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Matakanui Gold Limited (the applicant) substantive fast-track approval application for the Bendigo-Ophir Gold Project: Technical review on freshwater matters

1 Background

Matakanui Gold Limited (the applicant) is seeking fast-track approval for the Bendigo-Ophir Gold Project. The Otago Regional Council (ORC) has asked me to undertake a technical review of the water quality and aquatic ecology components of their substantive application.

The purpose of this memorandum is to summarise the scale of adverse effects of the Bendigo-Ophir Gold Project on the different impacted water bodies. Specifically:

- The potential for various parts of the proposed activity to impact surface water quality and aquatic ecology are briefly described;
- My opinion on the scale of these adverse effects is presented and, where possible, compared with the assessments provided by the applicants experts;
- My assessment of the appropriateness of the proposed consent conditions is presented, as well as any recommended amendments. Where such amendments are likely to result in 'trade-offs' for the Bendigo-Ophir Gold Project, this is also identified.

To inform this assessment I have reviewed the relevant parts of the application – *Matakanui Gold Limited Bendigo-Ophir Gold Project Substantive Application* document and the following attachments:

- B.04 – *Surface Water and Catchment Existing Environment and Effects Assessment* (Kōmanawa 2025c);
- B.06 – *Mine Impacted Water Overview Report* (MWM 2025), including:
  - B.06A – *Mine Impacted Water Overview Report – Appendix D: Baseline Water Quality Report*; and
  - B.06C – *Mine Impacted Water Overview Report – Appendix N*.
- B.07 – *Recommended Water Quality Compliance Limits for the Bendigo Ophir Gold Project* (Ryder 2025);
- B.17 – *Assessment of Effects on Aquatic Habitat* (Waterways 2025);
- B.18 – *Assessment of Freshwater Ecological Effects* (Boffa Miskell 2025a);
- B.43– *BOGP Flow Augmentation Strategy* (HGG 2025b);
- C.36 – *Proposed Stream Diversions;*
- D.02 – *Otago Regional Council Resource Consents and Conditions;*
- D.04 – *Schedule Two – General Conditions for Otago Regional Council Resource Consents*;
- G.01 – *Water Management Plan*
- G.13 – *Freshwater Ecology Management and Monitoring Plan*; and

- G. 14 – *Erosion and Sediment Control Management Plan*.

2 Scope and limitations

I have assumed the applicants modelling of the water quality and hydrological effects of the proposed activity are accurate, and that the proposed compliance site locations are placed to capture the full extent of these effects. If ORC's review of that modelling suggests this is not the case, my assessment will likely change.

3 Adverse effects on surface water bodies

3.1 Shepherds Creek

3.1.1 Water quality

3.1.1.1 Brief summary of baseline state

Water quality data provided in Appendix D of MWM 2025 suggests water quality in Shepherds Creek is currently impacted by the rural existing land-use. Specifically, neither of the two monitoring sites on this river (SC01 and SC03) meet meeting the Australian and New Zealand Guidelines (ANZG) for Fresh and Marine Water Quality (ANZG, 2018) physical and chemical stressors (PC stressors) default guideline values (DGVs) for:

- Ammoniacal nitrogen (NH_4-N);
- Dissolved oxygen (DO);
- Electrical conductivity (EC);
- pH;
- Nitrate nitrogen (NO_3-N);
- Total suspended solids (TSS);
- Total nitrogen (TN);
- Total phosphorus (TP); or
- Turbidity.

Indeed, of the parameters monitored by the applicant, only dissolved reactive phosphorus (DRP) was found to meet the PC stressor DGV at both sites. This suggests that there is a potential risk of adverse ecological effects in this stream having arisen from the current and historical land-use.

Nevertheless, while contaminant concentrations are currently elevated in Shepherds Creek, the monitoring data collected by the applicant suggests that any adverse ecological effects associated with this are likely indirect, and direct toxicity effects are unlikely. Specifically, all monitored toxicants meet the ANZG toxicant DGV for the protection of 95% of species (applicable to slightly to moderately disturbed systems like Shepherds Creek).

3.1.1.2 Modelled effects of the proposed activity

Based on the water load balance modelling presented in MWM 2025, my assessment of the adverse effects of the proposed activity on water quality in Shepherds Creek is as follows:

- During the operative phase of mine there appears to be a low risk of changes in water quality generating significant ecological effects as:

  - Peak and average concentrations of most parameters are expected to decrease or only slightly (<10%) increase when compared to the measured baseline at SC01.
  - While significant (500 times) increases in maximum nickel (Ni) concentrations are expected, assessment against the USEPA toxicity thresholds for this attribute suggests that acute toxicity effects on aquatic life are not expected. Chronic Ni toxicity effects are also not expected as predicted average concentrations meet the ANZG toxicant DGV for high ecological/conservation value system ecosystems (99%% species protection);
  - Despite significant increases in maximum lead (Pb) and molybdenum (Mo) concentrations, there does not appear to be a risk of this resulting in a meaningful increase in toxicity risk as:
    - Predicted maximum Pb concentrations and average concentrations of both metals are expected to meet the ANZG toxicant DGV applicable to slightly to moderately disturbed ecosystems;
    - WM 2025 notes that "*Mo exceedance is interpreted to be an artifact of the mixing model limitations rather than pose a real risk of non-compliance*";
    - The toxicity of Mo is poorly understood, and exceedance of the proposed compliance limit for this attribute cannot be considered evidence of a toxicity effect[1];
- During and after closure contaminant concentrations are expected to increase even with treatment and modelling demonstrates that:
  - The proposed treatment is absolutely necessary to ensure increases in NO_3-N, arsenic (As), Ni, iron (Fe) and Pb do not generate significant adverse effects on aquatic life (indicated by exceedance of the Hickey (2013) and ANZG (2018) 80% species protection toxicant DGVs).
  - With the proposed treatment, changes in water quality are unlikely to generate even minor effects on aquatic life, with average toxicant concentrations sitting below DGVs for the protection of slightly to moderately disturbed ecosystems (ANZG, 2018; Hickey, 2013). Furthermore, nitrate concentrations not expected to increase to the extent that the risk of nuisance periphyton blooms will be materially changed (based on under protection risk thresholds for the NPS-FM 2020 B attribute state for periphyton biomass in Snelder & Kilroy (2023))

While the changes in water quality associated with the proposed activity are unlikely to generate more than minor or significant adverse effects in isolation. It is important to note that water quality will be fundamentally altered by the proposed activity. The ecological relevance of this is discussed further in Section 3.1.4

3.1.1.3 Effects of proposed limits

The proposed consent limits set forward by Ryder 2025 and adopted in *D.03 – Schedule One - Central Otago District Council and Otago Regional Council Common Conditions* allow for contaminant concentrations far beyond what the proposed activity as described in the application is expected to generate. In my opinion, full implementation of these limits would degrade water quality to the extent that there would be a risk of more than minor or significant adverse effects on aquatic life.

[1] ANZG (2018)notes that the proposed compliance limit is a "*low reliability trigger value* [that] *should only be used as indicative interim working levels*".

The primary risk stems from the increase in NO_3-N and ammonia (NH_4-N) concentrations allowed for by the proposed limits. While the toxicity effects associated with this increase are not expected to be greater than what is allowed for by the limits set for other toxicants, it represents a substantial change in nutrient dynamics which could result in nuisance algal blooms that could undermine the value of the proposed diversion and stream rehabilitation works. Current combined median NO_3-N and NH_4-N concentrations (collectively known as dissolved inorganic nitrogen) sits at 0.085 mg/L. The proposed mining with treatment is expected to increase this to just ~0.27 mg/L, yet the conditions ask for a combined median limit of 2.64mg/L. This is approximately 30 times higher than current state and ten times higher than modelled concentration post-closure . Importantly these proposed limits exceeds the saturation threshold for periphyton, meaning that if there the consent conditions were fully implemented periphyton growth would not be limited in any way by nitrogen availability.

3.1.2 Habitat

The applicant is proposing to permanently re-route the majority of the Shepherds Creek catchment in order to avoid contamination from the Tailings Storage Facility and the Shepherds Engineered Land Form (ELF). From a physical habitat perspective there is not expected to be a loss of stream extent or habitat value under this proposal, with the *Freshwater Ecology Management and Monitoring Plan* and D.03 – *Schedule One - Central Otago District Council and Otago Regional Council Common Conditions* setting requirements around:

- Stream width;
- Stream length and area;
- Provision of a low flow channel;
- Stream sinuosity; and
- Provision of pool-run-riffle sequences.

While I consider that the wording of the conditions are not strong enough to have any certainty of outcome (see Table 1), it is clear that if designed in accordance with the application, the diversion of Shepherds Creek will provide as good or better quality habitat as the existing stream over the medium and long-term. However, in my opinion it is unlikely that the applicant will be able to exactly match habitat conditions in the diversion channels to the existing stream. Indeed, this would seem impossible, given they will be required to convey significantly higher flows (see Section 3.1.3). Accordingly, while habitat diversity and quality may not be worse under this proposal when assessed using measures such as the Rapid Habitat Assessment (RHA; as proposed in the *Freshwater Ecology Management and Monitoring Plan*), it will likely be different. The ecological impact of this is discussed further in Section 3.1.4.

3.1.3 Hydrology

Based on the findings and recommendations of MWM 2025, Kōmanawa 2025c and HGG 2025b my assessment of the ecological effects associated with the hydrological changes in Shepherds Creek associated with the proposed activity are:

- During the operation phase of the proposed mine, the ecological effects of changes in hydrology are unlikely to be more than minor provided that flow augmentation is undertaken in accordance with proposed condition 3 in D.02 (*Otago Regional Council Resource Consents and Conditions*) which effectively requires monthly average flows to be maintained in Shepherds Creek. Without careful planning there may well be a reduction in flow variability in Shepherds Creek compared to the existing stream (low peak flows and higher base flows). However, given the majority of the

stream is being moved into a new channel, I think the impacts of the change in flow variability will be indistinguishable from the larger diversion effects (see Section 3.1.4.).

- During and after mine closure the hydrology of Shepherds Creek will be significantly altered. Specifically, median flows are expected to double, and seven day mean annual low flow (MALF), is expected to increase by 500%. This is a significant change in hydrology that will likely influence the abundance and composition of macroinvertebrate communities (see Section 3.1.4.).

3.1.4 Aquatic life

In my opinion, the proposed activity will result in a significant change in the aquatic ecology of Shepherds Creek. However, whether this change can be considered an adverse effect is for the panel to decide.

Post-closure the new alignment of Shepherds Creek will have significantly higher flows than the existing stream, will have habitat constructed by design, rather than nature, and have higher nutrient concentrations, which may result in higher primary productivity. However, provided condition 20 to 23 in D.02 (*Otago Regional Council Resource Consents and Conditions*) are adhered to, and future water quality reflects the modelling in MWM 2025, it is possible, if not probable that the net effect of these changes is that performance monitoring will show an increase in habitat and ecological reporting indices[2]. This is due to a planned increase in woody riparian vegetation, the establishment of pool run riffle sequences, the construction of a hard bed, and a reduction in summer drought effects and a necessary increase in the amount of habitat provided by the stream due to higher flows.

Why I am unsure of whether this significant change in aquatic life, is potentially an adverse effect is due to the role of flow. The increase in flow in Shepherds Creek, represents a divergence from natural conditions, and any resulting increase in habitat heterogeneity, size or quality could be considered to have an adverse effect on aquatic life if measurable changes in community composition are recorded, even if those changes are higher Macroinvertebrate Community Index (MCI) scores.

3.1.5 Summary

Significant changes in flow and minor increases in contaminant concentrations are expected over the long term. Most of the creek will be relocated into engineered channels designed to replicate the existing stream bed as closely as possible. This effectively replaces Shepherds Creek with a constructed stream that will likely support different plant and animal communities than those currently present.

Based on available modelling, there is no evidence to suggest that habitat quality or macroinvertebrate health will be worse than current conditions when measured using traditional indices; in fact, they may improve. However, because these improvements will result from artificially increased baseflows rather than a return to natural conditions, it is uncertain whether they can be considered a positive ecological effect.

3.2 Tributaries of Shepherds Creek

The only reclamation of intermittent or perennial rivers is the loss of Jean Creek (intermittent) under the Shepherds ELF, and two first order streams on the true right of the Shepherds Creek within the TSF. I do not consider that the reclamation of these streams will have more than minor effects on aquatic life at

[2] Such as the RHA and the MCI (as suggested in Freshwater Ecology Management and Monitoring Plan)

the catchment scale given their very low or low value (as assessed in Waterways 2025) and the length of perennial stream length lost (less than one kilometre).

Note: *it is unclear if these streams will be permanently reclaimed. The landscape closure plan in Boffa Miskell 2025a shows permanent diversions at these locations but this is not consistent with Figure 5 in that document.*

3.3 Rise and Shine Creek

3.3.1 Water quality

3.3.1.1 Brief summary of baseline state

The available data suggest water quality in Rise and Shine Creek is impacted by the rural existing land-use, with at least one of the three monitoring sites on this river (RS01 to RS03) not meeting the ANZG PC stressor DGVs for:

- DO;
- EC;
- TSS;
- TN;
- TP; and
- Turbidity.

While contaminant concentrations are currently elevated, monitoring data suggests that any adverse ecological effects associated with this are likely indirect, with direct toxicity effects unlikely (all monitored toxicants meeting the ANZG toxicant DGV for the protection of 95% of species).

3.3.1.2 Modelled effects of the proposed activity

Based on the water load balance modelling presented in MWM 2025, my assessment of the adverse effects of the proposed activity on the water quality of Rise and Shine Creek is as follows:

- During the operational phase there appears to be a low risk of changes in water quality generating minor ecological effects as average concentrations of all toxicants are expected to remain under the ANZG 95% species protection thresholds, while maximum values are expected to remain below acute thresholds USEPA toxicity thresholds;
- During and after closure contaminant concentrations are expected to increase even with treatment. Modelling demonstrates that:
    - The proposed treatment is less essential in Rise and Shine Creek compared to Shepherds Creek, with untreated concentrations of all attributes unlikely to generate significant adverse toxicity effects (indicated by exceedance of the Hickey (2013) and ANZG (2018) 80% species protection toxicant DGVs); and
    - With the proposed treatment, changes in water quality are unlikely to generate even minor effects on aquatic life as:
        - Average toxicant concentrations sitting below the ANZG DGVs for the protection of slightly to moderately disturbed ecosystems (ANZG, 2018; Hickey, 2013); and
        - Nitrate concentrations are not expected to increase to the extent that the risk of nuisance periphyton blooms is materially changed (Snelder & Kilroy, 2023).

3.3.1.3 Effects of proposed limits

As in Shepherds Creek, the proposed consent limits set forward by Ryder 2025 and adopted in *D.03 – Schedule One - Central Otago District Council and Otago Regional Council Common Conditions* allow for contaminant concentrations in Rise and Shine Creek far beyond what the proposed activity is expected to generate, and if fully implemented would degrade water quality to the extent that there would be a risk of more than minor or significant adverse effects on aquatic life. The risk is greatest for NO_3-N and NH_4-N (median limits 88 times higher than predicted average concentration after closure) which could result in nuisance algal blooms at the proposed limits.

3.3.2 Habitat

The applicant is proposing to permanently re-route a short (~600 m) reach of Rise and Shine Creek. From a physical habitat perspective there is not expected to be a loss of stream extent of habitat value under this proposal, with the *Freshwater Ecology Management and Monitoring Plan and D.03 – Schedule One - Central Otago District Council and Otago Regional Council Common Conditions* setting requirements around:

- Stream width;
- Stream length and area;
- Provision of a low flow channel;
- Stream sinuosity;
- Provision of pool-run-riffle sequences.

While I consider that the wording of the conditions are not strong enough to have any certainty of outcome (see Table 1), it appears that if designed in accordance with the application, the diversion of Rise and Shine Creek stream will provide as good or better quality habitat as the existing stream over the medium and long-term.

3.3.3 Hydrology

Based on the findings and recommendations of MWM 2025, Kōmanawa 2025c and HGG 2025b my assessment of the ecological effects associated with the hydrological changes in Rise and Shine Creek associated with the proposed activity is:

- During the operation phase of the proposed mine the ecological effects of changes in hydrology are unlikely to be more than minor provided that flow augmentation is undertaken in accordance with proposed condition 3 in D.02 (*Otago Regional Council Resource Consents and Conditions*); and
- During and after mine closure the hydrology of Shepherds Creek will be significantly altered. Specifically, median flows are expected to almost double and seven day MALF, is expected to quadruple. This is a significant change in hydrology that will likely influence the abundance and composition of macroinvertebrate communities.

3.3.4 Aquatic life

In my opinion, the proposed activity will likely result in some degree of change in the macroinvertebrate community of Rise and Shine Creek, primarily due to post-closure flows increasing significantly. The nature and extent of this change is not possible to predict. However, any change is not expected to be as large as in Shepherds Creek due to the comparatively small amount of stream diversion and lesser

water quality impacts. As with Shepherds Creek these changes could result in an improvement in habitat and ecological reporting indices[2] despite being the result in a deviation in flow from natural state.

3.3.5 Summary

Rise and Shine Creek is expected to experience significant changes in flow and minor increases in contaminant concentrations as a result of the proposed activity. However, any resulting impact on aquatic life is not expected to be more than minor.

3.4 Tributaries of Rise and Shine Creek (Mt Moka Tributaries)

The applicant is proposing to reclaim 877 metres of perennial stream draining Mt Moka and replace it with 880 metres of diversion channel. Given there is no fish values in these streams, and no associated risk of stranding/mortality, it is my opinion that the effects of this reclamation on aquatic life is unlikely to be more than minor provided diversions are constructed in accordance with the *Freshwater Ecology Management and Monitoring Plan and D.03 – Schedule One - Central Otago District Council and Otago Regional Council Common Conditions.* This is based on the diversions providing the same length, area, diversity and quality of habitat as the original stream channel (note it would be helpful if the applicant could confirm the final diversion design, as there is conflicts on this topic within Boffa Miskell 2025a and between that document and C.36 – *Proposed Stream Diversions*)

4 Review of proposed conditions

My review of the proposed conditions is set out in Table 1 below.

Table 1: Comments on consent conditions

Application document	Condition number	Comments
D.04 – *Schedule Two – General Conditions for Otago Regional Council Resource Consents*;	22	**Problem:** By including terms such as 'as much as practicable', and describing things that are not require by the condition, the wording of this condition provides no certainty around how the diversion channels will be constructed. **Recommendation:** This condition should be amended to clearly set out the minimum standard that the diversions will be constructed to. E.g.: ~~As much as practicable, t~~The diversion<u>s</u> ~~should~~ <u>shall</u> be designed with an average width of no less than 0.8 m~~, and preferably 1 m for Shepherds Creek, and no less than 0.5 m for Rise and Shine Creek.~~ **Trade-offs:** This amendment will reduce flexibility around the design of the diversion channel, which conceivably could reduce the applicants ability to react to unforeseen changes in the proposal.
	23	**Problem:** The ecological monitoring to be undertaken during the term of consent is uncertain. **Recommendation:** Somewhere in the conditions the exact aquatic ecological monitoring to be undertaken should be specified, including location, frequencies and protocols. **Trade-offs:** There is no trade-off associated with this inclusion as the applicant has already identified they will undertake this monitoring.
	40 -41	**Problem:** A hard limit on the amount of sediment discharged to Shepherds Creek from the Shepherds silt pond is needed **Recommendation:** In my opinion conditions should include a specific turbidity performance standard that the pond will meet while discharging via the decant. **Trade-offs:** There is no trade off with this addition as the applicant already proposes to continuously monitor turbidity and the performance standard can be set in a manner that captures the normal range of turbidity expected out of a pond this size.

Application document	Condition number	Comments
	Attachment 2 surface water compliance standards and limits	**Problem:** The NH_4-N and NO_3-N limits allow for contaminant concentrations far beyond what the proposed activity is expected to generate, and if fully implemented would degrade water quality to the extent that there could be significant adverse effects on aquatic life. **Recommendation:** These levels need to be reduced to reflect the increases actually expected post-closure. **Trade-off:** There is no trade-off with this amendment as modelling shows these limits can be reduced significantly without changing any the proposed activity in any way.
		Problem: Greater clarity is needed on how toxicant limits are to be assessed. As they are based on the ANZG DGVs they should generally apply as medians. However, in my opinion this would necessitate a review of the modelling to determine if they are overly lenient when applied that way. My analysis suggests that if applied as medians, all of the proposed limits are at least three times higher than what the modelling suggests is necessary: **Recommendation:** Specify how each limit is to be applied and reduce further if a median is selected. **Trade-offs:** There is no trade-off with this amendment as resulting compliance limit will not require a change to the proposal.

5 Note on effects assessment approach

The following information is available across the application documents:

- The state of the waterways impacted by proposal;
- The effects of the proposal on stream length;
- The required actions to mitigate the effects of reclamation;
- The effects of the proposal on stream hydrology; and
- The effects of the proposal on stream water quality.

However, there is no synthesis document summarising the overall effects of the activity on stream values once all adverse effects are realised and mitigations are deployed. This has significantly hindered my ability to make this assessment as I find myself without an opinion from the applicant's ecologist that I can either agree of disagree with.

6 Conclusions

6.1 Effects in Shepherds Creek catchment

- Baseline water quality is already degraded by rural land use;
- The proposed mining activity is expected to cause minor degradation in water quality during the operational phase and significant changes post-closure without treatment;
- Treatment is essential to prevent significant toxicity effects and nutrient-driven algal blooms post-closure. However, if implemented should ensure increased contaminant concentrations do not have a more than minor effect on aquatic life;
- Hydrology is expected to change significantly post closure with baseflows increasing;
- Most of the stream will be replaced with engineered channels;
- Overall, Shepherds Creek will have different flows, water quality and habitat. As a result, the ecology of the stream could be substantially different than what has been observed in the existing creek. Nevertheless, measures of habitat quality and macroinvertebrate health will likely be maintained or even improved, but this could reflect a deviation from natural state, rather than an improvement towards it. Whether this should be considered an adverse effect is for the panel to decide.
- The reclamation and diversion of Jean Creek and other minor streams in Shepherds catchment is unlikely to have a more than minor effect on aquatic life at the catchment scale.

6.2 Effects in Rise and Shine Creek catchment

- Baseline water quality is already degraded by rural land use;
- Rise and Shine Creek is expected to experience significant changes in flow and minor increases in contaminant concentrations as a result of the proposed activity. However, any resulting impact on aquatic life is not expected to be more than minor; and
- Reclamation of Rise and Shine Creek and its tributaries draining Mt Moka is unlikely to have a more than minor effect on aquatic life provided they are constructed in the manner described with the application. This is based on the diversions providing the same length, area, diversity and quality of habitat as the original stream channel

6.3 Recommendations on consent conditions

Consent conditions should be amended to:

- To clearly set out the minimum standard that the diversions will be constructed to;
- Specify the exact aquatic ecological monitoring to be undertaken should be specified, including location, frequencies and protocols;
- Include specific turbidity performance standard that the Shepherds silt pond will meet while discharging via the decant;
- Include water quality limits that are clear and reflect the increases actually expected post-closure.

7 References

Australian and New Zealand Governments and Australian state and territory governments (ANZG), 2018. Australian and New Zealand guidelines for fresh and marine water quality. Governments and Australian state and territory governments, Canberra, Australia.

Hickey, C.W., 2013. Updating nitrate toxicity effects on freshwater aquatic species (Client Report No. HAM2013-009). NIWA, Hamilton, New Zealand.

Snelder, T., Kilroy, C., 2023. Revised Nutrient Criteria for Periphyton Biomass Objectives: Updating criteria referred to in Ministry for Environment 2022 guidance (LWP Client Report No. 2023–08). LWP Limited, Christchurch, New Zealand.

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