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MEMORANDUM

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Cc:	
Document Number:	J-H-NZ0235-001-M-Rev0
Document Title:	BOGP Wetland Drawdown Assessment.

Hydro Geochem Group Limited (HGG) was retained by Matakanui Gold Limited (MGL) to assess the potential extent of drawdown from mine dewatering activities at their Bendigo-Ophir Gold Project (BOGP) near Cromwell, NZ.

BACKGROUND

A number of wetlands have been identified surrounding the BOGP and within the direct disturbance footprint (RMA Ecology, 2025). Dewatering of open pits and underground workings has the potential to negatively affect these wetlands (if they are connected to the groundwater system that dewatering will influence) through drawdown of the water table.

HGG understand that any additional area outside the direct disturbance footprint of the BOGP, assessed as being influenced by drawdown, will be considered for some level of offset or compensation package.

This assessment aims to estimate the potential *radius of influence*[1] and drawdown magnitude associated with dewatering of mine features, including:

- Rise and Shine (RAS) Pit.
- RAS Underground.
- Come in Time (CIT) Pit.
- Srex (SRX) Pit.
- SHX East (SRE) Pit.

Locations of the mine features are shown in Figure 1.

[1] *Sharp (2023) define the radius of influence as follows: radial distance to points where hydraulic head is no longer noticeably affected by a pumping well.*

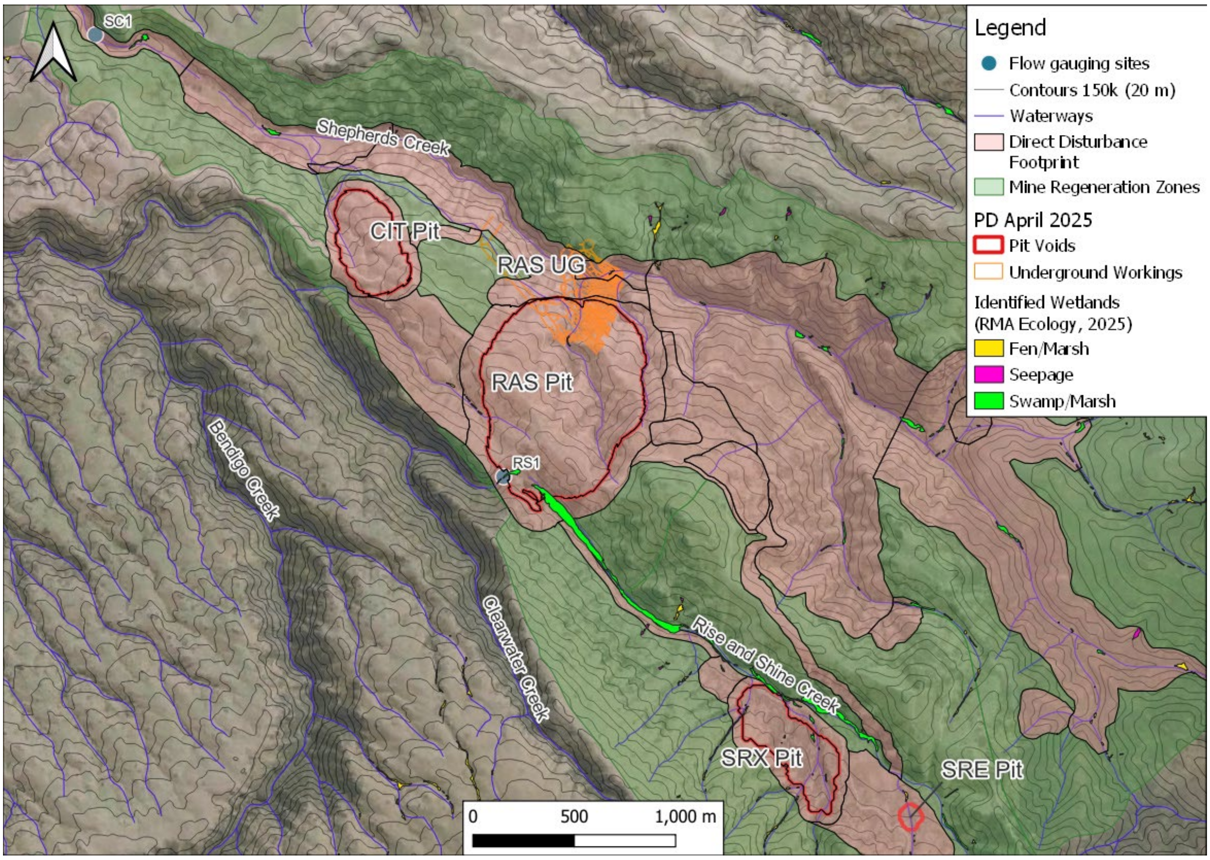

Figure 1: Site layout.

ENVIRONMENTAL SETTING

Topography and Drainage

BOGP is situated within the Shepherds and Bendigo Creek catchments of the Dunstan Mountains. The valley bottom creek channels are deeply incised into the bedrock terrain. Both creeks drain to the Clutha River system.

Climate and Hydrology

MWM (2025) describe the climate setting for BOGP, with monthly data shown in Figure 2. They make the following observations:

- Based on the Köppen-Geiger classification, the climate can be characterised as temperate, without a dry season, and as having a warm summer (Cfb). Mean annual air temperature is 8 °C.
- On an annual basis, precipitation (P) is approximately 510 mm while Potential Evaporation is approximately 815 mm.
- The climate is relatively dry, with a strong energy surplus (PE>P) present between September through March, and an energy deficit (PE<P) over the remainder of the year, most notably over winter.

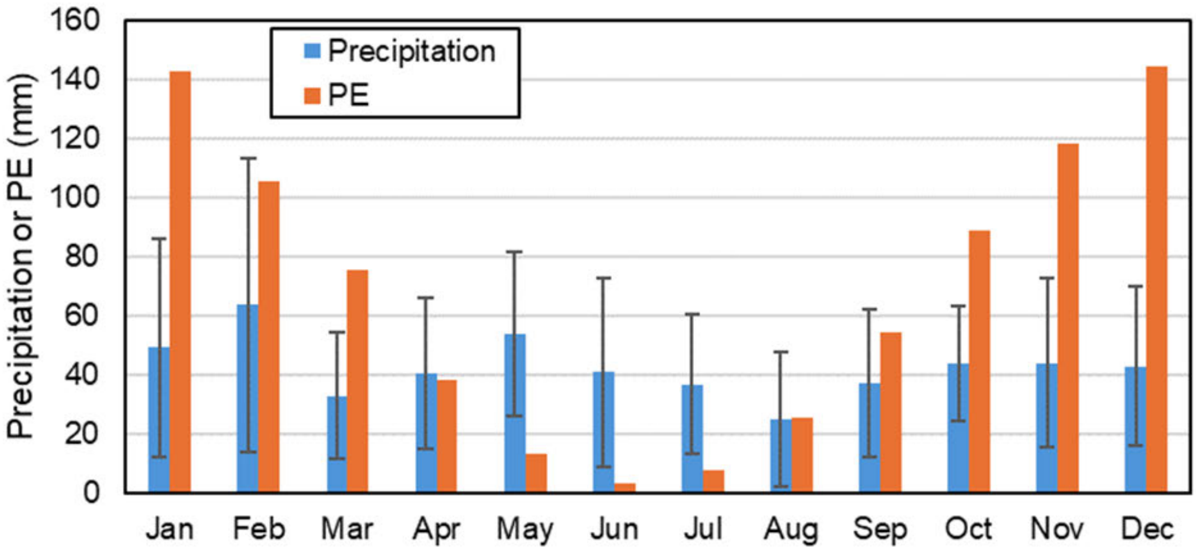

Figure 2: Monthly precipitation and PE summary.

PE=Potential Evaporation. Bars show monthly averages while error bars show rainfall standard deviation over the period of record.

Creek flow has been monitored at BOGP since 2022. Figure 1 shows the locations of two flow monitoring sites, SC01 and RS01, which have mean flows of 15.6 L/s and 8.80 L/s, respectively (KSL, 2025a). Flow records are shown in Figure 3 and Figure 4 and indicate a strong seasonal flow pattern, with higher flows in the wetter winter months and lower flows in the drier summer months.

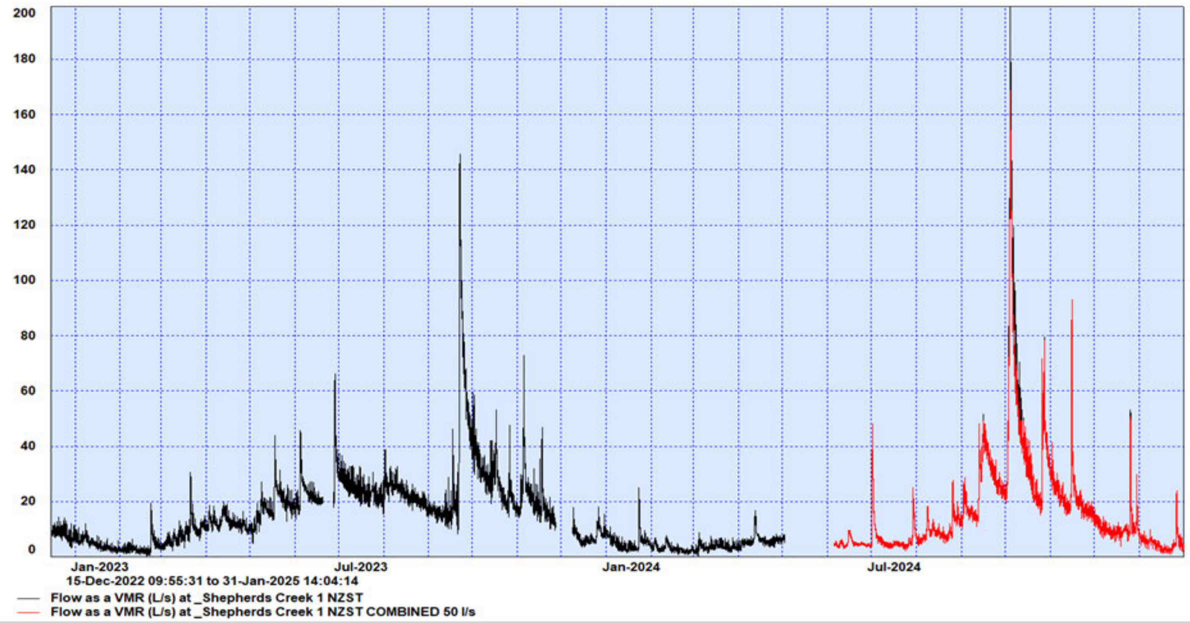

Figure 3: SC01 flow record.

Source: (KSL, 2025a).

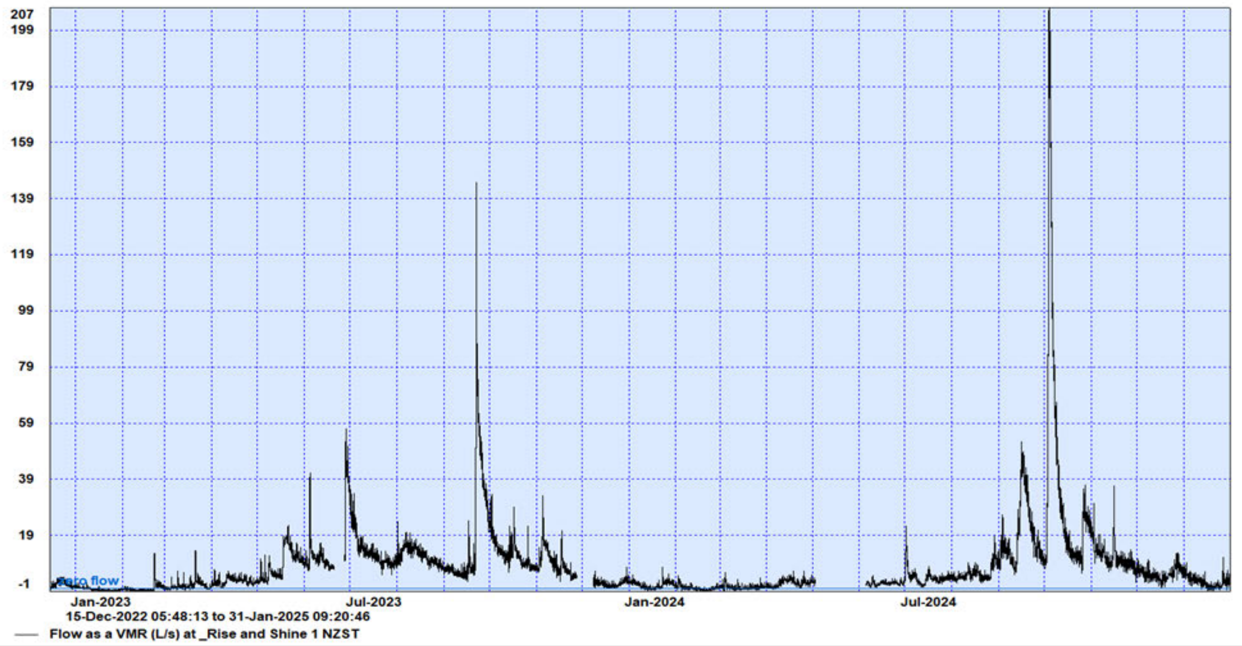

Figure 4: RS01 flow record.

Source: (KSL, 2025a).

Hydrogeology

Previous hydrogeological studies at BOGP (KSL, 2025b) have identified the Otago Schist as the main hydrogeological unit intercepted by mine features. Thin alluvium and colluvium are locally present in valley bottoms. This type of setting is similar to the Macraes Mine (e.g., GHD, 2024). At both sites, the schist rock is differentiated between shallow, weathered schist and deeper, unweathered schist. In both cases, the majority of any groundwater flow will be through fractures with little to no groundwater transmitted through the rock mass matrix.

KSL (2025b) describes the Thomsons Gorge Fault crossing the project area, cutting through both the Rise and Shine Creek and lower Shepherds Creek. The shear zone associated with this fault is the main source of mineralisation for the BOGP, termed the Rise and Shine Shear Zone.

Groundwater level data from KSL (2025b) indicate the following:

- Groundwater flows from topographic highs to lows (e.g., local creeks).
- Lateral hydraulic gradients are relatively steep, ranging between 0.2 and 0.5 m/m. This suggests a relatively low hydraulic conductivity setting.
- Vertical gradients are mixed, with some upwards and some downward.
- Localised, but persistent flowing artesian conditions were noted in ~1.5% of drillholes, suggesting some level of compartmentalisation.

Hydraulic testing of the schist rock mass at BOGP is reported in (KSL, 2025b). The hydraulic conductivity (K) data (n=9) show a geometric mean of approximately 10^{-8} m/s, ranging between 5×10^{-10} and 7×10^{-8} m/s. Testing depths ranged between ~60 and 266 m along hole. At Macraes, GHD (2024) report elevated K data for the upper 30-50 m of schist bedrock (~10^{-7} m/s, conceptualised as weathered schist) and interpret a decreasing trend in K with depth. Below 50 m depth, K data from

Macraes is similar to data reported by KSL (2025b). KSL (2025b) do not report a depth of weathering, but at Macraes, GHD (2024) indicate 'moderate' weathering extends to about 5 m depth, and 'slight' weathering extends to 35 to 50 m depth.

Three hydraulic tests reported by KSL (2025b) included either the Thompson Gorge Fault or Rise and Shine Shear Zone and did not show a significant difference in K from tests outside these features.

GHD (2024) report specific yield for the schist in the region of 0.01, and specific storage of 10^{-5} m^{-1}. These values are consistent with crystalline fractured rock with low primary porosity.

In summary, two hydrostratigraphic units are interpreted to be present across the BOGP:

- Weathered Schist, with a $K=10^{-7}$ m/s, approximately 30 m thick.
- Unweathered Schist, with a $K=10^{-8}$ m/s, >200 m thick.

Upscaling these two units together, produces a representative site wide scale transmissivity value of $5x10^{-6}$ m^2/s, or K= $2x10^{-8}$ m/s. For the purposes of this assessment, it is assumed the aquifer is unconfined, with a specific yield of 0.01.

Groundwater-Surface Water Interactions

Groundwater-surface water interactions can be complex in both space and time, varying along creek reaches and seasonally. At the BOGP, groundwater is conceptualised to typically discharge and feed creeks, springs, and channels. However, detailed information on groundwater-surface water interactions is not currently available to characterise interaction beyond this higher level conceptualisation.

RMA Ecology (2025) identified three wetland types during field surveys at the BOGP, describing them as follows:

- Hillslope seepages that are primarily groundwater fed.
- Fens present in narrow gullies that a fed by both groundwater and surface water overland flow.
- Swamps and marches present in flat wide valley flows that are primarily fed by overland flow.

While these interpretations seem reasonable, no data was presented support these conclusions.

The hydraulic connection between the schist bedrock groundwater system and wetlands is not well understood. There is the potential that wetlands could be disconnected from the schist groundwater system, and therefore less susceptible to drawdown in this unit. However, for the purposes of this assessment, in the absence of any evidence one way or the other, it is conservatively assumed the wetlands are hydraulically connected to the schist groundwater system, and therefore susceptible to drawdown associated with mine dewatering.

METHODOLOGY

Assessment of drawdown followed a twostep approach as follows:

1. Estimate the radius of influence for each mine feature.
2. Estimate drawdown magnitude using the radius of influence calculated in Step 1.

Radius of Influence

Based on the Cooper and Jacob approximation to the Theis equation, Hazel (2009, page 183) define the radius of influence as:

$$r_0 = 1.5\sqrt{\frac{Tt}{S}}$$

Where:

- r_0 = Radius of influence at time t after pumping/dewatering commenced.
- T = transmissivity.
- t = time since dewatering commenced.
- S = storage coefficient or specific yield.

The radius of influence for each mine feature was calculated based on the adopted values in Table 1.

Table 1: Adopted parameter values for radius of influence.

VARIABLE	VAULE
Transmissivity (m^2/s)	5×10^{-6}
Specific Yield (-)	0.01
Time (months)	RAS Pit = 135 RAS UG = 106 CIT Pit = 12 SRX Pit = 15 SRE Pit = 6

Duration of dewatering was adopted based on the provided mine schedule provided by MGL: BOGP_high_level_schedule_PFSconsent.xlsx

A 'buffer' around each mine footprint was then calculated in a GIS to visualise the aerial extend of the calculated radius of each mine feature. However, the radius of influence calculation does not take into account boundary conditions such as larger surface water features (such as creeks) that could buffer the extent of drawdown. To account for these, the buffers were subjectively clipped to creek channels to determine the final footprints of drawdown influence (except where mine features extended past creek channels, i.e., RAS Pit and UG), termed the *area of drawdown*.

Drawdown Magnitude

Drawdown magnitude was estimated based on the following equations (Haitjema, 1995, p.34):

$$\Phi_x = \frac{\Phi_2 - \Phi_1}{L} x + \Phi_1$$

$$\Phi_1 = 0.5kh_1^2 \text{ ; } \Phi_2 = 0.5kh_2^2$$

Where:

- h_1 = Hydraulic head above the base of the aquifer (assumed to be 200 m thick) at the radius of influence.
- h_2 = Hydraulic head above the base of the aquifer at the pit base or underground workings.
- k = Hydraulic conductivity.
- Φ_x = Head potential at distance x from radius of influence.
- Φ_1 = Head potential at radius of influence.
- Φ_2 = Head potential at pit edge.
- L = Distance between $h_1$and h_2 (radius of influence).
- x = Distance from radius of influence.

Adopted parameters for calculation of drawdown are tabulated Table 2.

Table 2: Adopted parameters drawdown calculation.

PARAMETER	RAS	CIT	SHX	SHXE	RAS UG
Hydraulic conductivity (k, m/s)			5×10^{-8}		
Head at radius of influence (h_1, m)			200		
Head at mine feature (h_2,m)	20	70	170	170	20

CALCULATION RESULTS

The calculated radius of influence for each mine feature is tabulated in Table 3, along with the magnitude of drawdown at 10 m from the edge of the radius of influence. The gives an indication of the drawdown magnitude close to the radius of influence (theoretically the drawdown at the radius of influence is negligible). Distances further from the radius of influence (i.e., closer the mine feature) would be greater than these values.

Table 3: Calculated radius of influence.

MINE FEATURE	RADIUS OF INFLUENCE	DRAWDOWN
RAS Pit	570 m	2 m
RAS UG	500 m	2 m
CIT Pit	170 m	5 m
SRX Pit	190 m	2 m
SRE Pit	120 m	1 m

Note: values are rounded to nearest 10 m for radius of influence and nearest 1 m of drawdown.

The estimated area of drawdown is provided in Figure 5. Calculated drawdown extent and magnitude is similar to results from numerical groundwater modelling completed by KSL (2024) for the BOGP.

The following limitations make derivation of these areas and drawdown magnitudes conservative (i.e., potentially overpredict the drawdown extent and magnitude):

- The maximum depth of a pit or underground workings level is adopted for the calculations. In reality, pit and underground working levels progressively deepen over time, which the calculations cannot account for.
- Post-closure conditions where pit voids and underground workings flood are not accounted for. As flooding occurs, drawdown extent and magnitude would reduce.
- The interaction of creeks with the estimated area of drawdown is represented in an approximate manner. Capture of groundwater discharge would tend to limit the drawdown area from a given mine feature.
- Vertical propagation of drawdown is not accounted for. This is most relevant to the underground workings which are understood to be 100 to 200 m below the Shepherds Creek level.

More detailed studies, such as numerical groundwater modelling can account for these limitations, and produce less conservative drawdown estimates.

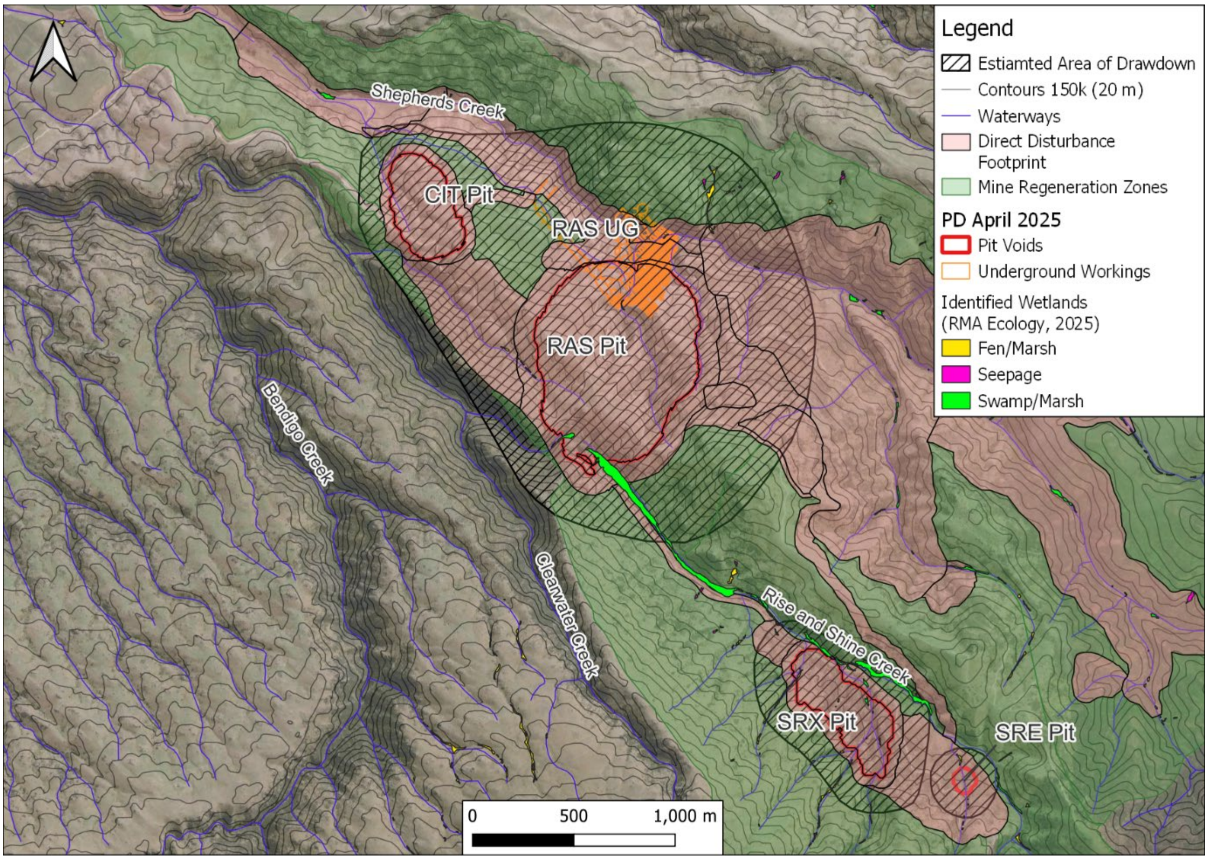

Figure 5: Estimated area of drawdown.

DISCUSSION

The drawdown areas encompass all three wetland types. The swamp and marsh wetlands associated with the Rise and Shine Creek making up the majority of the wetland area that could be potentially impacted. This is expected given their proximity to RAS Pit and SRX Pit. Hillslope seepage and gully fen wetlands within the drawdown areas are mainly located on the northern flank of the Shepherds Creek valley and upslope of the SRX Pit on the southern flank of the Rise and Shine Creek valley.

Calculations suggest the potential drawdown magnitude within the areas of drawdown could be over 1 m. Drawdown magnitude would be greater (e.g., 10’s of meters) closer to the mine features. Potential drawdown of this magnitude could negatively affect the hydraulic function of wetlands without additional mitigations.

Based on the hydraulic functions of the wetlands described by RMA Ecology (2025), susceptibility to potential drawdown impacts is characterised for each wetland type as follows:

- **Hillslope seepage wetlands** would be most susceptible to potential drawdown impacts given they are interpreted to be mainly groundwater fed. These wetland types may flow less or completely dry up.
- **Gully fen wetlands** would have a moderate susceptibility given they are interpreted to be fed by a mixture of groundwater and surface water. These wetland types may flow less or experience dryer conditions when overland flow is absent.
- **Swamp and marsh wetlands** would have the lowest susceptibility given they are interpreted to be primary surface water fed. Increased surface water leakage would buffer potential drawdown effects.

MITIGATION AND MONITORING

MGL plan to augment the Rise and Shine Creek flow and the associated valley bottom swamp and marsh wetlands to mitigate potential impacts as a result of the BGOP, with groundwater sourced from the Bendigo Aquifer. The Augmentation Strategy is described in HGG (2025). Such augmentation holds promise in mitigating any drawdown impacts given the interpreted surface water dominated nature of these wetlands. Further studies should be completed prior to mining development to:

- Confirm the hydraulic function of the wetlands described by RMA Ecology (2025).
- Understand how much drawdown the wetlands can tolerate.
- Confirm how much surface water is needed mitigate potential drawdown impacts.

Information gained in these studies, along with performance monitoring, can support proactive adaptive management such as trigger action response plans.

Groundwater and surface water flow performance monitoring is recommended to confirm the hydrological function of these wetlands are maintained, particularly those wetland areas close to pit voids where potential drawdown would be greatest. This monitoring will help demonstrate the mitigation measure is performing successfully.

No mitigation is planned for hillslope seepage or gully fen wetlands so these wetlands could still be impacted by drawdown.

FINDINGS AND RECOMMENDATIONS

Findings from this assessment were as follows:

- The potential drawdown areas encompass all three wetland types, with the swamp and marsh wetlands associated with the Rise and Shine Creek making up the majority of the wetland area that could be potentially impacted.
- Calculated drawdown as a result of dewatering the BOGP mine features suggest drawdown of over 1 m could reach up to approximately 550 m away from mine features dewatered for a prolonged period (i.e., RAS pit and underground). Drawdown magnitude would be greater (e.g., 10’s of meters) closer to the mine features. Potential drawdown of these magnitudes could negatively affect the hydraulic function of wetlands.
    - However, a number of limitations in the calculations completed make these estimates relatively conservative. More detailed studies, such as numerical groundwater modelling can account for these limitations, and produce less conservative drawdown estimates, if required.
- MGL plan to undertake measures to mitigate potential drawdown impacts to the Rise and Shine swamp and marsh wetlands by augmenting the Rise and Shine Creek and associated wetlands with groundwater sourced from the Bendigo Aquifer (see HGG, 2025). Given the interpreted surface water dominated nature of these wetlands, such augmentation holds promise in mitigating potential drawdown impacts. Forward works are recommended to advance this mitigation concept and provide confidence to stakeholders that it will indeed be effective.
- No mitigation is planned for hillslope seepage or gully fen wetlands so these wetlands could theoretically be impacted by drawdown if it reaches them. However, given drawdown estimates are known to be conservative, magnitudes and extents may less than estimated. As such, it would be prudent to establish performance monitoring (e.g., groundwater levels) to confirm these wetlands are not impacted by drawdown.

HGG recommend the following to proactively manage potential drawdown risks to Rise and Shine Creek wetlands:

- Further studies should be completed prior to mining development to (i) confirm the hydraulic function of the wetlands, (ii) understand how much drawdown the wetlands can tolerate, and (iii) improve confidence that augmentation measures will be effective at mitigating drawdown.
- Groundwater and surface performance monitoring is undertaken to confirm the hydrological function of the swamp and mash wetlands are maintained, particularly those areas close to pit voids where potential drawdown would be greatest.

Information gained in these studies, along with performance monitoring, can support proactive adaptive management such as trigger action response plans.

CLOSING REMARKS

Please do not hesitate to contact Ryan Burgess at [redacted] [redacted] [redacted] [redacted] or [redacted] should you wish to discuss our memorandum in greater detail.

REFERENCES

GHD, 2024. Macraes Phase IV | Coronation – Surface and Groundwater Assessment. Project Number 12576793. Dated 26 February 2024.

Haitjema, H., M., 1995. Analytic Element Modelling of Groundwater Flow. Academic Press, inc.

Hazel, C. P., 2009. Groundwater Hydraulics. Second Edition.

Hydro Geochem Group (HGG), 2025. BOGP Flow Augmentation Strategy. J-H-NZ0235-002-M-Rev0, Dated 20 October 2025.

Kōmanawa Solutions (KSL), 2024. Groundwater Modelling Analysis for Mining Bendigo Ophir Gold Deposit. Report No: Z24002BOG-2. Dated 3 December 2024.

Kōmanawa Solutions (KSL), 2025a. Bendigo - Ophir Gold Mine Project – Surface Water & Catchment Existing Environment & Effects Assessment. Report No: Z24002.1. Dated 15 May 2025.

Kōmanawa Solutions (KSL), 2025b. Bendigo – Ophir Gold Mine Project – Groundwater Existing Environment & Effects Assessment. Report No: Z24002BOG-Rev2. Dated 14 Feb 2025.

MWM, 2025. Net Percolation Assessment for the Proposed Bendigo-Ophir Gold Project Mine Waste Storage Facilities. Doc. No.: J-NZ0455-001-M-Rev3. Dated 12 August 2025.

RMA Ecology, 2025. Bendigo - Ophir Gold Project – Wetland Values Assessment. Report No. 2352. Dated August 2025.

Sharp, Jr., J. M., 2023. A glossary of hydrogeology. The Groundwater Project.