Technical Review

To:	Danielle Ter Huurne	**Date:**	2/04/2024
Authority:	Otago Regional Council	**Ref:**	23009.6D_2.0
Consent:	RM23.819 - Hawkeswood Mining Limited		

From	**Role in Audit**	
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1 Project Summary

Hawkeswood Mining Limited are seeking a range of consents associated with an alluvial gold mining activity at 1346-1536 Teviot Road, Millers Flat, including construction of a bore (the mine pit), dewatering and discharge to land for a ten year term (though mining is expected to be completed within 7 years). The site is situated on a terrace above the Clutha River/Mata-au. The water take is described as a non-consumptive take. The key documents reviewed include:

- MacDonell Consulting (2023). Hawkeswood Mining Limited Proposed Alluvial Gold Mine at Millers Flat. 16 November 2023.
- Environmental Associates (2023). Hawkeswood Mining Limited,–Technical Assessment of Proposed Groundwater Take and Discharge. October 2023 (included as Appendix 3).

The total area of the site to be affected by the mine will be 68 ha, with 27 ha of work area at any one time. The work area will consist of land stripped of soil and overburden, a mine pond within the pit with approximately 150 m by 100 m in area (1.5 ha) and 18 m deep, rehabilitation areas, 3 stockpile areas, roading, bunding, workshop and yard, and sediment ponds. Whilst the AEE states that mining will commence at the northern end of the resource and progress in a generally southerly direction, with the pit traversing from side to side within the resource limits, the provided Site Map (Appendix 2) indicates that Stage 1 of the

mining activity is in the southern half of the site. Rehabilitation (backfilling with tailings, overburden and finally top soil) is to occur progressively.

The site hydrology is complex and difficult to assess due to the Clutha River boundary extending along the southern and western boundary of the site, the Tima Burn flowing along the eastern boundary, a closed landfill to the north of the site, and historic mining being completed along the southern boundary in the past. The Clutha River provides a complex recharge boundary due to rapid water level fluctuations (over 1 m per day) caused by hydropower generation. Aquifer parameters were derived from previous aquifer testing of a bore situated in mine tailings (Parker aquifer test associated with RM19.310.01). Due to the complexity of the site hydrology, the aquifer testing is difficult to interpret however Environmental Associates states that this aquifer test was previously accepted by ORC. Some limited assessment of trial dewatering of the mine pit was completed, though no piezometer was installed to monitor drawdown outside the pit. No data from this test was provided, only the final drawdown within the pit which was then used to calculate transmissivity using Theis analysis of drawdown at an effective radius with an assumed storage value equivalent to that of the Parker test.

It is noted that this project was originally reviewed under RM23.474 and the groundwater assessment assumes that the change in mining extent does not impact on the groundwater assessment.

2 Groundwater Flow

The uncertainty and limitations regarding the pumping tests and calculated aquifer parameters is significant, however it is acknowledged that the actual pumping rates of the mine pit pumping test provide the best information (rather than the interpretations). Whilst additional models or assessment may not provide further certainty, this does not mean that there will not be effects on both the Tima Burn and other groundwater users, therefore monitoring the effects and using adaptive management strategies is appropriate mitigation for the potential effects.

The maps of depth to water, water elevations and saturated thickness data points indicate considerable variability across the site. The map of water elevations is to be reviewed understanding the inherent uncertainty due to coarse interpolated

land surface elevations[i]. It is noted that for an activity of this scale, establishing surveyed groundwater monitoring bores to measure baseline groundwater level and quality conditions prior to the activity occurring is considered to be best practice. It is noted with the data available, that several conceptual models could be used to explain the data.

2.1 Drawdown

Drawdown at the site will be very complex due to the variable rate pumping, recharge boundaries and small aquifer extents and whilst the groundwater AEE has attempted to be conservative, there is considerable uncertainty in the actual effects that will occur. For this reason, it is considered that there may be effects on both the Tima Burn and other groundwater users, therefore monitoring the effects and using adaptive management strategies is appropriate mitigation for the potential effects. The mapped drawdown assessment provided is replicated in Figure 1. This was based on the original mine extent provided under RM23.474. The two extents are compared in Figure 2.

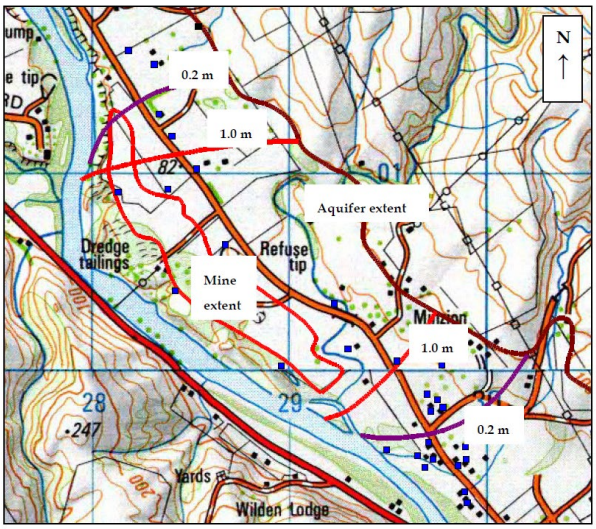

Figure 6.1 Potential Extent of Maximum Transient Drawdown External to the Mining Area

Notes: Aquifer boundary = brown contour.

Drawdown to 1.0 m = red contour.

Drawdown to 0.2 m = purple contour.

All wells that occur in the area are shown as light blue squares.

Figure 1: Drawdown Assessment provided in Environmental Associates (2023)

[i] There is now Lidar available for this area that could be used to improve the interpretation of data. (https://data.linz.govt.nz/layer/114888-otago-central-otago-lidar-1m-dem-2021/)

Given that the mine pit pond has not increased in area or depth, the main difference is in the lateral extent of the mining activities; most significantly the mining extends further to the north and west. The increased extent of the mine and the narrowing of the aquifer to the north-west may result in additional groundwater users being affected by the mining in this area.

It is noted that from correspondence with Environmental Associates (5/03/2024 to Danielle Ter Huurne) that is it considered that mining further to the south will cause greater drawdown in the north than mining in the north itself due to the lesser pumping required in that area. Due to the uncertainty however, it was agreed that the identification of potentially affected wells may now include G43/0184 and G43/0185. It has also been clarified that proposed condition 7 of the proposed groundwater take requires the consent holder to remedy any affected well water supply that will or has become no longer viable due to drawdown from the mine dewatering, irrespective of the list of wells that have been assessed as being potentially affected by the mine dewatering activity. For this reason, it is necessary that monitoring external to the mine site is used to identify drawdown over time and pre-empt any water supply issues.

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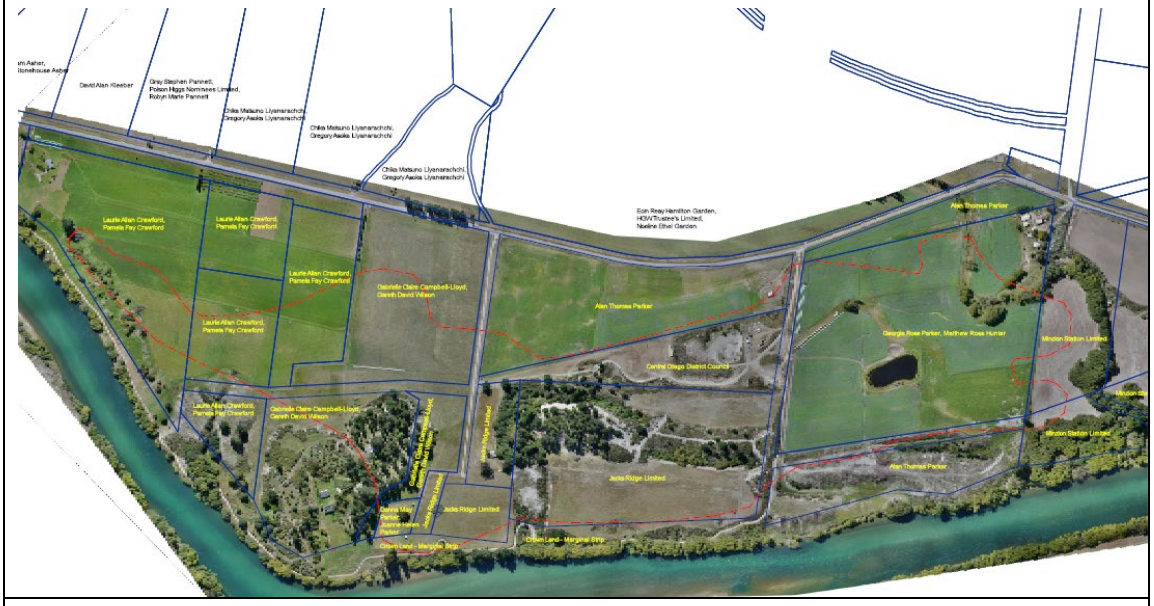
Initial proposal (May 2023)



Variation (November 2023)

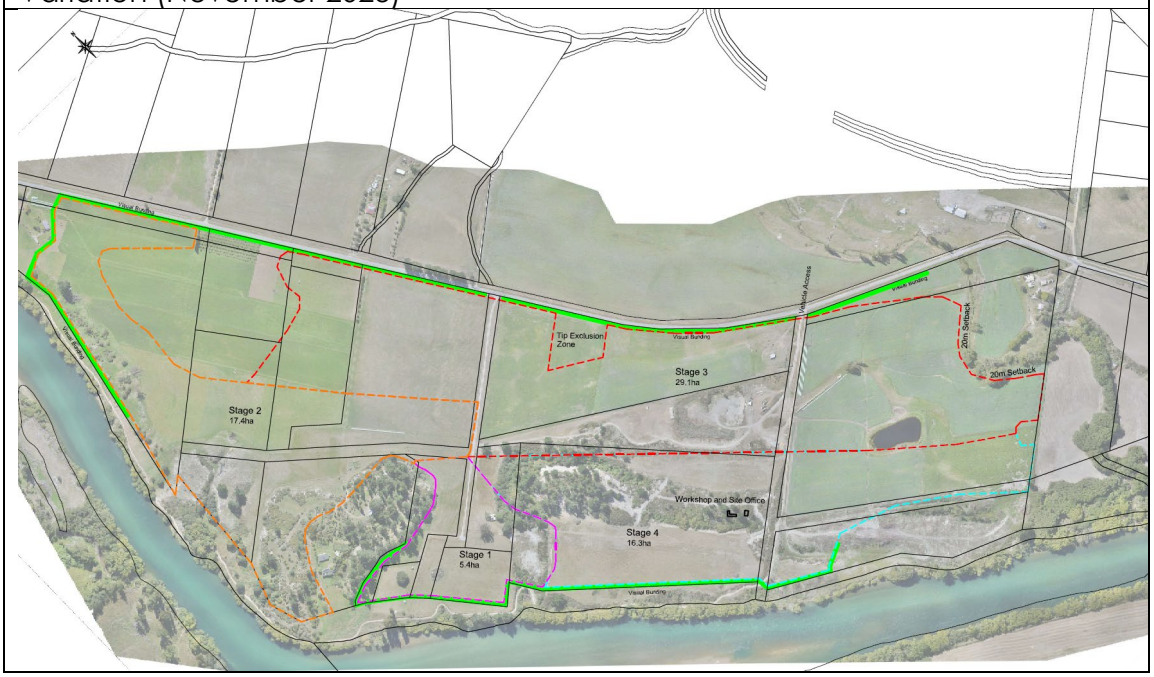


Figure 2: Difference in Mine Extent Between Proposals

2.2 Aquifer changes

Removal of gravel and washing of fines is expected to redistribute the sediment present in the gravels to sediment retention ponds. This will modify the aquifer storage and transmissivity, likely increasing the storage and transmissivity. This is not considered to be detrimental. Compaction of the aquifer is unlikely due to the gravel substrate.

2.3 Clutha River/Mata-au

Reduction in flow due to stream depletion is not expected to be observable due to the large flows in the Clutha River and the return infiltration flows to the Clutha River located in closer proximity to the Clutha River than the mine pond.

2.4 Tima Burn

The Tima Burn has a catchment area of 44 km^2 and the modelled MALF is 0.11 m^3/s[ii]. The REC modelled allocation for the Tima Burn is 0.021 m^3/s. Whilst this may be entirely lost to groundwater during dry seasons, there is no evidence that the watercourse is entirely disconnected from groundwater, or that groundwater drawdown may not extend the frequency and duration of drying. G43/0193, situated near the Tima Burn had a standing water level of 2.5 m below ground at the time of drilling. Further ecological assessment has now been completed and assessed by an ecologist. The proposed augmentation is considered to be an appropriate mitigation to support ecological values. The LiDAR available at this site could be used to reduce the uncertainty regarding surface water-groundwater interaction at this site.

3 Groundwater Quality

The key issues with respect to groundwater quality are discharge of sediments from washing, mobilisation of contaminants from landfill and the possible introduction of sediments during augmentation. There will be no earthworks within 20 m of any watercourse, and no discharge of treated water to land within 50 m of any watercourse, including the Clutha and Tima Burn.

[ii] NZ River Maps (niwa.co.nz), accessed 23/06/2023

There is a closed landfill outside of the mine footprint at 1484 Teviot Road. A PSI for the closed landfill by EC Otago was provided in the application, but no groundwater monitoring was undertaken, and very limited discussion was provided regarding historic sampling within the PSI. The AEE assumes that any contamination from the landfill will be significantly diluted. Dilution of contaminated waters is likely to attenuate effects, if the extent of the plume is not large. Dewatering will alter current flow paths. Sampling of groundwater below the landfill would provide greater certainty regarding risk from this source.

Wash water from the gold plant will either be recycled back into the mine pit or via a sediment retention pond to infiltration pits. The discharge is expected to only contain suspended sediment from the mine pit, which is intended to be settled out in the initial sediment retention pond before being discharged to groundwater via an infiltration pond and then migrating to the Clutha River. These infiltration ponds are intended to be located between the mine pond and the Clutha River, though no closer than 50 m to the Clutha River. Given that the infiltration ponds will cause some groundwater mounding, the gradient of flow is likely to be mostly towards the Clutha River from these locations. However, there may be some flow parallel to the Clutha River towards downgradient groundwater users due to the mounding and drawdown in the aquifer.

4 Mitigation

The key mitigation measures provided are:

- Buffers between activities and water courses
- Augmentation of the Tima Burn and providing alternative water supply to neighbouring groundwater users.
- Providing alternative water supply to neighbouring groundwater users is appropriate. The ability to obtain alternative supply should be confirmed.

5 Recommended monitoring

The applicant has proposed a monitoring programme to assess total suspended solids (TSS) and turbidity, at the infiltration pond and in the Clutha River upstream and downstream of the discharge area, and to monitor groundwater levels

within the mine pit pond. This is not adequate to give assurance to neighbouring groundwater users.

The proposed condition 7 should require monitoring outside of the mine pit to determine whether the mine pit drawdown may be affecting other groundwater users.

Dedicated monitoring bores should be installed on the site boundaries, with monitoring of water levels, turbidity, TSS and landfill contaminant indicators (likely NH_4-N, Cl, metals – review of the landfill monitoring thus far would be helpful to improve understanding or whether this is a risk). This monitoring would also provide an indication of the propagation of the drawdown cone and any contamination and early warning to groundwater users should monitoring indicate that they might be impacted, enabling provision of alternate water supply in a timely fashion. Trigger levels will need to be considered based on neighbouring bore depths and comparison with drinking water guidelines. This could also be used to support proposed condition 8 measuring water level decline adjacent to the Tima Burn.

Whilst out of the scope of this review, an erosion and sediment control plan should be provided as part of the environmental management plan for the site to ensure that topsoil stockpiles, overburden and runoff on the site is managed in a responsible manner, noting that the site extends across multiple catchments. Site rehabilitation plans should also be clarified. Monitoring of the Clutha River should occur upstream of the worksite, rather than just upstream and downstream of the infiltration pit due to the potential erosion and sediment impacts of the site as well as the infiltration impacts.