MINE WASTE MANAGEMENT
GREENROAD GROUP

5 Sir William Pickering Drive
Christchurch 8053, New Zealand

T. +64 3 242 0221
E. admin@minewaste.com.au

MEMORANDUM

Recipient:	Dean Fergusson – OceanaGold Limited
From:	Paul Weber – Mine Waste Management Limited
Date:	4 February 2025
Document Number:	J-NZ0229-010-M-Rev0
Document Title:	Response to S92(1): Consent Application Number RM24.184 12 December 2024

OceanaGold (New Zealand) Limited (OceanaGold) submitted a Resource Consent application (RM24.184) to the Otago Regional Council (ORC) for activities relating to the Macraes Gold Mine (Macraes) Phase 4 Stage 3 Project (the Project) on 28 March 2024.

REQUEST FOR INFORMATION

Processing of Resource Consent Application RM24.184 has included technical audits by GeoSolve Limited, Torlesse Environmental Limited, E3 Scientific Limited, and Specialist Environmental Services Limited.

As part of ORC's assessment, an additional request for further information was provided by the ORC dated 9 December 2024 under section 92(1) of the Resource Management Act 1991.

Mine Waste Management (MWM) has provided this memorandum to help address additional information relating to environmental geochemistry matters as requested by OceanaGold on 12 December 2024 (Table 1).

Table 1. s92 Request for Information (RFI) in respect of environmental geochemistry matters.

ITEM NO.	REVIEWER	S92 QUESTION
		GEOCHEMISTRY, WATER MODELLING, AND GROUNDWATER
4.1	E3 Scientific	Has any measurement of sulfides been completed across the water quality monitoring and if so, can further discussion be provided regarding sulfide concentrations in groundwater and surface water?
4.8	E3 Scientific	The GHD (2024) report regarding Coronation assumes that water quality of the overflow from the Coronation Pit Lake through the Trimbells WRS remains consistent and does not deteriorate further before entering the Trimbells silt pond and ultimately Trimbells Gully. Use of source control technologies and treatment has been assumed to prevent and further deterioration of water quality flowing through the Trimbells WRS. What are the realistic limitations of these technologies and what actual deterioration can be expected?
4.9	E3 Scientific	The section 92 response to Q1.4 states that water from Murphy's silt pond will have passive treatment systems in place to reduce sulphate concentrations by 30%. It does not specify which ones are likely to be used, or address the subsequent need to manage sulfides generated from sulphate reduction. The response recognises that further testing and field trials are required to be able to quantify the water quality improvement that can be achieved by these methods. Further response was provided to Q1.10 regarding treatments in which the Water Quality Management Plan, and its adaptive nature is discussed. This again specifies the need for further

ITEM NO.	REVIEWER	S92 QUESTION
		testing of passive treatment systems to manage mine water. The WQMP provided as Annexure 1 to the s92 FRI response does not commit to any definite active or passive methods. The implementation timeline does not include any fixed dates, and for the most part provides mitigation options, but does not confirm which have or haven't been used across the site and when they were implemented. Whilst many of the activities have been completed or are nearing completion, there is still no clear timeline or confirmation of which mitigations are to occur. What reductions in contaminants are realistic when the methods are yet to be confirmed? Given that the mitigation of effects relies on source control and treatment measures in a Trigger Response Action Plan, can these be provided so that effects can be assessed?

RESPONSE TO RFI 4.1

RFI:

"*Has any measurement of sulfides been completed across the water quality monitoring and if so, can further discussion be provided regarding sulfide concentrations in groundwater and surface water?*"

Response:

It is assumed the ORC Reviewer is concerned about the potential presence of un-ionised H_2S in receiving waterways downstream of the Macraes mining project, which can be deleterious to aquatic ecology (e.g., ANZECC, 2000).

Hydrogen sulfide (H_2S) is only expected in waters where anoxic conditions are present or waters are affected by anoxic drainage (e.g., anaerobic passive treatment systems or similar). This process is summarised by Equation 1 and can only occur under anoxic conditions when there is a labile source of carbon to provide electrons and sulfate is available to receive the electrons (assuming microbes will naturally be present).

Equation 1: $\mathrm{SO_4}^{2-} + 2\mathrm{CH_2O} \xrightarrow{\mathrm{SRB}} 2\mathrm{HCO_3}^{-} + \mathrm{H_2S}$ Where SRB = sulfate reducing bacteria.

H_2S is a common anaerobic degradation by-product where sulfate is present. H_2S can be found in natural sediments and is found in industrial wastes and landfill leachates (ANZECC, 2000). Mine-impacted waters can also be elevated in sulfate that can be converted to hydrogen sulfide under anoxic conditions where labile organic carbon is available. This process is driven by microbes seeking energy to drive metabolic activity where this energy is obtained from the transfer of electrons from electron-rich (reduced) substrates (e.g., organic matter) to electron-deficient (oxidised) species (e.g., nitrate, sulfate, etc). This is shown schematically in Figure 1 and an explanation of relative oxidation-reduction potential (Eh) for these reactions is shown in Figure 2.

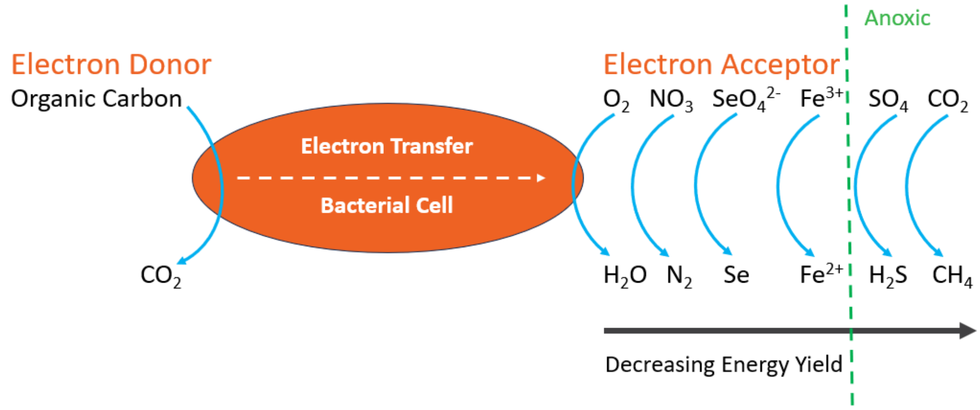

Figure 1. Energy yield and common oxidation-reduction (redox) sensitive species.

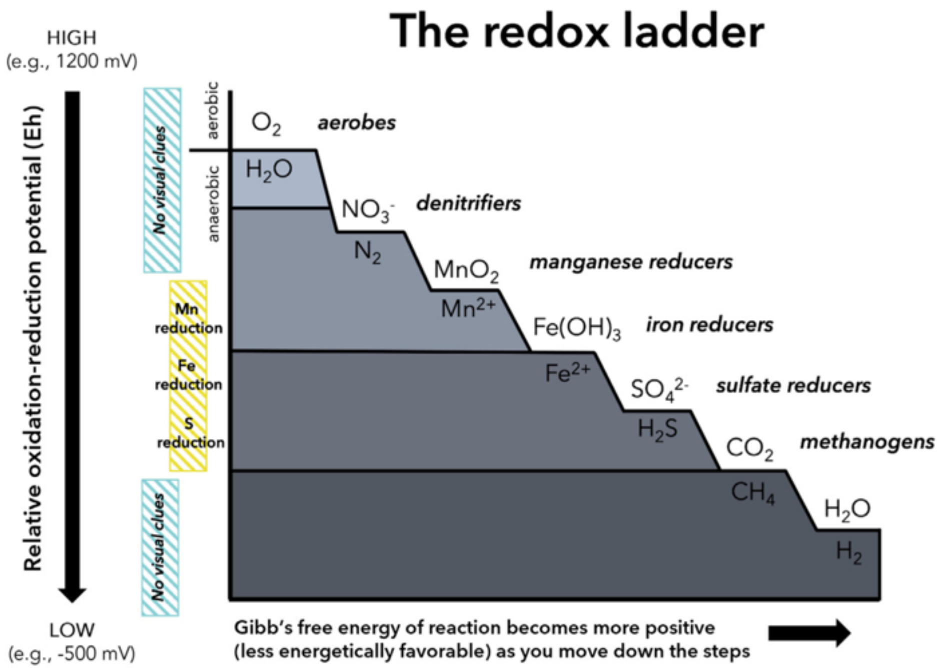

Figure 2. The Redox Ladder

Source: Sapkota et al. (2022)

Mine-impacted waters, elevated in sulfate, can be classified based on their redox state. A key distinction on whether mine-impacted waters can be elevated in hydrogen sulfide is the redox state of the water and whether the waters are anoxic[1]:

- Oxic waters - waters that contain measurable dissolved oxygen.
- Suboxic waters - waters that lack measurable oxygen or sulfide but contain significant dissolved iron (> ~0.1 mg/L).
- Reducing waters (anoxic) - waters that contain both dissolved iron and hydrogen sulfide.

[1] *https://www.uvm.edu/~gdrusche/Classes/GEOL%20195%20-%20Geochemistry/Fall%202007%20Lectures/Lecture%2016%20-%20Redox%20geochem%20II.ppt*

Mine impacted water at Macraes is likely to have a number of different redox states:

Waste Rock Stacks (WRSs)

WRSs at Macraes are generally formed by disposal methods that do not limit oxygen. The result of this is elevated sulfate concentrations in WRS seepage due to ongoing sulfide mineral (e.g., pyrite) oxidation and low iron (Fe) concentration (Figure 3). If the WRS were sub-oxic or anoxic, then Fe^{2+} could remain in solution at circum-neutral pH and be measured at higher concentrations. The fact Fe is low indicates WRS are unlikely to be anoxic and, therefore, should not contain appreciable amounts of hydrogen sulfide.

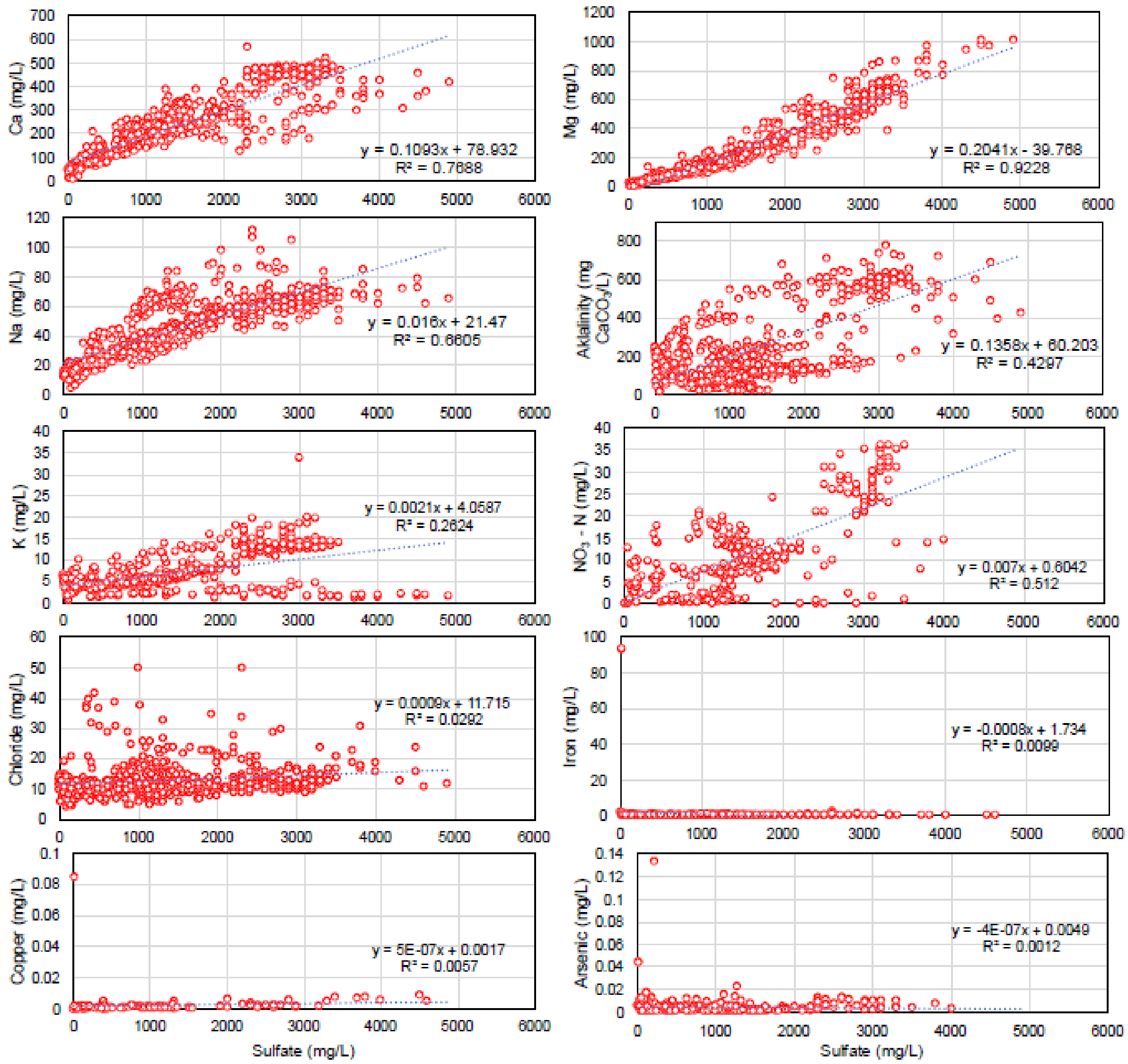

Figure 3. Sulfate versus other water quality parameters, notably iron (Deepdell North, North Gully East, North Gully West, Frasers West, Coronation, Coronation North, and Golden Bar).

Source: MWM (2023): Report J-NZ0205-003-M-Rev1 – Figure 4

Pit Lakes

Pit lakes at Macraes are unlikely to have elevated hydrogen sulfide concentrations. Recent studies (as presented in MWM (2024a) indicate that minor stratification of pit lakes can occur (e.g., Golden Bar) yet total oxygen concentrations did not decrease below 30%. This suggests the bottom waters are not anoxic and would not favour the formation of hydrogen sulfide.

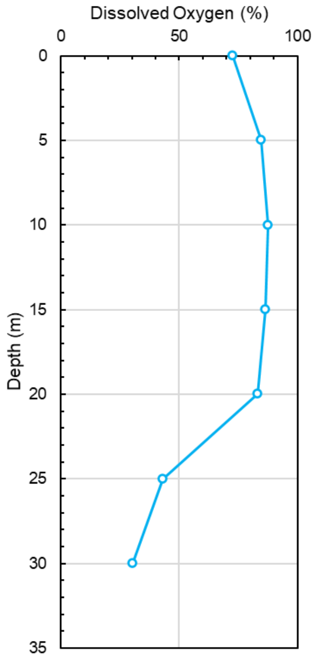

Figure 4. Dissolved oxygen content for the Golden Bar Pit Lake, Macraes Gold Mine.

Note: Further data on the sampling results etc are provided in MWM (2024a) – Section 2.8.5

<u>Tailings</u>

The tailings process water at Macraes is unlikely to contain hydrogen sulfide due to the Pressure Oxidation (POX) process used to liberate gold from the sulfide minerals. A similar conclusion could be applied to the TSF decant water derived from process water.

Tailings seepage water quality data (MWM, 2024a – Table 8) indicates that Fe is elevated, ranging from an average of 9.3 to an average of 36.8 mg/L. Because pH conditions are circum-neutral, this would indicate that either suboxic or anoxic conditions are present within the tailings. Ammoniacal N is also elevated ranging from an average of 7.3 – 9.1 mg/L, which is greater than nitrate N suggesting environmental conditions are favouring reduced species.

The use of cyanide for gold recovery introduces carbon and nitrogen into the tailings circuit at Macraes. Biological facilitated pathways exist for the transformation on HCN^- and CN^- to ammoniacal N (e.g., Mudder et al., 2001), which might explain the higher ammoniacal N concentrations measured in seepage from these facilities. Limited literature is available on whether the carbon associated with cyanide is labile and available for bacteria to convert sulfate to hydrogen sulfide (e.g., Equation 1). If this mechanism was possible, then the formation of hydrogen sulfide would contribute to the precipitation of sulfide minerals within the TSF. It could also contribute to seepage waters elevated in un-ionised hydrogen sulfide.

Where possible, TSF seepage waters are not discharged to surface water bodies and are recirculated back to the TSF. For 20 years after closure (the estimated TSF draindown phase), the TSF seepage will be directed to the Frasers Pit Lake where any sulfide would oxidise.

Post closure, following the completion of ore processing and following draindown of the TSF, seepage flows are expected to be a few litres per second will be treated by capture, storage, passive treatment and discharge to catchments during high background catchment flows GHD, 2024c. Passive treatment using anaerobic passive treatment systems will generate hydrogen sulfide. As noted in MWM (2024a – Section 8.3) this will require additional management (i.e., secondary treatment) to remove the sulfide. Such additional management would be, for instance, a polishing pond to encourage oxidation of the sulfide back to sulfate and or elemental sulfur.

Groundwater

Groundwater is unlikely to be anoxic such that sulfate is converted to hydrogen sulfide.

RESPONSE TO RFI 4.8

RFI:

"*The GHD (2024) report regarding Coronation assumes that water quality of the overflow from the Coronation Pit Lake through the Trimbells WRS remains consistent and does not deteriorate further before entering the Trimbells silt pond and ultimately Trimbells Gully. Use of source control technologies and treatment has been assumed to prevent and further deterioration of water quality flowing through the Trimbells WRS. What are the realistic limitations of these technologies and what actual deterioration can be expected?*"

Response:

EGL (2024b) note that the Coronation Pit (stage 5 and 6 voids) will eventually fill up with water at closure with an outlet channel at 660 mRL at the southern end of the Coronation Pit, which will ultimately discharge to Highlay Creek, a tributary of Deepdell Creek. However, there is a low point in the Northern wall of Coronation Pit (637 mRL) that will result in up to approximately 23 m of water depth being locally impounded against the Trimbells WRS. This will result in seepage through the Trimbells WRS, ultimately entering the Trimbells Gully Creek along a ~500 m seepage path. This flow path is shown in Figure 5. GHD (2024a) estimates that the Coronation Pit Lake would eventually reach the RL 660 m and spill into the Deepdell Creek catchment ~200 years after pit closure. Thereafter, the frequency and duration of pit lake spill would be determined by the annual water balance.

GHD (2024a) note the flow rate through the Trimbells WRS from the Coronation Pit Lake will increase from 0 L/s to 0.61 L/s as the pit lake increases in elevation from 637 to 660 mRL and that pit lake seepage from Coronation Pit Lake into Trimbells WRS will occur after 97 years. At this point in time, pit lake water quality is estimated to be 545 mg/L sulfate (MWM, 2024c) and Trimbells WRS seepage is expected to have a sulfate concentration of 3,585 mg/L (GHD, 2024). As noted by the ORC reviewer, there may be deterioration of this pit lake seepage water quality as it passes through the WRS. Further information was requested. A response is provided below.

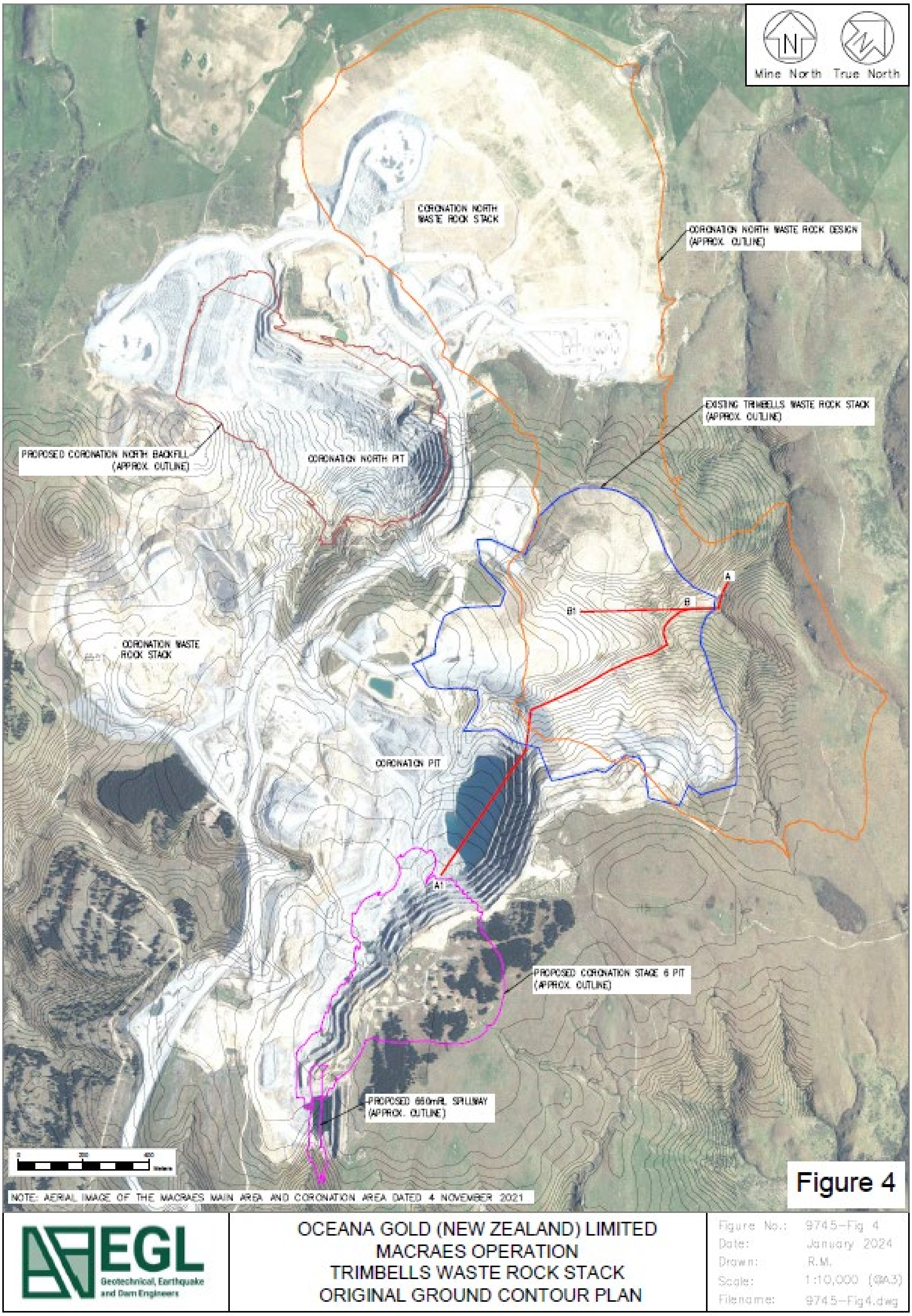

Figure 5. Expected Coronation Pit (Stage 5/6 Pit Void) flow path (red line A1-B-A beneath the Trimbells WRS (within the existing gully).

Source: EGL (2024b).

WRS Construction Effects

WRS at Macraes are constructed using high end-tips (10-15 m in height[2]) that can create grainsize segregation with larger materials rolling to the bottom of the slope (MWM, 2024a). This process is used to create 'French Drains' to facilitate basal drainage of WRS and often this design principle is used to fill in gullies to generate a basal flow path to prevent potential WRS instability. From an environmental geochemistry perspective this process:

- Generates a basal chimney zone that allows higher airflow into the WRS that would enable ongoing oxidation of sulfide minerals and ongoing sulfate generation.
- Creates a basal layer of coarser particles that has a lower surface area for oxidation reactions compared to the bulk WRS fill.

EGL (2024b) note that seepage may occur at the toe of the Trimbells WRS and recommend that a toe drain, and buttress be considered to avoid local slumping at the toe in closure. EGL (2024b) report this may need to be 25 m in height and 10 m wide at the toe of the Trimbells WRS and would be constructed from selected waste rock material onsite. The toe drain and buttress are shown in Figure 6.

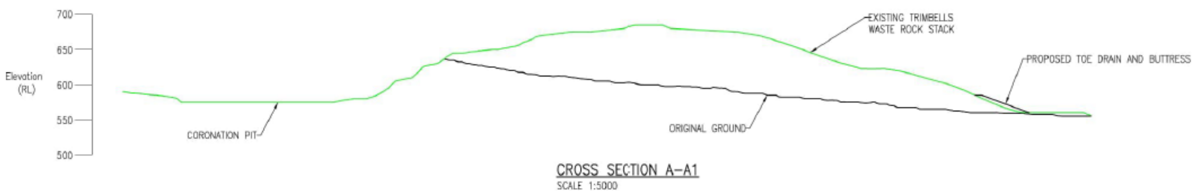

Figure 6. Trimbells WRS and flow path for Coronation Pit Lake seepage (along the ground surface) and the proposed toe drain and buttress.

Source: EGL (2024b) – Figure 7.

The pit side of the Trimbells WRS at the 'up stream' end of the basal seepage path will be flooded by the pit lake and so provide an 'natural' advective barrier on (generating an oxygen seal).

As noted in MWM (2024a – Section 7.2.4), an advective (oxygen) barrier at the (downstream) toe of the Trimbells WRS would control oxygen flux into the base of the WRS thereby minimising the ongoing oxidation of sulfide minerals in these basal materials. The toe drain and buttress proposed by EGL (2024b) could achieve this purpose, although further detailed design work is required to ensure advective oxygen flux is minimised Conceptually, this could include the construction of a toe buttress having 'Zone A[3]' properties and a culvert plus riser (to a manhole) to allow water to by-pass the advective oxygen seal but prevent the advective flow back of oxygen into the basal zone of the WRS..

Analysis of Potential Effects

If the advective ingress of oxygen was prevented along the basal drainage path, within the gully where Coronation Pit seepage would flow (red line in Figure 5), then only the existing stored sulfate load would be mobilised from this zone, which would not be replenished. The quantity of stored sulfate that is present in this basal flow path has been estimated in Table 2 where:

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[3] As per the Zone A of the tailings storage facility (TSF) embankment at Macraes

- A wetting width of 5 m was used and a wetting height of 5 m was used and is considered conservative for a basal flow path.
- Application of shake flask extraction (SFE) data to coarse backfill was used. Hence, these data are conservative given the larger particle size in the basal zone of the WRS compared to shake-flask grainsize.

Analysis (Table 2) indicates there could be ~9 tonnes of sulfate that could be mobilised by Coronation Pit Lake flow through the Trimbells WRS in ~100 years' time. It is assumed that the first flush of pit lake water through the WRS would mobilise this stored sulfate:

- If the first flush period was 1 year, then this could contribute an additional 465 mg/L of sulfate to the pit seepage increasing the concentration to ~1,010 mg/L for a 1-year period.
- If the flushing occurred over a 10-year period, the sulfate concentration in the pit lake basal seepage path would increase to 592 mg/L for this period.

Table 2. Trimbells WRS Stored Sulfate load within the basal drainage path

PARAMETER	UNITS	VALUE	REFERENCE
Width of base flow (French drain)	m	5	Assumed (conservative for 0.61 L/s flow rate)
Height of base flow	m	5	Assumed (conservative for 0.61 L/s flow rate)
Length of base flow (travel distance)	m	500	EGL, 2024b
Total volume	m3	12,500	Calc.
Density of WRS	t/m3	2.2	Calc.
Total mass of WRS in the base	t	27,500	Calc.
Sulfate release SFE[1] - Backfill (average)	mg/kg	326	MWM, 2024a - Figure 37
Total stored sulfate (SFE)	kg	8,951	Calc. = ~9 tonnes
Pit lake discharge	L/s	0.61	GHD (2024a)

[1] – SFE = Shake Flask extraction of crushed < 10 mm samples (RC drill chip a grab samples). Basal materials of the WRS are likely to be a much larger grainsize so the stored sulfate load (mg/kg) is expected to be conservative.

The ongoing generation of seepage from the Trimbells WRS would remain elevated in sulfate at ~3,584 mg/L for hundreds of years (GHD, 2024) and the flow rate is estimate at ~0.4 L/s by GHD in the site water balance model. <u>If no advective barrier was installed</u> and the basal materials had the capacity to generate 9 tonnes of sulfate per year (which is conservative), then the process of combining these flows results in the following at the toe of the Trimbells WRS:

- An increase in flow rate to 1.01 L/s.
- A decrease in sulfate concentration from 3,584 mg/L to 2,310 mg/L (due to the mixing WRS seepage waters with lower sulfate pit waters).
- An increase in sulfate load from 1,433 to 2,334 mg/s, which represents a 63% increase in sulfate load.

This variance is likely to be within the flow rate fluctuations of WRS that will be experienced at the site (e.g., MWM, 2024b).

Limitations

As noted above, the effect of ongoing oxidation of these basal materials is ~9 tonnes of sulfate per year if no advective barrier was introduced, which is based on the assumed flow path dimensions (Table 2). The introduction of pit lake flow to the WRS vertical infiltration decreases the concentration of the WRS toe seepage. The introduction of an advective barrier would limit the sulfate load to a first flush process (e.g., as materials were gradually wetted up over many years).

The limitations of the advective barrier relate to constructability issues to exclude advective oxygen ingress, which needs to consider, for instance:

- Width and height of the basal rubble layer that allows advective ingress of oxygen into materials along the pit lake seepage flow path. This can be determined by geotechnical assessment of WRS material properties as part of the detailed design.
- Toe buttress material properties including for instance, grainsize and long-term moisture content of the materials. This can be determined by geotechnical assessment of material properties as part of the detailed design and numerical modelling.
- Spatial constraints and the ability to construct a toe buttress, which can be resolved as part of the detailed design.

If a toe buttress cannot be constructed from materials at hand, then other options may be appropriate. This could include, for instance, geosynthetic clay liners (GCL), or an upstream bund between the pit and the WRS to prevent water flow through Trimbells WRS.

Recommendations

The following recommendations are provided:

- As per the MWM (2024a) report "If advective oxygen barriers are required to minimise oxidation in WRSs, then trials [to confirm the benefits of advective barriers] should be undertaken to validate the approach required". Trials could include the construction of advective oxygen barriers at the toes of WRS and the installation of oxygen probes to confirm design specifications are achieved.
- Trials should be done before mine closure to support optioneering studies and detailed design

RESPONSE TO RFI 4.9

RFI:

"*The section 92 response to Q1.4 states that water from Murphy's silt pond will have passive treatment systems in place to reduce sulphate concentrations by 30%. It does not specify which ones are likely to be used, or address the subsequent need to manage sulfides generated from sulphate reduction. The response recognises that further testing and field trials are required to be able to quantify the water quality improvement that can be achieved by these methods. Further response was provided to Q1.10 regarding treatments in which the Water Quality Management Plan, and its adaptive nature is discussed. This again specifies the need for further testing of passive treatment systems to manage mine water. The WQMP provided as Annexure 1 to the s92 FRI response does not commit to any definite active or passive methods. The implementation timeline does not include any fixed dates, and* *for the most part provides mitigation options, but does not confirm which have or haven't been used across the site and when they were implemented. Whilst many of the activities have been completed or are nearing completion, there is still no clear timeline or confirmation of which mitigations are to occur. What reductions in contaminants are realistic when the methods are yet to be confirmed? Given that the mitigation of effects relies on source control and treatment measures in a Trigger Response Action Plan, can these be provided so that effects can be assessed?*"

Response:

Passive treatment trials are on-going to identify the most appropriate passive treatment system (PTS) to treat toe seepage from WRSs at Macraes. It is reasonable to assume that this will involve anaerobic treatment processes such as those presented by Verum (2021) where more than 50% of the 3,000 mg/L of sulfate was removed in lab trials. As noted by MWM (2024a), Verum has been engaged to undertake field trials to validate this technology. Results are not yet available.

There are numerous types of anaerobic treatment system for sulfate-rich waters, however all anaerobic PTS rely on Equation 1 to convert sulfate to sulfide, which can then be removed as either metal sulfides (e.g., pyrite) or be converted to elemental sulfur.

<u>Passive Treatment Efficiencies</u>

MWM (2024a) suggested that 25% is a nominal treatment efficiency (i.e., half the reported Verum (2021) lab efficiency) to apply to field-based systems. OceanaGold's section 92 response (OceanaGold, 2024) states that sulfate loads will be reduced by 30%. These values are comparable to recent literature reviews of field-scale bioremediation systems. For instance, Zak et al. (2021) note that bioremediation systems (BIOS) can achieve a variable range of sulfate removal efficiencies (Figure 5). Analysis of these data indicate that the average treatment removal efficiency is 30.7% for sulfate influent concentrations that range from 2.5 to 8,000 mg/L. Hence, the efficiencies proposed by OceanaGold seem reasonable, although they require validation by completion of large-scale field trials.

D. Zak et al. Earth-Science Reviews 212 (2021) 103446

Table 2
Performance of field-scale bioremediation systems. CS=Composite System. CW=Constructed Wetland. SF=Surface Flow. SSF=Sub-Surface Flow. PRB=Permeable Reactive Barrier. *=refers to the cell of CS performing under anaerobic conditions. **=Water temperature reported in the studies. References: 1.Barton and Karathanasis (1999); 2. Hedin (2008); 3. Ji et al. (2008); 4. Di Luca et al. (2011); 5. Mitsch and Wise (1998); 6. Morrison and Aplin (2009); 7. Wieder (1993); 8. Woulds and Ngwenya (2004); 9. Wu et al. (2011); 10. Wu et al. (2012); 11. Benner et al. (2002); 12. Gibert et al. (2013); 13. Herbert et al. (2000); 14. Benner et al. (1999); 15. Caraballo et al. (2011); 16. Song et al. (2012); 17. Behum et al. (2011); 18. Matthies et al. (2012).

Reference	Type	Area/Volume (m²/m³)	Duration (y)	Plants	pH	T^a (°C)/Climate	Substrate	SO_4^{2-} inflow (mg L^{-1})	SO_4^{2-} removal (%)
1	CS/SSF*	1,022/705	1.5	Yes*	3.4	Temperate, USA	Limestone/ Organic*	3034	53.5
2	CS/SF*	49,000/–	2		6.2	Temperate, USA		1085	5.6
3	CS	–/–			2.1–7.7	Temperate/South Korea		2.5–3046	0–62
4	CW/SF	2,000/900	1	Yes	9–10	12.8–27**		270–1649	24–66
5	CW/SF/ SSF	3,869/3,757	1	Yes	3	Temperate, USA	Limestone/ Organic	1672	29
6	CW/SF	440/132	3	Yes	5.6–6.7	5.9–15.8**	Organic	355–969	15–25
7	CW/SF	180/54	2	Yes	2.9	Temperate, USA	Limestone/Peat	3132	0–14
8	CW/SF	–/–	0.5	Yes	2.6	Temperate, Scotland	Limestone/ Organic	900	17–18
9	CW/SSF	6/3	0.7	Yes		Temperate, Germany	Sand/Gravel	283.1	7
10	CW/SSF	6/3	6	Yes	6.7	Temperate, Germany	Sand/Gravel	790–995	32–54
10	CW/SSF	6/3	6	No	6.7	Temperate, Germany	Sand/Gravel	790–995	12–0
11	PRB	60/216	4	No	5–6	Continental, Canada	Gravel/Organic	2304–2880	13–50
12	PRB	154/580	3	No	3.5–4.5	Temperate, Spain	Calcite/Organic/ Fe	1000	2–43
13	PRB	60/216	2	No	4.6	Continental, Canada	Gravel/Organic	2400–8000	70
14	PRB	60/216	2	No	4–6	Continental, Canada	Gravel/Organic	1000–5000	74
15	Bioreactor	120/–	1.8	No	2.6	16,8–22,2**	Limestone/ Organic	900	20–40
16	Bioreactor	–/0.0035	0.5	No	3–4	Temperate, South Korea	Organic	1277	20–48
17	Bioreactor	/5,887	3	No	2–3	Temperate, USA	Limestone/ Organic	up to 4100	30
18	Bioreactor	1,511;1,124/ 1,209;899	6	No	5.8; 5.0	Temperate, UK	Limestone/ Organic	369/1074	13–40

Figure 7. Performance of field-scale bioremediation systems for sulfate removal.

Source: Zak et al., 2021.

Note: where a range is provided, half the range is used to determine the average treatment efficiency.

OceanaGold has a proven track record in the delivery of PTS with the successful construction of the PTS at Globe-Progress Mine to treat iron and arsenic (e.g., MWM, 2024a):

https://oceanagold.com/2021/01/27/delivering-innovative-passive-water-treatment-at-reefton/

This knowledge and reasonable treatment expectations should provide confidence to stakeholders that OceanaGold has the resources to deliver the project.

Use of a Trigger action response plan (TARP) would be a reasonable approach to manage potential risks to the receiving environment. Further work is required to develop these TARPS, which should be developed prior to mine closure, closer to when passive treatment is required to manage the risks associated with mine impacted waters.

REFERENCES

EGL, 2024b. Oceana Gold (New Zealand) Limited Macraes Operation Trimbells Waste Rock Stack Closure Stability Report. EGL Report 9745 dated 23 August 2024, 44 pp. **Appendix 5 of the AEE.**

GHD, 2024a. Macraes Phase IV Coronation – Surface and Groundwater Assessment. GHD report 12576793-REP-Macraes Coronation Stage III Final.docx dated 26 February 2024. 95 pp. **Appendix 11 of the AEE.**

GHD (2024c) Macraes Phase IV – Frasers TSF - Innes Mills – Golden Point and Cumulative Surface and Groundwater Assessment. **Appendix 13 of the AEE.**

Mine Waste Management, 2023. Waste Rock Stack Seepage Water Quality. Report J-NZ0205-003-N-Rev1 dated 23 February 2023. 17 pp.

Mine Waste Management, 2024a. Macraes Mine Phase 4.3: Environmental Geochemistry Assessment - OceanaGold Macraes Mine Site. Report J-NZ0229-004-R-Rev0 dated 28 February 2024, 340 pp. **Appendix 8 of the AEE.**

Mine Waste Management, 2024b. BRWRS Geochem Model. MWM report J-NZ0229-M-009 Rev0, dated 2 October 2024, 14 pp.

Mine Waste Management, 2024c. Macraes Phase 4.3 Coronation Pit Stage 5/6 Pit Lake Model Geochemistry Assessment. MWM Report J-NZ0285-001-M-Rev3 dated 16 January 2024. 27 pp. **Provided within Appendix 8 of the AEE (e.g., MWM 2024a).**

Mudder, TI, Botz, MM & Smith, A 2001, The Chemistry and Treatment of Cyanidation Wastes, 2nd ed, Mining Journal Books Ltd, London.

Sapkota, Y., Duball, C., Vaughan, K., Rabenhorst, M.C., Berkowitz, J.F., 2022. Indicator of Reduction in Soil (IRIS) devices: A review. Science of the Total Environment 852 (2022) 158419.

Verum Group, 2021. Enhanced passive treatment laboratory trials. Report number C32-20-0001. 40 pp.

Zak, D., Hupfer, M., Cabezas, A., Jurasinski, G., Audet, J., Kleeberg, A., McInnes, R., Kristiansen, S., Petersen, R., Liu, H., Goldhammer, T., 2021. Sulphate in freshwater ecosystems: A review of sources, biogeochemical cycles, ecotoxicological effects and bioremediation. Earth-Science Reviews 212 (2021) 103446.