. All vineyards in the region are irrigated, primarily from bores and sometimes from dams and rivers. Very typically the same water will be used in both the winery and vineyard. Williams Water and Land Advisory will provide more detailed information on the water quality situation.

*The following is noted for the sake of completeness. In the microenvironment in the rhizosphere, nutritional fertilisation simultaneously with lime and phosphorous (P) in the phosphate form could, in rare cases, increase *As* uptake. Plants are unable to distinguish between *As* and P, and very localized conditions could potentially see a short-term pH level above 9 in the immediate vicinity (microenvironment) of applied lime. Use of the Reactive Rock Phosphate (RPR) form of P will mitigate this (unlikely) possibility significantly. There may be other potential routes for *As* to enter the grapevine vascular system that I am not aware of. The grape and wine residue data available in the literature suggests that if these routes exist, they are insignificant.

Accumulation of *As* in Vineyard Soil Over the Life of the Mines

There is a consistent theme in the literature that elevated levels of As will change the composition of soil biota. In the case of regular deposition of *As* contaminated dust over time, I expect to see more bacteria, less fungi, and a different balance of fauna. This might arise where *As* contaminated dust being deposited in vineyards has a much higher concentration of *As* than what is already present in vineyard soils.

Fungi perform the critical role of nutrient recycling in the rhizosphere, amongst other functions. A gradual and long-term increase in *As* levels via dust accumulation could change the mix of flora and fauna in the vine rhizosphere, with a consequent change in the character of wine from the impacted vineyards. This would be insidious creep rather than noticeable change in a few seasons.

If this occurs, the effect will be irreversible and can be expected to continue long after the mining operation ceases.

In CO, arbuscular mycorrhizal fungi are one of the important fungi critical to vine health. They improve water and nutrient uptake by significantly increasing vine root area. They can be one of the first fungi to be impacted in adverse soil conditions. These fungi are very widely distributed in NZ, so much so that all vineyards with reasonable soil conditions in CO can be expected to host them.

Mycorrhizal fungi in particular are very sensitive to changing soil conditions. They are far more sensitive to heavy metal (includes *As*) contamination than most other fungi, and in comparison to plants, they are extremely sensitive.

It is well established that changes to a vineyard ecosystem, particularly the soil environment, can have either a positive or negative correlation with wine character. Given what we know about the importance of fungi to vine health and subsequent wine character, and the relationship between soil *As* levels and fungal health, it is extremely unlikely that increasing soil *As* will have a positive correlation with wine character.

Any accumulation of *As* over time would be non-reversible. I see this as real future threat, with the potential to negatively influence wine character at impacted vineyards. Any change is likely to be virtually unnoticeable on a season-to-season basis, but might be noticeable after many years of accumulation, when it’s too late to change anything.

The above leads me to the view that imposing strict controls over contaminated dust leaving the mining sites and access roads, together with <u>independent monitoring</u>, are the most important conditions that need to be achieved.

Assessment of potential impact on winemaking and market access from arsenic contaminated grapes, and any means of elimination, minimisation or mitigation within the winery.

This section of the report considers the potential impact on market access if grapes were to become contaminated by *As*, as well as steps that could be taken by producers to ensure that any resulting wine is safe for consumption.

Summary:

- New Zealand does not currently specify a maximum acceptable *As* level for wine, except that it must be *as low as reasonably achievable*.
- As approximately 90% of New Zealand wine is exported, compliance with all major export market requirements for maximum *As* levels in wine is vital (in addition to compliance with domestic requirements).
- An *As* maximum concentration of 0.1 mg/L or less would comply with the regulatory limits in key markets where a maximum concentration for arsenic is established. It would also meet the limit specified by the International Organisation of Vine and Wine (**OIV**).
- The baseline concentration of *As* in New Zealand wines is likely to be low, with the limited published data reporting mean levels for total *As* as 0.0038 mg/L in red wines and 0.0047 mg/L in white wines.
- Initial analysis of Central Otago wines produced in the vicinity of the proposed mine site suggest that the baseline levels of *As* are also low, with levels ranging from nil detectable (<0.001 mg/L) to 0.0015 mg/L.
- Under Wine Standards Management Plans (WSMP), any grapes, must, or wine suspected of contamination (of any form) must be dealt with by the winery in accordance with the facility’s WSMP.
- Winemaking processes offer several points for *As* minimisation and mitigation. In addition, some winemaking processes could also lead to trace levels of *As* in resulting wine (e.g. by the use of certain fining and

filtration aids), with no impact on the safety of the wine for consumption.

- *As* levels typically decrease during the winemaking process, however, there is conflicting literature on impact of winemaking technique (e.g. white winemaking, red winemaking) on *As* levels in final wine. This conflict is likely due to the source of the *As* being in the form of dust on the grapes versus being soluble within the pulp from being taken up by the plant.
- All reviewed studies found total *As* concentrations in wine to be below 0.1 mg/L, even where grapes were sourced from sites with known high soil *As* contamination.
- The presence of *As* in wine poses risks primarily related to food safety and regulatory compliance, rather than direct sensory or quality defects in the final wine. There is no literature that documents any quality effects on fermentation or the final wine from elevated *As* content directly. However, it is important to note that additional processing steps that may be utilised to remediate *As* contamination may impact on quality.
- Methods to decrease the amount of *As* in finished wine:
  - Natural yeast activity during fermentation and prolonged fermentation
  - Adsorption: Activated carbon, inactivated yeasts
  - Microfiltration (ultrafiltration) and reverse osmosis
  - Emerging technologies such as Molecularly Imprinted Polymers (MIPs), already used in wine for other contaminants/taints, and sorbents used to remove arsenic from water, may be able to be utilised for this application.

<u>Market access implications</u>

Domestic market requirements

The Australia New Zealand Food Standards Code Standard 1.4.1 establishes the general principle that levels of contaminants and natural toxicants in all foods should be kept As Low As Reasonably Achievable (the ALARA principle) and sets out the maximum levels of specified metal and non-metal contaminants and natural toxicants that may be present in certain foods. In the instance where there is no maximum level set for wine in Schedule 19, as is the situation for *As*, the level must be ALARA.

For further context, maximum levels for *As* have been established for the following foods, known to contain elevated levels of *As*, as listed in the Australia New Zealand Food Standards Code:

Contaminant	Food	Maximum level (mg/kg)
Arsenic (total)	cereal grains and milled cereal products	1
	salt	0.5

Arsenic (inorganic)	crustacea	2
	fish	2
	molluscs	1
	seaweed	1

The Water Services (Drinking Water Standards for New Zealand) Regulations 2022 specify a maximum acceptable value for *As* in drinking water of 0.01 mg/L. [However, it should be noted that the drinking water standard is not mandatory for use in winemaking[1]. This reflects the small volumes used (eg in cleaning) and the nature of the product (being microbiologically low risk).]

International market requirements
As approximately 90% of New Zealand wine is exported, compliance with export market requirements for allowable *As* levels is highly important to wine producers (in addition to compliance with domestic requirements).
An *As* maximum concentration of 0.1 mg/L or less would comply with the regulatory limits in all key markets where a maximum concentration for arsenic is established. It would also meet the limit specified by the OIV.
Maximum acceptable levels of *As* in wine, by market:

Market	**Limit for Arsenic in wine (mg/kg)**
European Union	0.1*
Canada	0.1
Taiwan	0.2
Great Britain	No defined limit
USA	No defined limit
Hong Kong	No defined limit
China	No defined limit
Switzerland	No defined limit
Singapore	No defined limit
Malaysia	No defined limit

[1]The requirements for water used for winemaking additions, inputs, and for the cleaning and sanitation of winemaking equipment are summarised as follows:

- Water from a registered drinking water supply (e.g. registered town supply) is considered to be suitable for use in winemaking.
- Self-supplied water solely for winery use (i.e. bore water, rain water, surface or ground water) may be used provided that it is tested every 12 months for E. coli and turbidity.
- The test for E.coli must be performed by a laboratory that is accredited to ISO/IEC 17025 for that test.
- Self-supplied water must meet the following criteria:
    - Escherichia coli – less than 1 in any 100 ml sample;
    - Turbidity – must not exceed 5 Nephelometric Turbidity Units (NTU).

Korea	No defined limit
Thailand	No defined limit
The International Organisation of Vine and Wine (OIV)	0.1

* There is currently no wine-specific maximum level for arsenic set in the EU. The 0.1 mg/l limit comes from the OIV, and while this has not been formally incorporated into EU-wide law, several Member States have incorporated it directly into their national law, so this is the lowest level for compliance across all EU markets.

Baseline levels of *As* in wine in New Zealand

The New Zealand Total Diet Study (NZTDS) is a nationwide survey that assesses foods sold in New Zealand to evaluate potential chemical exposure risks. In the 2009 NZTDS[2], total *As* was detected in all 16 wines analysed with mean concentrations of 0.0038 mg/L in red wines and 0.0047 mg/L in white wines. The study did not provide any information on the region the tested wines came from.

It is expected that white wines would have higher baseline levels of *As* compared to red wines due to bentonite being a common treatment utilised during the white wine making process. Bentonite, a clay used for fining and removing haze-forming proteins in wine, can introduce trace amounts of arsenic, typically increasing levels by around 20%. While it is a contributing source alongside soil and other filtration aids (like diatomaceous earth), arsenic levels from bentonite usually remain well below levels that would be considered contamination or of a regulatory concern.

As an initial baseline, 6 wines from the areas identified of being at risk of *As* contamination from the proposed Bendigo-Ophir opencast mines have been analysed. While not a comprehensive review, the results indicate that a low baseline for *As* should be anticipated for wines from this region, consistent with the NZDTS. The three red wines analysed all had nil detectable *As*, <0.001 mg/kg. The three white wines ranged from 0.0010 to 0.0015 mg/kg. All three white wines analysed had bentonite used during the winemaking process.

Management of potentially *As* contaminated grapes

A WSMP is a documented system under New Zealand's Wine Act 2003 that sets out how a winery manages food safety and regulatory compliance throughout the winemaking process. A WSMP must be registered with the Ministry for Primary Industries (MPI), and winery operations are regularly verified by an MPI-recognised verifier to confirm the plan is being correctly implemented.

If levels of *As* is suspected to be present in grapes entering the winery, that could result in contamination of wine produced, then the grapes must either be rejected or steps taken to ensure that the resulting wine will not be harmful to human health such that domestic and export market access is not compromised. Winemaking practices that can be employed to reduce *As* in the final product are discussed below.

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[2] 2009 New Zealand Total Diet Study Agricultural compound residues, selected contaminant and nutrient element. Appendix 9.1 Arsenic content (mg/kg) in foods of the 2009 NZTDS, page 150.

The only method to confirm the presence of *As* is through laboratory analysis.

<u>*As* reduction during winemaking</u>

Grapes may carry *As* residues externally (dust) and internally (root uptake). *As* concentrations within the grape berry localise mainly in the pulp and skin, with approximately 10% found in the seeds. It would be expected that *As* in the form of dust contamination would be more readily removed during the winemaking process as sediment, compared to *As* that is localised within the berry. Through the winemaking process, there is a demonstrated and substantial reduction in *As* content. One study on red wine processing observed a roughly 80% decrease in *As* content from the berries to the final bottled wine[3].

A summary of the reduction of *As* that occurs during each stage of the winemaking process is as follows:

1. Initial Processing

A negligible decrease in *As* content is typically observed after the crushing and pressing of grapes. This small reduction is likely due to the removal of stalks and stems, which often contain higher *As* levels than the fruit itself.

2. Pre-Fermentation Clarification

For rosé and white wines, the initial step of cold settling to remove particulates before fermentation to enhance clarity, causes a small decrease (about 4%) in total *As* concentration. Other methods used for solids removal (flotation, high solids crossflow, centrifuge) would be expected to achieve a similar reduction.

3. Alcoholic Fermentation

The fermentation phase consistently results in a notable decrease in total *As* concentration:

- Studies observed a decrease in total *As* content between 35% to 56% in both white winemaking and red winemaking after alcoholic fermentation.
- The loss of *As* during fermentation is likely due to the biosorption by yeast hulls, which settle as sediment, or the formation of a volatile *As* species.
- The presence of grape skins (red winemaking technique) did not appear to affect the loss of *As* during fermentation.

4. Post-Fermentation Treatment

The use of fining agents, which are added to separate unwanted compounds that affect physical quality (such as haze or colour), can lead to a reduction in arsenic levels in some wines:

- Fining treatments caused a loss of approximately 43% of total *As* in red wine in one study.
- However, the same fining treatments did not affect *As* levels in rosé wine, possibly because the haze-producing compounds were already

[3] Bertoldi, D.; Villegas, T. R.; Larcher, R.; Santato, A.; Nicolini, G. Arsenic present in the soil-vine-wine chain in vineyards situated in an old mining area in Trentino, Italy. Environ. Toxicol. Chem. 2013, 32, 773−779.

eliminated in the pre-fermentation clarification step applied to the rosé wines.

Mitigation within the winery

The reduction of *As* during the winemaking process can be further enhanced by employing various winemaking techniques such as prolonging fermentation (extending contact time with yeast), additional time on yeast lees, and/or using inactivated yeast to remove *As* through binding to yeast and being removed as sediment. Avoiding the use of diatomaceous earth and pre-rinsing (or using low-*As* content) bentonite can further reduce final *As* content.

Other remediations available include using reverse osmosis, ultra filtration, and fining agents such as activated carbon. It is important to assess the effect on quality prior to any remediation. Emerging technologies such as Molecularly Imprinted Polymers (MIPs), already used in wine for other contaminants/taints could potentially be explored for this application.

Conclusion

If grapes are contaminated with *As*, this could result in market access issues if the contamination is such that limits for *As* in the resulting wine are breached. It is unclear what level of contamination couldn't be mitigated through winemaking practices and would require destruction of the grapes. However, there are some winemaking practices that may be undertaken that may assist to reduce *As* levels in resulting wines such that the product is safe for consumption.

References:

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